

Forests as Climate Shields: Legal Pathways to Strengthen Indonesia's NDCs

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Abstract

Climate change presents a global challenge that necessitates engagement from all sectors, including forestry. Indonesia, with its extensive tropical forests, holds a significant position in mitigating climate change through sustainable forest management. This study analyses legal strategies to support the forestry sector in achieving Indonesia's Nationally Determined Contributions (NDCs). A qualitative approach was employed, utilizing interviews with key stakeholders. The findings indicate that, despite supportive policies and regulations, Indonesia faces persistent challenges, including limited public awareness, conflicting interests, and resource constraints. Addressing these issues requires several strategies: strengthening regulations on sustainable forest management, enhancing collaboration among government, communities, and the private sector, and providing economic incentives for forest conservation. The study underscores the necessity of a comprehensive and inclusive legal framework to reinforce the forestry sector's contribution to



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climate change mitigation and the attainment of Indonesia's NDC targets.

KEYWORDS *Forestry, NDC, Climate Change, Legal strategy*

Introduction

Climate change represents an urgent global challenge that necessitates collective action from all countries.¹ Indonesia, characterized by its rich biodiversity and extensive tropical forests, plays a crucial role in climate change mitigation.² The forestry sector serves as a primary pillar in the effort to reduce greenhouse gas emissions and enhance carbon storage. Through Nationally Determined Contributions (NDCs), Indonesia has committed to reducing greenhouse gas emissions by up to 29% by 2030, with the potential to increase this reduction 41% with international support.³ Achieving these targets requires an effective and integrated legal strategy. The forestry sector in Indonesia faces significant challenges, including deforestation, forest fires, and land conversion for agricultural and development purposes. These issues not only harm ecosystems but also contribute to the intensification of climate change.⁴

¹ Zujaja Wahaj, Md. Mahmudul Alam, and Abul Quasem Al-Amin, "Climate Change and COVID-19: Shared Challenges, Divergent Perspectives, and Proposed Collaborative Solutions," *Environmental Science and Pollution Research* 29, no. 11 (March 6, 2022): 16739–48, <https://doi.org/10.1007/s11356-021-18402-5>.

² Armida S. Alisjahbana and Jonah M. Busch, "Forestry, Forest Fires, and Climate Change in Indonesia," *Bulletin of Indonesian Economic Studies* 53, no. 2 (May 4, 2017): 111–36, <https://doi.org/10.1080/00074918.2017.1365404>.

³ Bimo Dwisatrio et al., *The Job Creation Law and REDD+: Possible Synergies and Challenges*, vol. 371 (CIFOR, 2022).

⁴ Ucok Siagian et al., "Low-Carbon Energy Development in Indonesia in Alignment with Intended Nationally Determined Contribution (INDC) by 2030," *Energies* 10, no. 1 (January 5, 2017): 52, <https://doi.org/10.3390/en10010052>.

In addition to these challenges, corporate-driven forest exploitation has emerged as a significant concern, threatening both biodiversity and the well-being of local communities. A notable example is PT. Riau Andalan Pulp and Paper (RAPP) is a subsidiary of the APRIL group. The company has engaged in extensive deforestation in Riau Province to clear land for pulp mills and oil palm plantations. This activity has resulted in the loss of critical wildlife habitats, including those of Sumatran tigers and orangutans, and has adversely affected local communities that rely on forests for their livelihoods. According to a Greenpeace report, RAPP has converted more than 1 million hectares of forest into plantations and mills, leading to severe ecosystem degradation.⁵

A notable case involves PT. Kallista Alam, which engages in land-clearing activities in peatlands in Aceh. The company cleared land for oil palm plantations within protected areas, resulting in significant damage to critical peat ecosystems. In a 2018 court decision, PT. Kallista Alam was found guilty of violating environmental laws and was ordered to pay compensation; however, the environmental damage had already occurred.⁶ PT. Sinar Mas, which operates as a subsidiary in the palm oil industry, has also come under scrutiny for deforestation in Kalimantan and Sumatra. The company's operations frequently involve burning forests to clear land, leading to environmental degradation and smog that adversely affect public health and air quality in surrounding regions. According to a report by Forest Watch Indonesia, Sinar Mas has participated in

⁵ Green Peace, "One Million Hectares Burned inside Forest Moratorium Area, Greenpeace Analysis Shows," *Green Peace*, 2019, <https://www.greenpeace.org/southeastasia/press/2834/one-million-hectares-of-forest-burned-inside-forests-moratorium-area-greenpeace-analysis-show/>.

⁶ FWA, "Quick Wins by Nusron Wahid, Minister of ATR/BPN: Revoke HGU, Protect Peatlands, Save Biodiversity," *Fwi.or.Id*, November 11, 2024, <https://fwi.or.id/en/quick-wins-by-nusron-wahid-minister-of-atr-bpn-revoke-hgu-protect-peatlands-save-biodiversity/>.

unlawful land burning, resulting in substantial losses to both the community and the environment.⁷

In North Sumatra, PT. Toba Pulp Lestari engages in forest exploitation for pulp production. The company has cleared tropical rainforests and converted land into monoculture plantations. These activities threaten biodiversity and disrupt the lives of indigenous peoples who rely on forest ecosystems. According to a report from WALHI (Indonesian Forum for the Environment), the company's operations have resulted in conflicts with local communities that have lost access to forest resources.⁸ These cases illustrate how corporate exploitation of forests can cause significant environmental degradation, biodiversity loss, and adverse effects on local communities.

Legal strategies to support climate change mitigation in the forestry sector include legislative frameworks and sustainable natural resource management policies. Key approaches involve reinforcing forest protection regulations, such as those outlined in Law No. 41 of 1999 on Forestry, Law No. 32 of 2009 on Environmental Protection and Management, Law No. 18 of 2013 on the Prevention and Eradication of Forest Destruction, and Law No. 32 of 2024 amending Law No. 5 of 1990 on the Conservation of Biological Natural Resources and Their Ecosystems. These legal instruments require further strengthening to enhance forest protection against illegal logging and unsustainable land conversion.⁹

⁷ Forest Watch Indonesia, "Catatan Awal Tahun 2019 FOREST WATCH INDONESIA," *Forest Watch Indonesia*, November 16, 2019, <https://fwi.or.id/catatan-awal-tahun-2019-forest-watch-indonesia/>.

