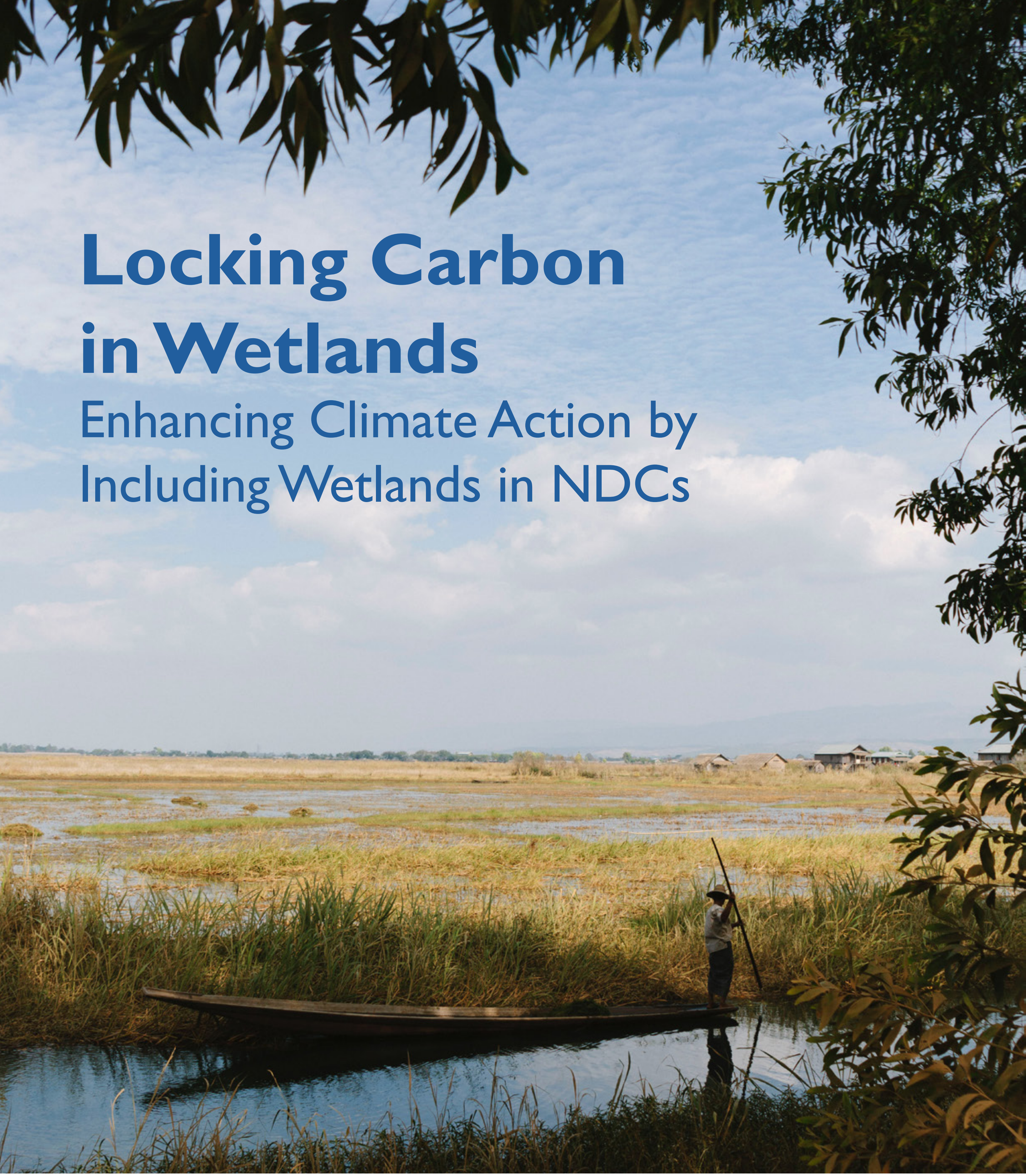

Locking Carbon in Wetlands

Enhancing Climate Action by Including Wetlands in NDCs

AGWA

Wetlands INTERNATIONAL

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Foreword

Norbert Barthle

Parliamentary State Secretary to the Federal Minister for Economic Cooperation and Development of the Federal Republic of Germany and the Federal Chancellor's Representative for the German-Greek Assembly

Climate action is one of the decisive issues determining humankind's future. Yet so far the response that has been mounted to the challenges of climate change has fallen short of requirements. Only by drastically cutting back on the amount of greenhouse gas emitted into the atmosphere and achieving greenhouse gas neutrality at a global level by the middle of the century can we limit global warming to significantly below 2.0°C, and ideally 1.5°C, as resolved in the Paris Agreement. We all — globally, nationally, locally — have a duty to take action on the targets of the Paris Agreement.

Healthy and intact wetlands are vital ecosystems. They play a crucial role in preserving biodiverse natural habitats. Wetlands are also the unsung heroes when it comes to climate change mitigation and adaptation. They help to minimise the negative impacts of climate change and boost climate resilience by protecting against flooding, landslides and drought. Beyond mitigating climate change, wetlands also deliver a whole range of ecosystem co-benefits. Healthy wetlands can not only be used for food production, they also regulate water supply and keep the air clean. And they are vital for preserving biodiversity, providing a home for a wide range of flora and fauna. In this way, they make a major contribution to preserving the basis for human life, because an intact environment is crucial to human health, too.

Peatlands are a specific type of wetland that play a particularly pivotal role in mitigating climate change. Although they make up only 3% of the planet's land surface, they absorb twice as much CO_2 as all the world's forests put together. Yet, despite their relevance for the global climate, wetlands are being destroyed faster than any other ecosystem. That is one of several reasons why this report comes at an important time. Many countries are currently in the process of updating their Nationally Determined Contributions under the Paris Agreement and their National Biodiversity Strategy and Action Plans under the Convention on Biological Diversity (CBD). And in 2021, the Conference of the Parties to the CBD is due to adopt a new global biodiversity framework, setting out the goals for the next decade and marking a turning point in efforts to preserve species. This process of updating strategic documents and negotiating ambitious goals offers us a unique chance to integrate the preservation and restoration of wetlands as a key plank of efforts both to mitigate climate change and to conserve biodiversity.

Germany is taking on board the major challenges of protecting our climate, conserving biological diversity and achieving the Sustainable Development Goals. That is why the German government is fully supportive of ambitious targets and effective implementation of the Paris Agreement, the Convention on Biological Diversity and the 2030 Agenda for Sustainable Development.

Foreword

Carola van Rijnsoever

Ministry of Foreign Affairs of the Netherlands, Director of Inclusive Green Growth and Ambassador of Sustainable Development

On behalf of the Netherlands, Co-Chair, NDC Partnership

As climate change communities look to COP26 and the 2020 deadline for submitting updated Nationally Determined Contributions (NDCs), this report presents a timely reminder of the importance and value of integrating ecosystems, and specifically wetlands, into our climate change and biodiversity conservation goals. Reports like this are essential to providing clear and concrete examples of how wetland conservation and restoration can be integrated into NDCs and used as an instrument to enhance climate ambition. This report reminds us that the way we collectively use, manage, and govern wetlands has a significant impact on national carbon budgets, the well-being and health of ecosystems, and the ability to communities to adapt to climate change.

