The Importance of Mangroves as a Blue Carbon Reserve

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Summary

Blue carbon plays a vital role in mitigating climate change dynamics because it has the potential to reduce emissions that cause climate change. As one of the blue carbon ecosystems, mangroves are a key coastal ecosystem that can sequester and store vast amounts of carbon over a very long period. However, the vital role of this ecosystem has not received much attention, and needs more information on the benefits of mangroves as a store of blue carbon reserves. So, this article aims to identify the role of mangroves in carbon sequestration to mitigate the effects of climate change. Mangroves can reduce carbon dioxide better than terrestrial vegetation. Mangroves can absorb around 600-1,800 tonnes C/Ha and store between 740-1,000 tonnes C/Ha. Indonesia has the world's largest mangrove forest, which is around 3.3 million hectares. The great potential of mangroves as a blue carbon ecosystem makes Indonesia one of the largest countries in absorbing (3138 million tonnes of C equivalent/year) and storing (33.3 gigatons) carbon. Therefore, sustainable mangrove management is needed to increase the value of mangroves in the environmental service commodity.

Keywords: Blue Carbon, Carbon stock, Climate Change, Coastal, Mangroves

Introduction

Blue carbon is carbon captured and stored by organisms in coastal and marine areas through the process of photosynthesis and accumulated in the biomass of mangrove plants, seagrass beds, phytoplankton, seaweed, and sediments. Blue carbon plays an important role in mitigating climate change dynamics because it can potentially reduce emissions that cause climate change by utilising coastal areas, mangroves, wetlands, and seagrass meadows (BRIN, 2022). Mangrove forests, as blue carbon, store 4-20 billion tons of carbon worldwide and are equivalent to the carbon emitted by all gas-fired power plants worldwide over four years (Jompa & Murdiyarso, 2022; Murray et al., 2023). Mangroves, tidal marshes, and seagrass meadows can be found along the coastline of every continent except Antarctica, with the total area of the three ecosystems covering approximately 49 million Ha (The Blue Carbon Initiative, 2019). Indonesia is one of the regions with the largest blue carbon potential in the world, thus playing an important role in climate change mitigation and adaptation nationally and globally (ICCTF, 2023).

As one of the blue carbon ecosystems, mangroves are a key coastal ecosystem that can sequester and store vast amounts of carbon over a very long period. However, the vital role of this ecosystem has received little attention, so more information is needed on the benefits of mangroves as a store of blue carbon reserves. Therefore, this article aims to identify the role of mangroves in carbon sequestration to mitigate the effects of climate change.

Blue Carbon Ecosystems

Coastal blue carbon ecosystems focus on rooted vegetation in the coastal zone, such as tidal marshes, mangroves, and seagrass meadows. These three wetland ecosystems are widely distributed (Figure 1) and have high carbon sequestration rates. In addition, they can also accumulate carbon in soils and sediments that can contribute to ecosystem-based adaptation. Mangroves, seagrass meadows, and tidal marsh vegetation can thrive at the interface between the coast and the sea, where other plants usually cannot grow. These plants are adapted to changes in salinity that can facilitate the storage of large amounts of carbon in the soil (Murray et al., 2023).

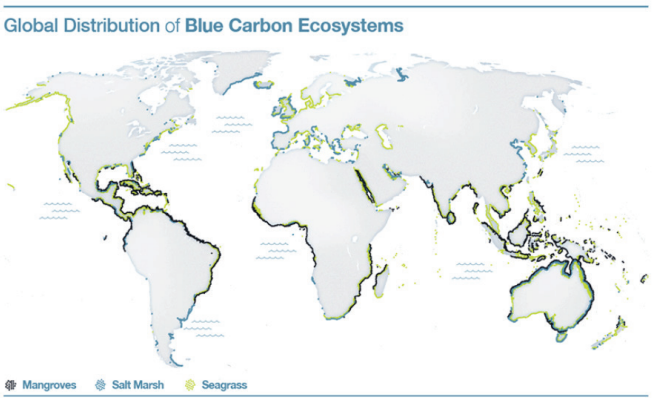

Figure 1. Global distribution of blue carbon ecosystem
Source: The Blue Carbon Initiative, 2019

Blue carbon ecosystems are relatively small compared to oceans and other terrestrial ecosystems. However, they have large carbon storage capabilities, particularly in sediments, and also have high net primary production compared to terrestrial ecosystems. Globally, it is estimated that mangroves hold between 4-20 billion tons of carbon and seagrasses 0.4-0.8 billion tons (Jompa & Murdiyarso, 2022). About 50-99% of the carbon sequestered by coastal ecosystems is stored in the soil six metres below the ground surface and can be retained for thousands of years (Sulistiani, 2018; Murray et al., 2023). If degraded or lost, coastal blue carbon ecosystems will likely release most of their carbon back into the atmosphere.