⁸ CNN Indonesia, "Walhi Desak PT TPL Ditutup Imbas Hutan Rusak Di Danau Toba," CNN Indonesia, 2021, <https://app.cnnindonesia.com/>.

⁹ Febrian Chandra, Harmaini Harmaini, and Fitri Kartika Sari, "Membangun Hutan Lestari: Analisis Undang-Undang Nomor 32 Tahun 2009 Tentang Perlindungan Dan Pengelolaan Lingkungan Hidup," *Politica: Jurnal Hukum Tata Negara Dan Politik Islam* 10, no. 2 (December 13, 2023): 179–88, <https://doi.org/10.32505/politica.v10i2.7514>.

Regulatory challenges, such as overlapping authority, contribute to persistent environmental issues in Indonesia. In recent years, the country has experienced a rise in forest fires during the dry season. These fires cause extensive ecological damage and substantially increase greenhouse gas emissions. Illegal logging and land conversion for agricultural purposes persist despite existing regulations.¹⁰ Furthermore, inconsistencies and a lack of integration in natural resource management policies have further complicated matters.

Ongoing deforestation, primarily driven by the conversion of forest land into farmland, plantations, and settlements, remains a critical concern. According to a report from Global Forest Watch (2021), Indonesia lost approximately 3.5 million hectares of forest between 2000 and 2020, ranking among the countries with the highest deforestation rates globally.¹¹ Ambiguous land use policies and weak enforcement of regulations further exacerbate these challenges, threatening the sustainability of forests and biodiversity.

Indonesia has enacted several laws and regulations aimed at forest protection; implementation is impeded by insufficient coordination among government agencies. Law No. 41 of 1999 on Forestry and Law No. 32 of 2009 on Environmental Protection and Management establish the legal framework for sustainable forest management. Nevertheless, persistent challenges in law enforcement and corruption undermine the effectiveness of these policies. Murdiyarso et al. (2011) found that, despite supportive policies, weak implementation and limited

¹⁰ Inu Kencana Hadi, Sigit Heri Mukti, and Wirastuti Widyatmanti, "Pemetaan Pola Spasial Kebakaran Hutan Dan Lahan Di Taman Nasional Gunung Merbabu Berbasis Penginderaan Jauh Tahun 2019," *Jurnal Geografika (Geografi Lingkungan Lahan Basah)* 2, no. 1 (June 30, 2021): 43, <https://doi.org/10.20527/jgp.v2i1.4536>.

¹¹ Global Forest Watch, "Indonesia Primary Forest Loss," *Global Forest Watch*, 2023, <https://www.globalforestwatch.org/dashboards/country/IDN/>.

accountability continue to contribute to ongoing forest degradation.¹²

Social issues represent a critical factor in Indonesia's forestry management. Numerous local communities rely on forests for their livelihoods; however, they are often excluded from decision-making processes for forest resource management. Sullivan (2013) emphasised that community participation in forest management is vital for achieving sustainability.¹³ Inequitable access to and control over forest resources can result in conflicts between local communities and forestry companies, ultimately contributing to increased forest degradation.

Climate change exerts a substantial impact on forestry in Indonesia. Deforestation and forest degradation contribute to increased greenhouse gas emissions, thereby intensifying climate change. According to the IPCC (2021), the forestry sector in Indonesia accounts for approximately 60% of the nation's total greenhouse gas emissions.¹⁴ Consequently, implementing sustainable forest management practices is essential for climate change mitigation. Research by Angelsen et al. indicates that REDD+ programs offer a potential solution for reducing emissions from deforestation and forest degradation. However, the effectiveness of these programs relies heavily on political commitment and community participation.¹⁵

¹² Yonky Indrajaya et al., "Tropical Forest Landscape Restoration in Indonesia: A Review," *Land* 11, no. 3 (February 23, 2022): 328, <https://doi.org/10.3390/land11030328>.

¹³ Maximilian Oehl, "The Role of Sustainable Development in Natural Resources Law," 2018, 3–38, https://doi.org/10.1007/8165_2018_1.

¹⁴ Arild Angelsen B T - REDD+ as Performance-Based Aid, "REDD+ as Performance-Based Aid," WIDER Working Paper (Helsinki, Finland: UNU-WIDER, 2013).

¹⁵ Intergovernmental Panel On Climate Change, "Climate Change 2007: The Physical Science Basis," *Agenda* 6, no. 07 (2007): 333, https://www.slvwd.com/sites/g/files/vyhlf1176/f/uploads/item_10b_4.pdf.

These phenomena indicate a significant gap between existing legal policies and practical realities. Consequently, several fundamental issues require resolution, including the formulation of effective legal strategies to support climate change mitigation within the forestry sector, identification of obstacles to the implementation of these strategies, mechanisms to ensure active involvement of local communities in forest resource management, and concrete measures to enhance coordination among government agencies in climate change mitigation efforts. A comprehensive understanding of these issues will enable this research to contribute meaningfully to climate change mitigation in Indonesia through a more integrated and sustainable legal framework.

