NATURE'S MIGHTY CARBON STORES

Why conserving freshwater wetlands is a climate imperative

ENVIRONMENTAL JUSTICE FOUNDATION

EJF

Protecting People and Planet

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Acronyms and abbreviations

AFOLU	Agriculture, Forestry and Other Land Use
CH_4	Methane
CO_2	Carbon dioxide
COP	Conference of the Parties
DRC	Democratic Republic of the Congo
EEA	European Environment Agency
EU	European Union
Gt	Gigatonne (equal to one billion tonnes)
ha	Hectare
IBGE	Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics)
IPCC	Intergovernmental Panel on Climate Change
IPs	Indigenous peoples
LCs	Local communities
KAZA	Kavango-Zambezi Transfrontier Conservation Area
NbS	Nature-based solutions
NCS	Natural climate solutions
NDC	Nationally Determined Contributions
REDD	Reducing emissions from deforestation and forest degradation in developing countries
RoC	Republic of the Congo
SDG	Sustainable Development Goals
UN	United Nations
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change

Glossary of terms

Carbon dioxide (CO_2) emission budget (or carbon budget): For a given temperature rise limit, for example a 1.5°C or 2°C long-term limit, the corresponding carbon budget reflects the total amount of carbon emissions that can be emitted for temperatures to stay below that limit.

CO_2 equivalent: A metric measure used to compare the emissions from various greenhouse gases on the basis of their global warming potential, by converting amounts of other gases to the equivalent amount of CO_2 with the same global warming potential.[1]

Carbon sequestration: The process in which CO_2 is removed from the atmosphere, measured as a rate of carbon uptake per year.

Carbon sink: Any location or reservoir that sequesters or stores a greater amount of CO_2 from the atmosphere than it releases.

Carbon storage: The long-term confinement of carbon (e.g. in plant materials or sediment), measured as a total weight of carbon stored.

Global warming potential: Term used to describe the relative radiative effect of a given greenhouse gas compared to another, integrated over a chosen time horizon.[2] CO_2 is currently taken as the gas of reference and given a 100-year global warming potential of 1.

Climate change mitigation: Actions or activities that limit emissions of greenhouse gases from entering the atmosphere and/or reduce their levels in the atmosphere.

Irrecoverable carbon: Ecosystem carbon that is vulnerable to release upon land use conversion and, if lost, could not be recovered on timescales relevant to avoiding dangerous climate impacts.[3]

Nature-based solutions: Term encompassing actions to protect, sustainably manage and restore ecosystems, in ways that address societal challenges, such as global heating, while benefiting both human well-being and biodiversity at the same time.

Paludiculture: Farming and agroforestry systems that are suitable or adapted to wetland habitats.

Peat: Dead and partially decomposed plant remains that have accumulated in situ under waterlogged conditions.[4]

Peatland: General term for land with a naturally accumulated layer of peat near the surface. Peatlands include both ecosystems that are actively accumulating peat, and degraded peatlands that no longer accumulate but in contrast lose peat. The threshold for the depth of peat that constitutes a peat soil, and thereby the definition of peatland, varies by country.[5]

A hyacinth macaw flying in front of a blooming yellow piúva tree
in the Pantanal of Miranda, Mato Grosso do Sul, Brazil © EJF

EXECUTIVE SUMMARY

Freshwater wetlands are nature's mighty carbon stores

- Wetlands are nature's carbon storage powerhouses. They occupy just 6% of the Earth's land surface, yet store the majority of global soil carbon.
- Wetlands are garnering increasing attention for their significant role in the global carbon cycle and impact on climate. While much attention has focused on coastal "blue carbon" ecosystems, the climate mitigation potential of inland, freshwater wetlands – which make up the majority of global wetland extent – has been largely overlooked.
- Peatlands are a type of carbon-rich freshwater wetland. Despite covering just 3–4% of the Earth's land surface, they contain as much carbon as all of the world's forests and store up to one-third of the world's soil carbon.
- Total peatland carbon stores are estimated at 450–650 billion tonnes, equivalent to 31–45 times total global greenhouse gas emissions in 2023. Peatlands store carbon more effectively, for longer periods and have the highest carbon density of any terrestrial ecosystem.

Ticking carbon bombs – wetland loss and degradation are exacerbating the climate crisis

- Wetlands are the most threatened ecosystem in the world, disappearing at a rate three times greater than forests. Losses have been particularly extensive and rapid for inland wetlands.
- When drained and degraded, wetlands release significant quantities of greenhouse gases into the atmosphere, turning natural wetlands from carbon sinks into a significant carbon source, exacerbating the climate crisis.
- Degraded peatlands cover just 0.4% of the Earth's land surface, yet contribute an estimated 4% of anthropogenic greenhouse gases annually. Significant wildfires on degraded peatlands – which are worsening with global heating – can double their contribution to greenhouse emissions.
- If current trends continue, greenhouse gas emissions from drained and degraded peatlands will consume an estimated 12-41% of the emissions budget that remains to keep heating below +1.5 to +2°C.

> Despite covering just 3–4% of the Earth's land surface, peatlands contain as much carbon as all of the world's forests and store up to one-third of the world's soil carbon.

> If current trends continue, greenhouse gas emissions from drained and degraded peatlands will consume an estimated 12-41% of the emissions budget that remains to keep heating below +1.5 to +2°C.

Conserving and restoring peatlands – a low-hanging fruit in climate mitigation

- Ensuring carbon remains locked within peatlands is critical to achieving the goals of the Paris Climate Agreement. Peatland carbon stocks accumulate slowly and persist over millennia, with losses essentially irreversible within Paris Agreement timescales.
- Reducing the degradation of peatlands is an impactful and cost-effective option for climate mitigation, associated with mitigation densities of around 1,230 tonnes of CO_2 equivalent per hectare, almost four times the mitigation density for forest protection.
- Significant climate mitigation potential exists in tropical peatland countries where an estimated 800 million tonnes of greenhouse gas emissions could be reduced annually (equating to 1.5% of global emissions) through peatland conservation and restoration.

A win-win-win for people, nature and climate

- Nature-based solutions (NbS) offer a means of addressing the interconnected climate and ecological crises, while simultaneously contributing to the Sustainable Development Goals.
- The protection and restoration of freshwater wetlands is an example of a holistic NbS that can be implemented with modest investment.
- Freshwater wetlands play a significant role in climate mitigation and adaptation, while providing numerous additional benefits for people as well as critical wildlife habitat and breeding grounds, including for endangered and endemic species.
- The ecosystem service value of wetlands is estimated at US$7.98 to US$39.01 trillion every year, equating to around 7.5%-36.7% of global GDP. Over 85% of this value is delivered by inland wetlands.

Urgent action is needed to lock carbon in wetlands and safeguard these critical carbon sinks

- Effective policy interventions and targeted finance are urgently needed to halt the degradation and conversion of freshwater wetlands such as peatlands, and prevent their immense carbon stores from being released. When adequately protected and restored, these ecosystems have a net cooling effect on the climate and are important carbon sinks.
- Finance flows to NbS are currently US$200 billion per year, representing just a third of the total needed to achieve climate, biodiversity and land degradation targets by 2030.
- There is a massive opportunity to redirect finance flows to ensure they align with climate and biodiversity targets. Estimated funding required for NbS globally is currently lower than subsidies provided to agriculture and forestry, while the estimated annual total investment required for peatland restoration is US$7 billion, equivalent to just 1.1% of the value of fossil fuel subsidies in 2023.
- Initiatives such as the UN Decade for Ecosystem Restoration (2021–2030) and the Freshwater Challenge can help to generate the political and private sector momentum to mobilise action on freshwater wetlands as a NbS.
- The forthcoming UNFCCC COP 30, to be hosted by Brazil – the country with the largest area and volume of peatland, and home to the world's largest tropical wetland, the Pantanal – presents a further opportunity to raise freshwater wetlands up the political agenda.

1. Introduction

Freshwater wetlands, and particularly those with peat deposits, are important carbon stores and play a crucial role in the global carbon cycle.[6] Peatlands are the most carbon-dense of all terrestrial ecosystems, locking carbon away more effectively and over longer time periods than any other ecosystem. Yet once drained and degraded, peatlands turn into massive sources of carbon, undermining all other efforts to navigate the escalating climate crisis.

There is an urgent need to protect these ecosystems intact – and to restore them where drained or degraded – to ensure their continued role in the fight against global heating. Wetlands are the most threatened ecosystem on Earth, disappearing three times faster than forests. Conserving and restoring wetlands can bring a wealth of co-benefits for people and wildlife, due to the array of ecosystem services – from water quality improvement, to flood regulation, nutrient cycling, food security and habitat provision – that these ecosystems provide.

The many ecosystem service benefits of wetlands are widely recognised. However, in terms of their role in climate mitigation, until recently, the primary focus has been on coastal “blue carbon” ecosystems such as mangroves, with carbon stored in inland, freshwater wetlands (also referred to as “teal carbon”) being largely overlooked. This briefing has been produced with a view to addressing this gap and encouraging Parties to the United Nations Framework Convention on Climate Change (UNFCCC) to mobilise efforts and resources urgently to ensure losses of these vital ecosystems are halted and degraded areas restored.

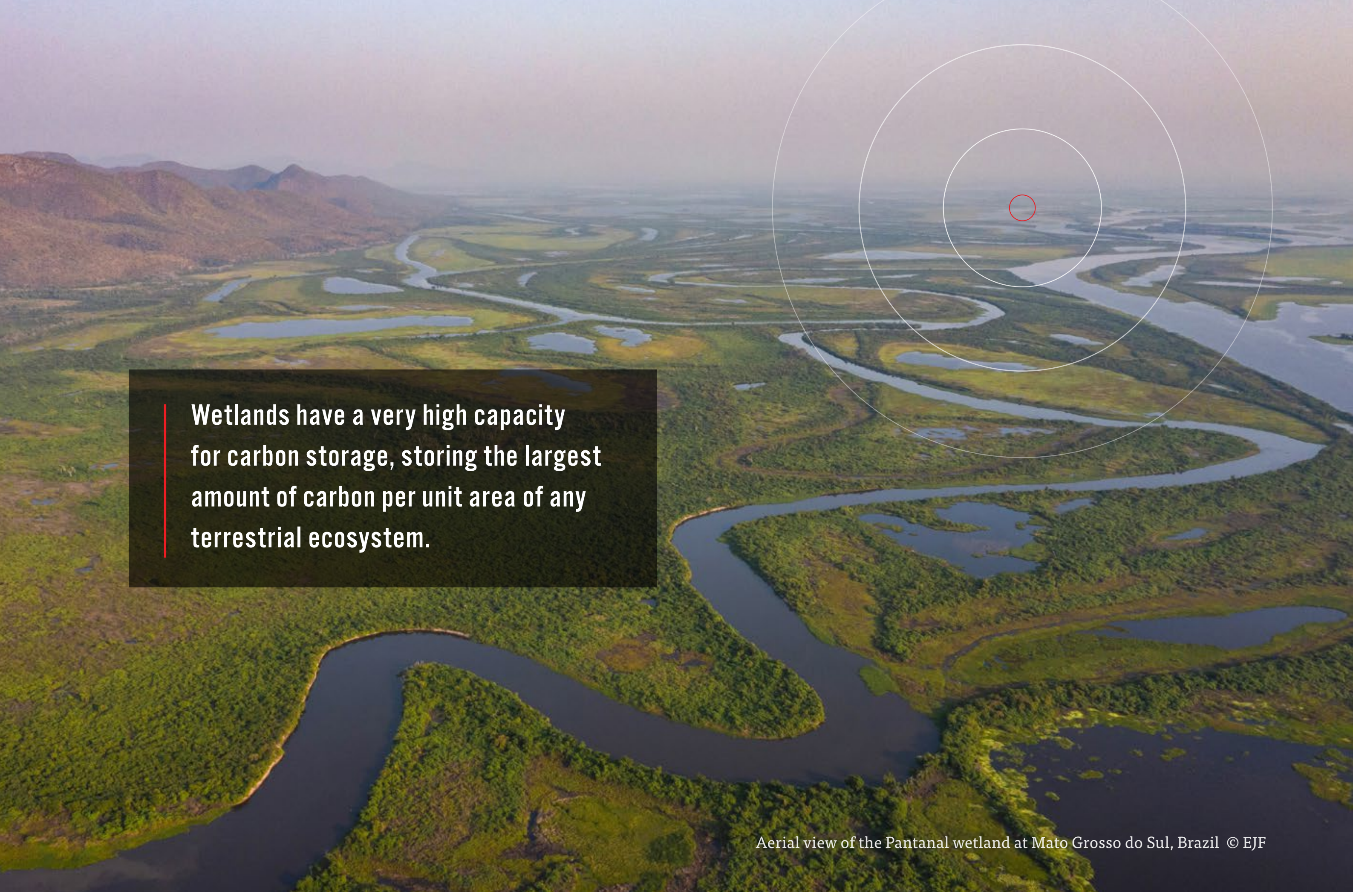
The UN Decade for Ecosystem Restoration (2021–2030), coupled with Brazil’s status as host to COP 30 in November 2025 – and one of the most important freshwater wetland countries in the world – can provide the political momentum needed to spur ambitious action. Such efforts would have significance not only to climate action, but to addressing the closely interconnected ecological crisis, as well as the Sustainable Development Goals (SDGs), with a holistic, “win-win-win” solution.

Section 2 of this briefing examines the carbon sequestration and storage capacity of freshwater wetlands compared to other terrestrial ecosystems. **Sections 3** and **4** consider the climate implications of their degradation and the climate mitigation potential associated with protection and restoration in the context of the broader contribution of nature-based solutions to achieving climate goals. **Section 5** examines the co-benefits for people and nature of protecting these carbon-rich yet under-valued ecosystems. **Sections 6** and **7** set out policy priorities and recommendations for action.

Box 1: What are wetlands?

Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life. They occur where the water table is at or near the surface of the land, or where the land is covered by water – saltwater, freshwater or a mix – either periodically or permanently. They can be found on coasts or inland and may be formed naturally or artificially.

Inland (or freshwater) wetlands include lakes and rivers, floodplains, inland deltas, swamps, non-tidal marshes and peatlands. They are the most dominant group of wetland types globally, comprising 92.8% of total wetland extent,[7] the largest areas being peatlands and lakes/pools.[8] Coastal (or marine) wetlands include mangroves, seagrass meadows, tidal flats, saltmarshes and coral reefs, as well as lagoons and river deltas found on the coast. They account for around 7.2% of total wetland extent[9] and are dominated by unvegetated tidal flats and saltmarshes.[10]



Wetlands have a very high capacity for carbon storage, storing the largest amount of carbon per unit area of any terrestrial ecosystem.

Aerial view of the Pantanal wetland at Mato Grosso do Sul, Brazil © EJF

2. From overlooked to essential – nature's critical carbon stores

Wetlands are nature's carbon storage powerhouses. They occupy just 6% of the Earth's land surface,[11] yet store the majority of global soil carbon.[12] They are highly productive,[13] meaning they are extremely efficient at absorbing carbon dioxide (CO_2) from the atmosphere and converting it into organic matter.[14] Compared to other ecosystems, wetlands store most of the captured carbon in their soils, which may account for up to 200 times as much carbon as the associated vegetation.[15] Critically, wetlands can retain carbon in their soils for centuries to millennia if left undisturbed, as organic matter decomposes very slowly under waterlogged (anoxic) soil conditions.[16]

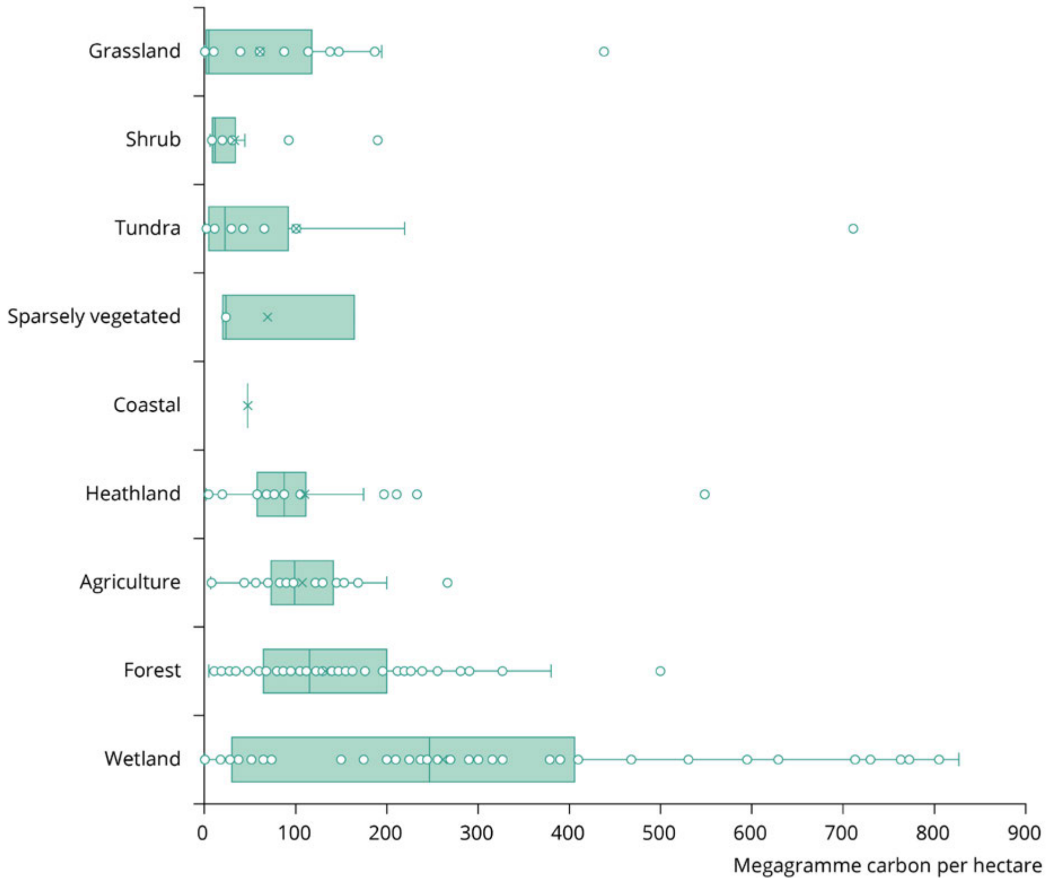
Wetlands therefore have a very high capacity for carbon storage, storing the largest amount of carbon per unit area of any terrestrial ecosystem (**Table 1** and **Figure 1**).[17] Globally, soil organic carbon stocks in inland wetlands are estimated at around 148-237 t C ha^{-1}, with tropical wetlands generally associated with higher stocks than temperate and boreal inland wetlands.[18] The rate at which they sequester carbon is also amongst the highest in the terrestrial biosphere. Rates of carbon sequestration have been estimated at around 1.0–2.5 metric tonnes of carbon per hectare per year (t C $ha^{-1} yr^{-1}$) for wetlands, compared to forests at around 1.50–3.00 t C $ha^{-1} yr^{-1}$.[19] For inland wetlands specifically, global estimates suggest sequestration rates of between 0.9 and 1.6 t C $ha^{-1} yr^{-1}$.[20] A recent study of carbon sequestration in European terrestrial ecosystems, found that average carbon sequestration for wetlands was second only to forest ecosystems, with rates as high as 6.50 t C $ha^{-1} yr^{-1}$ recorded at specific sample sites (**Table 2**). Globally, wetlands have the potential to sequester an estimated 0.7–1.75 billion tonnes of carbon annually,[21] equivalent to around 4.9–12.1% of global greenhouse gas emissions,[22] or the annual carbon emissions of around 0.6–1.5 billion cars.[23] During the period 2000-2020, wetlands sequestered one billion tonnes of carbon, on average, each year, with 70% contributed by tropical wetlands and South America, Asia and Africa accounting for 79% of the global total.[24] However, freshwater wetlands, in particular, are also important natural sources of greenhouse gases, particularly methane, which influences their overall contribution to the global carbon cycle (**Box 2**).