The grave reality is that wetlands are facing the most rapid decline of all ecosystems. If we hope to meet the goals of the Paris Agreement, global climate change communities need to take a holistic approach to implementing effective and efficient policies and measures to mitigate emissions and adapt to our changing climate. Our solutions need to integrate ecosystem-based approaches and capitalise on the benefits that nature can provide. By protecting and restoring wetlands, we are safeguarding crucial carbon sinks which can support countries in reaching mitigation targets, we are protecting vulnerable communities from floods, we are improving water quality and habitats for local species, and we are providing economic benefits to societies. Wetlands are a cross-cutting tool for achieving NDCs and are an essential foundation for local economies. Through these nature-based solutions, there is ground for hope in meeting the goals of the Paris Agreement and in achieving the UN Sustainable Development Goals.

The NDC Partnership, the largest coalition of countries and organisations committed to the ambitious implementation of NDCs, harnesses the strength and knowledge of its membership to support countries in implementing their NDCs. Of the 169 countries worldwide that have wetlands, half of them are members of the NDC Partnership. This report will be an invaluable tool in supporting countries to develop revised and enhanced NDCs that benefit economies, ecosystems, communities and biodiversity.

The NDC Partnership is committed to supporting countries in taking ambitious action on climate change. This report reminds us that there are smart solutions for those that want to embrace them. Let’s see more of these adopted as we ramp up our ambition in 2020.

Foreword

Martha Rojas Urrego

Secretary General, Ramsar Convention on Wetlands

Wetlands are prize land and not wastelands. Valuing wetlands has never been more urgent and this begins by widespread awareness and recognition of their pivotal role to the health and sustainability of our planet. Without wetlands, our collective ambition to reach our climate change target hangs heavily in the balance.

Climate action failure coupled with global biodiversity decline, are without doubt among the top threats facing our world today and our ability to survive into the future. Wetlands are a crucial ally to address these threats.

Wetlands include rivers, lakes, swamps as well as marshes, mangroves, coral reefs and peatlands. Peatlands are particularly effective carbon stores and therefore pivotal to tackling a climate emergency that is at the same time fuelling biodiversity decline.

Yet, the world has lost 35% of its wetlands since 1970 and degradation continues.

Locking Carbon in Wetlands: Enhancing Climate Action by Including Wetlands in NDCs provides evidence to help us understand the central role of wetlands for climate action. It includes examples and recommendations that demonstrate how through good governance and management, we can value wetlands.

It is time for the true value of wetlands to become mainstream and their protection, conservation and restoration to become a local, national and global priority.

Locking Carbon in Wetlands: Enhancing Climate Action by Including Wetlands in NDCs

Executive Summary

The purpose of this report is to demonstrate the value of wetlands as a way to achieve climate mitigation targets, while simultaneously unlocking co-benefits, with biodiversity conservation being chief among them. *Locking Carbon in Wetlands: Enhancing Climate Action by Including Wetlands in NDCs* is written for policymakers and national climate planners with three goals in mind: 1) to illustrate the scientific rationale behind the use of wetlands as a climate mitigation tool; 2) to demonstrate the prevalence and function of wetlands across landscapes and geographies; and 3) to provide a set of clear policy recommendations that will enable Parties to the UNFCCC to conserve, restore and wisely use wetlands by incorporating them into their climate mitigation plans.

The following key messages are reinforced throughout the report, its case studies and policy recommendations:

- Wetland conservation, restoration and wise use are effective climate change mitigation strategies and should be an integral part of Nationally Determined Contributions (NDCs).
- The aforementioned actions are practical, measurable and transparent enough to be included as NDC indicators and reported in the mitigation section of countries' mitigation plans.
- Climate-smart wetland management will yield significant co-benefits, with positive impacts on biodiversity, human livelihoods, climate adaptation, and disaster risk reduction (DRR).

1. A Global Agenda for Climate Mitigation and Adaptation

1. 1. Achieving the Goals of the Paris Agreement

The Paris Climate Agreement established a goal of keeping global average temperature increase substantially less than 2°C above the pre-industrial value, and making every attempt to keep it below 1.5°C. The NDCs of countries are designed to help meet these ambitious targets, while simultaneously improving society's capacity to adapt to climate change impacts and facilitating the finance needed to support these actions. As it currently stands, however, countries' existing pledges need to be tripled to meet this ambition. And, holding global warming below 1.5°C would require those existing commitments to be increased fivefold (United Nations Environment Programme [UNEP], 2018).

The urgency in addressing climate change is greater than ever. Even as the issue gains more attention, risks — from which society would not be able to adapt to or recover from — are being downplayed in the assessments of the economic impacts of climate change (DeFries et al., 2019). These risks include frequent and intense floods and droughts, fires, subsidence and loss of productive land, disruptions to oceanic and atmospheric circulation, destruction of biodiversity and collapse of ecosystems — and carry grave consequences for human populations and wildlife. The rapid spread and impact of the COVID-19 pandemic serves as a reminder that we must continue ambitious climate action to prevent risk multiplication. Greater attention is needed to address the biggest risks to lives and livelihoods.

To make well-informed decisions, leaders need to clearly understand climate-related risks and be well-versed in the strategies that can mitigate them. Reductions of greenhouse gas (GHG) emissions in the industrial sector alone cannot meet the scale of the challenge. GHG reductions from the land-use sector will be essential as part of a suite of successful climate actions. Putting nature-based solutions, which can incorporate ecosystem-based approaches, as central to NDCs is therefore crucial. **Nature-based solutions, such as wetland protection and restoration, can provide an important means through which Parties can meet both climate mitigation and adaptation goals, while simultaneously providing a multitude of co-benefits for ecosystems, economies and societies** (IPCC, 2014; Seddon et al., 2019; Finlayson et al., 2019).

The ecosystem services provided by natural wetlands make up 43.5% of the monetary value of all natural biomes (Davidson et al., 2019). Wetlands not only supply critical habitat for vegetation, birds and aquatic species — they are also important as floodplains and for tourism, recreation and cultural purposes (Lavorel et al., 2015). Their climate adaptation benefits are numerous, from flood mitigation and prevention of erosion resulting from extreme rainfall events, to salinity control, biodiversity conservation and more.

The role of wetlands in buffering the effects of climate change and hence supporting climate adaptation, DRR and resiliency — and many associated ecosystem services — has been widely recognised (Ramsar Convention on Wetlands, 2018a) and action is building. However, wetlands' role within the carbon cycle and their broader climate mitigation potential have been largely overlooked.

While wetlands hold some of the largest stores of carbon on the planet, when disturbed or drained, they release the three major heat-trapping GHGs: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O; mainly from ditches) (Moomaw et al., 2018). The ecological condition and functionality of wetlands is influencing the trajectory of global climate change; therefore, wetland management needs to play a more prominent role in climate action. Examples of climate-smart management and restoration and support on these approaches are contained in Section 4 of this report.

Box 1: Looking Beyond 'Blue Carbon'

Wetlands of all types offer vast potential for climate adaptation and mitigation. Numerous articles and initiatives can provide additional information on the concept of 'blue carbon' — a term generally used to represent the adaptation and mitigation value of carbon-rich coastal wetlands such as mangrove forests, tidal salt marshes and seagrass meadows (The Nature Conservancy et al., 2018). Since ample guidance is available on the role of blue carbon in NDCs, this report will emphasise the role of inland wetland systems in climate mitigation strategies.