Mangroves Ecosystem as One of Blue Carbon Storage

Mangroves provide a wide range of ecosystem benefits and contribute greatly to the well-being of coastal communities. Nowadays, mangroves are considered one of the most efficient coastal ecosystems in fixing atmospheric carbon dioxide levels and storing carbon in biomass and sediments, making them a key focus of climate change mitigation efforts (Holl, 2020; Trissanti et al., 2022). Mangroves can sequester and store vast amounts of carbon over long periods (Holl, 2020). They can reduce CO2 greater and better than terrestrial vegetation (Tahir et al., 2023).

Mangroves sequester an estimated up to 20 billion tons of carbon annually, making them one of the top three carbon-capturing ecosystems in the world, compared to other comparable biomes, including seagrass and dry forests (Jompa & Murdiyarso, 2022). They can sequester between 600-1,800 tons C/Ha (Sulistiana, 2018) and can store between 740-1,000 tons C/Ha or the equivalent of CO2 emissions from burning more than 2,000 barrels of oil, of which 98% is stored in sediments (Murray et al., 2023).

Mangroves in Indonesia: Threats and Opportunities to Achieve NDCs

Indonesia's blue carbon potential is one of the world's largest and most important in mitigating and adapting to climate change nationally and globally. Blue carbon or carbon stored in coastal and marine ecosystems has an important role in achieving the emission reduction target in Indonesia's Enhance Nationally Determined Contribution (NDC) of 21.89% with its efforts (National) and 43.20% with international assistance by 2030 (ICCTF, 2023). Indonesia's coastal and ocean areas have the potential to sequester approximately 138 million tons of carbon equivalent per year (which could reduce 25% of global carbon emissions) or five times greater than the sequestration potential of tropical forest ecosystems in Indonesia (Sulistiana, 2018). Indonesia has the potential to store up to 3.3 gigatons of carbon, or about 17% of global blue carbon, from mangrove and seagrass ecosystems (Tominaga, 2022).

Indonesia is known to comprise 50% of the world's mangrove ecosystem area (Imran et al., 2022), with an estimated mangrove area of 3,364,080 Ha of existing mangroves (Figure 2) and 756,183 Ha of potential mangrove habitat (Directorate of Soil and Water Conservation Ditjen PDASRH, 2021). However, 19.3% (equivalent to 600,000 Ha) of Indonesia's mangrove area is in critical condition (Jusuf, 2022).

Increased damage to mangroves will have a major impact on global warming and may cause accelerated changes in carbon sequestration (Directorate of Soil and Water Conservation Ditjen PDASRH, 2021); Imran et al., 2022; Ketaren, 2023). Damage to mangrove ecosystems occurs naturally or due to pressure from human activities. Disasters such as strong winds and waves cause natural damage factors. Meanwhile, factors from human activities are caused by the development of coastal areas, expansion of pond areas, opening of recreational areas, and excessive tree cutting.

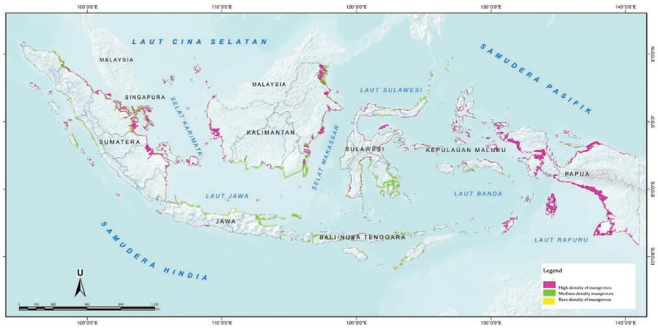

Figure 2. Mangrove distribution in Indonesia
Source: National Mangrove Map, 2021

Due to the great value they provide and concerns about the loss of mangrove forests, extensive efforts have been made to restore mangroves in many Asian countries, including Indonesia. On the other hand, the Indonesian government's policies are also towards low-carbon development. Therefore, as an essential carbon-absorbing ecosystem, mangroves need to be preserved. In efforts to restore and rehabilitate mangrove forests, the Indonesian government has also made several efforts, such as tightening industrial operational permits in coastal areas, integrating mangrove management policies in city planning, and an intensive payment system for environmental services for mangrove conservation such as reducing emissions from REDD+ Deforestation and Forest Degradation, PES Environmental Services Payments, among others (Holl, 2022; Jompa & Murdiyarso, 2022).