Table 1: Global carbon stock density in vegetation and soils down to a depth of one metre

		Carbon stock density (t C ha^{-1})		
Biome	**Area (10^9 ha)**	**Vegetation**	**Soil**	**Total**
Wetlands (inland and coastal)	0.35	43	643	686
Boreal forests	1.37	64	344	408
Temperate grasslands	1.25	7	236	243
Tropical forests	1.76	120	123	243
Temperate forests	1.04	57	96	153
Tropical savannas	2.25	29	117	147
Tundra	0.95	6	127	134
Croplands	1.6	2	80	82
Deserts and semi deserts	4.55	2	42	44

Source: Calculated from IPCC (2000).[25] There is considerable uncertainty in the numbers given, because of ambiguity of definitions of biomes. While more recent figures are available for specific ecosystems (see, for example, Goyette et al. (2024)[26] for peatlands and Sanderman et al. (2018)[27] for mangrove soil carbon), the figures from IPCC (2000) offer a useful, broad comparison of carbon stock density across ecosystems, down to a consistent depth. Notes: 1 gigatonne (Gt) is equal to one billion tonnes. ha - hectares; C - carbon; t - metric tonne.

Figure 1: Carbon stock density of terrestrial ecosystems



Source: European Environment Agency (EEA) (2024).[28] The "x" in the figure represents the average level, the green boxes signify the median values and the range is characterised by the individual dots. Values are for terrestrial ecosystems in the European Union.

Raised bog at Portmoak Moss in Scotland (CC BY-NC-SA 2.0: Emma Goodyer)

Table 2: Carbon sequestration rates of European terrestrial ecosystems (t C ha^{-1} yr^{-1})

Ecosystem	n	mean	median	min	max
Coastal	2	0.66	0.66	0.58	0.73
Forest	73	3.20	3.00	0.02	9.26
Grassland	1	0.24	0.24	0.24	0.24
Heathland	1	0.02	0.02	0.02	0.02
Shrub	5	0.15	-0.02	-0.73	1.26
Sparsely vegetated	2	0.02	0.02	0.00	0.04
Tundra	5	0.60	0.29	0.10	1.37
Wetland	85	1.01	0.35	-0.49	6.50

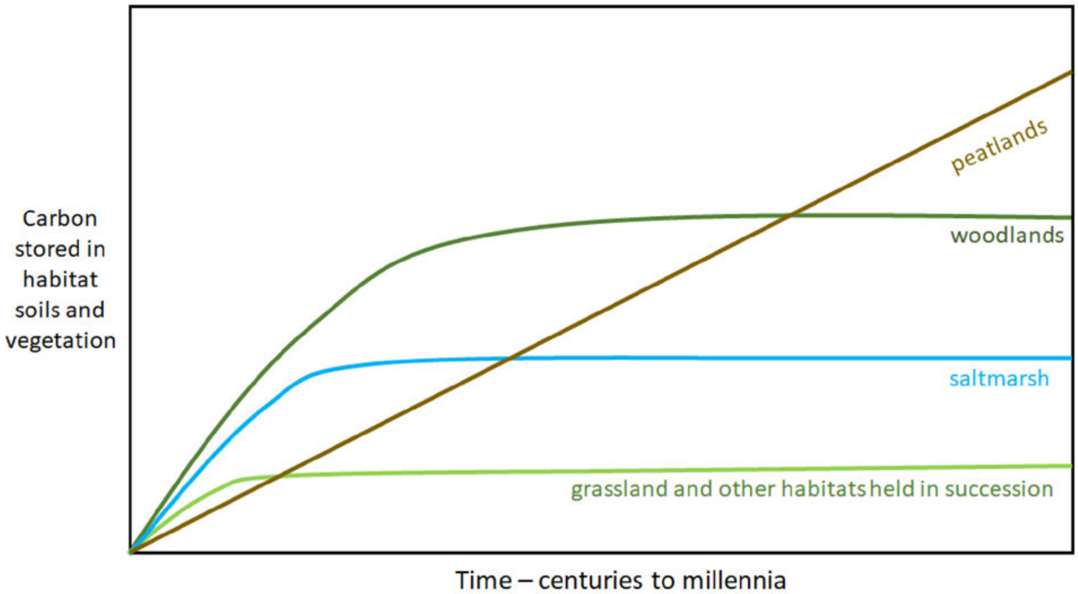
Source: Henriks et al. (2020).[29] Carbon sequestration rates in ecosystems (t C ha^{-1} yr^{-1}) mean, median, minimum, maximum and number of observations (n). Most of the data refers to the EU27 member states, however data from the UK is also included. Some data is related to climate zones such as boreal forests, which may refer to Scandinavia or to the boreal zone of North America. Data from outside of the EU27 is applied to the EUNIS habitat classification system and can therefore be considered as estimates for the EU27. In some cases there are a small number of observations which calls for further validation of the figures.

Peatlands – the most carbon-rich of all freshwater wetlands – make up around half of all wetlands,[30] encompassing a range of unique and diverse ecosystems, from northern bogs and fens to tropical forests and swamps.[31] They are characterised by year-round waterlogged conditions, resulting in slow rates of decomposition and the accumulation of dead plants to form carbon-rich peat.[32] In contrast to natural forests and other ecosystems, peatlands can continue to sequester carbon indefinitely if left undisturbed (albeit relatively slowly)[33] through the continuous formation of peat soils under saturated conditions (**Figure 2**).[34] Peat is the first step in the formation of coal: nearly all coal and lignite, and a proportion of oil and gas, originated from peat deposits from previous geological periods (**Figure 3**).[35] Peat releases important quantities of carbon when it is left exposed to oxygen through drainage or – like fossil fuels – when it is burnt.

Despite covering just 3–4% of the Earth's land surface,[36] peatlands contain as much carbon as all of the world's forests[37] and store up to one-third of the world's soil carbon.[38] They are the most important long-term carbon store in the terrestrial biosphere,[39] storing carbon more effectively and for longer periods than any other terrestrial ecosystem.[40] The total carbon stored in peatlands is estimated to be in the range of 450–650 billion tonnes of carbon,[41] equating to 31–45 times total global greenhouse gas emissions in 2023.[42] Total carbon stores may, however, be even greater. In some regions, the full extent of peatlands is still being mapped,[43] while vast stores of 'hidden' soil organic carbon are known to be contained in wetlands obscured by forest canopies.[44]

Examples of major peatland hotspots include Western Amazonia, Southeast Asia, the *Cuvette Centrale* of the Central Congo Basin and the frozen peatlands of Western Siberia.[45] Significant areas of peatland are still being discovered, including forest-covered peatlands in the tropics.[46] Tropical peatlands account for around 20–30% of peatland ecosystems and are estimated to store 152–288 billion tonnes of carbon.[47] **South America contributes the most to tropical peatland area and volume (approx. 44% in both cases), with Brazil leading the tropical peatland area and volume contribution**.[48] Asia hosts around 38% of tropical peatland area and volume, led by Indonesia as the main regional contributor.[49]

Figure 2: Comparison of carbon sequestration over time for undisturbed terrestrial habitats

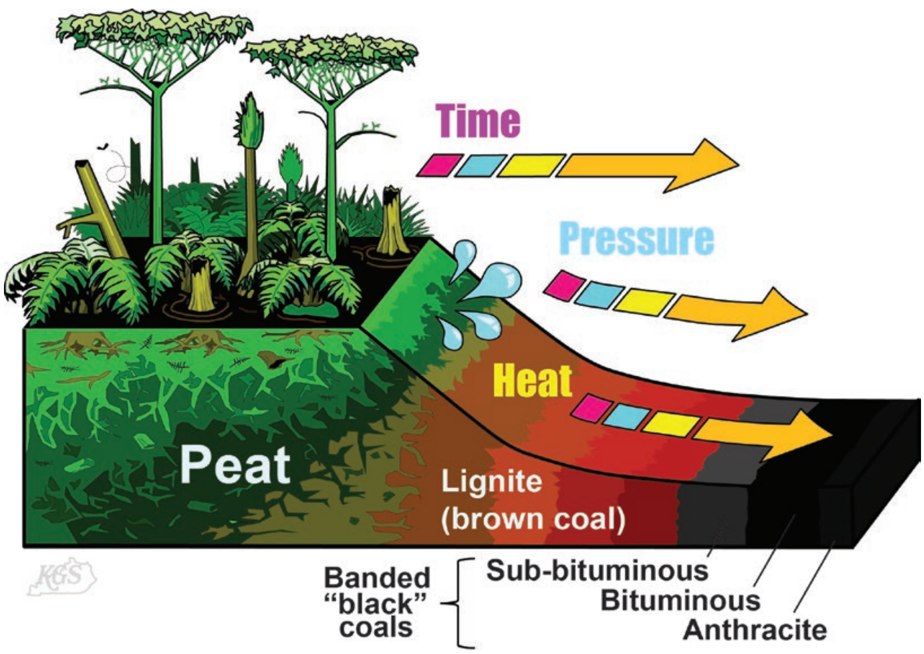


Source: Gregg et al. (2021).[50] Every site, with the exception of peatlands, has a carbon stock equilibrium specific to its management, climate and soils. Figure is conceptual, axes are for illustration and are not to scale.

The total carbon stored in peatlands is estimated to be in the range of 450–650 billion tonnes of carbon, equating to 31–45 times total global greenhouse gas emissions in 2023.

View of the marshes and tundra of the north of Western Siberia during autumn (credit: Grigorii_Pisotckii)

Figure 3: Process of coal formation from peat (coalification) over millions of years



Source: Greb, S. F. (2009), 'Coal formation diagram: Lateral layout with coal types', *University of Kentucky and Kentucky Geological Survey*. https://www.uky.edu/KGS/coal/coal-diagram-download.php (accessed 20 February 2025)

CO_2 emissions from nearly all drained peatlands need to be stopped by rewetting to meet Paris Agreement goals.

A global meta-analysis by Schuster et al. (2024) found that most restored (77%) and all natural peatlands were net carbon sinks, whereas most degraded peatlands (69%) were carbon sources.

A peat bog below the top of Doune Hill, Luss Hills, Scotland. Credit: Michal Klajban (CC BY-SA 4.0)

Box 2: Beyond carbon dioxide: methane, wetlands and the climate crisis

Wetlands play an important role in sequestering carbon from the atmosphere but are also natural sources of greenhouse gas emissions, especially methane (CH_4), contributing around 20–30% of the annual global methane budget.[51] Methane is more potent than CO_2 at trapping heat in the atmosphere, with a global warming potential 21 times greater than CO_2 on a 100-year timescale, and 56 times greater on a 20-year timescale.[52]

Methane therefore exerts a powerful influence on the climate, complicating assessments of the net impact of wetlands on the global carbon cycle. In the case of undisturbed peatlands, the impact of methane emissions may cancel out the climate mitigation benefits of CO_2 sequestration over short time horizons; however, over the longer term, peatlands have an overall cooling effect on the climate, as methane is removed rapidly from the atmosphere through oxidation (within around 12 years),[53] while atmospheric CO_2 continues to be absorbed.[54] Indeed, a global meta-analysis by Schuster et al. (2024) found that most restored (77%) and all natural peatlands were net carbon sinks, whereas most degraded peatlands (69%) were carbon sources.[55]

The time needed for restored wetlands to start producing a cooling effect on the climate, taking into account the balance between carbon sequestration and methane emissions, is still a matter of discussion, but it is generally accepted that wetland restoration has an overall positive impact on the climate.[56] Günther et al. (2020) found that CO_2 emissions from delaying rewetting have a greater impact on long-term warming than the radiative forcing of methane in rewetted peatlands, emphasising that CO_2 emissions from nearly all drained peatlands need to be stopped as soon as possible by rewetting to meet Paris Agreement goals.[57]

3. Ticking carbon bombs: how wetland loss and degradation are exacerbating the climate crisis

Freshwater wetlands are significant carbon stores and are critical to achieving the goals of the Paris Agreement (**Box 3**). However, they are being lost and degraded at an alarming rate, unlocking vast quantities of carbon that have been stored for centuries and exacerbating the climate crisis.

Wetlands are the most threatened ecosystem in the world,[58] disappearing at a rate three times greater than forests.[59] An estimated 35% of wetlands were lost between 1970 and 2015 alone,[60] with losses particularly extensive and rapid for inland wetlands,[61] driving declines of 81% of inland wetland species populations since 1970.[62] A major threat is land use change for industrial agriculture (**Box 4**), as well as dam construction, water abstraction, vegetation clearance and pollution, among others (**Box 5**).[63] Wetlands are also highly vulnerable to climate impacts,[64] from the melting of permafrost in northern peatlands,[65] to the increased burning of tropical peatlands as a result of drought conditions associated with strong El Niño–Southern Oscillation (ENSO) events.[66] Globally, around 89% of wetlands are unprotected, with human influence particularly extensive in Asia, where only around 8% of wetlands are protected (compared to 18% in South America).[67]

Wetlands are the most threatened ecosystem in the world, disappearing at a rate three times greater than forests.

"We have lost native vegetation, we have lost forest area, we have lost savannah, and we are losing the natural grassland areas of the Pantanal. And if we let this happen, the Pantanal will become a degraded pasture, which is what we are seeing today."

Eduardo Reis Rosa, Pantanal biome coordinator, Mapbiomas

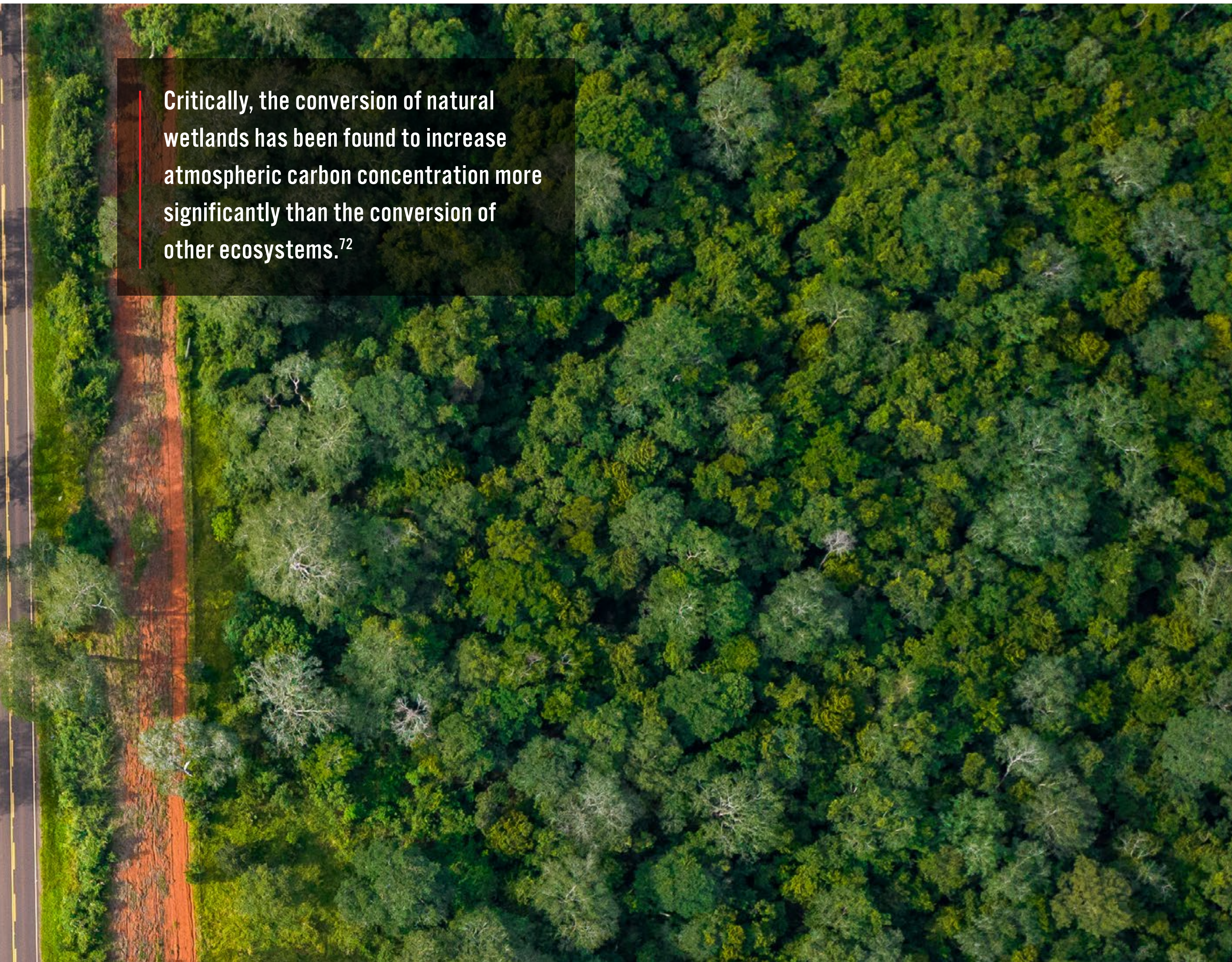
Deforestation of native vegetation in the Bonito region, on the outskirts of the Pantanal, in Mato Grosso do Sul, Brazil © EJF

