

OVERVIEW

Restoring and Protecting Wetlands



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Questions and comments are welcome at hello@givinggreen.earth.

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Summary

Wetlands can store large amounts of carbon for thousands of years if left undisturbed. However, when drained or dried, they release carbon dioxide, contributing to global greenhouse gas emissions. Protecting wetlands helps prevent these emissions and supports ongoing carbon storage.

Wetland restoration also aids in long-term climate change mitigation, but it's a more complex process. In particular, wetlands naturally emit nitrous oxide and methane, and during the early stages of restoration, the warming effects of these gases often outweigh the cooling effects of carbon storage. Over time, methane and nitrous oxide break down in the atmosphere, and their warming impact stabilizes. Because wetlands continue to absorb carbon dioxide, their cooling effects may eventually surpass the warming from methane and nitrous oxide emissions. However, restored wetlands may take decades or even centuries to fully reduce warming, even as they store carbon.

We have prioritized further research into other impact areas that we think have a higher scale, feasibility, and funding need than restoring and protecting wetlands. However, we think there could still possibly be highly impactful philanthropic opportunities within this impact area. In general, we are most optimistic about funding policy-based and research-centric approaches to conserving and restoring wetlands because we think they can achieve a higher scale in reducing emissions than funding direct efforts. We also think initiatives to protect and restore wetlands are probably more effective when they consider the root causes of wetland conversion, such as resource extraction or land development.

In general, we favor wetland conservation over restoration because of the former's immediate and clear climate benefits of preventing carbon loss. In terms of wetland restoration, we think climate-focused donors may want to take a nuanced approach depending on their personal preferences. We think those who value long-term impact and co-benefits like biodiversity might be interested in organizations focused on restoring all wetlands. Donors who are concerned about climate impacts over the next hundred years may favor coastal wetland restoration because other types of restored wetlands may not yield climate benefits until much later.



Background

What are the climate benefits of restoring and protecting wetlands?

Relative to their area, wetlands store a disproportionate amount of Earth's total soil carbon content. It is estimated that wetlands hold "between 20 and 30% of the estimated 1,500 Pg of global soil carbon despite occupying 5–8% of its land surface".¹

Organic matter, such as dead plant debris, decays slowly in wetlands, enabling long-term carbon storage in wetland soils. Indeed, wetlands can store carbon for millennia when left undisturbed.² However, the world has lost 54% to 57% of its wetlands since 1900 AD, which has implications for stored carbon.³ It is estimated that the conversion and degradation of vegetated coastal ecosystems (e.g., marshes, mangroves, and seagrasses) have led to emissions of 0.15 to 1.02 billion tons of CO₂ annually. For context, this is equivalent to 3% to 19% of emissions from global deforestation.⁴ Conserving and restoring wetlands benefits the climate because when wetlands are drained or dried up, they release carbon dioxide into the atmosphere.

What are some complexities of restoring wetlands?

Wetlands are natural producers of methane and nitrous oxide, which are potent greenhouse gases with shorter lifespans than CO₂. When degraded wetlands are restored, they may initially cause warming because methane and nitrous oxide emissions outweigh the cooling effects of carbon storage.⁵ However, over time, restored wetlands shift from causing warming to cooling, because methane and nitrous oxide eventually break down in the atmosphere and wetlands continue to store CO₂ indefinitely. The time it takes for this shift from warming to cooling is called the "switchover time." According to a meta-analysis of the climate change mitigation potential of wetlands and their switchover times:

The shortest time periods calculated were for mangroves (0 years, meaning that mangroves never have a net warming effect) and salt marshes (17 years). Peatlands (boreal and temperate) and freshwater marshes had important switchover time variability between study sites with a median value of 298.2 ± 100.6 and 2184 ± 1029 years, respectively.⁶

Currently, most coastal and inland wetlands have a net cooling effect, which highlights the importance of wetland conservation.⁷ In contrast, restored wetlands generally do not significantly reduce warming in the short term, even as they accumulate carbon in their soil.⁸

¹ (Nahlik & Fennessy, 2016). Pg: One petagram (Pg) is equal to one billion metric tons. Carbon storage: There is no consensus on how much carbon is truly stored in wetlands. According to Mitra et al. (2005) there is somewhere between 350 to 535 billion metric tons of carbon stored in wetlands. In contrast, Adhikari et al. (2009) believe that there is about 150 billion metric tons of carbon in wetland soils. Disagreements stem from differences in how wetlands are defined and differences in how carbon stock is estimated. Additionally, some types of wetlands are understudied. For example, freshwater wetlands in tropical regions receive relatively little attention.

² (Ezcurra et al., 2016)

³ (Davidson & Davidson, 2014)

⁴ (Pendleton et al., 2012)

⁵ (Schuster et al., 2024)

⁶ (Taillardat et al., 2020)

⁷ *ibid.*

⁸ *ibid.*



According to one study, mangrove restoration costs around \$1,800 USD per ton of carbon, while inland wetland restoration costs around \$4,200 to \$49,200 per ton of carbon.⁹ The cost difference is attributable to mangroves providing an immediate cooling effect, while inland wetlands take longer to do so.

What are some systems-based levers for restoring and protecting wetlands?

