POLICY BRIEF

Mangrove Restoration

Safeguards for climate-resilient ecosystems and communities

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Introduction and Background

Mangroves: Globally significant biomes that provide multiple benefits to communities

Mangrove forests host lush, biodiverse ecosystems that stretch across the globe in intertidal zones in the tropical or subtropical latitudes. With their iconic branching root systems, mangroves shelter a diverse array of life, including fish, shrimp, algae, barnacles, bivalves, sponges, and corals. They are recognized not only for their biodiversity but also for their numerous contributions to human well-being (Lee et al., 2025; Lovelock et al., 2025). Mangroves protect coastlines, buffering communities from storms and flooding. Their extensive root systems strengthen soil, helping to combat erosion while sequestering and storing vast amounts of carbon. Culturally, mangroves are valued for their contributions to spiritual and social connections, livelihoods, and education (Owuar et al., 2024).

Despite their global significance, mangroves are under threat, with climate change, disasters, pollution, conversion for agriculture and aquaculture, water extraction, and other risks depleting mangrove ecosystems worldwide. Together, aquaculture, oil palm plantations, and rice cultivation accounted for 43.3% of global mangrove loss between 2000 and 2020 (Leal & Spalding, 2024). Accelerating development and urbanization along coastlines only add to these pressures. In terms of total area lost, approximately 20%–35% of mangroves have disappeared in the last 5 decades (Beeston et al., 2023).

The Effectiveness of Mangrove Restoration Efforts

In the face of mounting pressures on mangrove forests, many mangrove conservation and restoration initiatives have emerged, including the Global Mangrove Alliance, Mangrove Breakthrough, and the Bonn Challenge. In parallel, "nature-based solutions" (NbS) continue to gather steam: these projects focus on restoration, conservation, and sustainable management actions that enhance the resilience of both people and the natural environment. Mangrove restoration is one example of NbS, and when it is implemented with climate adaptation as a specific objective, it can be considered a type of "ecosystem-based adaptation."

A global review of mangrove restoration initiatives reveals that restored mangroves provide more ecosystem functions than unvegetated mudflats and are worth the investment from a socio-economic perspective (Su et al., 2021). However, gaps in data and systematic reporting persist, particularly for socio-economic outcomes (Gerona-Daga & Salmo III, 2022). Where mangrove restoration failures have been reported, poor survival has been attributed to a multitude of factors, including inadequate long-term planning, monitoring, and post-planting care; a lack of technical training for site and species selection; and disjointed coordination among implementing organizations (Sunanda Kodikara et al., 2017).

Integrating Social and Environmental Safeguards Into Mangrove Restoration

The imperative for increased mangrove restoration and protection is clear. However, without adequate planning, mangrove restoration efforts can disrupt natural ecological functions (e.g., when mangrove seedlings are planted in areas where they do not naturally occur, such as tidal flats), alter hydrological regimes, or increase erosion. On the socio-economic side, a lack of stakeholder engagement and poor coordination and governance can lead to the loss of livelihoods, conflict over tenure or customary access, exacerbation of gender inequalities, and increased vulnerability to climate change impacts. Thus, it is imperative that mangrove restoration initiatives are underpinned by social and environmental safeguards that are considered throughout project conception, planning, implementation, and monitoring phases.

Mangrove restoration can be implemented for a variety of objectives, including restoring degraded land, promoting livelihoods, adapting to climate change, or generating revenue from carbon mitigation through carbon markets. This brief focuses on the use of safeguards within mangrove restoration projects whose objectives are climate change adaptation, economic diversification, and community resilience (and that do not address carbon projects). The Natur'ELLES mangrove restoration initiative in Senegal illustrates examples of social and environmental safeguards. The audience for this brief is policy-makers and practitioners seeking to plan and implement effective, inclusive coastal NbS for community resilience. By honing in on safeguard considerations, this brief complements existing, well-established, and widely used mangrove restoration and management guidelines, such as the *Best Practice Guidelines for Mangrove Restoration* (Beeston et al., 2023) and the *Mangrove Ecological Restoration Guide: Lessons Learned*,[1] in addition to guidelines addressing mangroves in specific regions.

[1] Spanish and English versions of the *Mangrove Ecological Restoration Guide: Lessons Learned* can be found here: https://www.cifor-icraf.org/knowledge/publication/8170/

Safeguards for Mangrove Restoration

What Does Effective Mangrove Restoration Mean?