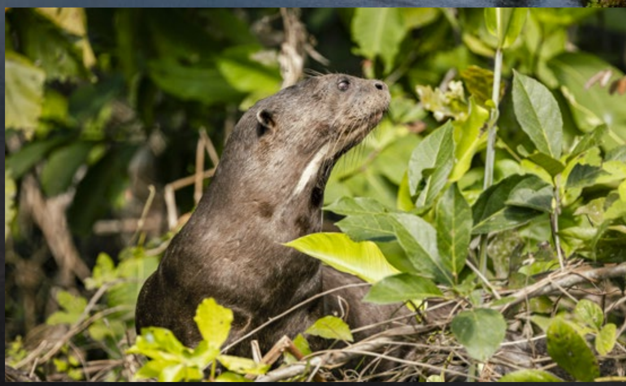
When drained and degraded, wetlands release significant quantities of greenhouse gases into the atmosphere through the oxidation and release of carbon from their soils,[68] turning natural wetlands from carbon sinks into a major carbon source.[69] According to one study, wetland degradation could result in greenhouse gas emissions equivalent to around 408 billion tonnes of CO_2 between 2021 and 2100, based on current trends,[70] equivalent to almost eight times the total recorded greenhouse gas emissions for all countries in 2023.[71]

Box 3: The Paris Climate Agreement

In 2015, the Parties to the UN Framework Convention on Climate Change reached an agreement in Paris which set the goal of keeping the global average temperature increase to well below 2°C above pre-industrial levels, and making every attempt to keep it below 1.5°C. Parties set out their pledges to meet these targets in their Nationally Determined Contributions (NDC), which contain a built-in “ratchet” mechanism, designed to increase ambition steadily over time. The first round of NDCs were submitted in 2015 for the period up to 2025 or 2030, and renewed or updated every five years thereafter, with a view to reaching net zero carbon emissions by the second half of the century.[73]

> Critically, the conversion of natural wetlands has been found to increase atmospheric carbon concentration more significantly than the conversion of other ecosystems.[72]





Sunbittern in flight (left) and giant otter (right) along the banks of the São Lourenço River, in the Porto Jofre region of the Brazilian Pantanal © EJF

Box 4: The Pantanal – Brazil's emblematic wetland under threat

Global heating and land use change are pushing the Pantanal into an increasingly precarious future. Urgent action is needed to protect this precious biome and secure the incredible range of services – from wildlife habitat to livelihoods, water supply and climate mitigation – that it provides. Indigenous peoples are on the frontlines of this crisis, their traditional cultures and way of life under threat. Yet, as stewards of this globally significant wetland, they may hold the key to its future.

The Pantanal is the world's largest tropical wetland, extending across Brazil (78%), Bolivia (18%) and Paraguay (4%), covering a total area of approximately 179,300 km^2.[74] It is seasonally transformed by the flooding of the Paraguay River and its tributaries,[75] creating a rich array of ecosystems and sustaining the greatest diversity of aquatic plants on the planet.[76] The Pantanal is home to numerous species, including over 174 mammals, 580 birds, 271 fish, 131 reptiles and 57 amphibians.[77] Included in this abundant biodiversity are endangered giant otters,[78] lowland tapirs, the world's largest parrot, the hyacinth macaw,[79] and the highest density of jaguars in the world.[80]

As well as being a site of significant biological importance, the Pantanal is a lifeline to over eight million people who live within the wider region, with this sponge-like wetland providing crucial flood protection and water supply.[81] It is also home to eleven Indigenous territories, with many local communities and Indigenous peoples directly dependent on the wetland for livelihoods, resources and cultural heritage.[82] This includes the Guató people, an ethnicity known as the Pantanal's lowland canoeists: a people highly dependent on fishing and whose way of life is closely connected to the Pantanal's intricate network of waterways.

Jaguars in the Poconé region of the northern Brazilian Pantanal in Mato Grosso © EJF

Once considered extinct, the Guatós have since been rediscovered,[83] however their exact numbers are unknown, estimated in the few hundreds to thousands.[84] Today, the remaining men and women of this emblematic ethnicity are threatened by droughts and climate change, as the rivers they depend on are dying.

Although inhabiting a small fraction of this iconic Brazilian biome, the Indigenous peoples of the Pantanal are important custodians of the ecosystem (**Box 8**). Research has specifically shown, for example, that Indigenous lands contribute strongly to maintaining natural vegetation and reducing deforestation, resulting in higher levels of CO_2 sequestration compared to other areas.[85] However, the expansion of cattle ranching has pushed Indigenous peoples and local communities off their traditional land,[86] threatening centuries-old cultures and their critical role as stewards of this globally important biome.

A Guató man washes clothes in one of the Pantanal's many waterways
Credit: André Luiz Siqueira- ECOA

A wetland in flames

Despite its significance to biodiversity and communities alike, the Pantanal is increasingly under threat.[87] Intensification of cattle-ranching is driving large-scale landscape conversion, removing native vegetation and replacing it with non-native pasture grasses. This conversion typically involves fires, a faster and cheaper strategy used to clear vegetation but which often turn into out-of-control blazes. In 2020, human-made fires combined with a prolonged drought to create the worst wildfires in the Pantanal's recorded history. [88] Approximately one third of the biome burned,[89] directly killing more than 17 million wild vertebrates[90] and emitting 115.6 million tonnes of CO_2,[91] more than Belgium's CO_2 emissions in the same year.[92] In 2023, wildfires once again engulfed the wetland, burning an area three times the size of London in the first three weeks of November alone, a month in which fires are not expected. In 2024, 2.6 million hectares, nearly one-fifth of the Brazilian Pantanal, burned again[93] – an indication that the catastrophic fires, once thought to be exceptional, are becoming recurrent. Fires have impacted every Indigenous territory in the Pantanal: one of the worst hit has been the Guató tribe, who lost 90% of their land in the 2020 fires[94] and the Kadiwéu people, who lost, in 2024 alone, almost 70% of their territory.[95]

Over 38,000 square kilometres – an area larger than Belgium – burned in 2020, killing more than 17 million wild vertebrates and emitting 115.6 million tonnes of CO_2.

The ever-expanding cattle industry in Brazil is being driven in significant part by international supply chains, which are fuelling conversion of native vegetation in the Pantanal. A study by EJF estimated that, between 2012 and 2021, over 46,000 hectares of native vegetation were converted to pasture in Pantanal-based cattle ranches with links to the EU market, an area equivalent in size to almost 6,500 football pitches.[96] A decade ago, scientists predicted that if high rates of deforestation persist, the Pantanal as an ecosystem could effectively disappear by 2050.[97]

"Of course there is local demand for food production, but what drives the big changes in production and land usage in the Pantanal and the surrounding area are very often [...] economies and demands from other countries."

Dr Fabio Roque, Ecologist, the Federal University of Mato Grosso do Sul

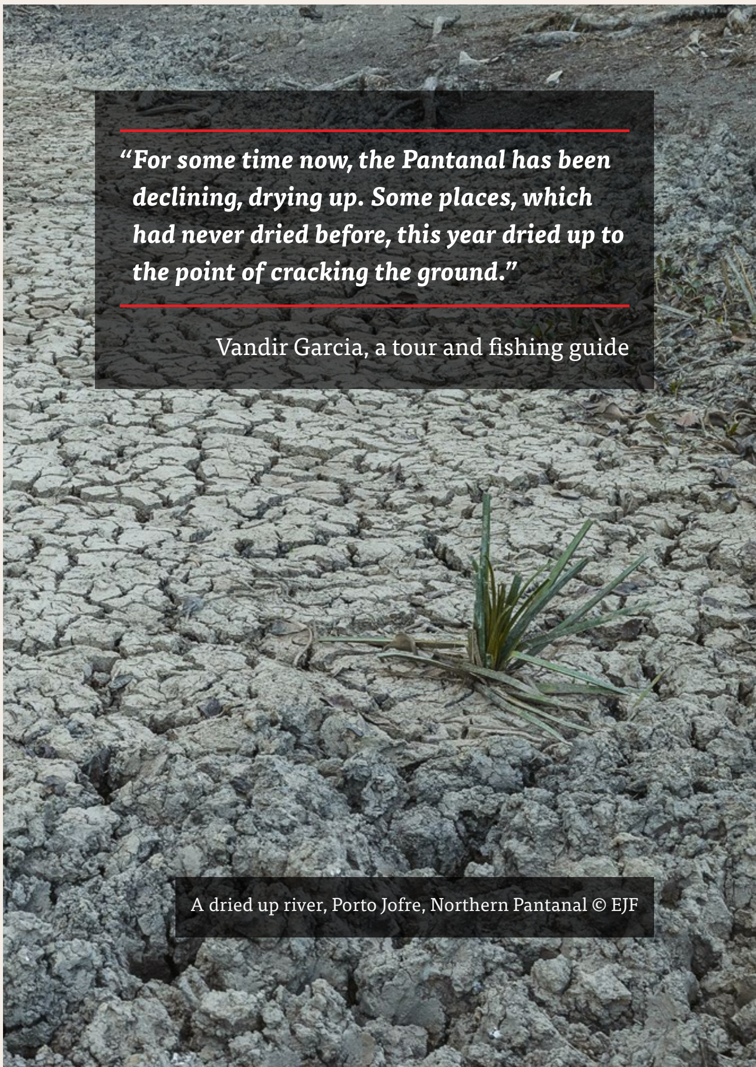
Deforestation for cattle ranching in Poconé, Northern Pantanal © EJF

Fires along the Transpantaneira highway, state of Mato Grosso, Brazil © EJF

Recent catastrophic fires and related emissions are also a consequence of disruptions to the Pantanal's hydrological cycle.[98] The lifeline of the Pantanal – the annual flood cycle – has been severely impacted by the construction of dams, which store and release water in response to energy demands, disrupting the natural flow regime.[99] In 2021, there were 57 hydropower plants in the Upper Paraguay Basin and a further 80 plants are under consideration, which, if built, would impact around 40% of the biome's water flow.[100] The annual flood pulse has reduced dramatically in recent years: between 1985 and 2022, the area of the Pantanal that remains flooded for six months or more shrank by around 82% (**Figure 4**).[101] Worryingly, in 2024, the Pantanal did not have a flood period – during the first five months of the year, the level of the Paraguay River was, on average, 68% below the expected average for the period, indicating another year of historic drought in the biome.[102] The resurgent Hidrovia Paraguay-Paraná navigation project represents a further and extremely significant threat. If given the green light, dredging and river channel alterations would disconnect the Paraguay River from its floodplain and shorten the inundation period, resulting in the severe degradation of the wetland.[103]

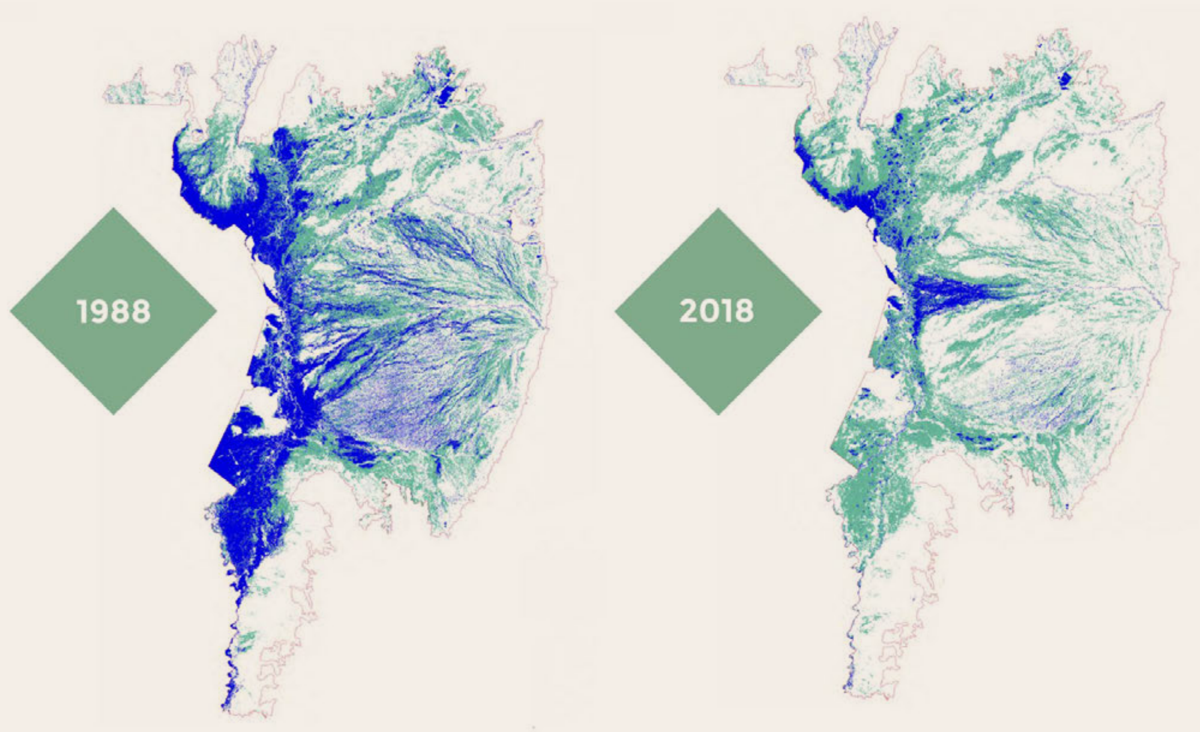
Global heating is compounding the impacts of these activities. The wildfires of 2020 were preceded by a period of extremely low rainfall in the Pantanal Basin, with the 2019-2020 rainy season recording 40% lower rainfall than the average of previous years, exacerbating a period of accumulated water stress.[104] Climate models indicate that severe and prolonged periods of drought are likely to increase in frequency in the coming decades, combining with higher temperatures and increased evaporation to impact the region's water balance.[105] According to one study, temperatures in the Pantanal could increase by up to 7°C by the end of the century.[106]

The implications of these developments for the ecological functioning of the Pantanal, and the wildlife and people who depend on it, are devastating. EJF urges the Federal Government of Brazil to take the actions needed, as a matter of urgency, to maintain and restore the hydrological and ecological health of the Pantanal to prevent the loss of an entire biome. EJF's detailed recommendations to the Federal Government are set out in **Box 10**.



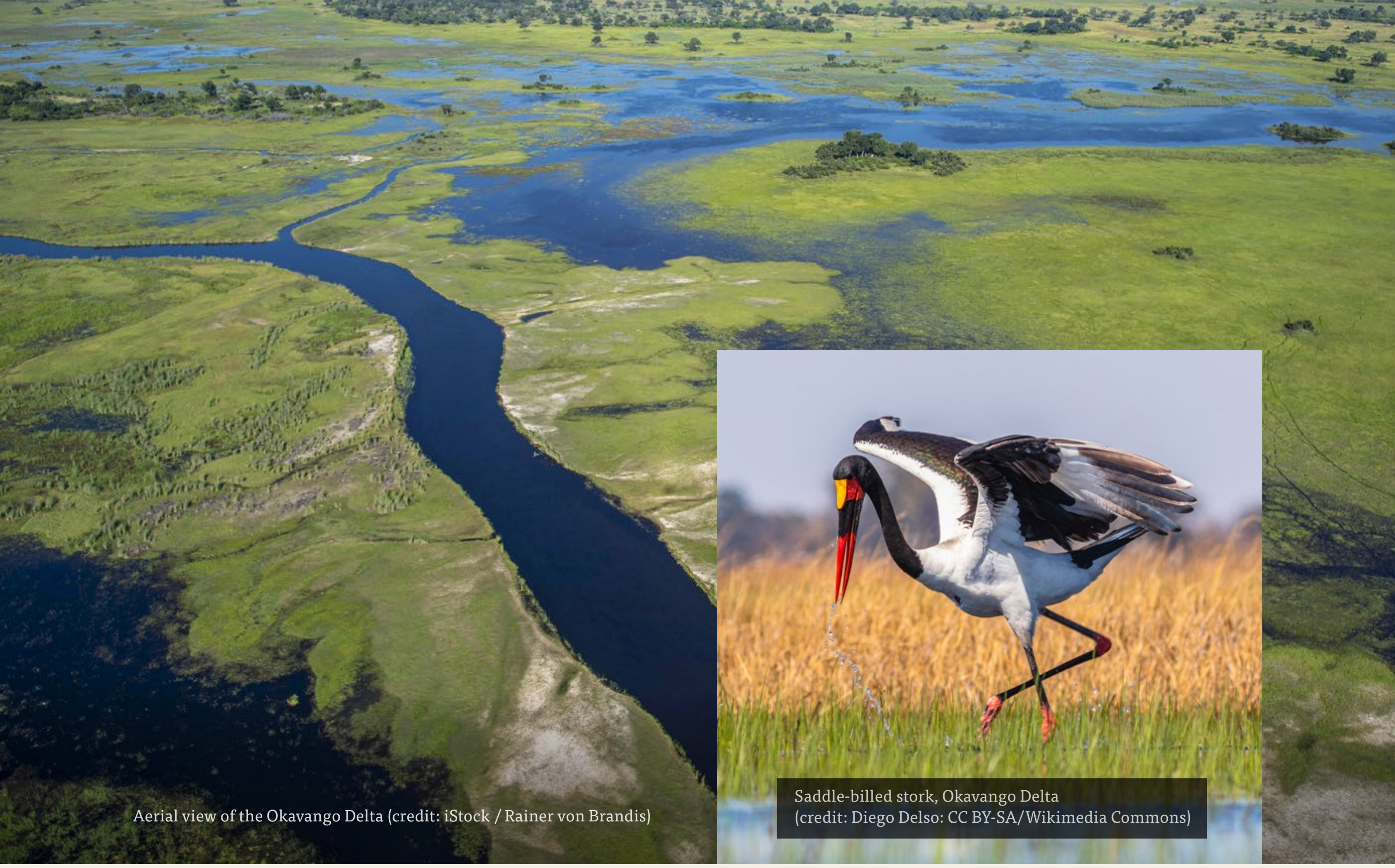
A dried up river, Porto Jofre, Northern Pantanal © EJF

Figure 4: Maps showing the decline in water coverage in the Pantanal during the wet season between 1988 and 2018



Flooded fields (light blue) and water bodies (dark blue) have declined significantly. Source: MapBiomas (2022)[107]

Dead caiman in Porto Jofre, Northern Pantanal © EJF



Aerial view of the Okavango Delta (credit: iStock / Rainer von Brandis)

Saddle-billed stork, Okavango Delta
(credit: Diego Delso: CC BY-SA/Wikimedia Commons)

Box 5: The Okavango Delta – exploiting 'Eden' for oil?

