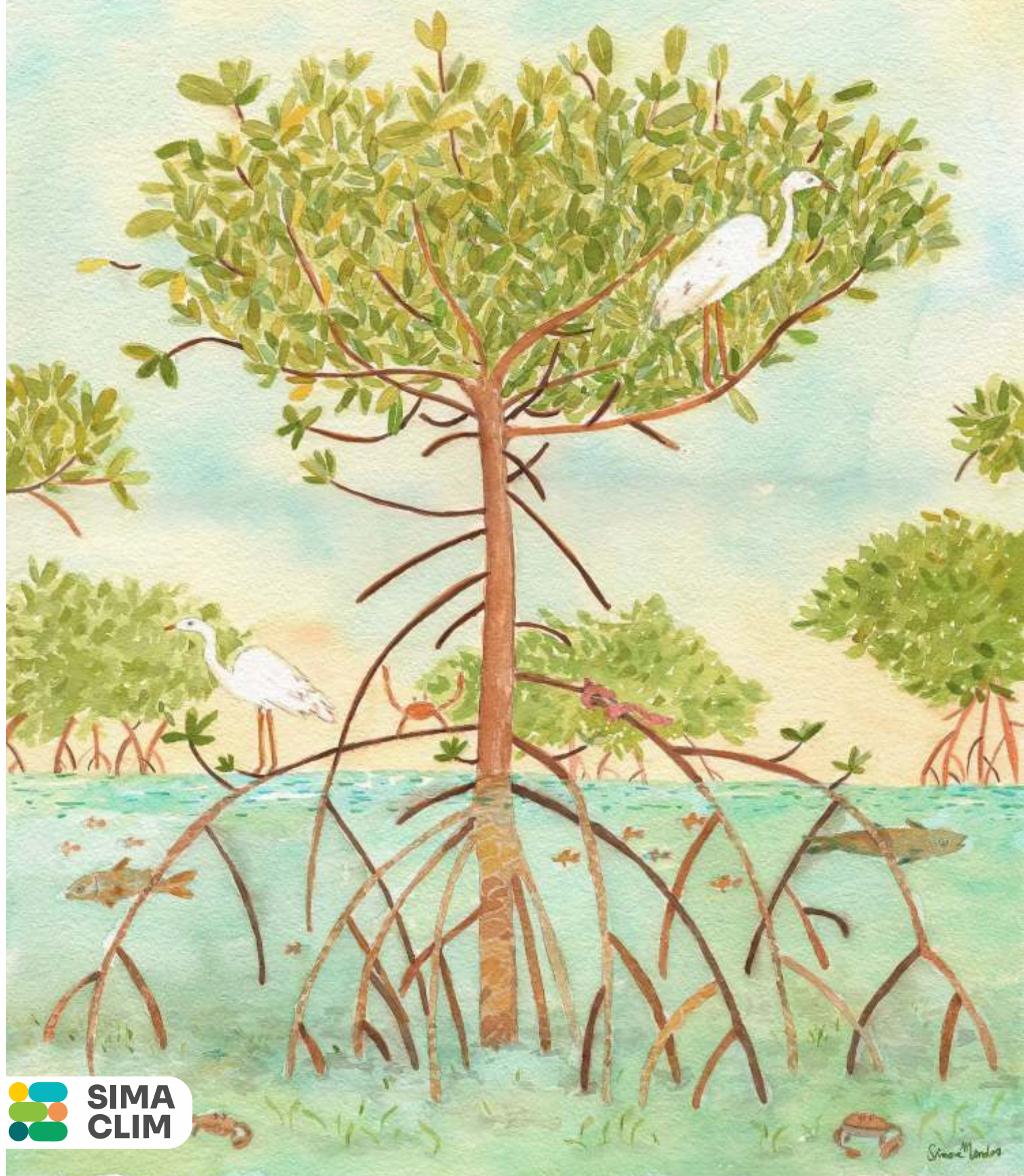


POTENTIAL OF MANGROVE FORESTS FOR CLIMATE CHANGE MITIGATION AND ADAPTATION IN BRAZIL





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POTENTIAL OF MANGROVE FORESTS FOR CLIMATE CHANGE MITIGATION AND ADAPTATION IN BRAZIL

Executive Summary

2025



Potential of mangrove forests for climate change mitigation and adaptation in brazil

Question

Brazil's coastal ecosystems, especially mangroves, contribute significantly to tackling climate change through mitigation and adaptation, as well as generating multiple benefits for society through the provision of essential resources and other vital ecosystem services.