Several studies have provided important insights into legal strategies within the forestry sector and their effects on climate change mitigation. Sari et al. (2021) examined the effectiveness of REDD+ policies in Indonesia,¹⁶ finding that although these policies have the potential to reduce deforestation and greenhouse gas emissions, significant challenges persist in their implementation and community participation. The authors emphasise the need to strengthen legal and policy frameworks to enhance local community involvement in forest management. Similarly, Prasetyo et al. (2022) discuss the role of law in sustainable forest management and its implications for climate change. Their findings indicate that adopting a more inclusive and participatory legal approach can improve the effectiveness of forest management and support Indonesia's NDC targets. Furthermore, this research underscores the importance of

¹⁶ M. Pasgaard et al., "Challenges and Opportunities for REDD+: A Reality Check from Perspectives of Effectiveness, Efficiency and Equity," *Environmental Science & Policy* 63 (September 2016): 161–69, <https://doi.org/10.1016/j.envsci.2016.05.021>.

collaboration among government, communities, and the private sector in developing policies that promote forest sustainability.¹⁷

Hidayati et al. demonstrate that, despite the existence of various regulations supporting forest protection, their implementation is frequently hindered by weak law enforcement and inadequate interagency coordination. Their study recommends reforms to the legal system to enhance forest protection and facilitate climate change mitigation efforts.¹⁸ Several of the aforementioned studies indicate that, while multiple legal strategies may be employed to support climate change mitigation within the forestry sector, significant challenges persist in implementation and enforcement. Consequently, this study will examine legal strategies that could improve the effectiveness of forest management in achieving Indonesia's NDC.

The novelty of this study lies in its integrated approach, which combines analyses of policy, law, and community participation in forest management. The research aims to identify existing legal strategies and to evaluate their effectiveness in implementation at both the local and national levels. Consequently, the study seeks to provide concrete, actionable recommendations to enhance climate change mitigation efforts in Indonesia through the forestry sector. Furthermore, analysing various legal strategies and their effectiveness in the context of Indonesia's NDC is expected to address key research questions. A comprehensive understanding of these issues may significantly contribute to climate change

¹⁷ E M Djafar et al., "Forest Management to Achieve Sustainable Forestry Policy in Indonesia," *IOP Conference Series: Earth and Environmental Science* 1181, no. 1 (May 1, 2023): 012021, <https://doi.org/10.1088/1755-1315/1181/1/012021>.

¹⁸ Mona Febriani Irma and Eva Gusmira, "Evaluasi Kebijakan Lingkungan Terhadap Emisi Gas Rumah Kaca Di Indonesia," *Jurnal Kolaborasi Sains Dan Ilmu Terapan* 2, no. 1 (December 15, 2023): 12–18, <https://doi.org/10.69688/juksit.v2i1.26>.

mitigation in Indonesia by promoting a more integrated and sustainable legal framework within the forestry sector.

Result & Discussion

A. What Are the Roles and Challenges of The Forestry Sector in Climate Change Mitigation?

Climate changes refers to changes in Earth's average temperature and prolonged weather patterns caused by human activities, particularly greenhouse gas (GHG) emissions from the transportation, industrial, and agricultural sectors. According to the Intergovernmental Panel on Climate Change (IPCC), global temperatures have increased by approximately 1.1°C since the late 19th century. There is more than a 50% likelihood that temperature will approach or exceed the 1.5°C threshold between 2021 and 2040.¹⁹ In a high-emission scenario, this limit could be reached even sooner between 2018 and 2037.²⁰ These findings emphasize the urgent need for significant and immediate reductions in emissions to limit global warming at this rate.

The impacts of climate change are pervasive and can cause significant losses to ecosystems, social and human health, and national and global economies. As a country with extensive forest cover and high biodiversity, Indonesia faces significant risks to food security, water resources, and environmental sustainability due to climate change. Rising temperatures can affect

¹⁹ Jarmo S. Kikstra et al., "The IPCC Sixth Assessment Report WGIII Climate Assessment of Mitigation Pathways: From Emissions to Global Temperatures," *Geoscientific Model Development* 15, no. 24 (December 20, 2022): 9075–9109, <https://doi.org/10.5194/gmd-15-9075-2022>.

²⁰ Xianchun Tan et al., "Carbon Emission and Abatement Potential Outlook in China's Building Sector through 2050," *Energy Policy* 118 (July 2018): 429–39, <https://doi.org/10.1016/j.enpol.2018.03.072>.

agricultural yields, which are highly dependent on specific weather patterns. Climate change can also worsen extreme weather conditions, such as floods and droughts, which often occur across various regions in Indonesia. One prominent example of this phenomenon is the increase in the frequency and intensity of floods affecting various regions of the country. In Jakarta, for example, annual floods caused by heavy rainfall often led to significant economic and social losses. Inadequate infrastructure and deforestation in the watershed exacerbate this situation, preventing rainwater from being adequately absorbed and resulting in severe inundation.²¹

Table 1. *The Role of the Forestry Sector in Climate Change Mitigation*

Aspect	Explanation	Relevance to Climate Change Mitigation
Carbon Sink Function	Indonesian forests absorb and store significant amounts of carbon dioxide from the atmosphere	Reduces greenhouse gas concentrations and supports emission reduction targets
Biodiversity Protection	Forest ecosystems preserve flora, fauna, and ecological balance	Strengthens ecosystem resilience against climate change impacts
Peatland and Mangrove Conservation	Peatlands and mangroves store significant carbon stocks and protect ecosystems	Prevents large-scale carbon emissions and coastal degradation
Water and Disaster Regulation	Forests regulate water systems and reduce risks of floods, droughts, and erosion	Supports environmental stability and climate adaptation
Support for Local Communities	Forests provide livelihoods and natural resources for indigenous and local communities	Encourages sustainable resource management and social resilience

²¹ Maria Obiminda L. Cambaliza et al., “Regional and Urban Air Quality in Southeast Asia: Maritime Continent,” in *Handbook of Air Quality and Climate Change* (Singapore: Springer Nature Singapore, 2023), 533–91, https://doi.org/10.1007/978-981-15-2760-9_68.

Aspect	Explanation	Relevance to Climate Change Mitigation
REDD+ Implementation	Forest conservation programs reduce emissions from deforestation and degradation	Supports Indonesia's commitment under the Paris Agreement
Sustainable Forest Management	Selective rehabilitation, conservation maintain sustainability	logging, and policies forest Balances development with environmental protection

The forestry sector plays a crucial role in reducing greenhouse gas emissions through sustainable forest management, the protection of peatlands, the conservation of mangrove forests, and the implementation of REDD+ mechanisms. Forest ecosystems are essential for maintaining ecological balance, protecting biodiversity, and supporting the livelihoods of the local community. Therefore, strengthening forest governance is essential not only for environmental sustainability but also for enhancing national climate resilience.