Nestled within the otherwise arid Kalahari Desert, the Okavango Delta is a cradle of life. This wetland, one of the largest inland deltas in the world, provides an irreplaceable sanctuary for endangered wildlife and a critical source of water and livelihood for communities in the region.[108] Located in north-west Botswana, the Okavango Delta is formed by the fourth longest river in Southern Africa, the Okavango River.[109] At the height of Botswana's dry season, life-giving waters flow from the Angolan highlands, through Namibia and into the Okavango, creating a series of marshes, floodplains, peat bogs, islands, and deep lagoons encompassing a vast area of around 200,000km^2.[110] This mosaic of waterways is said to support one million people,[111] including the Bayei, Tawana, Hambukushu, Herero and Banoka ethnic groups, whose hunter-gatherer activities have co-existed sustainably with the delta for centuries.[112]

The Okavango sustains some of the world's most iconic and endangered species.[113] As the Delta floods, cheetahs, African wild dogs, giant ground pangolins and critically endangered rhinos descend onto the waterways, along with the largest remaining population of African savanna elephants.[114] In its entirety, the wetland habitats support abundant biodiversity, including 1061 species of plant, 89 fish, 64 reptiles, 482 birds and 130 mammals.[115] The wetland is an important location for community-based ecotourism, which supports rural livelihoods and maintains Indigenous cultures, while providing an important source of national revenue, and underpinning monitoring and management.[116]

The Okavango has been designated as a Wetland of International Importance under the Ramsar Convention and a UNESCO World Heritage Site. Around 95% of the Ramsar Site is communally-owned under the Tribal Land tenure system, and contains significant cultural landscapes, including sacred sites and traditional land uses.[117] Traditional organisational structures and land management by local communities have contributed positively to the conservation of the Delta.[118] However, this unique and irreplaceable wetland remains under unprecedented pressure from persistent drought and upstream water abstraction and diversion, as well as from land use change, logging and wildlife poaching.[119]

> ***"We are not only custodians of these ancestral lands but have a deep connection to nature. […] We have been living on this land and protecting all the life that it supports."***
>
> Communities of the Kavango River Basin, Saving Okavango's Unique Life (SOUL)[124]

African elephants congregate in the Khwai area of the Okavango Delta, Botswana (credit: iStock / janainamatarazzo)

Compounding these threats, a Canadian company has been granted oil and gas exploration concessions in Namibia and Botswana, which overlap with the watershed of the Okavango Delta and the wider Kavango-Zambezi Transfrontier Conservation Area (KAZA). Exploration and drilling operations have the potential to wreak havoc on this fragile ecosystem, bringing inherently destructive infrastructure development, new roads and land use change, with serious concerns already raised about groundwater pollution and its impacts.[120] To date, the company stands accused of alleged environmental and human rights violations, including failure to consult with Indigenous peoples and local communities, intimidation of local leaders, improprieties around wastewater treatment and disposal,[121] illegal clearance of virgin forest[122] and drilling inside wildlife reserves without proper permissions.[123]

EJF calls on the governments of Namibia and Botswana to protect this ecosystem of vital regional and global importance by:

- immediately ordering the cessation of oil and gas exploration activities;
- upholding their commitments under the Paris Agreement by not granting new oil and gas licences in the region; and
- along with the government of Angola, pushing for the expansion of the UNESCO World Heritage Site to protect the entire watershed.

> ***"We […] ask the regional governments to implement a full moratorium on oil and gas development in this vital ecosystem and […] assist in helping create new livelihoods and opportunities for people based around sound environmental principles and long-term sustainability."***
>
> Communities of the Kavango River Basin, Saving Okavango's Unique Life (SOUL)[125]

Degraded peatlands cover just 0.4% of the Earth's land surface, yet contribute an estimated 4% of anthropogenic emissions of greenhouse gases annually.

Cleared peatland in Central Kalimantan, Indonesia (credit: Anna Finke/CIFOR)

Emissions from peatland degradation

Carbon-rich wetlands, such as peatlands, are particularly vulnerable to degradation.[126] Around 11-15% of the world's peatlands have been drained for agriculture, forestry and grazing, and a further 5-10% are degraded due to land use or land cover change.[127] Every year, 0.5 million hectares of peatlands that are accumulating (i.e. actively capturing and storing) carbon are destroyed by human activities.[128] Europe has seen almost half of its peatlands degraded, while Southeast Asia lost more than half of its peat swamp forest between 1990 and 2010.[129]

Compared to other terrestrial ecosystems, peatlands are dangerously under-protected. A recent study found that just 17% of peatlands are within protected areas, significantly less than other high value ecosystems such as mangroves (42%) and tropical forests (38%).[130] Even peatlands within protected areas are vulnerable due to absent or poorly implemented legal frameworks and a lack of management. Nearly a third of global peatlands, and almost half of temperate and tropical peatlands in protected areas, are still experiencing medium to high human pressure.[131]

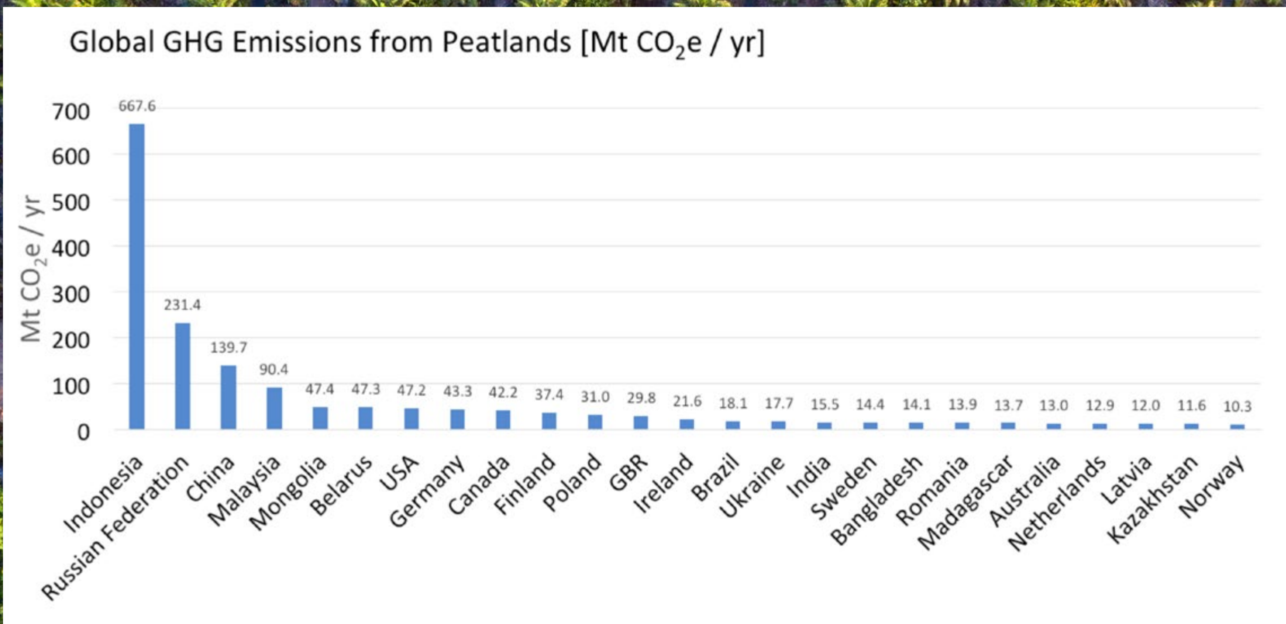
With their immense carbon stores under threat from human activity, peatlands are nature's ticking carbon bombs. Although they cover just 0.4% of the Earth's land surface, degraded peatlands contribute an estimated 4% of anthropogenic emissions of greenhouse gases annually, equating to more than 1.9 billion tonnes of CO_2 equivalent, excluding emissions from fires.[132] Tropical peatlands are responsible for around 80% of anthropogenic peatland carbon emissions, a significant portion originating from peatland conversion in Indonesia (around 60%) (see **Figure 5**).[133] In Southeast Asia, large areas of peatland have been converted to oil palm plantations. Over a typical 25 years of cultivation, a single hectare of oil palm on peat will emit more than 2,000 tonnes of CO_2,[134] equivalent to the consumption of 4,630 barrels of oil.[135] Impacts are predicted to worsen with global heating, as severe droughts increase CO_2 emissions from peat soils and lead to higher methane emissions from fires.[136]

Significant peat fires that burn and smoulder below-surface in degraded peatlands can cause their contribution to greenhouse gas emissions to double.[137] Annual emissions from peat fires are highly variable but are estimated at, on average, 0.5–1.0 billion tonnes of CO_2 equivalent per year,[138] equating to around 1-2% of global greenhouse gas emissions.[139] Drained peatlands are more at risk of peat fires as a result of drier soil conditions, a situation exacerbated by global heating.[140] In 2015, particularly intense forest and peatland fires in Southeast Asia released more CO_2 per day than the entire European Union in the same time period.[141] During the 1997 El Niño event, wildfires raged through Indonesia's forested peatlands, releasing an estimated 0.81–2.57 billion tonnes of carbon into the atmosphere, equivalent to 13–40% of mean annual global carbon emissions from fossil fuels and contributing to the largest annual increase in atmospheric CO_2 concentration detected since records began.[142] Smouldering peat fires emit large quantities of volatile organic compounds and 15 times more mercury than regular flaming fires, with serious implications for human health.[143] Air pollution from peatland fires causes, on average, 33,100 adults and 2,900 infants to die prematurely in Indonesia each year.[144]

The implications for climate mitigation efforts are significant. If current trends continue, greenhouse gas emissions from drained and degraded peatlands will consume an estimated 12-41% of the emissions budget that remains to keep heating below +1.5 to +2°C.[145] Around 85% of these emissions originate from just 25 parties to the UN Framework Convention on Climate Change, with Indonesia by far the greatest contributor to peatland emissions, at approximately 667.6 million tonnes of CO_2 equivalent per year (**Figure 5**).[146]

> In 2015, particularly intense forest and peatland fires in Southeast Asia released more CO_2 per day than the entire European Union in the same time period.

Figure 5: Estimated global greenhouse gas emissions from degraded peatlands from the top 25 countries



Source: Global Peatlands Assessment data retrieved from the Global Peatland Database compiled by the Greifswald Mire Centre. Includes only net, on-site greenhouse gas emissions. Wildfire emissions are not included.

Aerial view of an oil palm plantation in Borneo © EJF

Forest surrounding the village of Tomázia in the Kadiwéu Indigenous territory, Mato Grosso do Sul © EJF

4. Nature-based solutions: cost-effective and proven climate mitigation

The scale of the climate crisis requires deep and immediate cuts in greenhouse gas emissions across every sector of the global economy. Yet ambition to date has been lacking, with cuts in global emissions of 42% and 57% still required by 2030 and 2035, respectively, to limit warming to 1.5°C.[147] Commitments by countries in their NDCs (**Box 3**) have fallen far short of the action required to avert dangerous levels of global heating, putting the world on course for a catastrophic temperature increase of 2.6-3.1°C this century, with "debilitating impacts to people, planet and economies".[148] The window for action is shrinking each year: in 2024, the remaining carbon budget was estimated at 900 billion tonnes of CO_2 to limit warming to 2°C and 200 billion tonnes of CO_2 to stay below 1.5°C, the latter equating to just 3.8 times total global greenhouse gas emissions in 2023.[149]

Mitigation potential of nature-based solutions (NbS)

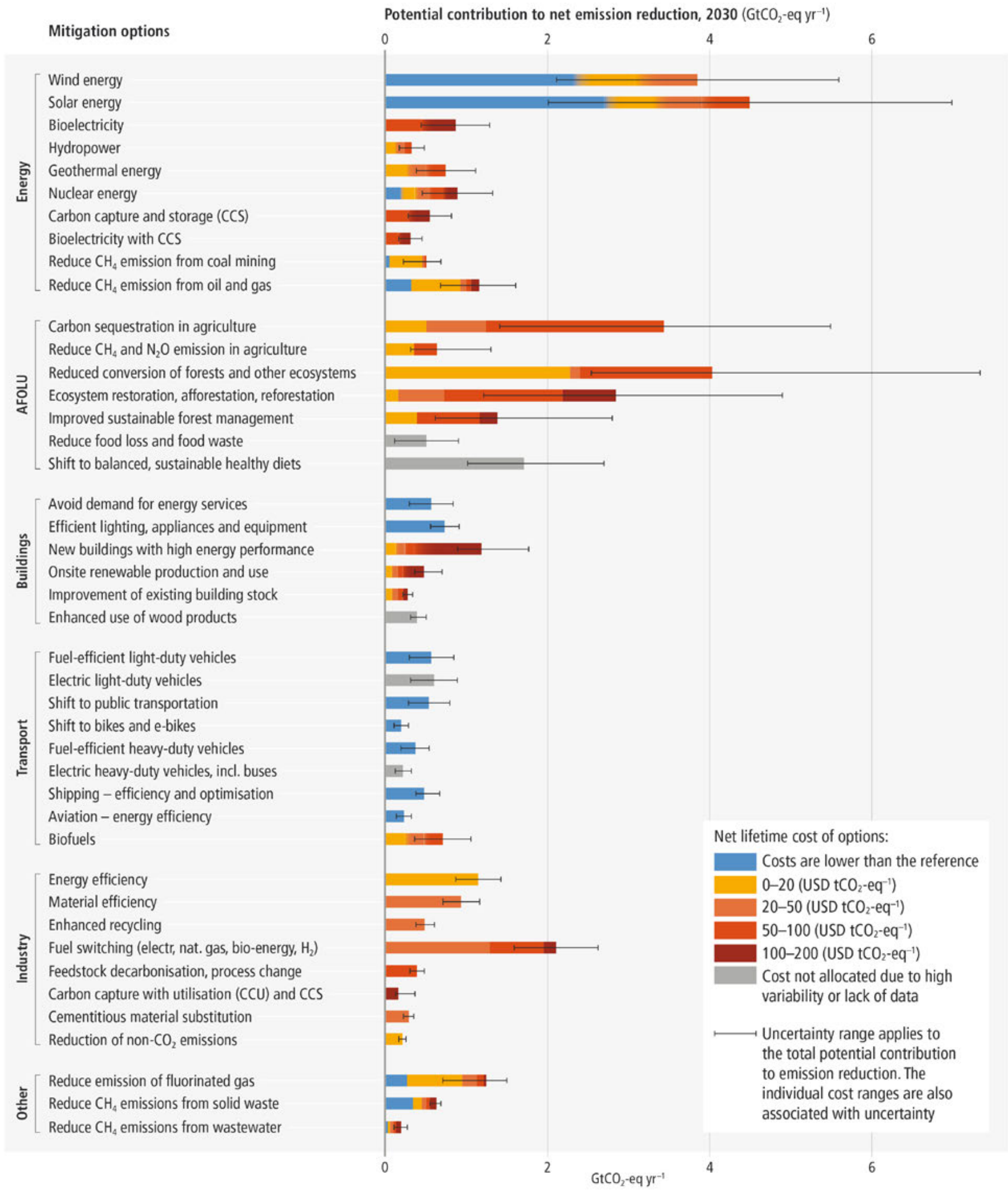
Emissions from land use – or Agriculture, Forestry and Other Land Use (AFOLU) emissions – are a major contributor to global heating, accounting for 22% of total global emissions.[150] Measures that aim to reduce AFOLU emissions, or enhance carbon removals (sequestration) within the land system, are therefore a critical part of action to address the climate crisis.[151] Such measures may include the conservation or improved management of natural or man-made ecosystems, such as forests, wetlands, grasslands, croplands and pasture. Climate mitigation actions within the land system are often referred to interchangeably as AFOLU mitigation, land-based climate mitigation measures or natural climate solutions (NCS).[152]

NCS have some of the highest mitigation potentials of all sectors (**Figure 6**),[153] with the potential to contribute around 20–30% of the cost-effective mitigation needed up to 2050 to limit warming to +1.5°C (**Figure 7**).[154] According to the IPCC, AFOLU mitigation measures can deliver mitigation of 8–14 billion tonnes of CO_2 equivalent per year at costs of less than US$100 per tonne between 2020 and 2050, of which 30–50% is available at less than US$20 per tonne of CO_2 equivalent.[155] The majority of NCS mitigation options are available and ready to deploy, meaning that emission reductions can be unlocked at pace.[156] Just 15 countries account for 62% of global mitigation potential from NCS, in descending order: Brazil, China, Indonesia, United States, India, Russian Federation, Canada, the Democratic Republic of the Congo (DRC), Colombia, Mexico, Argentina, Australia, Bolivia, Peru, and Myanmar (**Figure 8**).[157]

When implemented with benefits to human well-being and biodiversity, NCS are referred to as nature-based solutions (NbS). NbS is a broad term that encompasses any actions aimed at protecting, sustainably managing and restoring ecosystems in ways that address societal challenges such as global heating, while delivering co-benefits for people and nature.[158] In the context of climate mitigation, NbS may enhance the ability of ecosystems to sequester CO_2, or reverse the degradation of an ecosystem so that it no longer emits greenhouse gases and reverts to being a net carbon sink.