Problem

Despite the fact that Brazil has the **second largest area of mangroves in the world (around 1.1 million hectares)** and that most of them are located within Conservation Units (CUs), **Brazilian mangrove forests are still under threat and are suffering significant losses and degradation**. The annual net loss is approximately 11,000 hectares, equivalent to a rate of 0.13% per year. The **combination of various human pressures and the increasing impacts of climate change** is compromising the health and resilience of these ecosystems.

These current impacts and future risks are driven by a combination of factors:

1. **Direct anthropogenic pressures:** Suppression of vegetation for conversion into pastures, shrimp farming areas, urban expansion, installation of salt pans, construction of highways and port expansion.
2. **Extreme climatic events:** Increased frequency and intensity of events such as severe droughts and heat waves (associated with El Niño), which lead to forest mortality.
3. **Rise in relative mean sea level:** The rise in sea level causes drowning, suffocation due to excess sediment and erosion of mangroves.
4. **Hydrological changes:** Damming rivers upstream reduces sediment input into estuaries, putting the health of mangroves at risk.
5. **Pollution and eutrophication:** Effluent discharge, including from shrimp farms and urban sewage, increases the input of nutrients (phosphorus, nitrogen), causing eutrophication, reducing carbon sequestration capacity and increasing methane and nitrous oxide emissions.

6. **Regulatory weakening and legal loopholes:** The relaxation of the Forest Code in 2012 legalized shrimp farming in "apicum" areas, reducing the area available for forest restoration and natural migration.
7. **Occupation of the adjacent tidal plain:** The occupation of "salt marshes" or "apicuns" prevents the natural migration of mangroves towards the mainland in response to the rise in mean sea level.
8. **Fragmentation of coastal habitats:** Fragmentation reduces connectivity between mangroves and adjacent habitats (seagrass beds, reefs), compromising ecological functions and ecosystem services.

Implications

The degradation and loss of Brazilian mangroves, driven by various human pressures and climate change, are generating significant consequences that directly affect society, the economy and the environment:

1. **Transformation into sources of greenhouse gases:** Conserved mangroves are important carbon sinks as they accumulate around **4.5 million tons of carbon per year**, removing an average of **12 tCO₂eq/ha/year**. However, loss or degradation turns these ecosystems into sources of greenhouse gases (GHG). Conversion to shrimp farming or pasture can result in the emission of more than **1 ton of CO₂ equivalent per hectare**.
2. **Commitment to national climate targets:** The loss of mangroves releases stored carbon and reduces future sequestration, impacting Brazil's ability to meet its GHG reduction targets (NDC) under international climate agreements.
3. **Increased coastal vulnerability to climate events:** Mangroves act as natural barriers, protecting the coast from storms, waves and erosion, as well as around 120 million people worldwide from climate events. Their degradation **increases the vulnerability** of cities and communities to extreme events intensified by climate change and rising sea levels.
4. **Direct impact on fishing and food security:** Mangroves serve as breeding, growth and feeding grounds for countless fishing species. Degradation harms fish stocks, affecting the livelihoods and incomes of some **278,000 artisanal fishermen** in Brazil who depend directly or indirectly on these ecosystems. This compromises the food security of coastal populations.
5. **Restriction of natural adaptation to rising sea levels:** As sea levels rise, mangroves tend to migrate to higher areas on the continent. However, human occupation and infrastructure in transition areas (apicuns) **block this migration**, limiting the mangroves' ability to adapt and making them more susceptible to drowning or erosion, especially in densely populated urban areas in the Southeast. The historical sedimentation rates of some Brazilian mangroves (**1.8 to 5.4 mm/year**) suggest that many may be close to their limit of adaptation to sea level rise.

6. **Loss of multiple essential ecosystem services:** In addition to carbon and coastal protection, the degradation of mangroves compromises other vital services, such as water purification, the immobilization of pollutants (such as microplastics – mangroves in the Amazon delta capture around **0.5 tons per year**), the provision of resources and support for cultural practices and tourism.