Indonesia's forestry sector is grappling with significant challenges, including deforestation, illegal logging, land conversion, forest fires, and weak law enforcement. Furthermore, overlapping institutional authority, inconsistent policies, and limited coordination among government agencies often hinder the effectiveness of forestry regulations. These issues highlight the need for legal and institutional reform to enhance climate mitigation efforts through the forestry sector.

A significant challenge in forest management is the limited involvement of indigenous peoples and local communities. Although various regulations exist to promote sustainable forest governance, there are considerable implementation gaps due to inadequate monitoring systems, corruption, and limited institutional capacity. To achieve Indonesia's NDC targets, it is essential to strengthen regulations, enhance integrated

governance, encourage public participation, and enforce policies effectively. Additionally, drought is a serious issue affecting many regions in Indonesia that depend on agriculture. The prolonged dry season, driven by changing weather patterns due to global warming, is causing a decline in agricultural production and threatening food security. In East Nusa Tenggara, for instance, farmers frequently experience crop failures due to extended droughts, which directly impact their livelihoods. The scarcity of clean water and the need for agricultural irrigation further exacerbate these conditions, creating a challenging cycle to break.²²

Climate change significantly impacts weather patterns and increases the risk of natural disasters. Global temperatures are rising, and extreme weather events, such as tropical storms and strong winds, are becoming more frequent. Recent years have seen this trend in Indonesia, where several regions have experienced strong winds that have damaged houses and infrastructure, resulting in substantial losses for the community. The effects of climate change are felt not only by the community but also by surrounding ecosystems. Forests, which act as natural buffers against natural disasters, are increasingly threatened by deforestation and climate change. This degradation reduces their capacity to absorb water and regulate the local climate.²³

Climate change presents complex and interconnected challenges that require urgent attention and collective action from all stakeholders to mitigate its impacts and enhance

²² Tonni Agustiono Kurniawan et al., "Implications of Climate Change on Water Quality and Sanitation in Climate Hotspot Locations: A Case Study in Indonesia," *Water Supply* 24, no. 2 (February 1, 2024): 517–42, <https://doi.org/10.2166/ws.2024.008>.

²³ Sanudin et al., "Management of Coffee Agroforestry Systems: Lessons Learned from a Social Forestry Program in West Java, Indonesia," *IOP Conference Series: Earth and Environmental Science* 1315, no. 1 (March 1, 2024): 012002, <https://doi.org/10.1088/1755-1315/1315/1/012002>.

community resilience to extreme weather events.²⁴ The IPCC has indicated that climate change has slowed agricultural productivity growth, particularly in regions with middle and low incomes, with a significant decline in crop productivity observed in Africa since 1961.²⁵ This decline poses a serious threat to national food security, as many agricultural areas have become unproductive due to climate change. In Indonesia, the forestry sector is especially vulnerable to the effects of climate change. Long-standing issues of deforestation and forest degradation have worsened this situation. Indonesia's forests are crucial carbon sinks; their loss not only increases GHG emissions but also diminishes the country's ability to absorb atmospheric carbon dioxide. According to a 2023 Global Forest Watch report, Indonesia loses approximately 3 million hectares of forest annually due to land conversion for agriculture and other illegal activities.²⁶ The IPCC noted that deforestation is one of the leading causes of increased global carbon dioxide emissions. Additionally, climate change has significant effects on biodiversity. Many species of flora and fauna in Indonesia are endangered due to rapid habitat changes driven by climate change. For instance, endemic species on small islands may have no suitable habitats to migrate to as temperatures rise and their environments are lost due to rising sea levels.²⁷

Local communities that rely on natural resources for their livelihoods are affected by this biodiversity loss, which harms

²⁴ Juri Kim and Tae-Hyoung Tommy Gim, "Assessment of Social Vulnerability to Floods on Java, Indonesia," *Natural Hazards* 102, no. 1 (May 8, 2020): 101–14, <https://doi.org/10.1007/s11069-020-03912-1>.

²⁵ Steven Block, "The Decline and Rise of Agricultural Productivity in Sub-Saharan Africa since 1961," in *African Successes, Volume IV: Sustainable Growth* (University of Chicago Press, 2014), 13–67.

²⁶ Roland Cochard, "Consequences of Deforestation and Climate Change on Biodiversity," in *Land Use, Climate Change and Biodiversity Modeling* (IGI Global, n.d.), 24–51, <https://doi.org/10.4018/978-1-60960-619-0.ch002>.

²⁷ Varsha Vijay et al., "The Impacts of Oil Palm on Recent Deforestation and Biodiversity Loss," ed. Madhur Anand, *PLOS ONE* 11, no. 7 (July 27, 2016): e0159668, <https://doi.org/10.1371/journal.pone.0159668>.

ecosystems. Climate change may exacerbate existing social inequities in a socioeconomic context. Due to limited adaptation resources, the poor are often the groups most at risk from the effects of climate change. For instance, small farmers might not have access to irrigation or contemporary agricultural technologies needed to cope with harsh weather.²⁸ To ensure that local communities have the resources they need to adapt to climate change, it is crucial to design adaptation policies that account for their needs. If global warming reaches 2°C rather than 1.5°C, the effects of climate change will be significantly more pronounced, according to the IPCC 2024 assessment. The risk of ecosystem loss will rise sharply at 2°C, including the loss of tropical rainforests and coral reefs.²⁹

Extreme weather events, such as heat waves and tropical storms, are expected to occur more frequently and with greater intensity. This trend indicates that every degree of warming seriously impacts both human life and ecosystems. In response to this issue, many countries, including Indonesia, have developed action plans to mitigate climate change through NDCs. According to its NDC, Indonesia aims to reduce greenhouse gas emissions by 29% by 2030 on its own and by up to 41% with assistance from other countries.³⁰ However, achieving this target requires the implementation of effective mitigation strategies and the active participation of all stakeholders. To effectively address the impact of climate change,

²⁸ Siri Eriksen et al., "Adaptation Interventions and Their Effect on Vulnerability in Developing Countries: Help, Hindrance or Irrelevance?," *World Development* 141 (May 2021): 105383, <https://doi.org/10.1016/j.worlddev.2020.105383>.

