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**ECONOMICS**

# The Role of Carbon Market in Net Zero Emission: Economic Impact of Carbon Credit and Forest Conservation in Indonesia

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## ABSTRACT

**Purpose:** This study analyzes the role of the carbon market in achieving Net Zero Emissions, focusing on how carbon credit development and tropical forest conservation can create new economic opportunities in Indonesia.

**Method:** This research employs a qualitative descriptive approach, using a case study of the REDD+ project in Indonesia. Data was collected through semi-structured interviews with various stakeholders, including government officials, local communities, and environmental organizations. Thematic analysis was utilized to identify key patterns related to the economic benefits and technical challenges of the carbon market.

**Result:** The study finds that the carbon market can provide substantial economic benefits through carbon credit trading, attracting investments in green technology and sustainability programs. It also has the potential to raise awareness of the importance of conserving tropical forests as critical carbon sinks. However, challenges such as regulatory gaps, limited community participation in decision-making, and technological constraints for monitoring and reporting must be addressed.

**Practical Implications for Economic Growth and Development:** Indonesia can harness the carbon market to drive sustainable economic growth while supporting environmental preservation and global carbon emission reductions. Active stakeholder engagement, technological capacity building, and regulatory strengthening are crucial for the successful implementation of the carbon market in the future.

***Keywords:*** *Carbon Market, Tropical Forest Conservation, Net Zero Emission, Carbon Credit, Economic Development, Sustainability*

## INTRODUCTION

Climate change presents the greatest challenge to our planet's sustainability, affecting environmental, economic, social, and political dimensions. The significant increase in global temperatures has resulted in more extreme weather events, ocean acidification, biodiversity loss, and reduced agricultural productivity. In response, various policy instruments have been developed to reduce greenhouse gas (GHG) emissions, including carbon trading, which provides a market-based approach to addressing the external impacts of carbon emissions (Afifullah et al., 2023; Fais et al., 2023).

One internationally adopted strategy is carbon trading, a market mechanism that enables the reduction of GHG emissions through the buying and selling of carbon credits (Posma, 2024). This system incentivizes parties that can cut emissions beyond their targets while allowing others to fulfill their emission reduction obligations. Additionally, the Reducing Emissions from Deforestation and Forest Degradation Plus (REDD+) approach aims to protect tropical forests, which serve as carbon sinks and support sustainable forest management (Harningtyas et al., 2024). These initiatives have successfully reduced deforestation and provided economic benefits to local communities through incentive payments and capacity-building programs (Nurulhadi, 2022). Advanced technologies, such as blockchain and satellite-based Monitoring, Reporting, and Verification (MRV) systems, have been proposed

to improve transparency and efficiency in carbon credit transactions (Mayada et al., 2023; Luo et al., 2022). Strengthening institutional coordination and establishing clear benefit-sharing frameworks are crucial for building trust and ensuring the long-term success of carbon trading efforts (Bebi, 2020).

Despite their economic advantages, carbon pricing mechanisms, including carbon taxes and rebate programs, have encountered political and public pushback. Research indicates that while carbon taxes are theoretically effective, public acceptance remains low due to concerns about economic impacts and skepticism toward government initiatives. Even rebate programs designed to alleviate household costs often suffer from limited awareness and understanding, hindering their effectiveness. The success of carbon rebate programs in Canada and Switzerland underscores the importance of transparent communication and public engagement strategies to foster policy acceptance (Mildenberger et al., 2022). With the world's third-largest tropical forest area, Indonesia plays a vital role in global climate change mitigation. Its forests not only function as natural carbon sinks but also provide essential economic resources for local communities dependent on these resources. Thus, Indonesia's carbon trading policy serves two primary purposes: as an economic instrument promoting investment in low-carbon solutions and as a conservation strategy for sustaining tropical forest ecosystems (Cadizza et al., 2024; Aditya, 2024).

Recently, Indonesia has shown a strong commitment to emissions reduction by adopting its Enhanced Nationally Determined Contribution (NDC) under the Paris Agreement. A key mechanism for achieving this target is the establishment of a carbon market through the REDD+ program, which aims to provide financial incentives for developing countries that successfully decrease emissions from forestry and land-use sectors (Sukhdev et al., 2020). However, challenges persist in implementing this mechanism, including regulatory uncertainties, a lack of transparency in carbon pricing, and minimal local community participation in carbon trading initiatives (Pamungkas, 2022; Maharani et al., 2020).