Solutions

1. **Strengthen the legal framework and its enforcement** to halt and reverse the loss of mangroves, guaranteeing full protection of Permanent Preservation Areas (APP) and transition areas such as apicuns. By strengthening the application of Law No. 12.651/2012 and CONAMA Resolution 303/2002.
2. **Invest in large-scale mangrove restoration and rehabilitation programs**, prioritizing areas with high biophysical potential and integrating traditional knowledge with restoration science, such as the National Program for the Conservation and Sustainable Use of Brazil's Mangroves (ProManguezal).
3. **Formally integrate mangroves into the national GHG emissions inventory** and the country's mitigation and adaptation strategies, recognizing their potential in the context of blue carbon.
4. **Develop Sustainable Financial Mechanisms:** Establish regulatory models and public-private partnerships to attract investments in blue carbon, seeking additionality and the generation of carbon credits, with a potential return of approximately **30 million USD/year**.
5. **Advancing the mapping and valuation of the multiple ecosystem services** provided by mangroves all along the coast, using this information to support territorial planning and the effective management of these areas.
6. **Increase investment in long-term research and monitoring** to reduce knowledge gaps about carbon stocks, GHG fluxes, mangrove responses to climate change and the success of restoration initiatives.
7. **Promote environmental education and social participation and traditional knowledge** in the management, conservation and restoration of mangroves, recognizing the importance of coastal communities as essential partners.

Benefits

The implementation of these solutions will bring multiple benefits, increasing the capacity to combat climate change through a Nature-Based Solution, avoiding serious consequences and promoting a more resilient future

1. **Climate change mitigation:** Significantly reduce GHG emissions and increase carbon sequestration, contributing to meeting national and global climate targets.



Brazilian mangroves accumulate around 4.5 million tons of carbon per year and remove around 12 tons of CO₂eq per hectare.

2. **Coastal adaptation and resilience:** Increasing the physical protection of the coastline against extreme weather events, erosion and sea level rise, protecting lives and infrastructure, Mangroves offer more efficient and cost-effective protection than built structures.
3. **Water and food security:** Maintaining and improving water purification and the provision of fisheries resources, which are essential for the livelihoods and incomes of coastal populations, including more than 278,000 artisanal fishermen.
4. **Socio-economic and cultural valorization:** Generate direct and indirect economic benefits (e.g. fishing, tourism, blue carbon markets) and preserve the cultural, educational and intrinsic value of mangroves for communities and society.
5. **Biodiversity conservation:** Protecting and restoring highly productive ecosystems that serve as a nursery and habitat for a vast diversity of marine and estuarine species.
6. **Attracting investment:** Opportunity to obtain significant financial resources through blue carbon markets and international climate finance.

About the Report “Potential of Mangrove Forests for Climate Change Mitigation and Adaptation Actions in Brazil”

This executive summary presents the main discussions contained in the Synthesis Report *“Potential of Mangrove Forests for Climate Change Mitigation and Adaptation Actions in Brazil”*, produced and made available by the Center for Synthesis on Environmental and Climate Change – SIMACLIM (<https://simaclim.com.br/>).

SIMACLIM’s main mission is to integrate accumulated and ongoing research from various national and international networks and research groups, organizing information and supporting the planning of the Brazilian State to achieve the goals established in Climate Change agreements. SIMACLIM is funded by the Ministry of Science, Technology and Innovation (MCTI) through the National Fund for Scientific and Technological Development (FNDCT), FINEP Process 01.22.0584.00.

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Use of Artificial Intelligence:

This summary was prepared with the assistance of Large Language Model (LLM) tools, also known as Artificial Intelligence (AI). To learn how these tools were used, please refer to the methodological annex available at this link: <https://simacлим.com.br/relatorios-de-sintese/>



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The complexity of the effects of global environmental and climate change, including their future projections, requires interdisciplinary and transdisciplinary approaches. These approaches are essential for understanding the interactions between social, biophysical, and ecological systems, characterizing the risks of impact, vulnerability, possibilities for mitigating their causes, and adaptation solutions. The Synthesis Center on Environmental and Climate Change (SIMACLIM) has as its main mission to integrate accumulated and ongoing research from various national and international research networks and groups, organizing information and assisting in Brazilian government planning to achieve goals established in agreements on climate change. SIMACLIM is funded by the Ministry of Science, Technology and Innovation (MCTI) through the National Fund for Scientific and Technological Development (FNDCT), FINEP Process 01.22.0584.00.

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