²⁹ Nabila Andini et al., "Global Warming Threats to Coral Bleaching Events and Their Impacts on Coastal Ecosystem Sustainability," ed. G. Jameson et al., *BIO Web of Conferences* 134 (October 28, 2024): 02009, <https://doi.org/10.1051/bioconf/202413402009>.

³⁰ Ika Sri Hastuti, "Assessing Indonesia's Enhanced Nationally Determined Contributions (NDC) to The Paris Agreement: Identifying The Obstacles Indonesia Has in Addressing Climate Change," 2024, 154–67, https://doi.org/10.2991/978-2-38476-269-9_14.

collaboration among governments, the private sector, civil society, and local communities is essential. The government must create policies that protect vulnerable communities from the negative consequences of climate change, including promoting reductions in GHG emissions. This can be achieved by encouraging sustainable farming practices and enacting legislation that supports renewable energy, thus reducing our dependence on fossil fuels.

One of the primary ways the forestry sector contributes to climate change mitigation is by reducing carbon dioxide (CO₂) emissions from deforestation and forest degradation. Forests serve as carbon sinks, helping to lower atmospheric CO₂ levels. According to the FAO's 2020 report, approximately 11% of total global greenhouse gas emissions are attributed to deforestation. Therefore, sustainable forest management and conservation are vital components of effective climate change mitigation strategies.³¹

In Indonesia, the forestry sector is a carbon sink and a source of life for local communities and biodiversity supporters. Indonesia's forests store the world's largest carbon stocks, accounting for 75% to 80% of global carbon stocks, including tropical forests, peatlands, and mangrove ecosystems. Maintaining these carbon stocks can lower carbon emissions into the atmosphere, reduce disaster risk, and help prevent climate change.³² Indonesia's forests also act as a significant carbon sink, helping reduce the concentration of greenhouse gases in the atmosphere. With a forest area of around 94 million hectares, the

³¹ Zunnuraeni Zunnuraeni, Muh Risnain, and Widodo Dwi Putro, "Mitigasi Perubahan Iklim Melalui Kebijakan Pengelolaan Dan Pelestarian Lingkungan Laut," *Jurnal Hukum Mimbar Justitia* 10, no. 1 (June 30, 2024): 154, <https://doi.org/10.35194/jhnmj.v10i1.4153>.

³² Cahyaning Windarni, Agus Setiawan, and Rusita Rusita, "Carbon Stock Estimation of Mangrove Forest in Village Margasari Sub-District Labuhan Maringgai District East Lampung," *Jurnal Sylva Lestari* 6, no. 1 (February 12, 2018): 66, <https://doi.org/10.23960/jsl1667-75>.

forestry sector has the potential to absorb around 1.1 billion tons of carbon dioxide per year.³³

In addition, the Indonesian forestry sector faces challenges of sustainable management. The main challenge is that, while various laws and policies support forest management, a lack of coordination between government agencies often hampers their implementation. For example, Law No. 41 of 1999 on Forestry and Law No. 32 of 2009 on Environmental Protection and Management provide a legal framework for sustainable forest management. Still, challenges in law enforcement and corruption often hinder the effectiveness of such policies. Therefore, effective, sustainable forest management is essential to maintain the functioning of these ecosystems. Sustainable forest management encompasses a range of practices that can reduce environmental impacts while meeting the economic needs of communities. These practices include selective felling based on tree type and trunk diameter, post-mining area rehabilitation, and forest fire prevention.

Community-based management initiatives, such as the Community Shared Forest Management program, play a crucial role in maintaining the sustainability of forest resources. Active community participation in forest management enhances resource sustainability and generates economic benefits for populations reliant on forests for their daily livelihoods. The Government of Indonesia has pledged to reduce greenhouse gas emissions by 31.89% by 2030 through the sustainable management of forest ecosystems.³⁴ Effective and sustainable

³³ Francisca Devina Putri Guntur, Sapto Hermawan, and Asianto Nugroho, "Peran Badan Restorasi Gambut Dan Mangrove Dalam Perspektif Lingkungan," *Demokrasi: Jurnal Riset Ilmu Hukum, Sosial Dan Politik* 1, no. 1 (February 23, 2024): 23–34, <https://doi.org/10.62383/demokrasi.v1i1.72>.

³⁴ Daniel Murdiyarso et al., "Refining Greenhouse Gas Emission Factors for Indonesian Peatlands and Mangroves to Meet Ambitious Climate Targets,"

management of the forestry sector is essential for achieving this target. These efforts demonstrate that significant reductions in greenhouse gas emissions are attainable through well-managed forestry practices in Indonesia.

Furthermore, policy integration is a critical component of effective forest management. Comprehensive forest management should address multiple dimensions, including land tenure security, productivity, and product diversification. This approach prioritizes timber as a primary resource while also considering other ecosystem services, such as biodiversity conservation and clean water provision. The escalating climate crisis necessitates a holistic strategy that harmonizes policy frameworks with management practices. Collaboration among governments, the private sector, civil society, and local communities is essential for the successful implementation of climate change mitigation strategies within the forestry sector. Engaging all stakeholders in decision-making and the execution of sustainability programs fosters a more adaptive forest management system that addresses the challenges posed by climate change.