The practice of mangrove restoration is more than just planting native mangrove seedlings; it needs to account for the myriad factors that enable these complex ecosystems to thrive. Mangroves are established when daily tides bring in a steady supply of sediments. They have unique adaptations that enable tolerance to saline conditions but remain susceptible to climate impacts, such as hypersalinity resulting from drought (Devaney et al., 2021). There are also multiple interconnections between mangroves and surrounding ecosystems, such as tidal flats, marshes, coral reefs, and seagrasses. These ecosystems also need to be protected and monitored, as their health can affect mangrove systems and vice versa (Leal & Spalding, 2024).

Guidelines such as the *Best Practice Guidelines for Mangrove Restoration* offer in-depth overviews of different approaches and tools for restoration, including natural regeneration, assisted natural regeneration, and community-based ecological mangrove restoration (Beeston et al., 2023). Considered together, global and regional guidelines note that restoration success should be measured by indicators that go beyond the spatial extent of the restored area or the number of mangrove seedlings planted. Given the structural and functional complexity of mangrove ecosystems, restoration considerations (such as site or species selection and planting density) need to be informed by biophysical variables, including sediment budgets, geomorphology, elevation above sea level, hydrological regimes, nutrient availability, and future climate conditions. The effectiveness of mangrove restoration therefore encompasses more than the number of hectares restored and more than survival rates for the planted species.

Beyond these metrics, building stakeholder and rightsholder motivations and values into restoration goals, respecting rights, and ensuring the equitable distribution of benefits and risks are key to the sustainability of a restoration project. As many coastal communities depend on mangroves for fishing, livelihoods, and cultural and spiritual connections, understanding community members' motivations and preferences and co-developing project plans and monitoring programs with local knowledge are critical to developing a project that addresses community needs. Both biophysical and socio-economic indicators of success need to be measured over the long term, beyond the 1 or 2 years where monitoring typically ends (Food and Agriculture Organization of the United Nations, 2018).

Social and Environmental Safeguards for Mangrove Restoration

Safeguards are measures taken to avoid the negative impacts of a conservation or restoration initiative on people, communities, and ecosystems (Convention on Biological Diversity [CBD], 2019). Donor governments, development banks, conservation or development organizations, or businesses typically require that projects they support be aligned with policies and standards to prevent harm. In the context of NbS, several safeguards were adopted by parties to the CBD as part of guidance for ecosystem-based adaptation (EbA; analogous to NbS

for adaptation). They include measures such as prevention of transfer of risks and impacts, prevention of harm to biodiversity and ecosystems, respecting human rights, and transparent governance (CBD, 2018).

The safeguards outlined in the CBD EbA guidelines are intentionally broad to encompass the diversity of restoration and conservation methodologies under the NbS/EbA umbrella across scales (spatial and jurisdictional) and ecosystems/landscapes. In the case of mangrove ecosystems, practical actions to realize particular safeguards can be outlined for each broad category in the CBD EbA guidelines (Table 1).

The safeguards and actions outlined here do not address the additional requirements for mangrove restoration initiatives that generate revenue from carbon mitigation as a primary goal. Safeguards for carbon projects include *permanence*, requiring that carbon storage must be long-term, or *additionality*, proving that mitigation outcomes would not have occurred in the absence of restoration. Safeguards for carbon projects are treated in more detail in the *Best Practice Guidelines for Mangrove Restoration* (in the Blue Carbon Module, pp. 151–213) and other blue carbon resources.