1.2. An Opportunity to Address Biodiversity and GHG Emissions Targets Simultaneously

Biodiversity and climate are strongly interconnected. On the one hand, biodiversity is negatively affected by climate change — hampering the functioning of critical ecosystems and affecting livelihoods. The loss of biodiversity and the degradation of ecosystems significantly reduces their resilience and undermines their capacity for carbon storage and sequestration, potentially leading to increases in emissions of GHGs. On the other hand, biodiverse and healthy, resilient ecosystems play a key role in strengthening the global response to climate change, while delivering multiple benefits. Achievement of the 20 Aichi Biodiversity Targets, the Sustainable Development Goals (SDGs) and the climate commitments under the Paris Agreement are thus strongly entwined. Better protection, management and restoration of natural and managed ecosystems such as wetlands can significantly contribute to mitigating human-induced climate change.

As many of the direct (e.g., changes in land and sea use) and most of the indirect (e.g., food consumption, energy production, use of resources) drivers of biodiversity loss and climate change are the same, efforts should be geared to addressing these common drivers for a holistic response to both challenges. How carbon stocks are managed can play a significant role in strategies not only to mitigate and adapt to climate change, but also in reversing biodiversity loss and ecosystem and land degradation.

The Ramsar Convention on Wetlands (2018b) states, '*Peatland restoration can contribute to the fulfilment of multiple obligations or commitments under different multilateral environmental agreements (MEAs), including, as appropriate, on climate-change mitigation and adaptation, disaster risk reduction, biodiversity conservation, better water regulation, mitigation of water runoff, and support to the Sustainable Development Goals and that, accordingly, it could be promoted as a cost-effective tool with cross-cutting benefits…*'

Understood in the context of global agreements on biodiversity, land degradation and climate, this information shows that wetlands have relevance for not only the targets set out in the Paris Agreement, but also those of the Land Degradation Neutrality Programme set by the United Nations Convention to Combat Desertification (UNCCD) and the post-2020 biodiversity framework led by the Convention on Biological Diversity (CBD). **Wetlands are the synergy between these global frameworks and can help countries achieve multiple targets with a holistic solution.**

2. Integrating Wetlands in NDC Commitments

2.1. A Time for Action: Wetlands and NDCs

Ecosystem-based approaches — strategies that integrate land, water and resources management to promote conservation and sustainable and equitable use — on their own can deliver at least a third of the cost-effective CO_2-equivalent emission mitigation needed through 2030 to meet the goals of the Paris Agreement (Griscom et al., 2017). The IPCC outlines conservation of high-carbon ecosystems such as wetlands, including peatlands and mangroves, as mitigation response options with high impacts (IPCC, 2019). So how — and when — can countries best incorporate these ecosystem-based mitigation (EbM) approaches into tangible climate actions?

Under the UNFCCC, Parties to the Paris Agreement are currently taking stock of how close they are to achieving the implications of the agreement: peaking global emissions as soon as possible and achieving net zero emissions in the second half of the century. This stocktaking effort is designed to inform and enhance national mitigation and adaptation commitments made under the next round of NDCs due in late 2020.

From 2020, when implementation of the Paris Agreement begins, and every five years on, Parties will be requested to resubmit their NDCs with revised and more ambitious targets — a process known as the 'ratchet mechanism' (Yeo, 2016); however, countries can also improve their NDCs within these five-year periods. At the time of writing, 33 countries have stated their intention to *update* their NDC by 2020 (including the European Union), 105 countries have stated their intention to *enhance ambition or action* of their NDC by 2020, and 10 countries have already submitted their *full* 2020 NDC (Climate Watch, 2020). **Now is an opportune moment for countries to strengthen their NDCs by considering wetlands as the low-hanging fruit for achieving mitigation and adaptation ambitions.**

2.2. Land Use as a Challenge and Opportunity

The Agriculture, Forestry and Other Land Use (AFOLU) sector, to which wetlands belong, contributes 20–24% of the global GHG emissions, primarily resulting from deforestation and the agricultural emissions from livestock, soil and nutrient management (Smith et al., 2014). It constitutes the second largest emissions by sector after energy. Wetland management falls under different headings depending on the country in question (see Section 3.2). Many include wetlands targets under their AFOLU sector, while others classify wetland activities and emissions under the Land Use, Land-Use Change and Forestry (LULUCF) sector. Although many countries mention AFOLU or LULUCF in their NDCs, few have set quantitative targets for emission reductions through wetland restoration (UNFCCC, 2019; Richards, et al., 2016).

Both terms appear in countries' NDCs. Under IPCC guidelines, CH_4, N_2O and some CO_2 emissions from land use are formally reported under the Agriculture category and thus fall under the AFOLU sector rather than LULUCF. As a result, AFOLU is used for a wider range of land-use emissions compared to LULUCF. **Regardless of where emissions are reported, the need to set clear and quantitative emissions reductions targets remains of utmost importance.**

The overall lack of quantitative emissions reduction targets is perhaps due in part to the complexity of accounting and taking inventory of the precise GHG sequestration and emissions levels within the LULUCF and AFOLU sectors, making it difficult to ensure solutions greatly reduce emissions and even create net carbon 'sinks'. Monitoring and inventory development require time and resources, yet they are vital to achieving mitigation reduction programs (see Section 3.5). Setting a baseline for LULUCF and AFOLU emissions (including those derived from wetlands) demonstrates that emissions reductions have been made. Improvements in the use of spatial data will help increase the accuracy of emissions reductions measurements. Countries should use the IPCC guidelines on GHG inventories for wetlands, which help identify the correct emission factor needed to calculate baseline emissions (IPCC, 2014).

As indicated above, further advances are still underway for the science of Measurement, Reporting and Verification (MRV) on wetland-related carbon accounting (such as FAO, 2020); however, there is sufficient support and guidance (see Section 3.5) for countries to immediately begin incorporating wetlands into their portfolio of climate action. A number of countries across the globe are already utilising proper wetland management within their climate strategies (see Section 4.2). For others only beginning to consider wetlands as a tool in addressing climate change, they can learn, improve and optimise their knowledge in line with the raising of ambition of their NDCs.

2.3. Wetlands Emerging in NDCs

In spite of their large potential for carbon mitigation, wetlands have not featured prominently within early climate commitments following the Paris Agreement. A preliminary analysis of INDCs and NDCs conducted in late 2019 suggests that 27 Parties were already including considerations of wetlands, swamps or peatlands as part of adaptation or mitigation activities within their LULUCF, water or ecosystem-related commitments. Among these references, 12 mention wetlands in the context of climate change mitigation — either as the use of wetlands as carbon sinks or in relation to inclusion in their GHG inventories. Two main takeaways can be drawn from the early analysis: 1) wetlands are not yet widely incorporated into climate mitigation strategies (at least not visibly); and 2) when they are, the context varies greatly. Table 1 provides examples of specific references to wetlands within the first round of NDCs as of December 2019.

Table 1: Selected references to wetlands for mitigation or adaptation in NDCs. Source: UNFCCC, 2019.