We are more optimistic about funding policy- and research-based efforts than directly funding wetland restoration and protection efforts because we believe they offer greater leverage for change.¹⁰ For example, policy could enable large-scale action relative to targeting specific projects and could establish long-term protections, regulations, and incentives for continued protection. Meanwhile, research could help improve how policies are implemented. Systems-based levers that could help restore and protect wetlands include the following:

- **Incorporating wetland actions into climate mitigation and resiliency plans** – According to the Convention on Wetlands, policymakers should include goals for restoring and protecting wetlands in national policies, including plans for climate action plans, adaptation, and disaster risk reduction.¹¹ Wetlands also provide co-benefits such as shoreline protection and flood storage and can therefore be incorporated into land and water use management solutions.
- **Establishing protected areas or species** – Establishing a wetland as a protected area could prevent degradation. Protecting specific species, such as certain types of plants or animals, could further limit environmental degradation.
- **Regulating to protect wetlands** – Regulations against upstream pollution and restrictions on water allocation can indirectly safeguard wetlands.
- **Addressing development concerns** – Wetland conversion is typically driven by economic factors, such as land demand for farming. Policies that address the needs of local communities in ecologically sound ways could help reduce wetland destruction and degradation.
- **Addressing knowledge gaps** – Research can help improve plans to protect wetlands, reduce emissions, and increase carbon storage. We think research could be especially important because our understanding is that restoration practices should be site-specific to ensure success. We also think building additional knowledge on wetlands' co-benefits could also strengthen economic and political arguments for restoration and conservation. We think there are likely scalable, cost-effective research gaps that could be applied across different field sites, such as improved monitoring methods.

In this report, we did not evaluate the scale, feasibility, and funding need of these specific levers due to capacity constraints. Instead, we evaluated wetland restoration and protection more generally.

⁹ *ibid.*

¹⁰ At the same time, we acknowledge that direct efforts to restore and protect wetlands could help support policy action by providing useful site-specific information.

¹¹ (Convention on Wetlands, 2021)



Scale

The Intergovernmental Panel on Climate Change (IPCC) reported that protecting and restoring peatlands and coastal wetlands could potentially mitigate between 1.02 and 9.56 billion tons of CO₂-equivalent per year, as detailed in **Table 1**.¹²

Table 1: Mitigation potential of various wetland interventions

Intervention	Mitigation potential (billion tons of CO ₂ -equivalent per year)	
	Technical ¹³	Economic ¹⁴
Protecting peatlands	0.43 to 2.02	0.2 to 0.68
Restoring peatlands	0.49 to 1.3	0.2 to 0.6
Protecting coastal wetlands	0.06 to 5.4	0.06 to 0.27
Restoring coastal wetlands	0.04 to 0.84	0.05 to 0.2

While the potential of wetland restoration to reduce emissions is relatively high, we have concerns about permanence and the length of time it can take before restored wetlands have a cooling effect on the climate. While wetland restoration can help mitigate climate change, we think challenges with implementation and long-term effectiveness reduce its overall impact.

Feasibility

We think it's likely that investing in wetland conservation will result in at least some preservation. We also think there are factors or conditions under which wetland restoration and conservation will be more successful. For example, local stakeholder participation is considered an important determinant in conservation initiatives; therefore, we think initiatives where local stakeholders are engaged will likely increase effectiveness.¹⁵

Additionally, wetland restoration and conservation offer important benefits beyond climate, such as improving biodiversity, water quality, and flood protection. We think these additional benefits can make these initiatives more politically appealing and increase the chances of passing protective policies compared to those focused solely on climate benefits. We also note recent policy wins for wetland restoration and protection, such as the [EU's Nature Restoration Law](#), which includes some language for restoring wetlands.

At the same time, because wetlands are often converted for economic reasons—such as resource extraction, agricultural development, infrastructure construction, and settlement expansion—we think efforts to restore or conserve wetlands will likely be unsuccessful over the long run if the

¹² (Nabuurs et al., 2022)

¹³ Technical potential: how much can be mitigated without considering financial and other constraints

¹⁴ Economic potential: how much can be mitigated at a cost up to \$100 per ton of CO₂-equivalent

¹⁵ (Sharma & Singh, 2022)



underlying reasons for wetland conversion are left unaddressed. We have some additional concerns related to enforcement, such as the implementation of regulations and the lack of effective governance in some contexts.¹⁶

Funding need

We have not yet assessed the funding gap for restoring and protecting wetlands because we have found limited information.¹⁷ Our impression is that private-sector and government support for wetland projects is relatively niche, but may be growing in interest. Anecdotally, we have been approached by potential funders who have expressed interest in engaging in wetland projects to work towards net-zero and other ESG (environmental, social, and governance) goals.

Bottom line

While we focus on other areas that we have assessed as having greater scale, feasibility, and funding need, we still see opportunities for philanthropy in wetland restoration and protection. We take a careful approach, understanding that the climate benefits of wetlands change over time. Our priority is preserving existing wetlands for their long-term carbon storage, with policy playing a key role in protection. For immediate climate benefits, we believe conservation should come first, as restored wetlands may take decades to be effective. Among restoration efforts, we prioritize coastal wetlands due to their cost-effectiveness and quicker climate benefits. We view inland wetland restoration as a long-term investment with limited climate impact in the next century. Overall, we support wetland conservation, and we believe donors' choices about restoration should depend on their priorities—those focused on long-term impact and biodiversity may support restoring all wetlands, while those concerned about short-term methane emissions and cost-effectiveness may favor coastal wetlands.

¹⁶ (Sharma & Singh, 2022)

¹⁷ For example, ClimateWorks Foundation does not isolate wetlands in its annual report on foundation giving. We found a list of wetlands funders developed by Ramsar but we are unsure of the time frame of this giving and what it means in terms of annual donations or funding trends.

ClimateWorks Foundation: <https://climateworks.org/report/funding-trends-2024/>

Ramsar:

https://contacts.ramsar.org/funding-organizations?name=&grant_size%5B2%5D=2&grant_size%5B3%5D=3&grant_size%5B4%5D=4&grant_size%5B5%5D=5&grant_size%5B6%5D=6&page=2