NbS are gaining increasing attention as a cost-effective and efficient means of sequestering atmospheric carbon,[159] working in tandem with cuts in fossil fuel emissions.[160] The IPCC, in its Sixth Assessment Report, analysed a range of NbS for their climate mitigation potentials, including measures to protect, sustainably manage and restore forests, peatlands, coastal wetlands, savannas and grasslands. These measures accounted for a substantial share of cost-effective mitigation potential (**Figure 6**), projected to reduce the emission of and/or sequester an estimated 7.3 billion tonnes of CO_2 equivalent per year, on average, between 2020 and 2050,[161] equating to around 14% of the global greenhouse gas emissions recorded in 2023[162] and accounting for around half of total mitigation potential from NCS/land-based climate measures.[163] Of the measures analysed by the IPCC, measures to protect natural ecosystems, such as reducing deforestation and the conversion/degradation of wetlands, had the single highest total mitigation (**Figure 6**) and the highest mitigation densities of the NbS studied (see also **Table 3**).[164] Protection measures can account for an estimated 28% of cost-effective mitigation potential, compared to 13% for restoration, according to a study by Roe et al. (2021).[165]

Figure 6: Overview of mitigation options and their estimated ranges of costs and potentials in 2030



Source: IPCC (2022)[166]

Figure 7: Contribution of NCS to stabilising warming to below 2°C

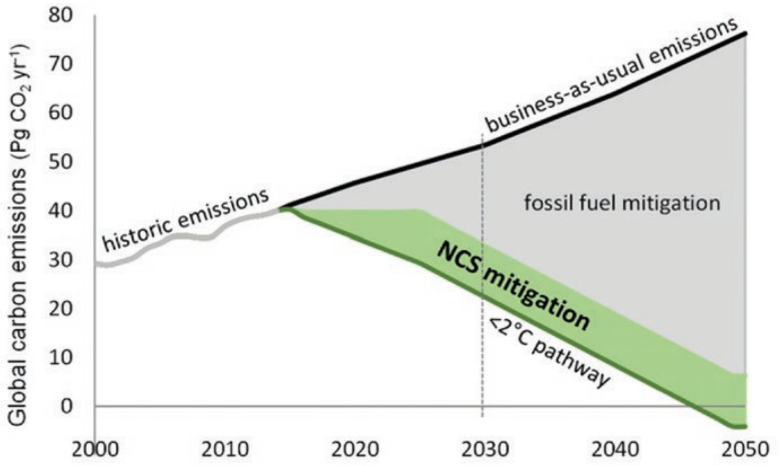


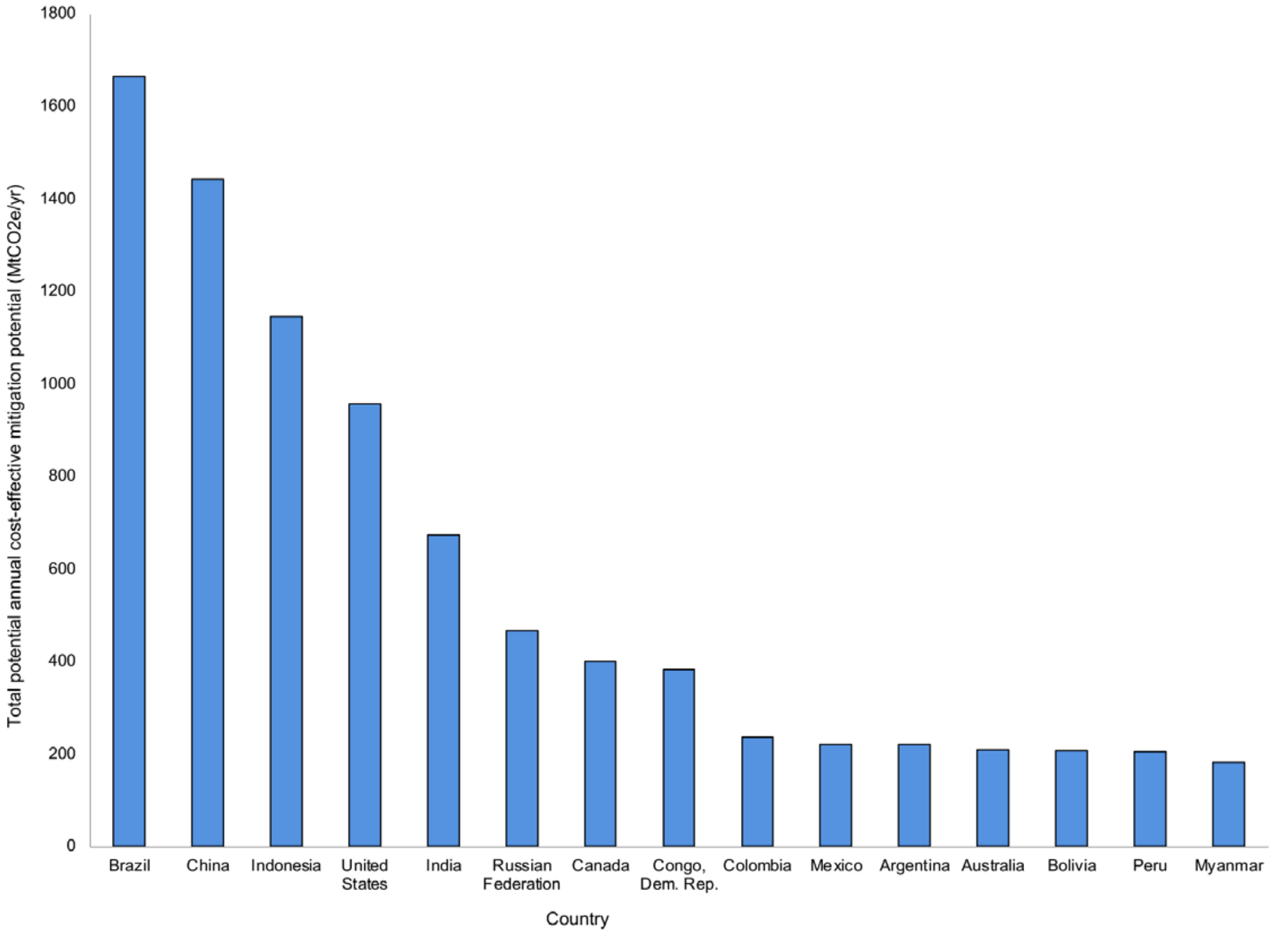
Fig. 2. Contribution of natural climate solutions (NCS) to stabilizing warming to below 2 °C. Historical anthropogenic CO_2 emissions before 2016 (gray line) prelude either business-as-usual (representative concentration pathway, scenario 8.5, black line) or a net emissions trajectory needed for >66% likelihood of holding global warming to below 2 °C (green line). The green area shows cost-effective NCS (aggregate of 20 pathways), offering 37% of needed mitigation through 2030, 29% at year 2030, 20% through 2050, and 9% through 2100. This scenario assumes that NCS are ramped up linearly over the next decade to <2 °C levels indicated in Fig. 1 and held at that level (=10.4 $PgCO_2$ y^{-1}, not including other greenhouse gases). It is assumed that fossil fuel emissions are held level over the next decade then decline linearly to reach 7% of current levels by 2050.

Source: Griscom et al. (2017)

Just 15 countries account for 62% of global mitigation potential from NCS, in descending order: Brazil, China, Indonesia, United States, India, Russian Federation, Canada, the Democratic Republic of the Congo (DRC), Colombia, Mexico, Argentina, Australia, Bolivia, Peru, and Myanmar.

Aerial view of the Formoso River in the state of Mato Grosso do Sul © EJF

Figure 8: Top 15 countries with the highest global cost-effective mitigation potential from land-based measures (NCS)[167]



Source: Based on data from Roe et al. (2021)

Table 3: Carbon mitigation densities of natural climate solutions for key terrestrial ecosystems

Ecosystem	Type of intervention	Natural climate solution	Mitigation density (tCO_2/ha)
Forests	Protect	Reduce deforestation	316
	Manage	Improve forest management	29
	Restore	Afforestation and reforestation	166
Coastal wetlands	Protect	Reduce mangrove loss	1505
	Restore	Mangrove reforestation	704
Grassland and savanna	Manage	Grassland and savanna fire management	10
Freshwater wetlands	Protect	Reduce peatland degradation	1232
	Restore	Peatland restoration	857

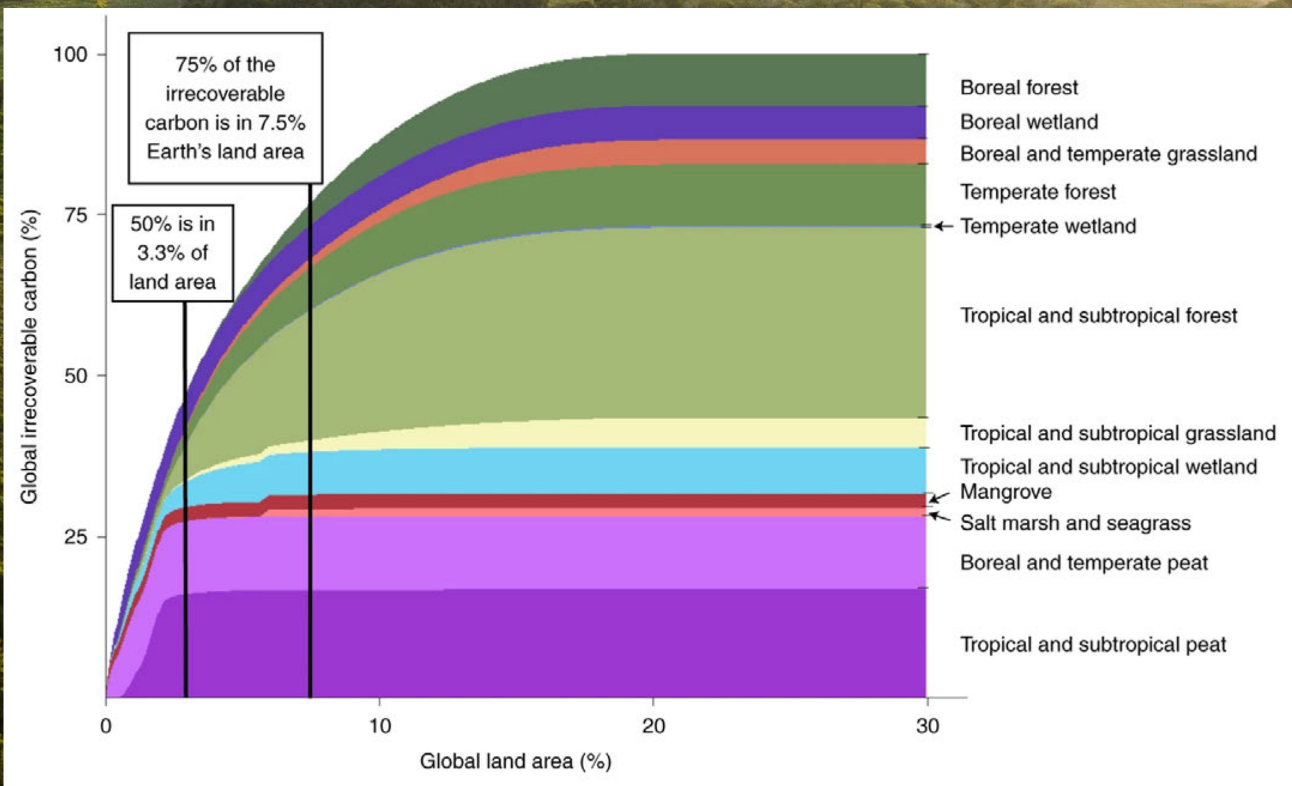
Source: Based on data in Roe et al (2021)[168]

Locking carbon in peatlands

Ensuring carbon remains locked away in carbon-rich ecosystems, such as tropical forests and peatlands, is critical to achieving the goals of the Paris Agreement. Protecting these ecosystems is one of the most impactful and cost-effective options available for climate mitigation[169] comparing favourably with conventional methods of securing emissions reductions, e.g. in the energy and transport sectors (**Figure 6**).[170] If degraded or lost, the carbon stored within these ecosystems would generally not be recoverable through restoration by 2050, the timeframe necessary to meet the 1.5–2°C goals of the Paris Agreement.[171]

With this in mind, there are increasing calls to prioritise areas of "irrecoverable carbon" (**Figure 9**) for protection and sustainable management,[172] which would deliver significant co-benefits for sustainable development and conservation of biodiversity (see **Section 5** below).[173] Large, high density reserves of irrecoverable carbon are located in the tropical forests and peatlands of the Amazon, the Congo Basin (**Box 6**) and Southeast Asia, as well as the boreal peatlands of eastern Canada and Western Siberia.[174]

Figure 9: Areal extent of global irrecoverable carbon by terrestrial ecosystem showing the significant contribution of peatlands



Source: Noon et al. (2021)[175]

Aerial view of the Brazilian Pantanal in Mato Grosso, near the Transpantaneira © EJF

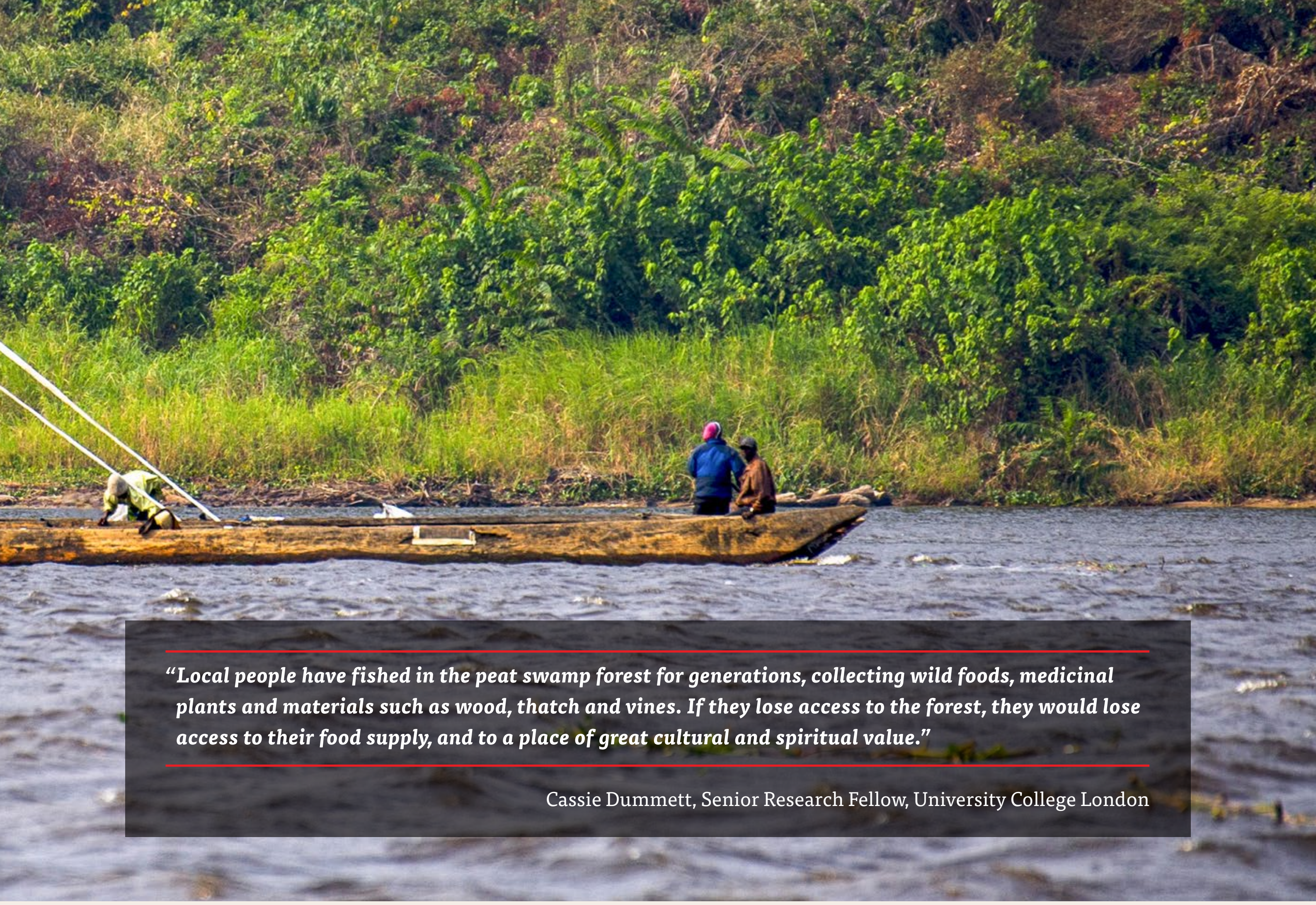
> The central Congo Basin peatlands are estimated to hold around 29 billion tonnes of carbon, which is as much carbon as all of the above-ground forest biomass in the Congo Basin or equivalent to around 33 years of greenhouse gas emissions from the EU.