Country	Wetlands Reference
Antigua and Barbuda	By 2030, all remaining wetlands and watershed areas with carbon sequestration potential are protected as carbon sinks
Belarus	Republic of Belarus in 2015–2030 will ensure the environmental rehabilitation of at least 10,000 ha. of damaged bogs, thus increasing the area of restored peatlands to at least 60,000 ha. by 2030
Canada	Protecting and enhancing carbon sinks including in forests, wetlands and agricultural lands
China	To strengthen the protection and restoration of wetlands and to increase carbon storage capacity of wetlands
Malaysia	The inclusion of non-forest land (cropland, grassland, wetlands and settlement) will be determined (for GHG inventory) later
Pakistan	The wetlands in Pakistan have also been recognised as promising areas for carbon sequestration
Eswatini	Strategically plan and manage the ecological infrastructure, which includes healthy grasslands, rivers, wetlands, woodlands and natural forests
Switzerland	Base year emissions from non-forest land (cropland, grassland, wetlands, settlements, other land) will be included, as necessary, after completion of a current study on these emissions
Uganda	The estimation of the Greenhouse Gas reduction in the wetlands sector is based on international benchmarks: the annual mitigation impact could be between 0.8 $MtCO_2e$, and net zero
United Arab Emirates	The UAE has developed and implemented a number of strategies and plans, which aim to improve understanding of wetlands, including coastal carbon systems, and will also assist in minimising anthropogenic impacts
Uruguay	Through activities that promote the conservation and rational use of wetlands within the implementation of the Ramsar Convention [on Wetlands], Uruguay will maintain at least 50% of the peatlands area without additional means of implementation

3. Understanding the Role of Wetlands in Climate Change Strategies

3.1. The Status of Wetlands: Mounting Losses and Threats

Wetlands are the most rapidly declining ecosystems in the world (UNESCO & UN-Water, 2020). More than 85% of global wetlands present in the year 1700 had been lost by 2000 and continue to disappear at a rate three times faster than forest loss (UNESCO & UN-Water, 2020; Ramsar Convention on Wetlands, 2018b). As the demand for water, land and food increases and climate change intensifies, wetland systems are coming under acute pressure, even from low emission energy development measures such as hydropower.

Between 1970 and 2015, natural inland and coastal wetlands both declined by approximately 35% (Ramsar Convention on Wetlands, 2018a). In that same time period, these declines have affected 81% of inland wetland species populations and 36% of coastal and marine species (Ramsar Convention on Wetlands, 2018a). Meanwhile, human-made wetlands for water storage, agriculture, wastewater treatment and other purposes almost doubled over this period. These human-made wetlands — mostly rice paddies and reservoirs — now account for 12% of all wetlands, though compensate little for the loss of natural systems (Ramsar Convention on Wetlands, 2018a).

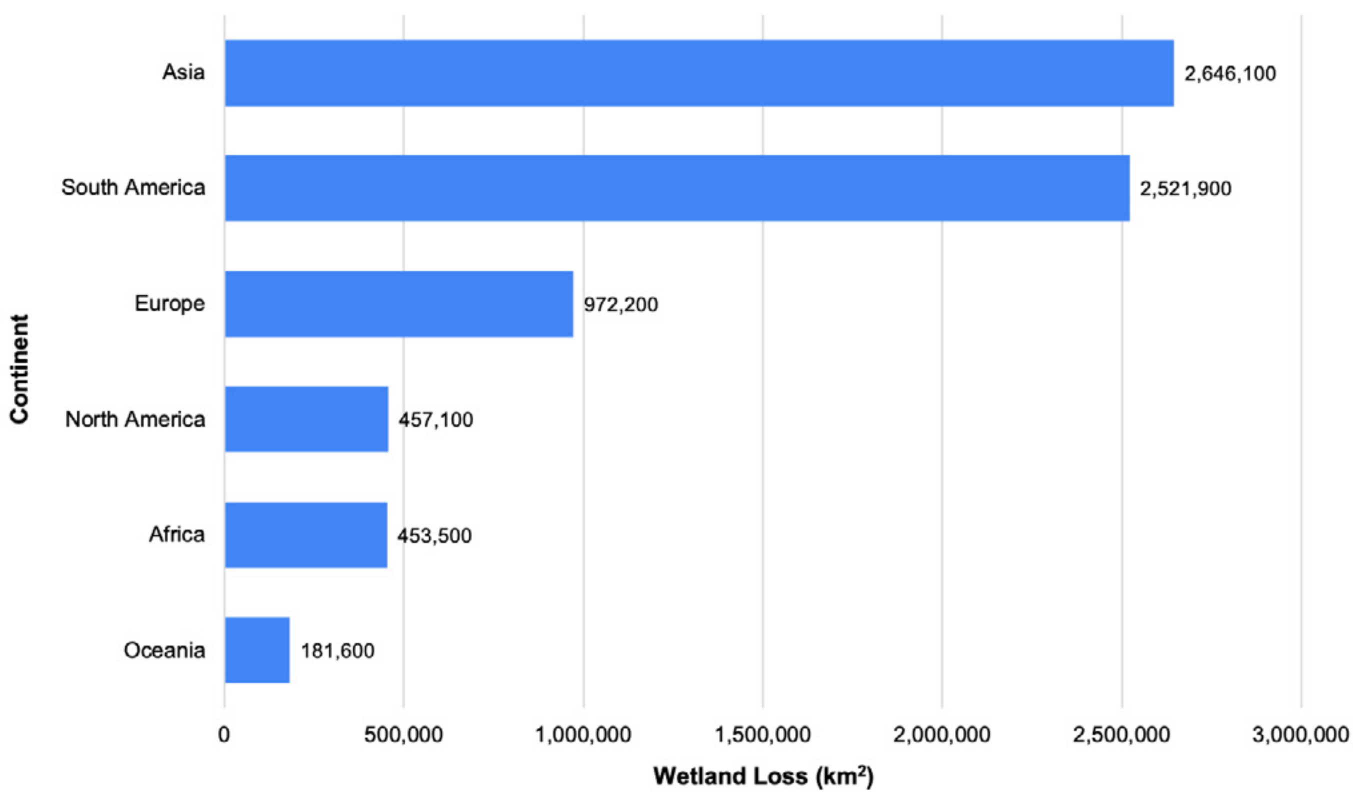

Figure 1: The area of wetland loss through 2009 among different continents. Source: Redrawn from Hu et al., 2017.

Peatlands, defined as having a layer of peat with a thickness of 30 cm or more, make up about half of all wetlands. About 15% of the world's peatlands have been drained for agriculture, forestry and grazing, which leads to oxidation and the release of the carbon stored in their soils. In Europe about half of the peatlands are drained (Tanneberger et al. 2017). Degraded peatlands contribute at least 5% to the total global anthropogenic emissions despite covering only 3% of the global land surface (Joosten et al., 2012). The biggest reason for draining tropical peat is to cultivate oil palms and paper pulp. Palm oil is one of the world's most profitable crops and used in a vast variety of consumer products from food to cosmetics. But, over a typical 25 years of cultivation, a hectare of oil palms will emit more than 2000 metric tonnes of CO_2 (Pearce & Madgwick, 2020). Drainage of peatlands leads to peat fires and subsidence, which further increases the risk to human health, flooding and saltwater intrusion (see Section 4.3). In fact, Davidson et al. (2019) suggest that the largest annual loss of ecosystem services in monetary value is from forested peatlands.

Coastal wetlands face mounting losses as well. Globally each year, coastal wetlands (with the exclusion of the Russian Arctic) are losing an area of 1–2% of tidal marshes, 0.7–3% of mangroves and 0.4–2.6% of seagrass. These losses are causing a total increase of GHG emissions between 0.15 to 1.02 billion metric tonnes of

CO_2 eq. per year (Pendleton et al., 2012). In the past 50 years, an alarming 50% of mangrove forests have been lost or degraded worldwide from a wide range of human threats including coastal development (e.g., ports and resorts) and unsustainable aquaculture and agricultural practices like shrimp farming and palm oil production (International Union for the Conservation of Nature [IUCN], 2017). The removal of mangroves and their degradation through erosion affects coastal protection and allows for increased occurrences of flooding and salt water intrusion to fertile inland coastal areas.

