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Editorial

Reinventing Forestry Education to Support Net Zero Emissions 2060 and Indonesia Emas 2045: Integrating Climate Mitigation, Bioenergy, and Human Resource Transformation

Reinventing Pendidikan Kehutanan dalam Mendukung Net Zero Emissions 2060 dan Indonesia Emas 2045: Integrasi Mitigasi Iklim, Bioenergi, dan Transformasi Sumber Daya Manusia

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ABSTRACT

Previous research had shown that climate change often posed a critical challenge to humans, both currently and in the future. This had led to the implementation of targets by countries around the globe for the transition to net-zero emissions. Indonesia, in particular, had a target of achieving net zero by 2060, as well as a national vision of 'Golden Indonesia 2045'. Therefore, this research aimed to discuss the strategic role of the forestry sector in climate mitigation through forest and land management, emissions-reduction actions, carbon-sequestration enhancement, and forest-based renewable energy development. The results emphasized the importance of reinventing forestry education to support the transition. Curriculum transformation toward interdisciplinary, integrative, and collaborative approaches was required to develop adaptive graduate capacities to achieve the targets.

KEYWORDS

climate change, forestry policy, renewable energy, forest education

INTISARI

Perubahan iklim merupakan tantangan kritis bagi kita di saat ini dan masa mendatang. Negara-negara di seluruh dunia telah menetapkan target untuk beralih ke emisi nol bersih. Indonesia berupaya mencapai nol bersih pada tahun 2060 dan juga visi nasional 'Indonesia Emas 2045'. Artikel ini membahas peran strategis sektor kehutanan dalam mitigasi iklim melalui pengelolaan hutan dan lahan, tindakan pengurangan emisi, peningkatan penyerapan karbon, dan pengembangan energi terbarukan berbasis hutan. Artikel ini kemudian menekankan pentingnya mereinventarisasi pendidikan kehutanan untuk mendukung transisi tersebut. Transformasi kurikulum menuju pendekatan interdisipliner, integratif, dan kolaboratif diperlukan untuk mengembangkan kapasitas lulusan yang adaptif guna mencapai target tersebut.

KATA KUNCI

perubahan iklim, kebijakan kehutanan, energi terbarukan, pendidikan kehutanan

Climate Change and Net Zero Emission (NZE) Targets

Climate change is one of the pressing global issues that threatens the sustainability of life on Earth (Hsieh & Yeh 2024). The Intergovernmental Panel on Climate Change (IPCC) report emphasizes that the world must keep global temperature rise below 1.5–2°C to prevent irreversible climate impacts (Rhodes 2019). As a concrete action to address the impacts, several countries in recent years have set NZE targets between 2050 and 2070, with 2060 being a key milestone in the global agenda (Bandh et al. 2025).

For Indonesia, the year 2060 holds strategic significance as an “ecological and developmental deadline.” The country has committed to achieving NZE by 2060, as outlined in its Long-Term Strategy on Low Carbon and Climate Resilience (Zhong et al. 2025). Indonesia also envisions “*Indonesia Emas 2045*” or “Golden Indonesia 2045,” aiming to become an economically developed country on the centenary of its independence (Bräuchler 2026). However, the key challenge lies in ensuring that economic growth and development progress do not compromise environmental sustainability or the well-being of future generations.

The Role of the Forestry Sector in Indonesia's Emission Reduction Targets

As outlined in its Nationally Determined Contribution (NDC), Indonesia has set a target of reducing greenhouse gas emissions by 31.89% with its own efforts and up to 43.20% with international support by 2030 through the Enhanced Nationally Determined Contribution (ENDC) (Hastuti 2024). At present, the country has increased its emission reduction target as stated in the Second Nationally Determined Contribution (SNDC), where net emissions are projected to reach 1,489 million tons of carbon dioxide equivalent (CO₂e) by 2035. In this commitment, the forestry and other land use (FOLU) sector plays a key role with a target of reducing emissions by 60% compared to other sectors (Government of Indonesia 2025). This shows that the forestry sector is the main pillar of the national carbon sink in achieving the NZE 2060.

To strengthen its commitment to achieving NDC, the Government of Indonesia (GoI) has launched a policy program called FOLU Net Sink 2030. The

program is designed as a mitigation action to ensure that the forestry and land sector is in the net sink condition, describing that emissions absorption in the atmosphere is greater than the resulting emissions (Dharmawan & Pratiwi 2023). The program includes controlling deforestation, rehabilitating degraded land, managing sustainable forests, and increasing carbon stocks through replanting and agroforestry. In addition to mandatory approaches through national policies, emissions reduction efforts can also be implemented through voluntary mechanisms, such as carbon trading. Therefore, the forestry sector not only contributes to climate change mitigation but also opens up new economic opportunities based on environmental services.