View from the Congo River between Kinshasa and Lukolela, Democratic Republic of Congo (credit: Ollivier Girard/CIFOR, CC BY-NC-ND 2.0)

Box 6: The central Congo Basin peatlands

The central Congo Basin peatlands are the largest tropical peatland complex (i.e. near contiguous peatland) in the world, extending across the Democratic Republic of the Congo (DRC) and the Republic of the Congo (RoC). Recent studies have found the complex to be larger than previously thought, covering an estimated area of 167,600 km^2 – equivalent in size to England and Wales combined – and accounting for around 36% of the world's tropical peatlands.[176] It is estimated to hold around 29 billion tonnes of carbon,[177] which is as much carbon as all of the above-ground forest biomass in the Congo Basin[178] or equivalent to around 33 years of greenhouse gas emissions from the EU.[179] The peat swamp forests host important populations of bonobo and dwarf crocodile, as well as the critically endangered lowland gorilla and forest elephant, and species such as Allen's swamp monkey that are highly dependent on swamp forests.[180]

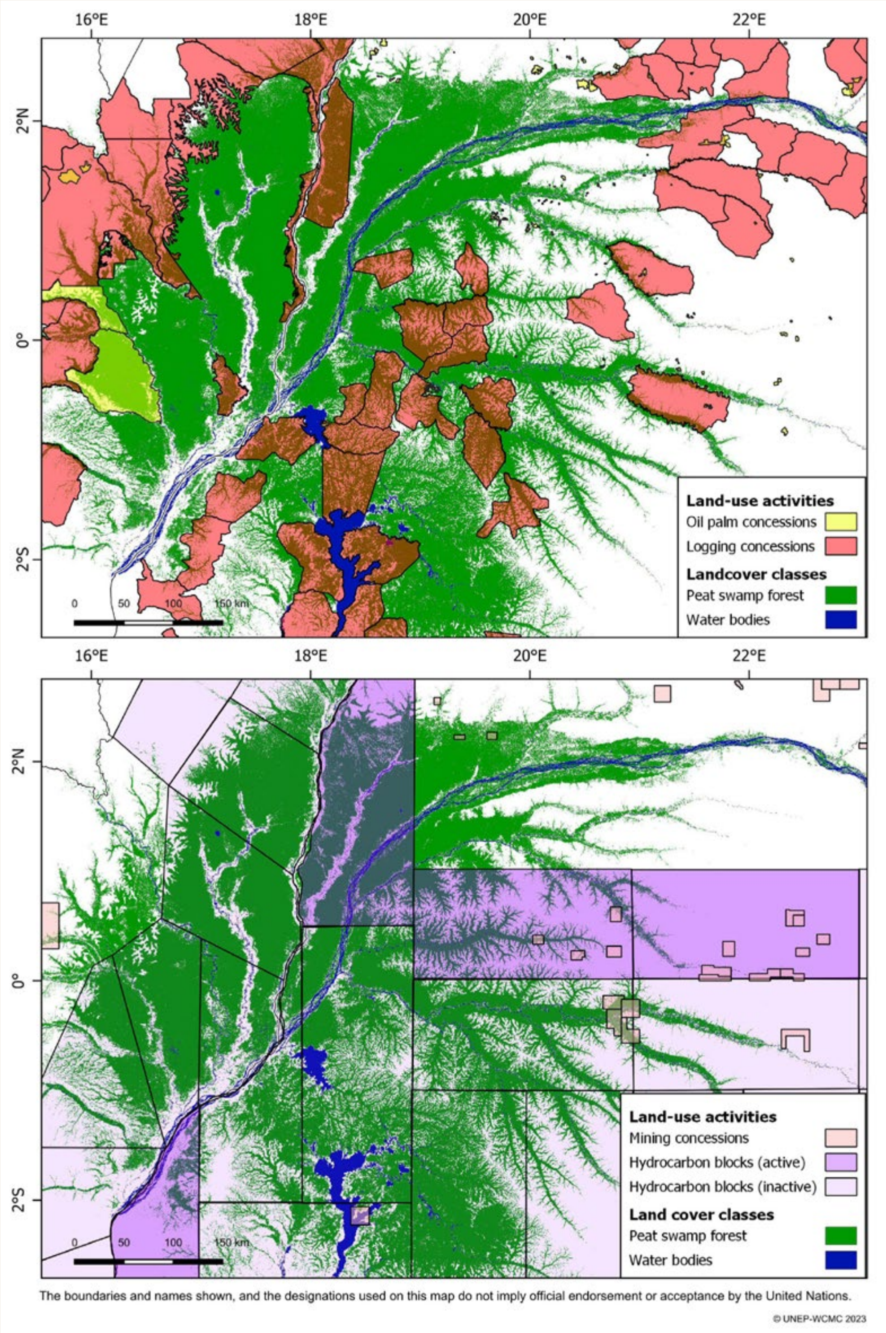
A female Western Lowland Gorilla holding her baby, Congo Basin (credit: guenterguni)



Around 5.5 million people live within or around the central Congo Basin peatland complex, the majority (>80%) in DRC.[181] The DRC is home to an estimated 700,000-2,000,000 Indigenous peoples,[182] including groups of nomadic and semi-nomadic forest-dwelling people who inhabit the peatlands.[183] Communities from the Bantu ethnic group, among others, also live in the Basin, with the different groups having distinct customary tenure systems.[184] For peatland-dependent communities, the peat swamp forest is a source of food, fuel wood, traditional medicine, construction materials and livelihoods.[185] Fishing is a major subsistence and livelihood activity which, alongside hunting and harvesting of wild produce, is considered largely sustainable.[186] The peatlands have significant cultural and spiritual value, as the home of the spirits of the ancestors.[187] Local customary tenure, culture and traditions have played an important role in the conservation and sustainable management of the peatlands.[188] However, Indigenous peoples face high levels of discrimination in the Congo Basin, and their customary rights to the forest are often ignored.[189]

In spite of their importance for people, biodiversity and the global climate, the central Congo Basin peatlands are under intense pressure from logging, oil and gas exploration, infrastructure development and drainage for large-scale agriculture.[190] Together, oil palm, logging and mining concessions cover areas representing over 7 billion metric tonnes of carbon, or around a quarter of the peatland's carbon stock.[191] Significant areas of peat swamp forest are already subject to oil and gas and mining concessions (see **Figure 10**) – in 2022, the government of the DRC launched a tendering process for 27 oil blocks to drill in the Congo Basin, three of which overlapped with the central Congo Basin peatlands, encompassing one million hectares of peatland.[192] Oil and gas drilling would threaten the release of vast quantities of carbon from the peat soils, while disrupting peatland hydrology, polluting groundwater and waterways, driving vegetation and biodiversity loss, and displacing communities.[193] The peatlands are themselves also vulnerable to climate impacts: evidence from peat cores suggests that future droughts may tip the ecosystem from a carbon sink to a major carbon source, further accelerating the climate crisis in a dangerous feedback loop.[194]

Figure 10: Map of land-use concessions which threaten the central Congo Basin peatlands



Source: CongoPeat Consortium[195]

"Industrial concessions and fortress conservation pose a threat to local people. New concessions for palm oil, forestry, mining, or oil, would bring an end to the customary tenure and traditional management of the peatlands that has been effective for generations."

Cassie Dummett, Senior Research Fellow, University College London

The continued protection of the central Congo Basin peatlands is vitally important to prevent major emissions and to safeguard the multitude of ecosystem goods and services upon which rural and Indigenous communities depend.[196] Currently around 8% of the complex's peat carbon lies within nationally protected areas,[197] with additional areas protected through international Ramsar Sites and community forests.[198] In recent years, the RoC and DRC have increased collaboration and efforts to protect the peatlands, with the Brazzaville Declaration signed in 2018, and inclusion of peatlands in their NDCs, national forest policies and REDD+ strategies, among other initiatives.[199] Nevertheless, these commitments must be backed by sustained political will and finance to drive implementation and enhance protection of the peatlands. Although threatened, the peatlands are still relatively intact, presenting significant opportunities for finance to support the global carbon and biodiversity benefits.[200]

The CongoPeat Consortium has put forward a number of options to secure the long-term protection of the central Congo Basin peatlands, including:

(1) Strengthening regulations and legislation on harmful land-use in peatland areas, including hydrocarbon exploration, mining, agriculture and industrial logging.
(2) Revoking agricultural, logging and hydrocarbon concessions where operations have not yet started, and for concessions in operation, rapidly phasing out activities while ensuring a just transition.
(3) Developing fair and inclusive policies and legislation, which recognises local and Indigenous land rights and land tenure, and providing communities with the tools to map, secure and manage their customary lands in the long-term.
(4) Adopting co-management for all peatland areas, empowering and compensating stewardship by local communities and Indigenous peoples.
(5) Developing (joint) management plans for existing Ramsar Sites, and considering whether peatlands not currently covered by Ramsar Sites would benefit from Ramsar designation.
(6) Expanding protective governance mechanisms such as national protected areas and community forest reserves/concessions, and creating a buffer around peatland areas to discourage harmful land-use activities, while recognising and protecting the human rights, land tenure and traditional practices of local and Indigenous peoples.

"Achieving the climate goals of the Paris Agreement requires protection of all remaining intact peatland and rapid restoration of almost all drained peatlands."

Secretariat of the Convention on Wetlands (2021)[201]

Preventing the conversion and degradation of carbon-rich peatlands is particularly critical to prevent an acceleration of the climate crisis. Peatland carbon stocks accumulate slowly and persist over millennia, with losses essentially irreversible within Paris Agreement timescales.[202] There is an urgent need to protect the peatlands that remain – and particularly the 88% of peatland ecosystems that have not yet been drained or heavily degraded – to prevent their massive carbon stocks from being released.[203] Reducing the degradation of peatlands is associated with particularly high mitigation densities of around 1,230 tonnes of CO_2 equivalent per hectare – almost four times the mitigation density for forest protection – and second only to mangrove protection at 1,500 tonnes of CO_2 equivalent per hectare (**Table 3**).[204]

While there is some debate as to the impact of peatland restoration on net emissions (**Box 2**), there is broad consensus that both the protection and restoration of peatlands are necessary to achieve a 2°C mitigation pathway,[205] with the potential for significant emissions reductions.[206] Indeed a resolution adopted under the Ramsar Convention on Wetlands specifically encourages Parties to pursue peatland conservation and/or restoration measures that reduce anthropogenic emissions and increase removals, as a way to contribute to their NDCs.[207] Restoration involves the rewetting of drained or degraded peatlands to restore ecosystem functions, prevent emissions, and reduce incidence of fires and floods.[208] Estimates suggest that some 50 million hectares of drained peatlands need to be rewetted and restored by 2050, equivalent to around two million hectares per year, around half of which are currently under agricultural use.[209]

Together, the conservation and restoration of peatlands could contribute an estimated 10% of total emissions reductions and removals from ecosystem-based solutions by 2030.[210] Significant mitigation potential exists in the tropics, where large carbon stocks are present (e.g. in tropical peat forests) and where rates of carbon loss associated with land cover changes are high.[211] In tropical peatland countries alone, an estimated 800 million tonnes of greenhouse gas emissions could be reduced annually (equivalent to 1.5% of global emissions) through peatland conservation and restoration, at a total cost of US$40 billion.[212] The co-benefits associated with peatland solutions are also considerable (see **Section 5**), particularly in the tropics, supporting the effectiveness of this mitigation strategy.[213]

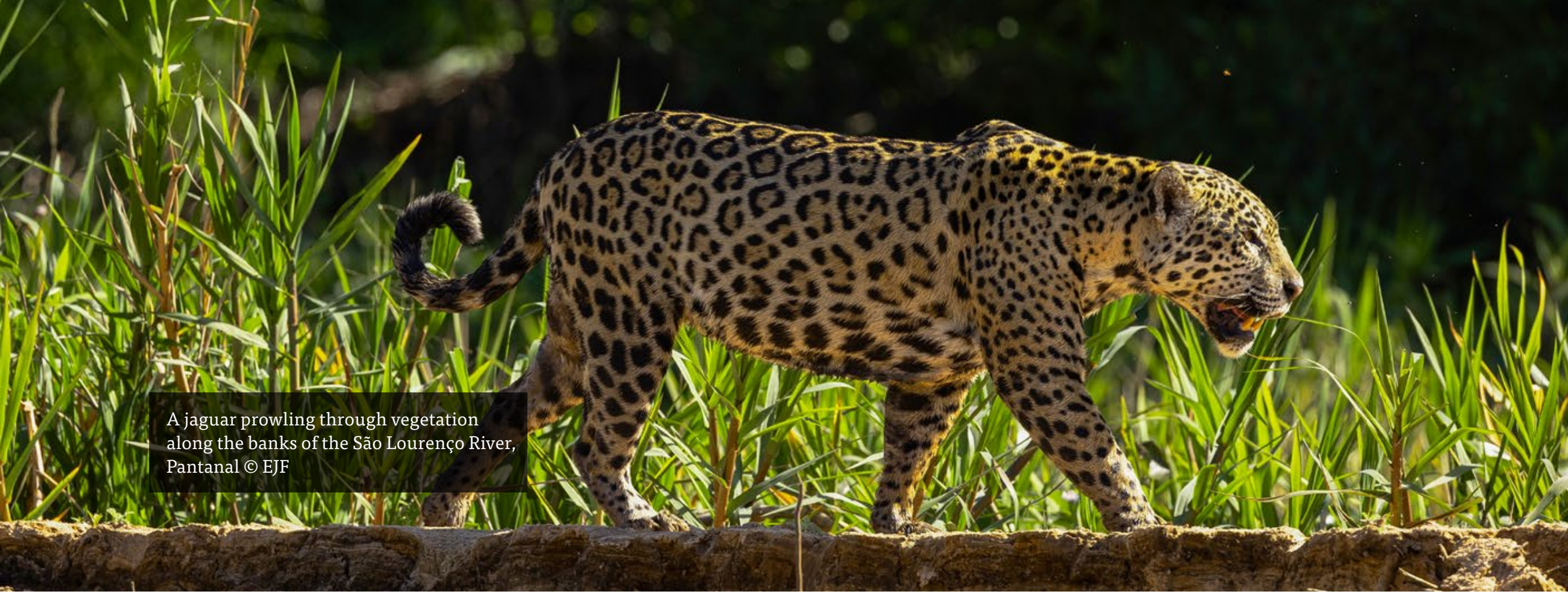
The protection and restoration of peatlands will inevitably remove or reduce land available for agricultural production. According to model projections, however, this would have minimal impacts on regional food security.[214] Peatlands contribute disproportionately to global emissions yet contribute a relatively small share of agricultural land globally.[215] Climate-smart wetland management can also offer a means of using peatlands both productively and in harmony with ecosystem functions, protecting the carbon stock and securing livelihoods. An example is paludiculture, where crops are grown on the wet or rewetted peatlands in a way that preserves the peat soil, minimising emissions and protecting biodiversity (**Box 7**).[216]

Box 7: Examples of peatland restoration and paludiculture initiatives

In Central Russia, a project to rehabilitate almost 100,000 hectares of drained peatlands aimed to prevent a repeat of the devastating peatland forest fires of summer 2010. Rewetting of the peatlands resulted in emissions reductions of around 320,000 metric tonnes of CO_2 equivalent per year, with fire prevention reducing emissions by a similar amount again. The project included improved water level management, ecosystem restoration, and improved infrastructure for fire control and monitoring. Restoration costs were around €30–100 per hectare for ecosystem restoration and €3,000–5,000 per hectare for improvements in infrastructure.[217]

In Belarus, more than half of the country's peatlands (which cover around 15% of its territory) had been drained for mining, agriculture and forestry. Since 2006, various restoration efforts have been carried out, including rewetting of around 50,000 hectares of peatland and promotion of alternative livelihoods from the restored ecosystems.[218] GEF et al. (2010) reported emissions reductions equivalent to around 87,500 tonnes of carbon per year, as well as numerous co-benefits.[219] Rewetting of the peatlands halted the occurrence of fires, resulting in public funds saved that were previously directed at fire-fighting/prevention and health care services for communities impacted by smoke and dust.[220] Biodiversity was also reported to have increased in the restored ecosystems.

In Germany, the Greifswald Mire Centre is running a paludiculture project to demonstrate how peat moss (sphagnum) can be grown and harvested on rewetted peatlands. The sphagnum is harvested, dried and processed as a replacement for peat in horticultural applications. In Indonesia, communities are being supported to develop sustainable business models based on growing sago on peatlands instead of oil palm, which supports high water tables, prevents the release of carbon and reduces fire risk. Sago provides food and the waste can be fed to ducks.[221]



A jaguar prowling through vegetation along the banks of the São Lourenço River, Pantanal © EJF

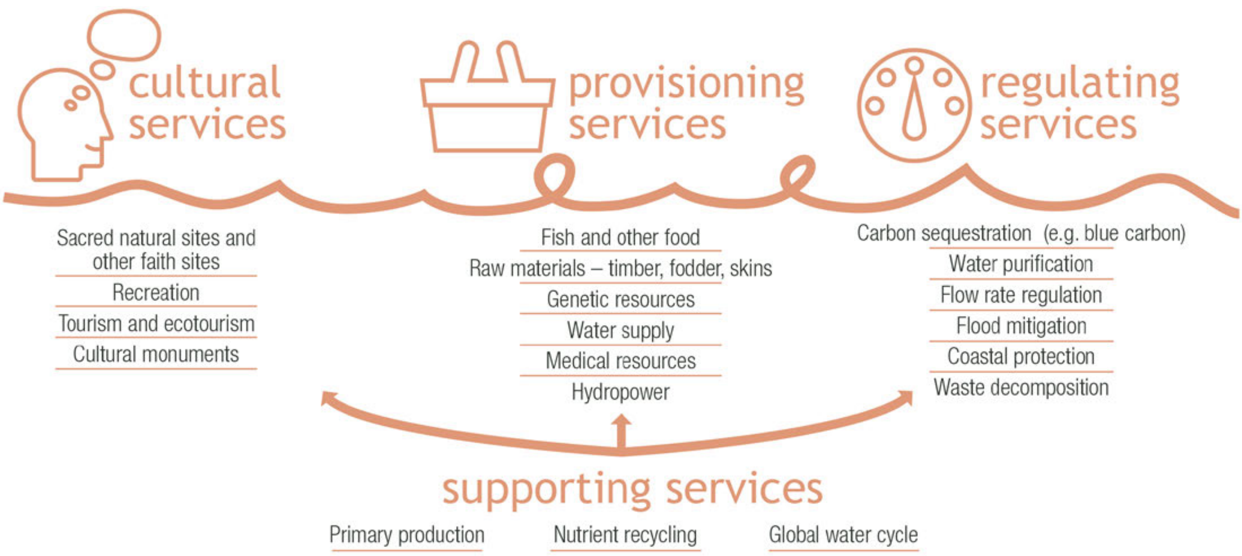
5. Protecting and restoring freshwater wetlands: A win-win-win for people, nature and climate

An unrealised opportunity to meet climate, biodiversity and sustainable development goals

Freshwater wetlands not only sequester and store vast quantities of carbon, they can help societies and wildlife to adapt to the impacts of global heating.[222] Climate adaptation functions include the mitigation of flooding, prevention of erosion resulting from extreme rainfall events and provision of refugia for species during unfavourable climatic conditions.[223]

Protecting and restoring freshwater wetlands can therefore help countries meet both climate mitigation and adaptation goals, while providing a multitude of co-benefits for people and nature.[224] Benefits include the regulation of water quality, replenishment of groundwater supplies, support for food production, and provision of a water source for crops, aquaculture and livestock (**Figure 11**). More than a billion people worldwide rely on wetlands for their livelihoods, and an even greater number for the recreational, cultural, spiritual and health benefits they provide (**Box 8**).[225] Freshwater wetlands also provide critical wildlife habitat and are often globally important hotspots for biodiversity[226] (see below and **Boxes 4** and **5**).