Wetlands face threats beyond human development and changing land-use patterns. Climate change is a direct and indirect driver of change, predominantly through its impacts on wetland hydrology. For instance, sea level rise will stress coastal wetland systems as they face inundation and changes in water salinity levels (Short et al., 2016). Meanwhile, changes in rainfall distribution (i.e. extreme drought and extreme rains) as well as higher air temperatures will cause larger water fluctuations and seasonal water table drawdown, resulting in peat mineralisation and changing vegetation. Permafrost thaw and highland glacial melting is caused by a combination of climate change and damaging land use, and significantly contributes to GHG emissions.

3.2. Context-Specific Wetlands Management

Across the globe there are different types of wetlands, each with their own unique characteristics in terms of hydrology, ecology and their role in the carbon cycle. The Ramsar Convention on Wetlands (2002) suggests that no single classification is likely to meet all needs of different wetland inventories, and instead recommends choosing or developing a classification suited to the purposes of a particular inventory. Each wetland type requires its own specific type of management; therefore, Parties to the Paris Agreement should better understand their local context to best incorporate wetlands into their NDCs.

An understanding of the types of wetlands present within national boundaries is needed to be able to more accurately gauge climate mitigation potential. While all types of wetlands provide the ability to store carbon, the amount of carbon stored varies.

- Coastal and estuarine wetlands have one of the highest primary productivities on earth but are small in their total global area. Seagrass meadows cover anywhere from 300,000 to 600,000 km^2 globally in shallow marine areas; they hold about 2.7 gigatonnes of carbon (Houghton, 2007).

- Mangroves cover about 160,000 km^2 globally. In spite of a small geographic footprint, mangroves hold approximately 3 billion metric tonnes of carbon, sequestering approximately 24 million metric tonnes of carbon in their soil per year (Rivera-Monroy et al., 2017).

- Peat covers about 3% of the global land surface (4 million km^2) and is currently estimated to contain the planet's largest store of carbon. Peatlands store about 30% of terrestrial carbon (Parish et al., 2008), or approximately 400 to 700 gigatonnes.

- Floodplain areas are often the most biologically productive in the landscape, and consequently the capacity for carbon sequestration is high (Dudley et al., 2010).

3.3. Managing Carbon in Wetlands

While drained and degraded wetlands, and especially peatlands, emit significant quantities of GHGs, proper management and wise use can reverse this trend and prevent emissions, and, in some instances,

promote GHG sequestration. Wetlands, including their biodiversity and their ecosystem services, need to be conserved in as intact a state as possible to keep carbon in the ground. Wetlands that have been drained and degraded need to be rewetted to restore their functionality, prevent further GHG emissions, prevent fires and reduce flood risk. These actions also support a sustainable local economy and livelihoods (for example, through the use of wet agriculture and forestry practices on wetlands and integrated mangrove-aquaculture). Wise wetland management and restoration techniques will ensure that wetlands function as net sinks of GHGs while maintaining their biodiversity and other ecosystem services such as water storage in peatlands and fisheries in mangroves.

Parties to the Paris Agreement need assistance and advice to enhance their knowledge and understanding of the role of wetlands in the carbon cycle, and, in particular, to translate this into decisive action. The various types of wetlands have complex biological sequestration and emissions mechanisms. A thorough understanding of these mechanisms, in combination with appropriate carbon accounting measures and properly adjusted management practices, will reduce further emissions from degraded wetlands and prevent healthy wetlands from becoming net sources of GHGs.

While drained and degraded wetlands, and especially peatlands, emit significant quantities of GHGs, proper management and wise use can reverse this trend and instead promote GHG sequestration.

Intact wetlands function as vital storage mechanisms for carbon and GHGs. Wetlands sequester carbon through reduced rates of decomposition. The organic matter accumulation/accretion rates are in the orders of 1 mm to 1 cm per year for both human-made and natural wetlands. Soil carbon in wetlands is recognised as an important component of global carbon budgets, and has therefore received significant research interest in understanding and enhancing the mechanisms of sequestration (Foster et al., 2012). The avoidance of wetland loss, along with wetland restoration, are considered among the key land management actions for natural climate solutions (Griscom et al., 2017).

The infographic in Figure 2a-b describes land-use impacts on peatlands. The land use in peatlands and, in particular, the drainage associated with it, results in the most significant emissions and hence should be a subject of the most considerable reductions. Fluxes depend on the type of land use and impacts. The IPCC's *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands* (hereafter referred to as the *2013 Wetlands Supplement*) provides emission factors for different cases and guidance on which algorithm is the best for the particular land-use scenarios. For example, emission factors are provided for drained peatlands, which are a significant source of methane and nitrous oxide, as well for the dissolved organic carbon emission to other water bodies. Understanding how land use is changing the carbon balance will help countries to plan and undertake activities aimed at reducing emissions (i.e. conservation, restoration and wise use) and how to best report on these activities.