B. Legal Strategies in Climate Change Mitigation for Achieving Nationally Determined Contributions

The Nationally Determined Contribution (NDC) is a commitment by participating nations in the Paris Agreement to reduce greenhouse gas emissions and enhance resilience to climate change impacts. Indonesia, which has the third-largest tropical forest globally, has articulated ambitious targets in its NDC. In its 2016 NDC, Indonesia pledged to reduce greenhouse gas emissions by 29% from the business-as-usual (BAU) scenario by 2030 and by 41% with international assistance from other

Proceedings of the National Academy of Sciences 121, no. 17 (April 23, 2024), <https://doi.org/10.1073/pnas.2307219121>.

countries.³⁵ In August 2024, Indonesia initiated the implementation of its Second NDC to reinforce its commitment. This updated NDC introduces several key revisions compared to previous commitments. Notably, it adopts 2019 as the new reference year for calculating greenhouse gas emission reductions, thereby enabling more accurate cross-country comparisons of emission reduction efforts.³⁶

This new commitment aims to reduce greenhouse gas emissions through capabilities (unconditional) and with international support (conditional) from 2031 to 2035, consistent with the 1.5°C global warming scenario. Indonesia has identified additional sectors for inclusion in greenhouse gas emission reduction calculations, such as the marine and upstream oil and gas sectors.³⁷ The inclusion of the marine sector reflects Indonesia's focus on managing coastal and marine ecosystems as integral components of its climate change mitigation strategy. Furthermore, new sub-sectors, including the replacement of HFC-134a refrigerant with HFO-1234 in the refrigeration sector, are being developed to address emissions from environmentally harmful greenhouse gases. The Second NDC will also reinforce Indonesia's commitment to climate change adaptation by implementing the previous Enhanced NDC.³⁸ This approach aligns with the agreement reached at COP 28 in Dubai on the Global Goal on Adaptation in 2023 and

³⁵ Waluyo Eko Cahyono et al., "Projection of CO₂ Emissions in Indonesia," *Materials Today: Proceedings* 63 (2022): S438–44, <https://doi.org/10.1016/j.matpr.2022.04.091>.

³⁶ Theresia Mayke Nindiya and RR Ratih Dyah Kusumastuti, "Supply Chain Analysis Study: Pengaruh Rantai Pasokan Terhadap Kapabilitas Ekonomi Sirkular Indonesia," *Journal of Entrepreneurial Economic* 1, no. 2 (August 31, 2024): 12–24, <https://doi.org/10.61511/jane.v1i2.2024.1006>.

³⁷ Alfian Nurdiansyah, "Urban Slum Upgrading Policy In Jakarta (Case Study: Kampung Deret Program Implementation)," *The Indonesian Journal of Planning and Development* 3, no. 1 (February 28, 2018): 19, <https://doi.org/10.14710/ijpd.3.1.19-31>.

³⁸ Vitaly Yaropud, "Experimental Studies of Design-and-Technological Parameters of Heat Exchanger," *Przegląd Elektrotechniczny* 1, no. 10 (October 3, 2022): 59–62, <https://doi.org/10.15199/48.2022.10.10>.

recognizes the potential for Loss and Damage funding to enhance Indonesia's climate resilience across economic, social, ecosystem, and landscape dimensions. Consequently, the Second NDC document emphasizes both mitigation and adaptation measures for climate change.

Achieving Indonesia's ambitious climate targets requires recognition that NDCs cannot be accomplished in isolation. Effective climate change mitigation depends on collaboration among governments, the private sector, civil society, and local communities. This collaborative approach necessitates the alignment of sectoral policies, including those related to the energy transition and the sustainable management of natural resources. Legal strategies for climate change mitigation encompass a range of policies and regulations that govern the use and management of natural resources, particularly forests. According to Bodansky, a practical legal approach to climate change mitigation should incorporate precise regulation, robust law enforcement, and active community participation in decision-making processes.³⁹ In the forestry sector, one effective strategy is to strengthen regulations by enforcing strict controls on deforestation and unsustainable forest management practices.

Law enforcement targeting businesses or individuals responsible for forest destruction is a critical component of environmental protection. To address this challenge, the Ministry of Environment and Forestry has issued several regulations. Notably, the Regulation is the Minister of Environment and Forestry Regulation No. 17 of 2021 on Ecosystem-Based Forest Management, which aims to ensure that all forestry activities prioritize biodiversity preservation and environmental sustainability. Enhanced law enforcement, including sanctions against violators, is necessary to prevent

³⁹ Daniel Bodansky, "International Environmental Law," in *The Handbook of Global Climate and Environment Policy* (Wiley, 2013), 179–96, <https://doi.org/10.1002/9781118326213.ch11>.

illegal deforestation and ensure corporate compliance with environmental standards. Furthermore, the implementation of economic incentives constitutes a vital element of the legal strategy for climate change mitigation. Mechanisms such as Payments for Ecosystem Services (PES) can motivate communities to engage in forest conservation by providing compensation to those who maintain and protect forest ecosystems.⁴⁰

The 2020 report from The Conversation states that Indonesia has introduced an incentive mechanism through the REDD+ program to reward communities and landowners who contribute to forest protection and carbon emission reduction. An example of the PES implementation in Indonesia is evident in the Laman Satong Village Forest in West Kalimantan, where the community secured a contract valued at Rp100 million to protect their forest from 2013 to 2014. Multi-stakeholder collaboration is crucial for fostering synergies in forest management. Partnerships among government, community, and private sector actors can enhance the effectiveness of climate change mitigation initiatives.⁴¹

Initiatives such as the Aik Bual Community Forest in West Nusa Tenggara demonstrate that collaboration between government and local communities can generate economic benefits while protecting the environment. Within this multi-stakeholder framework, it is crucial to enhance community capacity for active participation in forest resource

⁴⁰ Joko Tri Haryanto and Luhur Fajar Martha, "Kerangka Hukum Instrumen Ekonomi Lingkungan Dalam Upaya Penurunan Emisi Gas Rumah Kaca," *Jurnal Konstitusi* 14, no. 2 (November 2, 2017): 262, <https://doi.org/10.31078/jk1422>.