In addition to regulatory and technical hurdles, emission monitoring and oversight pose significant challenges in developing Indonesia's carbon market. The Monitoring, Reporting, and Verification (MRV) mechanism still struggles to incorporate advanced technologies, such as satellite imagery and blockchain, to enhance the accuracy of traded carbon data (Luo et al., 2022). Therefore, the success of the carbon trading system relies not only on regulatory clarity but also on strengthening technological capacity and ensuring active participation from all stakeholders.

Previous studies have explored various aspects of carbon trading in Indonesia, particularly regulations, carbon pricing mechanisms, and stakeholder participation. Some research indicates that despite the introduction of policies like Presidential Regulation No. 98 of 2021 on the Economic Value of Carbon, uncertainties in technical implementation still undermine the effectiveness of the carbon market (Cadizza et al., 2024). Furthermore, investigations reveal that local community involvement in carbon trading is limited due to inadequate outreach and the complexity of carbon credit application processes (Boediarto, 2024). Research also shows that while REDD+ programs have been successfully implemented in certain regions, significant challenges remain, including unclear benefit-sharing mechanisms for local communities and insufficient institutional capacity to ensure program effectiveness (Guizar-Coutiño et al., 2022). Additionally, some studies emphasize the need for satellite-based and blockchain monitoring technologies to improve transparency and accountability in carbon emissions verification (Luo et al., 2022; Maharani et al., 2020). However, much of the existing research has focused on isolated aspects of carbon trading, lacking a comprehensive integration of the relationships among market mechanisms, environmental sustainability, and economic impacts.

This study provides a comprehensive analysis of carbon trading in Indonesia by integrating three critical components: carbon credit development, tropical forest conservation, and green economic growth. In contrast to previous research that has addressed these aspects in isolation, this study aims to explore how the interplay between carbon market mechanisms, regulations, technology, and community participation can foster a more effective and

sustainable carbon trading ecosystem (Aditya, 2024; Siagian et al., 2024). Furthermore, this research evaluates current policies and offers evidence-based strategic recommendations to support future policymaking.

This study evaluates the role of the carbon market in Indonesia's transition to Net Zero Emissions. It has three main objectives: first, to analyze the economic impact of carbon credit trading, particularly regarding its promotion of green investment and job creation in sustainable sectors; second, to identify regulatory and institutional barriers that limit the carbon market's effectiveness; and third, to develop policy strategies that integrate carbon trading with forest conservation and environmental sustainability (Ningsih, 2024; Yoshino et al., 2021). By adopting a comprehensive approach, this study aims to provide significant scientific contributions to the design of a more inclusive and evidence-based carbon trading policy.

## METHOD

This research employs a qualitative descriptive approach to gain a deeper understanding of the role of carbon markets in achieving Net Zero Emissions and how the development of carbon credit sales and tropical forest conservation generates new economic opportunities in Indonesia. Interviews serve as the primary data collection method, allowing direct access to the experiences, perceptions, and views of stakeholders. This method was chosen to explore various aspects of policies, technologies, and social dynamics related to the implementation of carbon trading. The research design centers on a case study of ongoing carbon trading projects in Indonesia, including the REDD+ Project in East Kalimantan and the Katingan Mentaya Project in Central Kalimantan. This case study approach facilitates a thorough investigation of the implementation processes, as well as the regulatory, technical, and social challenges involved.

Informants were selected purposefully, focusing on individuals or groups with a direct connection to and deep understanding of carbon trading in Indonesia. The informants included eight individuals: four academics specializing in environmental economics and forestry, two government representatives involved in climate policy and carbon market regulation, and two representatives from an environmental NGO engaged in REDD+ initiatives and forest conservation efforts. The study collects primary data through semi-structured interviews with predetermined key informants, focusing on the roles, challenges, and opportunities within carbon trading.