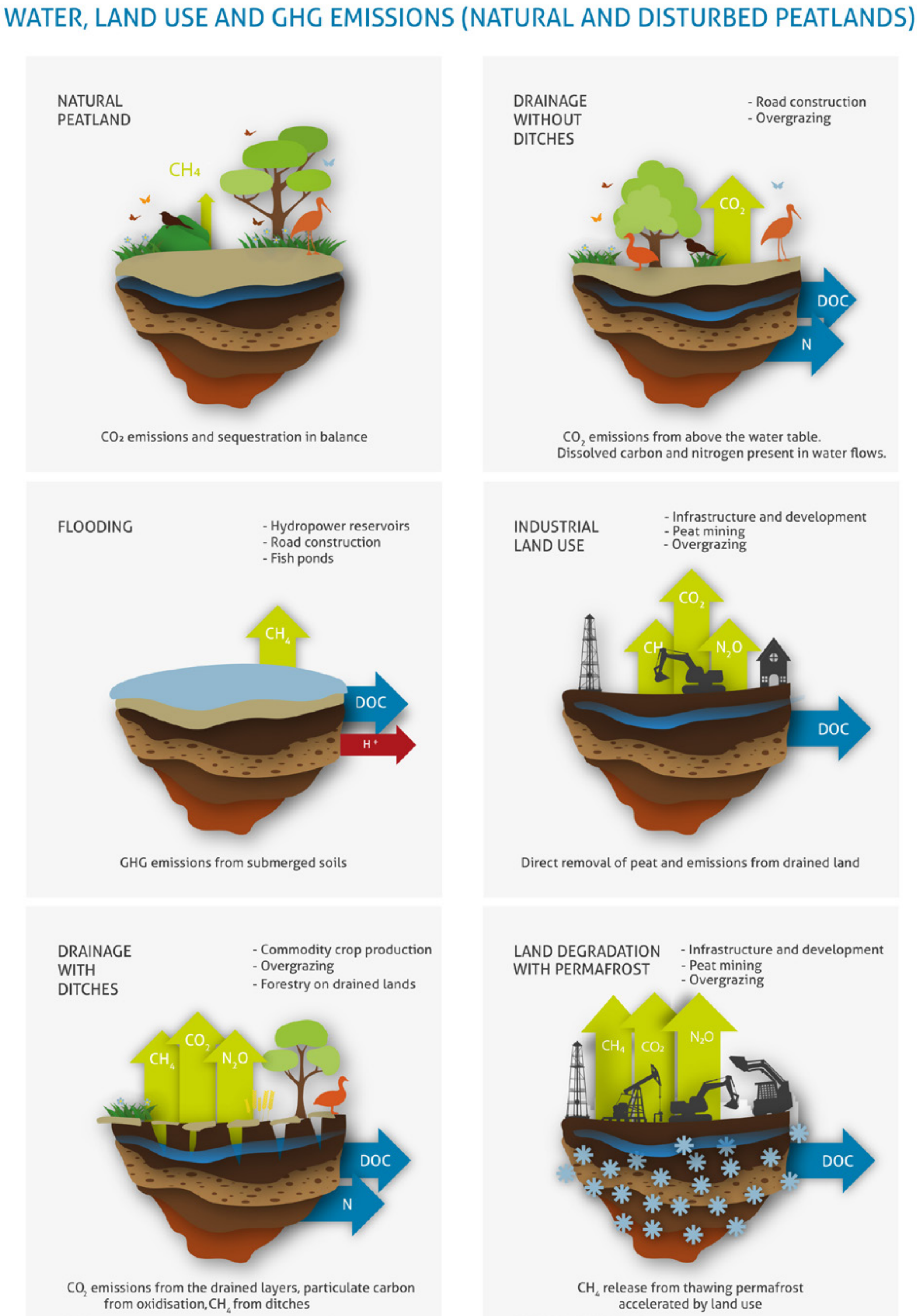

Figure 2a: A comparison of land uses affecting peatlands and the associated impacts on GHG emissions. See legend in Figure 2b.

MULTIPLE GHG IMPACTS OF LAND USES ACROSS A CATCHMENT

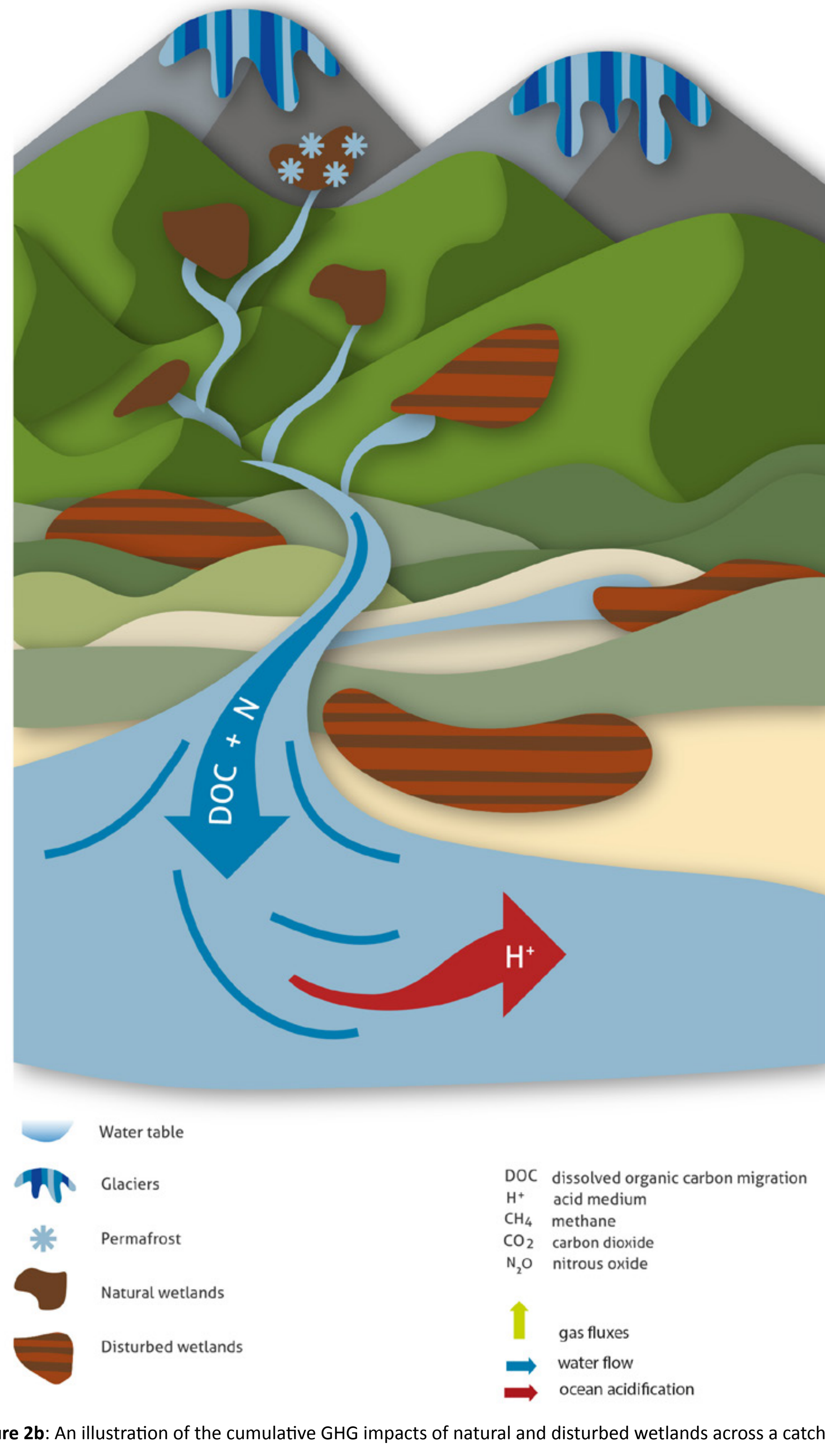

Figure 2b: An illustration of the cumulative GHG impacts of natural and disturbed wetlands across a catchment.

3.4. Targeted Action for High-Impact Areas

Climate-smart wetland management and wise use are necessary globally; however, specific regions are home to particularly important wetlands in terms of their emissions reduction and carbon storage potential. Good management practices will result in a higher positive net impact on climate mitigation. Conversely, their degradation would have an outsized deleterious impact in terms of carbon emissions per hectare. Whenever possible, these high-impact areas should be prioritised when determining resource allocation and protection/restoration.

For peatlands, which make up a significant portion of stored carbon globally, current efforts are focused on understanding carbon storage functions in arctic, temperate and tropical climates. A quarter of all the carbon stored in the world's wetlands, soils and forests is estimated to be found in the frozen peatlands of western Siberia (Smith et al., 2004), though, worryingly, the greatest quantities are in the northern areas most susceptible to thawing (Grosse et al., 2011). Russia, Canada, Alaska, China, Mongolia and the Scandinavian countries have extensive frozen reserves under threat. The same threat applies to the frozen highlands of the world. The total store of carbon accumulated in permafrost peat is estimated at around 1,700 billion metric tonnes (Tarnocai et al., 2009), or twice the amount in the atmosphere. If land-use activities and human-induced global warming continue to thaw permafrost (see Section 4.2), this carbon will continue to bubble up — either as carbon dioxide or as methane. Maintaining wetlands, and especially peatlands, as intact helps protect permafrost from thawing and releasing GHG emissions (Minayeva et al., 2018). Arctic countries and others hosting high altitude permafrost peatlands should therefore engage in wetland ecosystem conservation and restoration to protect important carbon stocks.