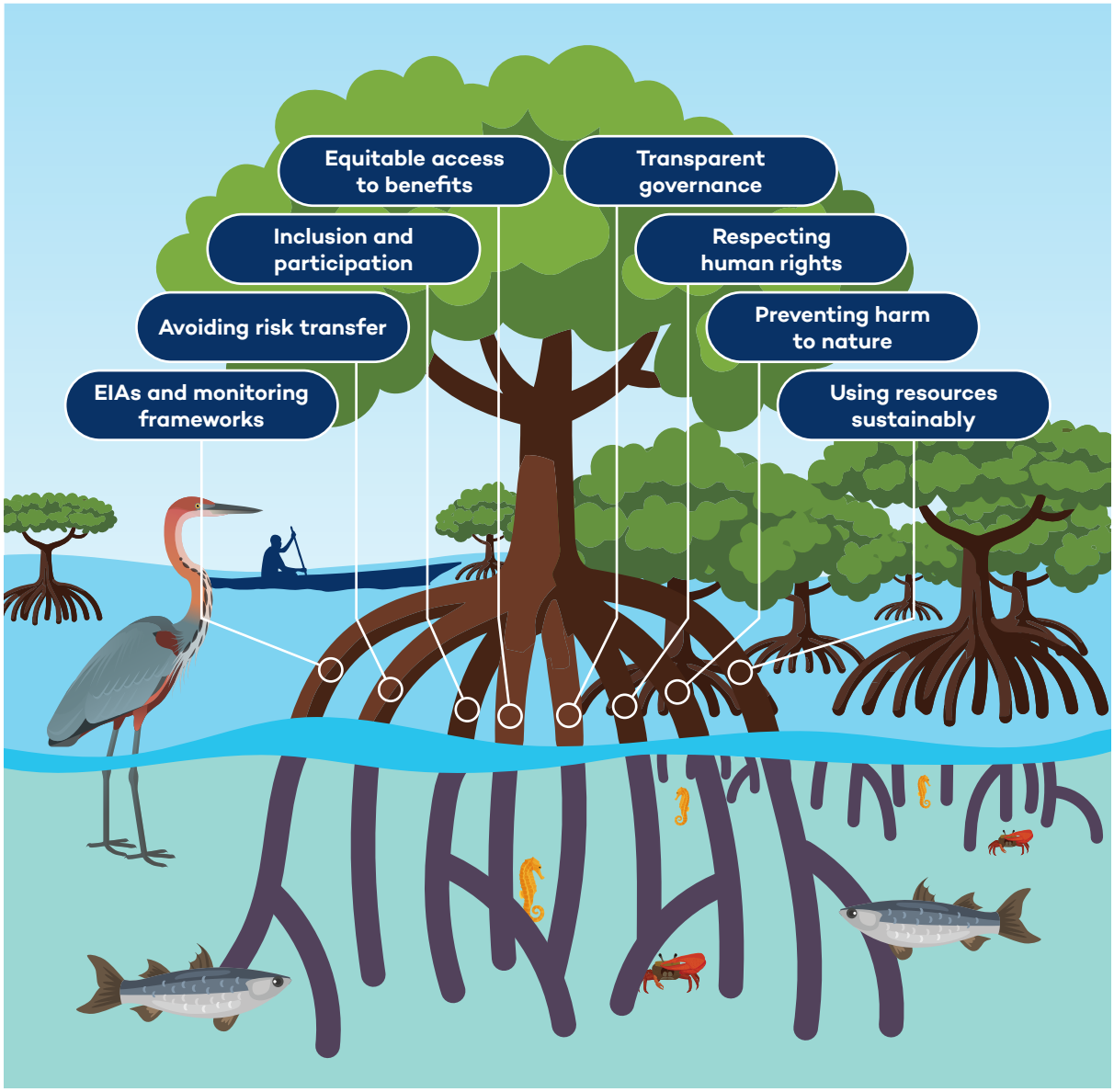
Table 1. Social and environmental safeguards for mangrove restoration for adaptation

Type of social and environmental safeguards	Actions for mangrove restoration to implement safeguards
Apply relevant environmental impact assessments and robust monitoring and evaluation	• Restoring mangroves may require direct interventions that trigger an environmental impact assessment (EIA), or environmental and social impact assessment, such as repairing hydrological flows or removing infrastructure that prevents landward migration of mangroves. Proponents must ensure that relevant regulations, guidelines, and norms are applied when undertaking the EIA.
Avoid the transfer of risks and impacts	• Conduct environmental and socio-economic surveys on a landscape scale, including baseline data from ecosystems connected to mangroves (such as mudflats or coral reefs) to complement the EIA.
Prevent harm to biodiversity, ecosystems, and ecosystem functions and services	• Assess underlying drivers of risks to mangroves. • Identify existing and past restoration efforts and needs. • Develop post-harvest care and long-term monitoring plans. • Conduct climate risk assessments to understand how current and future climate risks may impact the restored area. • Ensure that adaptive measures are built in, such as preventing coastal squeeze by selecting sites enabling landward migration of mangroves or selecting species resilient to climate stressors.
Use sustainable resources in the restoration/ conservation measure	• Assess the supply of mangrove propagules (waterborne seeds) and seedlings before establishing mangrove nurseries with native seedlings.