Data analysis in this study utilizes thematic analysis methods (Heriyanto, 2018) conducted in several stages. Initially, data reduction involves categorizing raw data from interviews and documentation into key themes for more efficient analysis. Subsequently, data presentation organizes the condensed information descriptively, enhancing accessibility and interpretability. Finally, conclusions are drawn by summarizing the main findings, which emphasize the challenges and opportunities of carbon trading in Indonesia. This structured approach ensures a comprehensive understanding of the study's results.

## RESULT AND DISCUSSION

### Economic Benefits of the Carbon Market

The carbon market has become one of the most innovative economic mechanisms for tackling climate change while fostering sustainable economic growth. An academic notes,

> "*The economic benefits of the carbon market include new income opportunities, green investments, and improved natural resource management. Carbon trading through carbon credits allows companies that successfully reduce their carbon emissions to receive financial incentives*" (Informant A, 2024).

Another academic adds,

> "*The carbon market not only provides financial benefits but also has long-term impacts on technological innovation and energy efficiency. Investments in low-carbon technologies, such as renewable energy and green transportation, are encouraged by the economic incentives from carbon trading*" (Informant B, 2024).

For instance, renewable energy projects, such as solar panel installations in remote areas, not only provide access to electricity but also create new jobs in the green technology sector. Consequently, the carbon market acts as a vital catalyst for transforming the economy toward a low-carbon future.

**Tropical Forest Conservation as a Strategic Asset**

Indonesia's tropical forests, among the largest in the world, are vital for mitigating climate change. These forests serve as natural carbon sinks and are home to a remarkable diversity of species. According to an environmental expert,

> "*Conserving tropical forests presents significant economic opportunities through the carbon credit mechanism. Engaging local communities in conservation efforts, such as forest patrols and ecosystem restoration, is one effective approach. This involvement not only provides economic benefits to local communities but also enhances their understanding of environmental sustainability*" (Informant C, 2024).

An NGO representative added,

> "*Forest conservation projects often provide direct benefits to local communities through incentive payments. For example, in some REDD+ projects, communities that protect forests receive compensation that can be used to build village infrastructure or improve access to education. However, the success of these programs relies heavily on fair benefit-sharing mechanisms. Without a clear regulatory framework, inequalities in benefit distribution may undermine the sustainability of such projects*" (Informant D, 2024).

**Challenges in Carbon Market Implementation**

The implementation of the carbon market in Indonesia faces several complex challenges. A significant issue highlighted by informants is the absence of comprehensive regulations. An environmental policy expert noted,

> "*While there is a foundational policy, such as Presidential Regulation No. 98 of 2021 on the Economic Value of Carbon, its technical implementation often lacks consistency. This inconsistency creates uncertainty for market participants and investors*" (Informant E, 2024).

An academic added,

> "*Without clear and consistent regulations, the carbon market risks losing credibility in the eyes of the international community*" (Informant F, 2024).

A government representative emphasized,

> "*Corruption at both local and national levels poses a major challenge in managing the carbon market. Implementing monitoring, reporting, and verification (MRV) mechanisms based on advanced technology is essential for ensuring transparency. Technologies like satellite imagery and AI-based*

> *analytics can verify carbon sequestration claims in real-time, thereby reducing the risk of data manipulation*" (Informant G, 2024).

An NGO representative pointed out,

> "*The lack of public awareness regarding the carbon market concept limits participation. Many local communities do not realize how their activities, such as tree planting or forest protection, can generate income through carbon credits. Therefore, intensive education and outreach programs are necessary to improve public understanding of the benefits of the carbon market*" (Informant H, 2024).

### Opportunities for Green Investment

Green investment plays a vital role in Indonesia's carbon market strategy. An academic noted,

> "*The development of green infrastructure, such as campus arboretums and low-carbon buildings, provides tangible examples of how green investments can be implemented. These projects not only reduce carbon emissions but also raise environmental awareness within the community*" (Informant A, 2024).

A government representative emphasized,

> "*Renewable energy initiatives, like solar panel installations and biogas energy management from organic waste, hold significant potential for improving local community welfare. These projects offer environmental benefits while also enhancing economic resilience through job creation*" (Informant G, 2024).