⁴¹ Cahyo Nugroho, Jatna Supriatna, and Ahmad Kusworo, "Dapatkah Pembayaran Jasa Lingkungan Mencegah Deforestasi Dan Meningkatkan Kesejahteraan Masyarakat? Pelajaran Dari Hutan Desa Laman Satong, Kabupaten Ketapang, Kalimantan Barat," *Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan (Journal of Natural Resources and Environmental Management)* 9, no. 4 (December 2, 2019): 882–92, <https://doi.org/10.29244/jpsl.9.4.882-892>.

management.⁴² In the context of NDC, Indonesia has set an ambitious target to reduce greenhouse gas emissions by 29% from the BAU scenario by 2030, and up to 41% with international support.⁴³ The government should develop policies that facilitate reductions in greenhouse gas emissions while safeguarding vulnerable communities from the adverse effects of climate change. Therefore, a comprehensive legal strategy for climate change mitigation in the forestry sector is essential to achieve Indonesia's NDC targets. Regulatory strengthening, economic incentives, and multi-stakeholder cooperation must be effectively integrated to ensure forest sustainability and climate change mitigation.

Existing legal frameworks, including Law No. 32 of 2009 on Environmental Protection and Management, establish the foundation for sustainable environmental governance. This legislation addresses pollution control and environmental degradation, with specific provisions for greenhouse gas emissions. Law No. 41 of 1999 on Forestry is also instrumental in promoting sustainable forest management and protection, and it supports the implementation of the REDD+ program, which targets emissions reductions in the forestry sector. Presidential Regulation No. 61 of 2011, which outlined the National Action Plan for Reducing Greenhouse Gas Emissions, was superseded by Presidential Regulation No. 98 of 2021 on the Implementation of Carbon Economic Value for achieving Nationally Determined Contribution Targets and Greenhouse Gas Emission Control in National Development. This regulation sets emission reduction

⁴² Nurdin et al., "The Environmental Communication Based On Local Wisdom: A Case Study On Water Conservation Of Rimang Baling Wildlife Reserve," *Russian Journal of Agricultural and Socio-Economic Sciences* 105, no. 9 (September 16, 2020): 23–29, <https://doi.org/10.18551/rjoas.2020-09.02>.

⁴³ Syaharani Syaharani and Muhammad Alfitras Tavares, "Nasib Target Emisi Indonesia: Pelemahan Instrumen Lingkungan Hidup Di Era Pemulihan Ekonomi Nasional," *Jurnal Hukum Lingkungan Indonesia* 7, no. 1 (December 22, 2020): 1–27, <https://doi.org/10.38011/jhli.v7i1.212>.

targets and strategies, integrating sectors such as forestry, energy, and agriculture. Indonesia's NDC commits to reducing greenhouse gas emissions by 29% by 2030, with the potential to reach 41% through international cooperation. Legal strategies to achieve these targets include reinforcing REDD+ policies, adopting green economy principles, and ensuring robust law enforcement. Strengthening REDD+ policies promotes sustainable forest management and encourages local community participation, while applying green economy principles integrates sustainability into national development planning.

Policy implementation in Indonesia faces significant challenges due to insufficient inter-agency coordination and weak law enforcement. Although several legal provisions support environmental protection, including Article 69 of Law No. 32 of 2009, which mandates government responsibility for environmental protection, and Article 5 of Law No. 41 of 1999, which underscores sustainable forest management, persistent obstacles remain. European countries such as Germany and Sweden have implemented stricter emission-reduction policies and promoted renewable energy use. The European Union has also committed to achieving net-zero emissions by 2050. Similarly, the United States, under the Biden administration, has renewed its commitment to the Paris Agreement and established more ambitious emission reduction targets⁴⁴. Nevertheless, climate policy in the U.S. remains fragmented, with regulations differing across states. These international examples indicate that Indonesia could benefit from adopting the best practices and implementing more ambitious policies to achieve its climate change mitigation objectives.⁴⁵

⁴⁴ Alicia Zhao et al., "High-Ambition Climate Action in All Sectors Can Achieve a 65% Greenhouse Gas Emissions Reduction in the United States by 2035," *Npj Climate Action* 3, no. 1 (July 24, 2024): 63, <https://doi.org/10.1038/s44168-024-00145-x>.

⁴⁵ Sean Sweeney, "Five Years On, the Paris Climate Agreement Needs an Overhaul," *New Labor Forum* 30, no. 1 (January 4, 2021): 102–9, <https://doi.org/10.1177/1095796020980166>.

Although challenges in implementation and enforcement persist, opportunities exist to enhance the effectiveness of legal strategies by adopting a more integrated and participatory approach. Greater public awareness and engagement on climate change, along with advancements in green technologies and innovations in the energy and forestry sectors, offer prospects for a more sustainable future. Collaboration among government, society, and the private sector can strengthen climate change mitigation efforts in Indonesia, resulting in more effective and enduring policies to safeguard the environment and natural resources for future generations.

Indonesia's forestry sector encounters significant challenges in mitigating climate change due to limitations within the current legal framework. While several laws aim to protect forests and the environment, certain provisions that may undermine efforts toward sustainable forest management. Law No. 41 of 1999 concerning Forestry is frequently scrutinized in this context. Article 5, which addresses sustainable forest management, is subject to broad interpretation, resulting in inconsistent policy implementation. Furthermore, Article 17, which governs forest use permits, is hampered by a lengthy, complex licensing process, thereby increasing the risk of irresponsible forest exploitation.

Article 50 of the same law establishes sanctions for violations of forestry regulations. Nevertheless, weak law enforcement and corruption frequently undermine the effectiveness of these sanctions, leading to persistent violations of forestry laws. Additionally, Law No. 32 of 2009 on Environmental Protection and Management contains provisions that present further challenges. For instance, Article 69 outlines the government's responsibility to protect and manage the environment; however, inconsistent implementation and insufficient inter-agency coordination often impede effective environmental protection.