The Role of the Forestry Sector in the Renewable Energy Development

In the development of renewable energy, the forestry sector also has a strategic role to produce new renewable energy by using biodiesel- and bioethanol-producing plants. Plants used for biodiesel include *Sterculia foetida*, *Calophyllum inophyllum*, *Pongamia pinnata*, *Aleurites moluccanus*, and *Jatropha curcas* (Thangaraj & Solomon 2020). Bioethanol uses *Arenga pinnata* and *Sorghum bicolor* plants that can be developed both in monoculture and agroforestry systems (Ansar et al. 2020). Biodiesel and bioethanol are alternative energies that have been widely developed to reduce dependence on fossil fuels that tend to increase emissions (Sivakumare et al. 2010).

In an effort to support national energy security and reduce carbon emissions, the Faculty of Forestry Universitas Gadjah Mada is committed to developing renewable energy sourced from non-timber forest products (NTFPs). For example, biodiesel has been developed from *Kepuh* seeds (*Sterculia foetida*) and bioethanol from *Sorghum* plants (*Sorghum bicolor*). This innovation not only produces clean energy but also increases the economic value of forest areas and empowers communities around the forests.

Reinventing Forestry Education Towards NZE

The transition towards NZE 2060 and Golden Indonesia 2045 requires not only policies and technology but also adaptive human resources. Therefore, the concept of reinventing forestry

education is crucial in this context. In the 21st century, humans must be able to learn, unlearn, and relearn to survive amidst rapid change (Moss-Zobel 2025). Similarly, it is also emphasized the importance of sensing, seizing, and reconfiguring strategies in enhancing organizational capabilities (Karadağ 2019). Forestry education in Indonesia tends to focus on technical aspects such as silviculture, forest management, and conservation. While these aspects are important, the approach is insufficient to address cross-sectoral challenges such as climate change, the green economy, bioenergy, and food security. Therefore, reinventing forestry education means a paradigm shift toward a more integrative, interdisciplinary, and collaborative approach.

References

- Ansar, Sukmawaty, Abdullah SH, Nazaruddin, Safitri E. 2020. Physical and chemical properties of a mixture fuel between palm sap (*Arenga pinnata* Merr) bioethanol and premium fuel. *ACS Omega* 5(22):12745–12750. DOI: 10.1021/acsomega.0c00247.
- Bandh SA et al. 2025. Track to reach net-zero: Progress and pitfalls. *Energy & Environment* 36(5):2345–2370. DOI: 10.1177/0958305X241260793.
- Bräuchler B. 2026. Golden Indonesia 2045: Neoliberal development policies and environmental journalism. *Journal of Current Southeast Asian Affairs* 45(1):3–29. DOI:10.1177/18681034251345832.
- Dharmawan IWS, Pratiwi. 2023. Implementation of forestland rehabilitation to support the enhancement of carbon stock on Indonesia's FOLU net sink 2030 strategy. *IOP Conference Series: Earth and Environmental Science* 1180:012010. DOI: 10.1088/1755-1315/1180/1/012010.
- Government of Indonesia. 2025. Second nationally determined contribution Republic of Indonesia. Available from <https://unfccc.int/documents/615082> (accessed February 3, 2026).
- Hastuti IS. 2024. Assessing Indonesia's enhanced Nationally Determined Contributions (NDC) to the Paris agreement: Identifying the obstacles Indonesia has in addressing climate change. *Advances in Social Science, Education and Humanities Research* 854:154–167. DOI: 10.2991/978-2-38476-269-9_14.
- Hsieh Y-L, Yeh S-C. 2024. The trends of major issues connecting climate change and the sustainable development goals. *Discover Sustainability* 5:31. DOI: 10.1007/s43621-024-00183-9.
- Karadağ H. 2019. Dynamic capabilities and entrepreneurial management: A review of selected works of David J. Teece. *Journal of Social and Administrative Sciences* 6(1):10–15. Available from <https://journals.econsocieties.com/index.php/JSAS/article/view/1850>.
- Moss-Zobel A. 2025. Learning, unlearning & relearning. *The Applied Business & Management Review* 1(1). Available from <https://abmr-journal.org/index.php/intl/article/view/9>.
- Rhodes CJ. 2019. Only 12 years left to readjust for the 1.5-degree climate change option – Says International Panel on Climate Change report: Current commentary. *Science Progress* 102(1):73–87. DOI: 10.1177/0036850418823397.
- Sivakumar G, Vail DR, Xu J, Burner DM, Lay JO, Ge X, Weathers PJ. 2010. Bioethanol and biodiesel: Alternative liquid fuels for future generations. *Engineering in Life Sciences* 10(1):8–18. DOI: 10.1002/elsc.200900061.
- Thangaraj B, Solomon PR. 2020. Scope of biodiesel from oils of woody plants: A review. *Clean Energy* 4(2):89–106. DOI:10.1093/ce/zkaa006.
- Zhong S, Su B, He J, Ng TS. 2025. Moving towards a net-zero emissions economy in Indonesia. *Science of The Total Environment* 1001:180542. DOI: 10.1016/j.rsres.2022.112226.