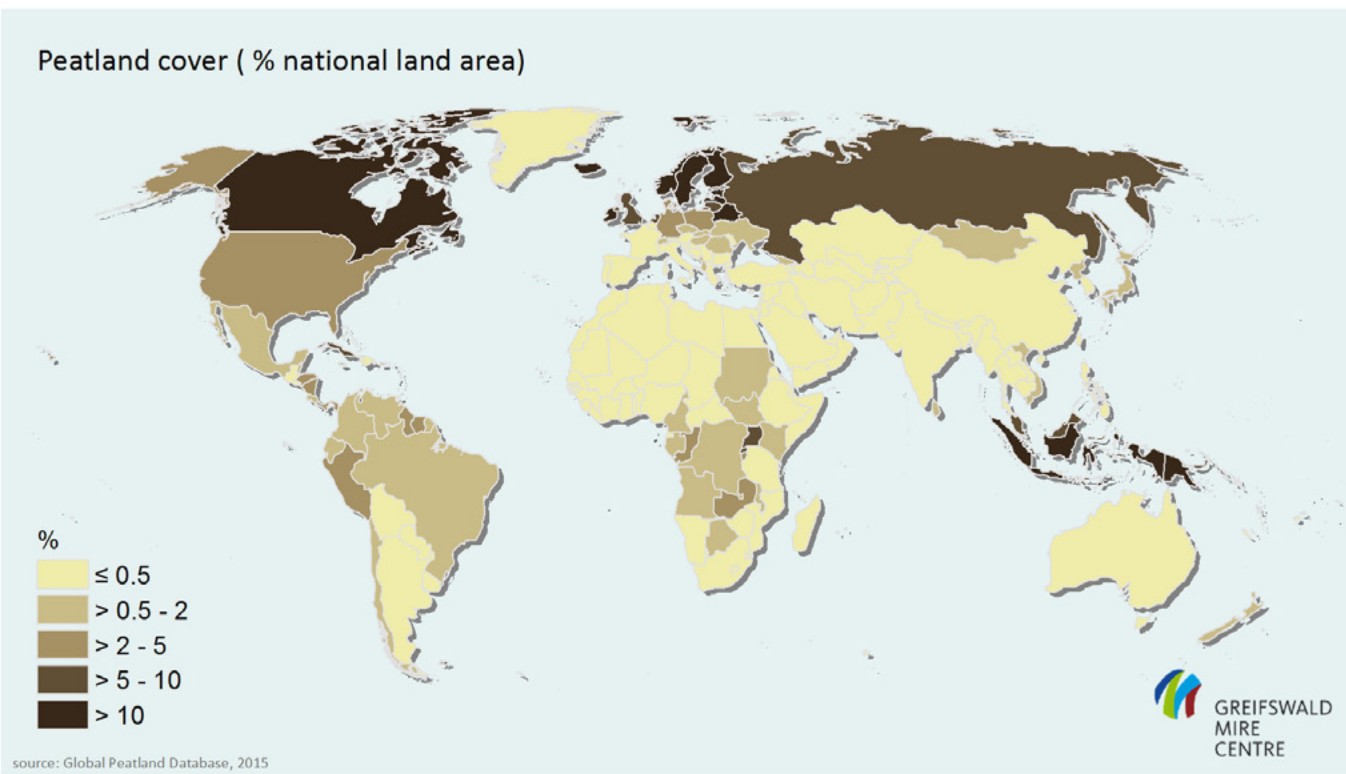

Figure 3: Peatland area per country globally as a percentage of total country area. Based on data from the Global Peatland Database. Source: Greifswald Mire Centre, 2015.

The discovery of vast new peat stores across the Amazon and Orinoco rivers, the Congo and potential for those in the Sudd and Inner Niger Delta provides important new impetus for the protection of the world's largest tropical wetlands against land-use change and degradation (Pearce & Madgwick, 2020). Data indicate that the top countries contributing to GHG emissions from drained organic soils have an outsized impact, even when excluding emissions resulting from peat fires. **The top three countries are responsible for 70% of the drained or organic soil emissions, with the top six countries being responsible for 80% of emissions in this category** (Greifswald Mire Centre & Wetlands International, 2020). This analysis provides a clear focus for decisive action.

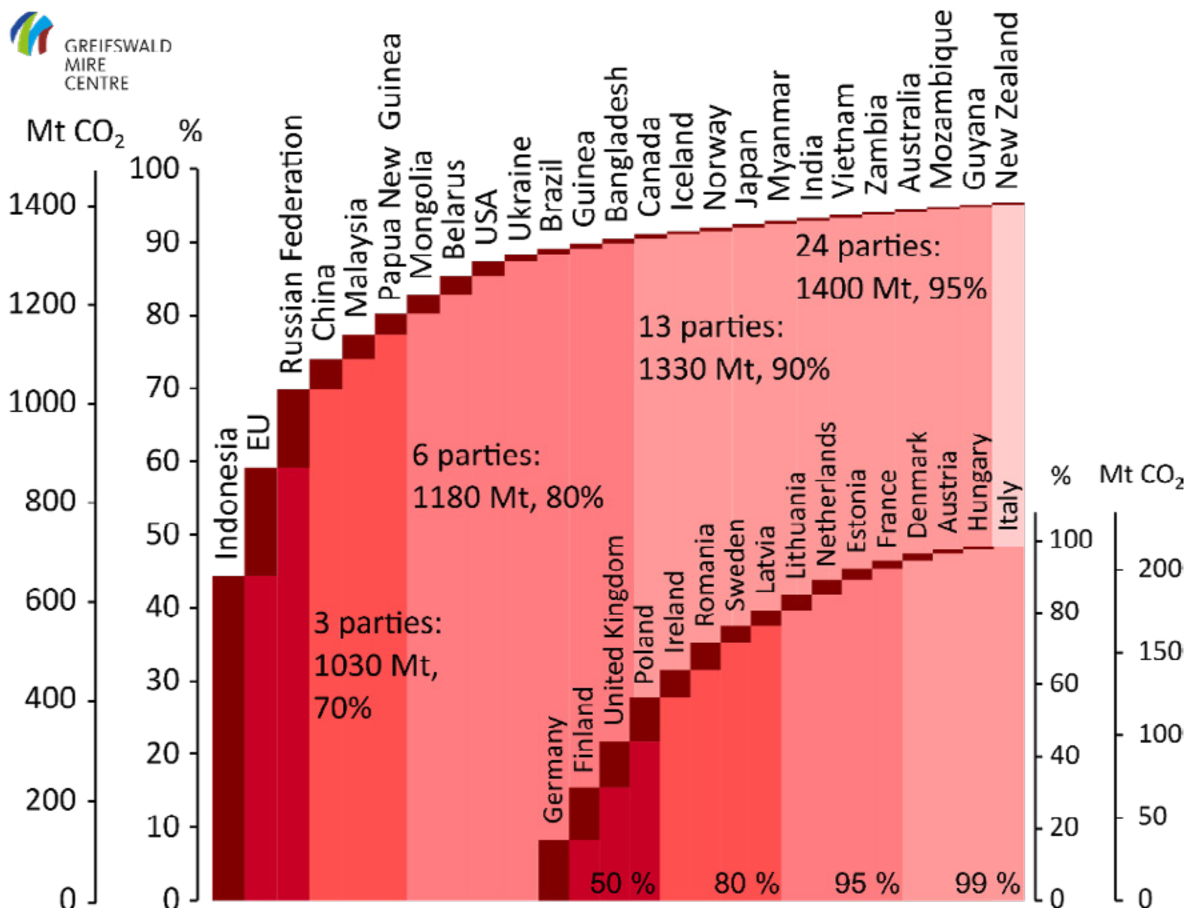

Figure 4: GHG emissions from drained organic soils, excluding emissions resulting from peat fires. Source: Greifswald Mire Centre & Wetlands International, 2020.