Conclusion

Mangroves are one of the most productive ecosystems of wetland forests in sequestering carbon. Mangroves have various benefits for the ecosystem and contribute greatly to the welfare of coastal communities. In addition to protecting coastal areas, mangroves can absorb emissions released from the ocean and air. The conversion of mangroves will decrease the ability to absorb carbon in the atmosphere and the decomposition of stored carbon into the atmosphere, which can affect global climate change. Therefore, sustainable mangrove management is needed to increase the value of mangroves in the environmental service commodity.

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References

BRIN. (2022). Kajian Blue Carbon Modelling untuk Mitigasi Perubahan Iklim. BRIN - Kajian Blue Carbon Modelling Untuk Mitigasi Perubahan Iklim. Retrieved November 13, 2023, from https://www.brin.go.id/news/110434/kajian-blue-carbon-modelling-untuk-mitigasi-perubahan-iklim

Directorate of Soil and Water Conservation, Ditjen PDASRH. (2021). Peta Mangrove Nasional Tahun 2021. Holl, K. D. (2020, May 11). Asian mangroves - blue forests. Blue Forests. Retrieved November 14, 2023, from https://blue-forests.org/en/knowledge/resources-publications/asian-mangroves-community-involvement-in-mangrove-restoration-provides-coastal-hazard-reduction-and-enhances-human-livelihoods-indonesia-and-sri-lanka/

ICCTF. (2023). Kick-Off Meeting Blue Carbon Project: Integrasi Karbon Biru dalam Kebijakan Perubahan Iklim di Indonesia – ICCTF. Indonesian Climate Change Trust Fund. Retrieved November 13, 2023, from https://www.icctf.or.id/kick-off-meeting-blue-carbon-project-dengan-tema-integrasi-karbon-biru-dalam-kebijakan-perubahan-iklim-di-indonesia/

Imran, Z., Easteria, G., & Yulianto, G. (2022). Estimasi stok karbon mangrove rehabilitasi di Pulau Harapan dan Kelapa, Taman Nasional Kepulauan Seribu, Jakarta. Jurnal Ilmu Dan Teknologi Kelautan Tropis, 14(2), 191–204. https://doi.org/10.29244/jitkt.v14i2.39861

Jompa, J., & Murdiyarso, D. (2022). Rehabilitasi Kawasan Pesisir untuk Adaptasi Perubahan Iklim: Peran kunci mangrove dalam Nationally Determined Contributions. https://doi.org/10.17528/cifor-icraf/008792

Jusuf. (2022). PROSIDING G20 Indonesia 2022 – Side event of 3rd Development Working Group Blue Carbon: Enabling Conservation and Financial Capital

Ketaren, D. G. K. (2023). Peranan kawasan mangrove dalam penurunan emisi gas rumah kaca di Indonesia. Jurnal Kelautan Dan Perikanan Terapan, 1, 73. https://doi.org/10.15578/jkpt.v1i0.12050

Murray, L. S., Milligan, B. M., Ashford, O. S., & Von Unger, M. (2023). The blue carbon handbook: Blue carbon as a nature-based solution for climate action and sustainable. ResearchGate. https://www.researchgate.net/publication/375090357_The_blue_carbon_handbook_Blue_carbon_as_a_nature-based_solution_for_climate_action_and_sustainable_development

Sulistiana, S. (2018). Potensi Mangrove Sebagai Karbon Biru Indonesia Bagi Pembangunan Berkelanjutan. Universitas Terbuka. http://repository.ut.ac.id/id/eprint/7472

Tahir, I., Mantiri, D. M. H., Rumengan, A. P., Muhammad, A., Ismail, F., Paembonan, R. E., Najamuddin, N., Akbar, N., Inayah, I., Wibowo, E. S., Siolimbona, A. A., & Harahap, Z. A. (2023). Simpanan karbon sedimen di bawah tegakan spesies mangrove alami dan mangrove rehabilitasi. Jurnal Ilmu Kelautan Kepulauan, 6(1). https://doi.org/10.33387/jikk.v6i1.6517

The Blue Carbon Initiative. (2019). Mitigating climate change through coastal conservation. Retrieved November 14, 2023, from https://www.thebluecarboninitiative.org/

Tominaga, J. (2022). PROSIDING G20 Indonesia 2022 – Side event of 3rd Development Working Group Blue Carbon: Enabling Conservation and Financial Capital

Trissanti, V. N., Amalo, L. F., Handayani, L. D. W., Nugroho, D. a. A., Yuliani, A. R., & Mulyana, D. (2022). The estimation of biomass and carbon stocks in mangrove forest ecosystem of Karawang Regency, West Java. IOP Conference Series, 1109(1), 012099. https://doi.org/10.1088/1755-1315/1109/1/012099