An NGO representative added,

> "*Fiscal incentives, including tax breaks and subsidies, are crucial for attracting investors to the green sector. To maximize the impact of green investments, partnerships among the government, private sector, and civil society are essential*" (Informant D, 2024).

## Discussion

Findings from interviews align with existing literature that emphasizes the dual benefits of the carbon market, particularly in promoting economic growth and environmental conservation. Research by Fais et al. (2023) confirms that strong regulations and transparent income distribution mechanisms can attract more investors to engage in environmentally focused projects. The increase in investment in sectors such as renewable energy, sustainable agriculture, and waste management technology is primarily driven by opportunities created through carbon trading. This supports the idea that effective market mechanisms can facilitate sustainable development while ensuring financial viability for investors and stakeholders.

In addition to economic benefits, carbon market initiatives like REDD+ programs have shown their capacity to raise local community awareness about the importance of forest conservation. Communities involved in conservation activities, such as forest patrols and ecosystem restoration, often receive direct financial compensation (Boediarto, 2024). Moreover, these initiatives frequently lead to improvements in local infrastructure, including better access to education and healthcare services. These findings underscore the interconnectedness of environmental preservation and social development, highlighting the potential for carbon trading mechanisms to enhance community well-being beyond mere financial incentives.

Despite these advantages, the lack of comprehensive regulations and institutional coordination poses a significant obstacle to the successful implementation of carbon trading in Indonesia. As noted by Cadizza et al. (2024), the absence of detailed technical guidelines

creates uncertainty for market participants and investors. This uncertainty is further exacerbated by the lack of a clear legal framework for carbon pricing and taxation, which hampers long-term investment in green projects (Pamungkas, 2022). The minimal involvement of local communities in carbon trading projects further complicates these challenges, often resulting in land conflicts and bureaucratic hurdles that impede project success (Boediarto, 2024). The importance of Free, Prior, and Informed Consent (FPIC) in REDD+ projects is emphasized by Nurulhadi (2022), who argues that inclusive project design is essential for the sustainability of carbon trading initiatives.

Technological advancements are crucial for enhancing the transparency and efficiency of carbon credit transactions. The integration of blockchain and satellite-based Monitoring, Reporting, and Verification (MRV) systems is vital for maintaining credibility in the carbon market (Luo et al., 2022). However, the absence of globally accredited certification mechanisms limits the competitiveness of Indonesia's carbon credits in the international market (Maharani et al., 2020). To address this issue, investment in technology and capacity building for local consultants is necessary to ensure the credibility and long-term viability of carbon trading projects.

Given these challenges, a holistic and integrated approach is essential to maximize the potential of the carbon market in Indonesia. Strengthening the regulatory framework should be a top priority, as suggested by Fais et al. (2023). Developing clear and transparent technical guidelines, along with aligning regulations across various sectors and levels of government, will create a more predictable and stable investment climate. Additionally, establishing an independent regulatory body can enhance accountability and reduce corruption risks within the carbon trading sector.

Enhancing technological capacity is also urgently needed. Investments in satellite-based MRV technology and artificial intelligence can improve trust in the credibility of Indonesia's carbon market. Furthermore, priority should be given to training programs for local consultants and stakeholders on carbon accounting and certification processes to support the sustainability of the carbon market.

Education and public awareness campaigns are vital for increasing community participation in carbon trading initiatives. Outreach programs involving local communities, academics, and the media should be implemented to communicate the economic and environmental benefits of the carbon market. Improved literacy in these areas can boost public trust and encourage greater community involvement in carbon-based conservation programs.

Collaboration among the government, private sector, and civil society must be strengthened to ensure the long-term success of carbon trading initiatives. Engaging local communities in the planning and implementation of conservation projects can foster a sense of ownership and sustainability. Moreover, partnerships with the private sector can provide the financial resources and technological advancements necessary to maximize the positive impact of the carbon market. Boediarto (2024) highlights the importance of a collaborative approach in resolving land conflicts and enhancing community participation, further emphasizing the need for multi-stakeholder engagement.