Article 71, which regulates environmental impact analysis (EIA), frequently lacks transparency. The absence of community involvement may lead to decisions detrimental to both the environment and local communities. Government Regulation No. 26 of 2008 on Regional Spatial Planning also presents significant challenges. Specifically, Article 12, which governs land use allocation, is often ambiguous. This ambiguity can lead to conflicts between development objectives and forest conservation, thereby increasing the risk of deforestation.

Presidential Regulation Number 98 of 2021, which governs the National Action Plan for Reducing Greenhouse Gas Emissions, establishes specific goals and targets for emission reduction in Articles 2 and 3. Nevertheless, the absence of robust monitoring and evaluation mechanisms introduces uncertainty regarding the attainment of these targets. Similarly, Law No. 18 of 2013 on the Prevention and Eradication of Forest Destruction faces significant challenges. Although Article 4 addresses the prevention of forest destruction, inadequate implementation and insufficient law enforcement resources frequently undermine its effectiveness.

Although multiple forestry and environmental regulations exist, certain legal provisions continue to hinder the effective implementation of sustainable forest governance in Indonesia. Law No. 41 of 1999 concerning Forestry serves as the primary legal framework for forest management; however, several of its provisions present practical challenges. For instance, Article 5, which addresses forest management authority, is subject to inconsistent interpretation. This inconsistency leads to overlapping institutional authority between central and regional governments, resulting in legal uncertainty and weak coordination in forest governance.

Furthermore, Article 17, which regulates forest utilisation permits, has frequently been criticised for its complex, lengthy, and protracted licensing procedures. These procedural challenges may facilitate corruption and promote unsustainable

forest exploitation. Similarly, Article 50, which addresses sanctions for forestry violations, has not been effectively enforced due to inadequate law enforcement and limited institutional oversight. Consequently, illegal logging, forest burning, and unlawful land conversion persist despite the presence of legal prohibitions.

Comparable challenges are evident in Law No. 32 of 2009 on Environmental Protection and Management. Articles 69 and 71, which address environmental protection obligations and environmental impact assessment mechanisms, are frequently hindered by inadequate implementation, insufficient transparency, and limited public participation. As a result, environmental governance in the forestry sector often fails to achieve effective ecological protection or sustainable resource management.

The challenges in Indonesia's forestry sector extend beyond environmental concerns and encompass structural weaknesses in legal implementation, institutional coordination, and governance mechanisms. Strengthening legal certainty and enhancing institutional effectiveness are therefore critical to advancing climate change mitigation efforts and achieving Indonesia's Nationally Determined Contributions (NDCs).

Although Indonesia possesses a legal framework supporting forest management and climate change mitigation, significant challenges persist in implementation, law enforcement, and inter-agency coordination. Reform of policies and law enforcement is necessary to ensure that forest management is conducted sustainably and effectively, thereby advancing Indonesia's climate change mitigation efforts. Addressing weaknesses in the legal framework and enhancing collaboration among government entities, communities, and the private sector will strengthen Indonesia's capacity to address climate change and safeguard its natural resources for future generations.

Table 2. *Role of the Forestry Sector in Climate Change Mitigation and Indonesia's NDC Achievement*

Forestry Aspect	Role in Climate Change Mitigation	Contribution to Indonesia's NDC
Tropical Forests	Serve as carbon sinks by absorbing and storing carbon dioxide emissions	Contribute to achieving greenhouse gas emission reduction targets established under the Paris Agreement
Peatland Ecosystems	Prevent large-scale carbon emissions resulting from peatland degradation and fires	Reduces emissions associated with land-use change and forest fires
Mangrove Forests	Store significant amount of blue carbon and protect coastal ecosystems	Enhance coastal climate resilience and facilitate carbon sequestration
Biodiversity Conservation	Promotes ecosystem balance and advances environmental sustainability	Enhances ecological resilience to the impacts of climate change
REDD+ Mechanism	Facilitates emission reductions through forest conservation and sustainable management practices	Contributes to the fulfilment of international climate mitigation commitments
Community-Based Forest Management	Promotes the sustainable utilization of forest resources by fostering local stakeholder participation	Strengthens inclusive and sustainable climate governance frameworks

Conclusion

The forestry sector plays a strategic role in supporting Indonesia's commitment to achieving its NDCs through climate change mitigation efforts. Indonesia's extensive tropical forests serve as carbon sinks and ecological buffers supporting

biodiversity, environmental sustainability, and community livelihoods. Despite the presence of various legal instruments and policy frameworks, the implementation of sustainable forest governance is hindered by persistent deforestation, weak law enforcement, overlapping institutional authority, limited public participation, and inconsistencies in policy coordination between central and regional governments. These challenges highlight a substantial gap between normative legal frameworks and their practical implementation.

The study further finds that existing legal mechanisms, such as forestry and environmental legislation, have not fully ensured the effective protection of forest ecosystems because of weak institutional capacity and insufficient monitoring systems. Furthermore, limited participation by indigenous peoples and local communities in decision-making processes has diminished the effectiveness of climate governance within the forestry sector. Consequently, achieving Indonesia's NDC targets requires not only stronger regulations but also a more integrated, participatory, and enforceable legal framework that aligns environmental protection with sustainable development objectives.

Drawing on these findings, several policy recommendations are proposed. First, the Government of Indonesia should enhance the implementation and enforcement of forestry and environmental laws by improving institutional coordination, increasing transparency, and imposing stricter sanctions on illegal logging, forest burning, and unsustainable land conversion. Second, sustainable forest governance should be promoted through inclusive policies that engage indigenous peoples, local communities, civil society organizations, and the private sector in forest management and climate mitigation initiatives. Third, the government should broaden economic incentive mechanisms, such as REDD+, Payments for Ecosystem Services (PES), and green investment schemes, to foster community participation in conservation activities. Fourth,

Indonesia should establish a comprehensive monitoring and evaluation system, supported by digital technology and cross-sectoral data integration, to ensure accountability in achieving NDC targets. Ultimately, a collaborative and evidence-based legal framework is crucial to reinforce the forestry sector's role in climate resilience, environmental sustainability, and Indonesia's sustained commitment to global climate governance.

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