Type of social and environmental safeguards	Actions for mangrove restoration to implement safeguards
Promote full, effective, and inclusive participation	• Engage with rightsholders and stakeholders to understand the values that different actors ascribe to mangroves. • Ensure climate risk assessments are inclusive and participatory. • Consult with Indigenous or local Knowledge Holders to understand how best to weave knowledge systems together and follow relevant protocols to protect data sovereignty.
Fair and equitable access to benefits	• Conduct gender analyses to determine differentiated climate risks and vulnerabilities among affected community members and target restoration efforts to reduce specific climate risks for different social groups, prioritizing the most vulnerable.
Transparent governance and access to information	• Develop a data management plan. • Work with local officials and communities to communicate information about restoration in local languages using preferred communication channels (radio, podcast, newsletter, community round table).
Respect human rights	• Analyze relevant human rights frameworks to apply to the target mangrove system. • Conduct tenure and access assessments and mapping to determine governance, ownership, and management arrangements that respect tenure rights and customary access, including free, prior, and informed consent.

Source: Author's own recommendations, based on safeguards in CBD, 2019.

Figure 1. Inclusive and equitable mangrove restoration rooted in social and environmental safeguards



Source: Authors.

Natur'ELLES: A case study of mangrove restoration with social and environmental safeguards

Senegal is a globally significant biodiversity hotspot. Its mangrove forests cover 185,000 ha, spanning the tropical dry savannah region of Casamance in the south, the semi-arid Sine-Saloum delta region on the central coast, and the desert ecosystems in the north.

Over the past several decades, Senegal's mangrove forests have been degraded by deforestation for timber and urban development, as well as by climate change impacts, including drought

and rising sea levels. In Sine-Saloum, the Sahelian droughts of the 1970s and 1980s caused extreme soil salinization that supported mangroves, resulting in large-scale die-offs. Since then, some recovery has been supported by the recurrence of rainfall and small- and large-scale reforestation efforts by local communities, non-profit organizations, and international organizations (Devaney et al., 2021). In other mangrove ecosystems in Senegal, coastal erosion as a result of sea level rise and deforestation is placing communities at risk.

The Natur'ELLES project, funded by Global Affairs Canada, aims to restore mangroves, with gender equality, climate adaptation, and economic development as its primary objectives. The Natur'ELLES project utilizes ecological mangrove restoration techniques, including both assisted natural regeneration and direct interventions, and promotes inclusive governance of natural resources, capacity building, and behavioural change for conservation. The project targets the Casamance and Sine-Saloum mangrove ecosystems, which have lost 45% and 30% of their mangroves, respectively, in less than 30 years. The 5-year project began in 2023 and will run to the end of 2026.

The initiative is led by Socodevi, in partnership with the International Institute for Sustainable Development (IISD), the International Union for the Conservation of Nature, Tayo Climate Partners, and a multitude of local Senegalese partners, including Nebeday, the Comité d'Appui et de Soutien au Développement Economique et Social (CASADES), the Coordination des Actions pour la Restauration des Ecosystèmes Mangroves (CAREM), and the Réseau des Femmes de la Pêche Artisanale du Sénégal (REFEPAS). The partners work at the community level to promote positive outcomes for biodiversity, restoration effectiveness, sustainable and diverse livelihoods, and women's empowerment. These organizations are helping to raise local awareness through community radio programs, debates, and campaigns to promote positive masculinity, women's leadership, and good environmental practices.

Implementing Safeguards for the Natur'ELLES Project

The Natur'ELLES project implemented a number of measures to prevent unintended impacts. The following safeguards are illustrated here: prevention of harm to biodiversity, inclusive participation, and equitable access to benefits (the latter two are discussed together).

Prevention of Harm to Biodiversity, Ecosystems, and Ecosystem Functions and Services

Reforestation activities are being conducted by local organizations, communities, and diverse stakeholders, who each have a voice in environmental management committees that meet to exchange knowledge and develop strategies for restoration, learning from previous restoration attempts. The management committees decided (with consensus) to plant native *Rhizophora* and *Avicennia* species based on assessments of site suitability, salinity tolerances, and current and future climate risks. In Casamance, *Rhizophora* have access to both fresh and saline water. In the Sine-Saloum delta region, where fresh water is limited, *Avicennia* are favoured, as they are more tolerant of hypersaline conditions. Working with experienced local organizations and utilizing their knowledge to select suitable sites and species helps safeguard and prevent harm to biodiversity and ecosystems. Results to date include the following:

- Five land-use and management plans have been drawn up and updated to define protected and conserved areas, assisted reforestation and natural regeneration sites, breeding and nursery areas, and bio-ecological monitoring and surveillance strategies. These include four Indigenous and Community Conserved Areas and one marine protected area.
- For each protected area, a study on Traditional and Indigenous Knowledge was conducted and included in the management plans.
- 123 ha of mangrove and 68 ha of continental forest have been restored.
- Beyond hectares restored and survival, comprehensive biodiversity monitoring is being carried out, including
    - a plan to monitor fish biodiversity in protected areas, developed and implemented by scientific sub-committees,
    - a partnership with the government of Senegal to conduct monthly and annual bird counts in the protected areas as part of their national biodiversity monitoring program, and
    - a partnership with a private company to install monitoring traps in protected areas, analyzing pollen samples collected from bees as an indicator of flora biodiversity.

Promotion of Full, Effective, and Inclusive Participation, and Fair and Equitable Access to Benefits

The project team conducted a gender analysis and engaged with communities in workshops to gather information on gender-differentiated climate vulnerabilities. Their findings indicated the following:

- Women own more than 60% of small-scale production fisheries, collecting oysters and other seafood from mangroves to sell at markets. However, loss of income from mangrove degradation means that women and girls may need to migrate to urban areas to look for other job opportunities, as they normally channel their income into basic needs for their families, including school expenses for their children. Urban life can increase women's and girls' vulnerability to gender-based violence.
- Women have a high burden of unpaid work, such as cooking, cleaning, fetching food or water, and caring for children and the elderly.
- Women also have limited access to financial services, agricultural extension services, and technologies that would allow them to better adapt to climate change, reducing their capacity to develop income-generating activities, seek employment, or hold decision-making positions.
- Due to unequal patriarchal systems, women have limited participation in natural resource management bodies. Compounding the problem, non-governmental organizations and governments often work with larger, more structured, or established organizations due to reporting requirements, so smaller women-led enterprises do not participate in climate change consultations and debates.

The Natur'ELLES project team used the results from the gender analysis to develop a gender equality strategy, working with experts from feminist organizations (REFEPAS and UR Sant Yalla). They developed leadership, literacy, and financial skills training for women in the mangrove communities, increasing their independence and sense of agency and enhancing equitable access to business opportunities and income streams. These are the results to date:

- 79 women participated in the leadership skills training, and 661 were enrolled in the literacy program (targeted to women only) (Sambou & Lo, 2025).
- 45 women are currently holding decision-making positions across 10 environmental management committees, increasing their leadership and participation in restoration management. This represents a three-fold increase in women's representation over 2 years (Frédérique Thomas, personal communication, 2026).
- 427 women received improved cookstoves and training on how to use them to prevent deforestation due to wood gathering for cooking to help preserve local forest resources, thus addressing the underlying drivers of mangrove degradation (Frédérique Thomas, personal communication, 2026).
- Integrated economic assessments of restoration that consider gender-differentiated community values for mangroves and different perceptions of the drivers of mangrove degradation (Nature-based Infrastructure Global Resource Centre, 2025; Sambou 2025).
- Community round tables raised awareness among various stakeholders, including institutional, traditional, and religious authorities, on gender equality, women's invisible work, and unpaid care activities through community talks. The round tables ensure that targeted support for women does not result in increased male control over their activities and income, which could reinforce their vulnerability to climate change and economic shocks.

Summary

This brief covered inclusive approaches to mangrove restoration initiatives, with a focus on integrating social and environmental safeguards into projects to prevent harm to ecosystems and communities. The Natur'ELLES project in Senegal provided a lens through which to examine specific actions to implement safeguards in mangrove restoration. The project team implemented ecological restoration techniques with gender-responsive programming based on a gender equality analysis. Partnerships with the government and a private company enabled biodiversity monitoring, taking indicators of restoration success beyond the numbers of seedlings planted and the number of hectares restored. Partnering with feminist organizations with strong local roots and a deep understanding of social dynamics and power relations in the target areas was key to fostering inclusion and designing gender-responsive activities.

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NATUR'ELLES

The Natur'ELLES project restores and conserves mangrove biodiversity while strengthening the climate resilience of women and their communities in Senegal's Sine Saloum and upper Casamance regions. Socodevi is the lead implementor of Natur'ELLES, working in partnership with local and international organizations, including the International Institute for Sustainable Development (IISD). Natur'ELLES is supported financially by Global Affairs Canada.

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