To promote green investments, the government should offer fiscal incentives such as tax breaks and grants for renewable energy projects and sustainable infrastructure. Facilitating access to financing for SMEs engaged in green initiatives can also accelerate the transition toward a more inclusive and sustainable economy. By implementing these strategic measures, Indonesia can fully harness the potential of the carbon market to achieve both economic and environmental sustainability.

## CONCLUSION

This research evaluates the role of the carbon market in Indonesia's transition to Net Zero Emissions, emphasizing the economic opportunities created through carbon credit development and tropical forest conservation. By integrating economic, social, and

environmental perspectives, the study aims to provide a comprehensive understanding of the challenges and opportunities associated with implementing the carbon market in Indonesia. Furthermore, it offers strategic recommendations to improve the effectiveness of carbon trading mechanisms in achieving sustainable development goals.

The findings of this study reveal that the carbon market presents significant potential as both a tool for mitigating climate change and a catalyst for sustainable economic growth. Using a qualitative approach, this research demonstrates that carbon credit trading, particularly within the REDD+ framework, offers tangible economic benefits to local communities by generating new income streams through forest conservation efforts. Active community participation in these programs—whether through forest patrols, ecosystem restoration, or performance-based incentive schemes—has been shown to enhance awareness of the vital role tropical forests play as major carbon sinks.

Interviews with various stakeholders, including government representatives, environmental organizations, and local communities, highlight that tropical forest conservation provides not only environmental advantages but also extensive economic and social benefits. Many informants noted that community involvement in carbon projects can improve local livelihoods by bolstering village infrastructure and reinforcing economies centered on ecotourism and sustainable agriculture. However, this study also identified significant challenges in implementing the carbon market, such as regulatory uncertainty, limited community engagement in decision-making, and technological limitations in Monitoring, Reporting, and Verification (MRV) systems.

Moreover, issues of transparency and benefit-sharing mechanisms are critical and must be addressed to ensure the sustainability of these programs. Some civil society organization representatives expressed concerns that, despite the substantial opportunities presented by REDD+, ambiguous benefit distribution mechanisms often result in disparities in the reception of incentives. Therefore, there is a need for more inclusive policies and improved technological capacity to ensure fair and transparent carbon trading. Conversely, this research also uncovered that the carbon market is unlocking green investment opportunities in renewable energy, regenerative agriculture, and ecotourism. Companies and investors involved in carbon trading are increasingly channeling their capital into sustainable projects that not only help reduce carbon emissions but also strengthen the economic resilience of local communities. Thus, these findings support the notion that the carbon market can effectively serve as both a climate change mitigation tool and a driver of a greener, more sustainable economic transformation.

Strengthening regulations is vital for providing legal certainty to carbon market participants. This necessitates clear and comprehensive regulations that align with sectoral policies and establish an independent oversight body to ensure transparency and accountability. Furthermore, active community engagement in carbon trading projects is essential for ensuring fair benefit distribution and project sustainability. Institutionalizing mechanisms like Free, Prior, and Informed Consent (FPIC) can empower local communities and enhance their involvement in decision-making processes.

Investment in advanced technologies, such as blockchain and satellite-based Monitoring, Reporting, and Verification (MRV) systems, is critical for improving the accuracy and credibility of carbon credit transactions. To further support the growth of the carbon market, implementing fiscal policies, such as tax breaks and subsidies for renewable energy projects, can attract private sector investment in green initiatives. By addressing these practical challenges, Indonesia can unlock the full potential of its carbon market, advancing both national and global climate goals while promoting sustainable economic growth.

Several important aspects warrant further exploration in future research. First, conducting a quantitative impact analysis through cost-benefit studies can help measure the socio-economic effects of the carbon market on local communities and the national economy. Additionally, examining the feasibility of a hybrid carbon pricing model that integrates carbon taxes with a cap-and-trade system could create a more robust and flexible mechanism. From

a technological standpoint, research could investigate the potential of innovations such as Web3 and smart contracts to improve the transparency and efficiency of carbon credit transactions. Furthermore, it is crucial to explore the long-term socio-economic impacts on vulnerable communities, particularly regarding income distribution and access to resources. Lastly, the role of international collaboration in cross-border carbon trading and technology transfer, especially through agreements like Article 6 of the Paris Agreement, offers a compelling avenue for future research.

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