Figure 11: Ecosystem services from wetlands



Source: Ramsar Convention on Wetlands (2018)[227]

Box 8: Indigenous peoples and local communities – rightful custodians of wetland ecosystems

Indigenous peoples (IPs) and local communities (LCs) are vital custodians of the Earth's remaining natural landscapes, including wetlands.[228] Globally, at least 36% of the most important places for biodiversity lie within IP and LC lands, and over half of this area is located outside of formal protected areas.[229] IP and LC lands tend to be in better health, with the vast majority in good (65%) or moderate (27%) ecological condition, meaning they are subject to (relatively) low levels of human modification.[230] Research has shown, for example, that the loss of intact forest and forest carbon stores has been considerably lower on IP lands than on other lands.[231] Of all global lands in good ecological condition, at least 42% are located within IP and LC lands, comprising a total area of around 66 million square kilometres.[232]

> IPs and LCs are custodians of over a third of the world's most important places for biodiversity.

Wetlands are often precious areas for IPs and LCs. They form part of many traditional territories, provide the basis for livelihoods, and often have significant cultural and spiritual value (see **Boxes 4** and **5**).[233] Many IPs have developed their cultures based on interactions with wetlands and water, and their ways of life, cultural expressions and value systems are deeply connected to these ecosystems.[234] IPs and LCs are therefore significantly impacted by the mounting threats to wetlands around the world, including displacement due to the intensifying climate crisis.

The Ramsar Convention recognises that the traditional knowledge, resource use practices and cultural values of IPs and LCs are of significant importance for the wise use and conservation of wetlands. It therefore encourages Parties to strengthen the active participation of IPs and LCs in wetland management and conservation[235] and promotes recognition of customary law and traditional rights in relation to their protection.[236]

> The Ramsar Convention acknowledges Indigenous peoples' stewardship of wetlands and the multiple benefits it has brought, and calls for the strengthening of their traditional practices.[237]

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"Indigenous peoples play a very important role in the preservation of the environment [...] because the relationship itself with the environment, with nature, it's this relationship of respect and care. And understanding that this is exactly what ensures life."

Sonia Guajajara, Minister of Indigenous Peoples of Brazil.

Jessica, a Terena woman from Mato Grosso do Sul, participates in a reforestation project at the Indigenous Territory Buritizinho. Credit: Chalana Esperança

> **The ecosystem service value of wetlands is significant. According to a recent assessment, the 1,425 million hectares of remaining wetlands provide an estimated US$7.98 trillion (median 2023) to US$39.01 trillion (mean 2023) of benefits to people every year,[238] equating to around 7.5%-36.7% of global GDP.[239]**

Over 85% of this value is delivered by inland wetlands (lakes, peatlands and inland marshes/swamps), equating to an estimated US$6.91 to US$35.12 trillion per year,[240] which takes into account climate and water flow regulation, food and water provision, and erosion prevention, among other services.[241] Over the past 50 years, the loss of wetlands has resulted in an estimated cumulative loss of benefits to humanity of US$5.14 trillion,[242] the vast majority (92.6%) due to the destruction of inland wetlands.[243]

Peatlands – due to their sizable carbon stores – offer a significant, largely unrealised opportunity to meet emissions reductions targets while simultaneously contributing to sustainable development and biodiversity objectives under multiple international agreements and agendas. Protecting and restoring peatlands can contribute to targets under the Kunming-Montreal Global Biodiversity Framework adopted by the parties to the Convention on Biological Diversity, the Sendai Framework for Disaster Risk Reduction 2015–2030, and the Convention on Migratory Species of Wild Animals, as well as Land Degradation Neutrality targets under the UN Convention to Combat Desertification, among others.[244]

> ***"Peatland conservation, restoration, and sustainable management can offer a triple win for the climate, people, and the planet."***

Global Peatlands Assessment (2022)[245]

Solutions in peatlands, and in freshwater wetlands more broadly, are also relevant to the achievement of a number of SDGs, including SDG 6, Target 6.6 on protecting and restoring water-related ecosystems and SDG 15, Target 15.1, on conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, as well as 15.5 on reducing degradation of natural habitats. These SDGs, in turn, can support the delivery of freshwater ecosystem services to support SDG 2 on food security and SDG 13 on climate resilience.[246]

> ***"The benefits of wetland conservation and restoration cut across these different frameworks and can help countries achieve multiple targets with a holistic solution."***

Anisha et al. (2020)[247]

Orangutan, Tanjung Puting National Park in Kalimantan, Borneo © EJF

> **Despite covering just 6% of the Earth's surface, wetlands provide critical habitat and breeding grounds for around 40% of all plant and animal life.**

Addressing the twin climate and biodiversity crises

Despite covering just 6% of the Earth's surface,[248] wetlands provide critical habitat and breeding grounds for around 40% of all plant and animal life.[249] Freshwater wetlands are biodiversity havens, hosting an abundance of species and offering vital breeding, stopover and wintering sites for migratory birds.[250] The Pantanal – the world's largest tropical wetland – is host to an estimated 174 species of mammal, including the highest density of jaguars in the world (see **Box 4**). Across the globe, peatlands are home to an array of endangered and endemic species, from the orangutans of the tropical peatlands of Southeast Asia, to the Western Lowland Gorillas of the *Cuvette Centrale* peatlands of the DRC and Republic of the Congo (see **Box 6**).[251] The tropical peat swamp forests of Southeast Asia are biodiversity hotspots, estimated to support up to a third of all species of mammals and birds in Peninsular Malaysia and Borneo.[252]

The conservation significance of all types of wetland is recognised under the Ramsar Convention, one of the oldest multilateral environmental agreements, dating from 1971. More than 2,500 Ramsar Sites – Wetlands of International Importance – have been designated under the Convention, spanning over 2.5 million square kilometres.[253] However, around 89% of freshwater wetlands remain unprotected, while even wetlands within protected areas may be subject to high human influence.[254]

Globally, freshwater ecosystems are under intense pressure. According to the Living Planet Index, freshwater species populations have suffered the heaviest declines, falling by 85% since 1970, compared to 69% for terrestrial and 56% for marine.[255] Around a quarter of the world's freshwater wetland-dependent species are now listed as threatened, of which 6% are critically endangered.[256]

The dramatic loss of biodiversity across freshwater wetland sites is a major threat to the climate mitigation potential of these ecosystems. Research has shown that biodiversity and climate mitigation are mutually reinforcing, with biodiverse wetlands associated with higher rates of carbon sequestration and a greater capacity to store carbon.[257] High biodiversity also contributes to greater ecosystem resilience, which can increase the resilience of carbon stocks to disturbance.[258] Conversely, biodiversity loss across all ecosystems has been found to reduce their capacity to store carbon and increase carbon emissions (**Box 9**).

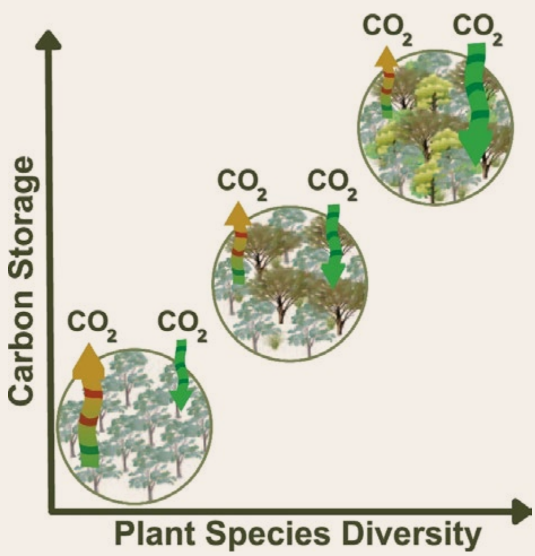
Efforts to conserve and restore freshwater wetlands can address, simultaneously, both biodiversity loss and the climate crisis, in a manner that meets objectives under both the Kunming-Montreal Global Biodiversity Framework and the Paris Agreement. The cross-cutting benefits of peatlands for climate mitigation/adaptation, and for conserving biodiversity, is recognised in resolutions of the UN Environment Assembly,[259] the International Union for the Conservation of Nature,[260] the Convention on Biological Diversity[261] and the Ramsar Convention on Wetlands.[262] Measures to conserve and restore freshwater wetlands are not only relevant to Targets 2 and 3 of the Kunming-Montreal Global Biodiversity Framework concerning the restoration and conservation of freshwater ecosystems, but also Target 8, on the link between biodiversity and climate. The focus of Target 8 is on minimising the impact of climate change on biodiversity, the contribution of biodiversity to climate mitigation and adaptation, and fostering positive impacts of climate action on biodiversity.[263]

Box 9: Implications of biodiversity loss for global carbon storage

There is increasing understanding of the link between biodiversity and an ecosystem's potential to sequester and store carbon. A recent paper published in *Nature Communications* found that increased biodiversity loss was linked to reduced global carbon storage potential and increased carbon emissions.[264] The paper estimated that biodiversity declines from climate and land use change could lead to a global loss of 7.44–103.14 billion tonnes of carbon under a global sustainability scenario, and 10.87–145.95 billion tonnes of carbon under a fossil-fuelled development scenario. Concerningly, climate change is itself a driver of biodiversity loss, which in turn leads to even greater carbon emissions and fuels more climate change in a positive feedback loop.

The findings highlight the importance of biodiversity conservation and restoration in climate change mitigation and the need to account for biodiversity loss in emissions scenarios. According to the paper, biodiversity loss could potentially take up around 73.3% of the remaining carbon budget for limiting warming to 1.5°C and 33.1% of the carbon budget for limiting warming to 2°C, based on the high-end estimates under a global sustainability scenario (although uncertainties are significant). Increasing plant diversity, in addition to increasing the extent of natural ecosystems, such as through the expansion of protected areas, can therefore contribute to increasing carbon storage potential, while also helping to build ecosystem resilience to the impacts of climate change.

Figure 12: Relationship between plant diversity and carbon storage



Source: Weiskopf et al. (2024).[265] Conceptual graphic representing the role played by biodiversity in biological carbon sequestration. Biomass stock increases with increasing plant diversity, depicted as an increasing ratio between carbon sequestration (green arrows) and carbon emissions (yellow arrows).

Aerial view of the Pantanal at Serra do Amolar, Mato Grosso do Sul, Brazil © EJF

A Pantanal caiman on the banks of the São Lourenço River, Porto Jofre region, Pantanal © EJF

6. The way forward

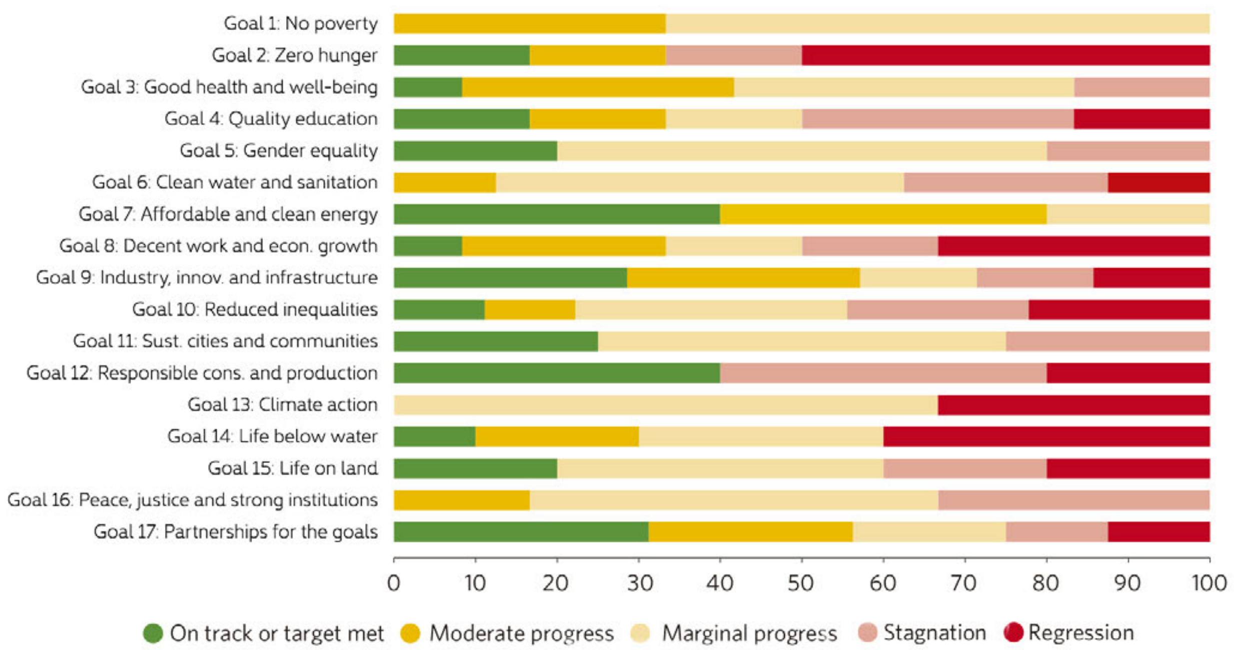
The global community is failing to meet the challenges of the climate crisis, risking dangerous levels of heating with perilous consequences for humankind and the natural world. At stake is a liveable, secure planet for future generations, and the survival of the diverse and incredible wildlife with which we share our precious home.

To date, countries have failed to bring adequate ambition to their emissions reduction pledges under the Paris Agreement. This lack of action is mirrored in other areas, from a failure to meet the Aichi Biodiversity Targets[266] to major setbacks on the SDGs (**Figure 13**).[267] Biodiversity declines continue to take place at an unprecedented rate while the pressures on nature are intensifying.[268] Progress on the SDGs has stalled and even regressed across multiple target areas, resulting in an additional 23 million people being pushed into extreme poverty and over 100 million more suffering from hunger in 2022 compared to 2019.[269]

> ***"Without massive investment and scaled up action, the achievement of the SDGs — the blueprint for a more resilient and prosperous world and the roadmap out of current global crises — will remain elusive."***

United Nations (2024)[270]

Figure 13: Progress assessment for the 17 SDGs based on assessed targets, by Goal (percentage)



Source: Adapted from United Nations (2024)[271]

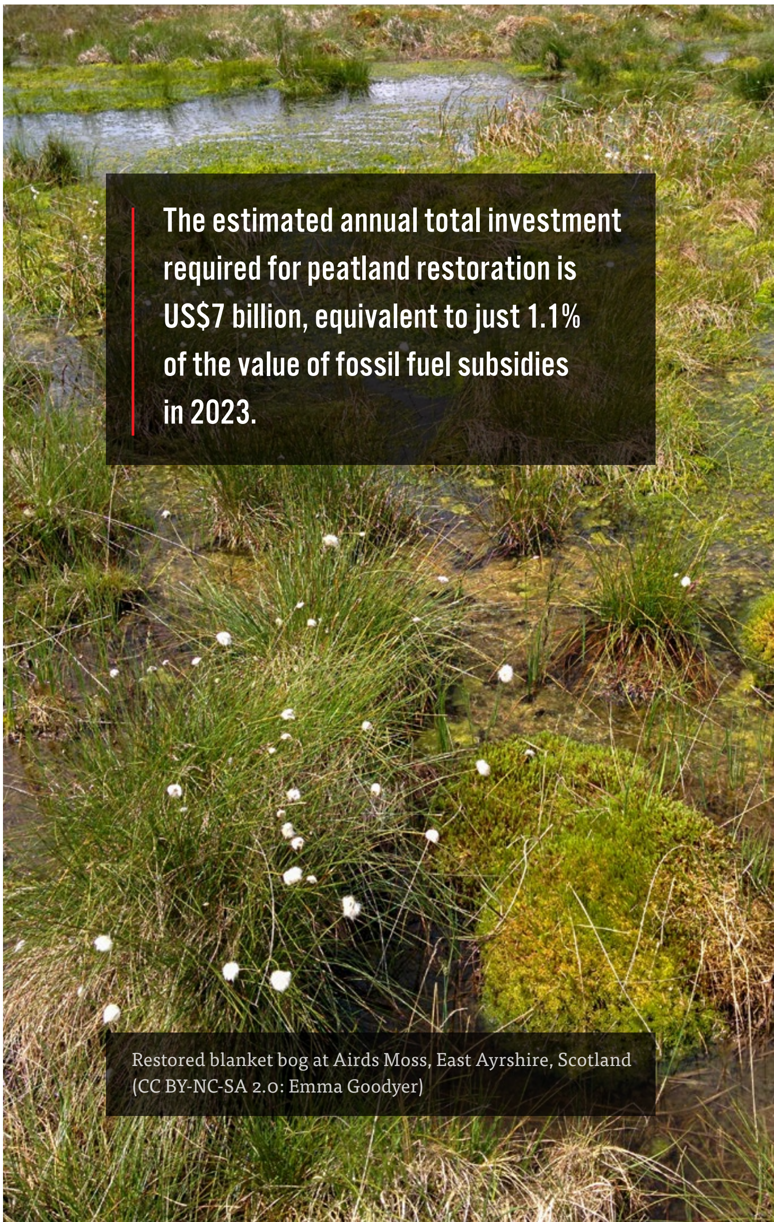
NbS offer a means of addressing these interconnected crises, with solutions generally ready to deploy, cost-effective and bringing multiple co-benefits. The protection and restoration of freshwater wetlands, such as peatlands, is one such example, offering a holistic solution that can be implemented with net benefits to society and with modest investment. Such measures have been termed a "low-hanging fruit" for achieving mitigation and adaptation ambitions,[272] which can be scaled up immediately and integrated into country NDCs.[273]

The third round of NDCs under the Paris Agreement are due for submission by UNFCCC Parties in 2025. In the second round of NDCs, wetlands received more attention compared to the first submissions in 2015, although the focus was largely on blue carbon ecosystems, especially mangroves (included in 62% of NDCs), as opposed to peatlands (included in 13% of NDCs) and overall levels of ambition remained low.[274] Few NDCs contained specific actions or targets with respect to wetlands,[275] or attempted to address the human drivers of degradation.[276]

Effective policy interventions and targeted finance as part of NDCs can drive the deployment of NbS which to date have fallen far short of their potential.[277] Between 2009 and 2019, land-based climate measures delivered total mitigation of just 8 billion tonnes of CO_2, equating to around 0.5% of total emissions during that 11-year period.[278] While barriers to NbS implementation are context-specific they frequently include a lack of financing and investment for the deployment and scaling up of mitigation.[279]

Finance needs to be mobilised at pace to leverage mitigation gains, considering the urgency of emissions reductions targets, and the need to lock immense quantities of carbon within ecosystems such as peatlands. According to UNEP's 2023 State of Finance for Nature report, finance flows to NbS are currently US$200 billion per year – the vast majority from public funds (82%) – representing just a third of the total needed to achieve climate, biodiversity and land degradation targets by 2030.[280] Despite this shortfall, there is a massive opportunity to redirect finance flows to ensure they align with climate and biodiversity targets.[281] Estimated funding required for NbS globally, for example, is currently lower than subsidies provided to agriculture and forestry.[282] The estimated annual total investment required for peatland restoration is US$7 billion,[283] equivalent to just 1.1% of the value of fossil fuel subsidies in 2023.[284]

Initiatives such as the UN Decade for Ecosystem Restoration (2021–2030)[285] and the Freshwater Challenge[286] can help to generate the political and private sector momentum to mobilise action on freshwater wetlands as a NbS. As of March 2025, 49 countries had joined the challenge, which aims to accelerate the restoration of 300,000 km² of degraded rivers and 350 million hectares of degraded wetlands by 2030, as well as conserve intact priority freshwater ecosystems.[287] The forthcoming UNFCCC COP 30, to be hosted by Brazil – the country with the largest area and volume of peatland, and home to the world's largest tropical wetland – presents a further opportunity to raise freshwater wetlands up the political agenda, on par with deforestation of the Amazonian rainforest (**Box 10**).



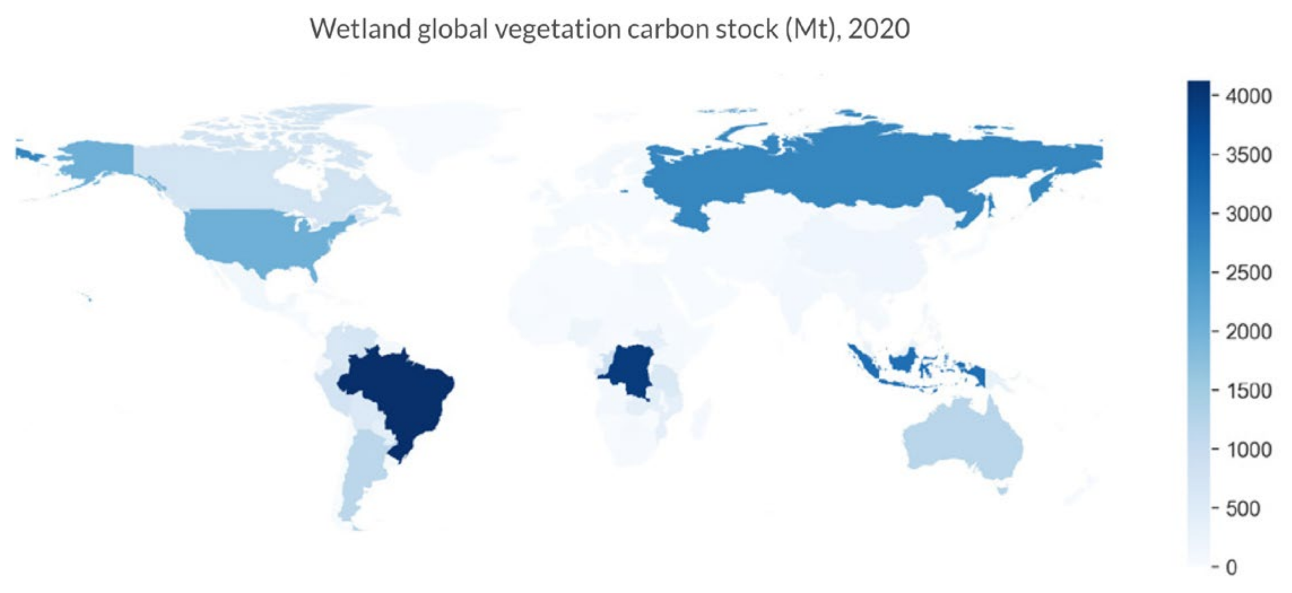
Restored blanket bog at Airds Moss, East Ayrshire, Scotland (CC BY-NC-SA 2.0: Emma Goodyer)

Aerial view of the Brazilian Pantanal in Mato Grosso, near the Transpantaneira © EJF

Box 10: Brazil – leading wetland nation and host to UNFCCC COP 30

Brazil's status as host country for UNFCCC COP 30 provides impetus for action to conserve the country's unique and vulnerable inland wetlands, and for wetland conservation globally. Brazil has been identified as one of the top five priority countries for wetland conservation,[288] and is host to some of the largest wetlands on the planet, including the emblematic Pantanal (**Box 4**). Globally, it contributes the highest proportion of wetland vegetation carbon stock (excluding soil carbon)[289] (**Figure 14**) and has been identified as the country with the highest total cost-effective mitigation potential from natural climate solutions (**Figure 8**) (see **Section 4**).[290]

Figure 14: Contribution to wetland global vegetation carbon stock in 2020



Source: World Bank (2024)[291]

Models suggest that the Pantanal, which covers just 1.8% of Brazil's land area, may be the most peatland-dense of Brazil's ecosystems.

Brazil is the tropical country with the largest peatland area, estimated at 26 million hectares, although significant areas remain unmapped to date.[292] The country's peatlands are major carbon stores, playing a crucial role in national and global carbon cycles. They store an estimated 39 billion tonnes of carbon, which if released would be equivalent to around 44 times the EU's total greenhouse gas emissions in 2023.[293] They also store water for the dry season and help to prevent wildfires, mitigating the local impacts of global heating.[294]

Peat soils in Brazil are often found in patches, forming a mosaic spanning the country's terrestrial ecosystems.[295] Around 75% of Brazil's peat soils are found in Brazilian Amazonia, with significant areas located in the Pantanal, Cerrado and Atlantic Forest (**Table 4**).[296] Models suggest that the Pantanal, which covers just 1.8% of Brazil's land area, may be the most peatland-dense of Brazil's ecosystems, with peat soils found across an estimated 12.3% of the biome, compared to 4.1% for Amazonia. This is a potentially significant finding, highlighting the disproportionately large climate mitigation benefit that could be derived through targeted investment and policies to conserve the Pantanal.

Table 4: Area of organic soils by Brazilian biomes in km² and as proportion of total biome areal extent

	Peat soils dominant (km²)	Peat soils in patches (km²)	Total (km²)	Total area of biome (km²)	Biome as % of Brazilian territory	% of biome with peat soils
Pantanal	183	18,375	18,558	150,355	1.8	12.3
Amazonia	212	170,930	171,142	4,196,943	49.3	4.1
Atlantic Forest	12,079	4,121	16,200	1,110,182	13.0	1.5
Pampa	1,033	1,253	2,286	176,496	2.1	1.3
Cerrado	3,696	14,140	17,836	2,036,448	23.9	0.9
Caatinga	35	0	35	844,453	9.9	0

Source: EJF calculations based on data from the Global Peatland Map 2.0 set out in Greifswald Mire Centre (GMC), Federal University of Vales do Jequitinhonha e Mucuri (UFVJM) & Instituto Nacional de Pesquisa do Pantanal (INPP) (2024) *Peatlands in Brazil – the most carbon dense ecosystem under threat.* Briefing paper. 6 p.[297] Areal extent of biomes from IBGE/MMA, Map of Biomes of Brazil - First Approximation, (2004): https://brasilemsintese.ibge.gov.br/territorio.html It is noted that figures for peatland areas in Brazil are almost entirely based on modelling, with limited ground data available. The numbers in this table are therefore estimates.[298]

Yet, in spite of their importance, peatlands remain virtually unrecognised and unprotected under Brazilian law.[299] The country's Native Vegetation Protection (LPVN) Law[300] provides only limited protections for wetland ecosystems, and omits several types of wetland from its definitions, including areas that are permanently saturated with water such as peatlands.[301] Freshwater wetlands are subject to intense pressure in Brazil, particularly from industrial agriculture including cattle grazing, corn and soy production, water extraction, and deforestation (see **Box 4**).[302] Currently Brazil does not monitor or report emissions from land use on organic/peat soils to UNFCCC, representing a major gap in accounting of emissions from peatland drainage, agriculture and urban development, which are likely to be significant.[303]

COP 30 can mark a turning point in the fate of Brazil's wetlands, an opportunity to harness their might in the pursuit of climate imperatives, with benefits for biodiversity and local people. The Federal Government is advised to seize this opportunity and to demonstrate leadership at COP 30 by committing to:

(1) Ensure that actions, targets and means of financing for wetland protection and restoration are included in the sectoral plans currently under development as part of the National Adaptation Strategy[304] and National Mitigation Strategy[305] within the framework of Brazil's Climate Plan to achieve its NDC commitments.

(2) Adopt and implement more effective and coherent protections for wetland ecosystems, such as the Pantanal, designating areas where activities that result in the permanent loss of native vegetation, and its associated carbon storage and biodiversity impacts, are prohibited.

(3) Recognise and strengthen the role of Indigenous peoples and local communities as custodians of the Pantanal, ensuring that protected areas are designed and implemented with the active participation of Indigenous peoples and local communities that live or depend on them.

(4) Put a stop on plans to extend the Hidrovia waterway project to the Northern Section of the Paraguay River that flows into the Pantanal, and to dredging and rock-blasting in existing downstream sections, which would definitively drain the Pantanal and destroy its wetlands, biocultural diversity, hydrological buffering and carbon storage.

(5) Halt the construction of dams on the tributaries of the Cuiabá and Paraguay rivers.

(6) Enact measures to regulate land use at the catchment level to support the hydrological functioning of wetlands and ensure sufficient groundwater recharge to maintain water supply.

(7) Revise the definition of wetlands in federal and state environmental laws to properly include and protect all wetland types, with explicit recognition of peatlands as a distinct type of wetland due to their critical role in carbon storage and water regulation.

(8) Protect carbon stocks by halting the conversion and drainage of peatlands including through the designation of new Ramsar Sites and the reinforcement of Brazilian law such as the Forest Code to improve protections for Permanent Protected Areas (PPAs).

(9) Monitor and report on emissions from land use on organic/peat soils to UNFCCC.

"The diagnosis is that we could lose the Pantanal by the end of the century. [...] [E]ach year we lose vegetation cover, whether due to deforestation or fires, you harm the entire basin and so, according to [scientists], by the end of the century, we could lose the largest floodplain on the planet."

Marina Silva, Minister of Environment and Climate Change[306]

"There is no more time to waste. [...] Anyone who goes to the Pantanal during the fire season wants to cry. Either we really act on the cause, for real, in a pact, producers, ranchers, state governments with the federal government and return to having this biome restored in the most original way possible or we will lose the Brazilian Pantanal."

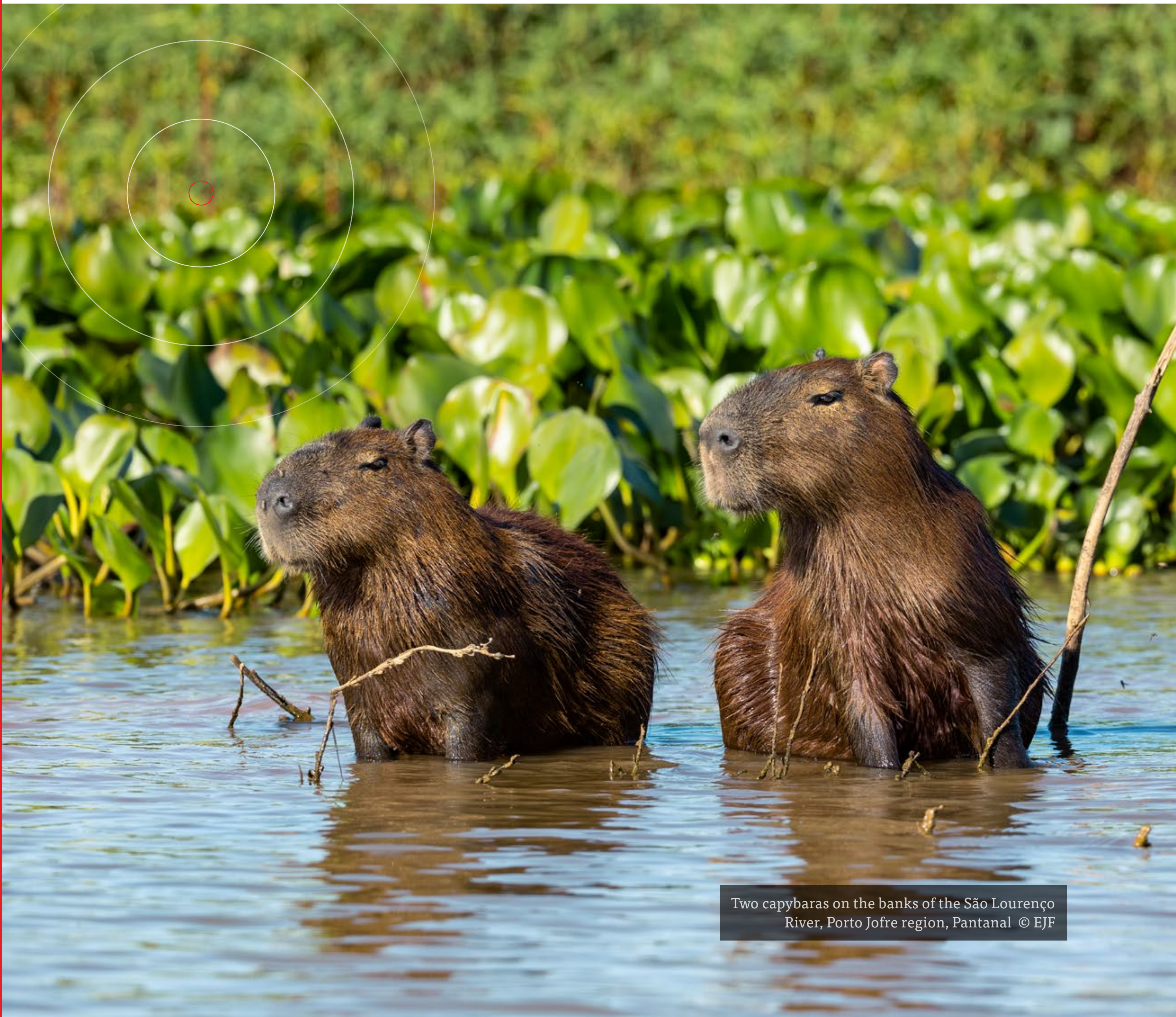
Carlos Fávaro, Minister of Agriculture and Livestock[307]

7. Recommendations

This briefing has highlighted the immense carbon storage value of freshwater wetlands and the significant co-benefits for people and biodiversity if they are protected and restored. Measures can be implemented immediately, at modest financial and political cost, and with potentially huge gains for the mitigation of greenhouse gas emissions and adaptation to the worst effects of the climate crisis.

Failure to take urgent action to halt the loss and degradation of carbon-rich peatlands, in particular, risks the release of vast quantities of carbon that have been stored in these ecosystems for millennia. These carbon bombs are poised to derail the goals of the Paris Agreement and must be prioritised for conservation and restoration.

The next few years represent a critical window for action to avert dangerous levels of global heating and the collapse of life-sustaining ecological systems. Working with nature, and harnessing the power of nature-based solutions, offers a powerful ally in this endeavour. However, political ambition and investment must be mobilised urgently behind these solutions, and at a scale commensurate with the climate and ecological emergencies we face.



Two capybaras on the banks of the São Lourenço River, Porto Jofre region, Pantanal © EJF

EJF calls on governments around the world to pledge to protect and restore freshwater wetlands, in line with the SDG targets and international agreements, and to acknowledge their critical role in averting the worst effects of the climate crisis. More specifically, based on the findings set out in this briefing, it is recommended that governments:

1. Take urgent action to protect the carbon stored in freshwater wetlands by halting their conversion and drainage. Strictly protect intact peatlands which have not been drained or disturbed for carbon sequestration, carbon storage and biodiversity conservation.

2. Expand the network of protected areas, including Wetlands of International Importance (Ramsar Sites), to increase coverage of freshwater wetlands, including peatlands, ensuring protections are supported by robust legislation with consequences for non-compliance, and that sufficient resources are allocated to ensure their effective implementation. Prioritise areas for protection that provide opportunities for climate mitigation and adaptation, and co-benefits for wildlife and people, and ensure the design and implementation of protected areas is carried out with the active participation of Indigenous peoples and local communities that live in or depend on them.

3. Recognise and strengthen the role of Indigenous peoples and local communities as custodians of wetlands, through recognition of customary law and traditional rights, proper representation of these groups in management structures at all levels, ensuring their continuous enjoyment of wetland benefits, and fully integrating traditional knowledge, resource use practices and cultural values into wetland protection and sustainable use.

4. Prioritise the maintenance of ecological and hydrological functioning and connectivity in the protection of freshwater wetlands, including through the monitoring and regulation of activities at the catchment level, enactment of legislation to guard against activities that negatively impact wetland hydrology, and adoption of integrated river basin management plans.

5. Scale up targeted finance for the conservation and restoration of freshwater wetlands, including through the development of economic incentives that match economic returns from competing land uses and the gradual redirection of agricultural and forestry subsidies.

6. Integrate targets for freshwater wetland/peatland protection and large-scale restoration in NDCs under the Paris Agreement, as well as in National Biodiversity Strategies and Action Plans (NBSAPs), National Adaptation Plans (NAPs), National Adaptation Programmes of Action (NAPAs), Strategic National Action Plans (SNAPs) for Disaster Risk Reduction, Land Degradation Neutrality (LDN) targets, National Ramsar Strategy and Action Plans and National Implementation Plans for the SDGs. Link these to national investment plans to generate the funding necessary for implementation.

7. Leverage the opportunity presented by the UN Decade on Ecosystem Restoration to rapidly scale up restoration efforts focused on freshwater wetlands, and particularly for peatland rewetting and restoration.

8. Continue to refine emissions factors and facilitate knowledge exchange to improve greenhouse gas inventories and accounting to more accurately understand the impacts of wetland drainage, burning and conversion on greenhouse gas emissions. Include emissions from organic soils and emissions from peatland rewetting and restoration in national greenhouse gas inventories.

9. Support further research into the extent, peat depth, carbon stores, biodiversity and importance of peatlands to local communities, societies and economies, for example, in tropical countries where field data on peatlands is lacking at present, such as Brazil.

10. Ensure that the protection and carbon storage/biodiversity value of freshwater wetlands is integrated into land use and sectoral policies, including agriculture, forestry, transport infrastructure, energy, and spatial planning, and promoted through appropriate incentives.

A female jaguar in the vegetation, Miranda region of the Pantanal in Mato Grosso do Sul © EJF

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