As part of their analysis into the largest contributors from peatland emissions, Wetlands International and the Greifswald Mire Centre created a set of staged guidelines to accelerate action in these "hotspot" countries. The following roadmap is intended to promote action to curb the concerning volume of peatland-related emissions (Wetlands International & Greifswald Mire Centre, 2015):

1. Hotspot analysis of degraded peatlands
2. An online Global Peatland Hotspot Atlas
3. International collaboration for targeted finance
4. Capacity building and upscaling
5. Large scale implementation via major programmes

Following this roadmap will focus global efforts and drive delivery of targeted peatland conservation and restoration for maximum impact on GHG emissions.

3.5. Measurement, Reporting and Verification

Reporting on emissions reductions from wetland management is essential to show how measures are resulting in reduced emissions, working towards targets identified in NDCs in line with the Paris Agreement. The first step is to include anthropogenically-changed wetlands into the national GHG inventories as emission sources. For Annex 1 countries, it is essential to establish 1990 baseline values for emissions from these wetlands.

The *2006 IPCC Guidelines for National Greenhouse Gas Inventories* provided methodologies for estimating national anthropogenic emissions and reductions. Under these guidelines, the inventories of emissions and removals from LULUCF have to be reported under six land-use and management categories: Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land. Reporting under the UNFCCC follows similar categorization for land-use inventories. Common reporting format (CRF) tables for LULUCF and Agriculture have been developed and revised over the years, including more recent updates in the context of the IPCC's integrated guidance combining both Agriculture and LULUCF into a single AFOLU volume (Iverson et al., 2014), though both terms appear in countries' NDCs. It should be noted, however, that certain agricultural practices on farms resulting in emissions of CH_4, N_2O and some CO_2 emissions from land use are formally reported under the Agriculture category (and thus AFOLU) rather than LULUCF.

Peatlands may occur in all land-use categories and also in the Agriculture category. According to the hierarchical approach adopted, the land-use category Wetlands only includes areas of peat extraction and land that is covered or saturated by water for all or part of the year, and that does not fall into the Forest Land, Cropland, Grassland or Settlements categories. The 2006 Guidelines were supplemented by the *2013 Wetlands Supplement*, which provides updated emission factors for inland organic soils, wetlands on mineral soils, coastal wetlands including mangrove forests, tidal marshes, seagrass meadows and human-made wetlands constructed for wastewater treatment.

Only those countries that have reported anthropogenic emission from degraded wetlands can include wetlands restoration activities and claim reduction in subsequent reporting. Measurement, Reporting and Verification (MRV) in the LULUCF sector is based on the spatial information of the land-use change. It is vital for Parties to show the surface area where the emissions reduction management has taken place, using geo-spatial or grounds-based mapping, as well as the magnitude of emissions reduction for each of the management methods (i.e. emission factors before and after management in each land-cover class).

Specific references should include the accounting of emissions from all categories, including wetlands, within the LULUCF sector. Countries which already include numerical indicators in their NDCs should consider in their obligations the predicted volume of GHG reductions caused by rewetting.

There are standard emission factors in the *2013 Wetlands Supplement*. But, some countries have developed their own, more sophisticated, emission factors based on solid scientific evidence. FAO and Wetlands International's *Peatlands: Guidance for Climate Change Mitigation Through Conservation, Rehabilitation and Sustainable Use* (Joosten et al., 2012) summarises the methodologies and data available for quantifying GHG emissions from peatlands and organic soils. The guidance document also presents practical approaches concerning MRV and accounting of GHG emissions as well as country-specific case studies to illustrate the problems, solutions and opportunities associated with peatland management. To support the development and advancement of knowledge, Parties to the UNFCCC are encouraged to share their experiences in the development of their wetland management approaches, their MRV methodologies and their results.

3.6. Costs Associated with Wetlands

Broadly speaking, the costs associated with wetlands can be divided into three main categories: 1) the hard costs of implementing management or restoration actions; 2) costs of securing land; and 3) costs of foregone opportunities. Costs in each category will be context-specific and will vary based on the size of the project, the geography and the region's underlying economy (among other factors).

The management, protection, or — in cases of degraded systems — restoration of wetlands has inevitable hard costs. These costs may include equipment procurement, labour and technical assistance. Costs will vary greatly based on the factors listed earlier. Governments or management agencies must purchase, lease or otherwise secure rights to implement ecosystem-based mitigation (EbM) measures with the wetlands on site. There is another inherent cost: lost opportunities from other uses. A large portion of wetlands lost in the past several decades involved development for uses such as livestock grazing, aquaculture and palm oil production, residential or industrial use. These foregone opportunities will factor into the underlying costs associated with wetlands for EbM. However, there are benefits associated with climate-smart peatland management where crops are grown in harmony with the wet peatlands (Paludiculture). Traditional cost-benefit analysis, however, while considering foregone opportunities, neglects the impacts on natural and social capital. To fully consider these costs and benefits, Parties can draw on a 'True Cost Accounting' approach.

Costs must be weighed against the direct benefits of wetland conservation and restoration, and in comparison to other NDC options for mitigation. Several studies on these ecosystem-based approaches to address climate change indicate that the benefits provided to the communities are often more cost-effective and viable in the long-term than other technical solutions (e.g., deep groundwater pumping, water treatment, etc.) (Campbell et al., 2009). Some wetland-based mitigation options might involve limited displacement of certain types of food production, but the extremely high carbon density and the valuable ecosystem services provided by wetlands suggest that protecting them offers a net societal benefit (Griscom et al., 2017). Research on peatlands demonstrates that restoration benefits more than just human welfare; restoration can be an economically efficient use of public investments with benefits exceeding costs (Glenk & Martin-Ortega, 2018). However, EbM measures are only one option among several available activities to reduce GHG in and by the water sector (GIZ, PIK & adelphi, 2020).

3.7. Achieving Multiple Co-Benefits through Wetland Conservation and Restoration

Wetlands provide numerous co-benefits — many of which either indirectly or directly support the communities living in and around the wetlands — and are key to economic and climate resilience at a time of looming economic crisis. Ecosystem-based approaches provide solutions that go far beyond climate change mitigation and have manifold synergies with adaptation and resilience (Doswald & Osti, 2011). Well-functioning wetlands offer water storage, flood protection, water quality control and sediment retention, while also supporting local agricultural, forest- and food-based livelihoods (UNESCO & UN-Water, 2020). Restoration projects involving communities can be developed in such a way that supports local enterprise and sustainable development (see Section 4.1). In addition, wetland restoration as an adaptation option can contribute to reduction of energy consumption by means of carbon-neutral water filtration and improved water quality (Global Water Partnership, 2018).

Wetlands can function as a cross-cutting tool within NDCs while providing essential functions for local economies (Table 2). Ecosystem-based approaches such as climate-smart wetland management provide extensive, interlinked benefits, ensuring the continued delivery of services necessary for water regulation and disaster risk reduction while sustainably managing and protecting the environment (Doswald & Osti, 2011).

Table 2: Co-benefits of wetlands.

Category	Description of Wetlands' Services and Functions
Water Quality	• Protect water quality by trapping sediments and retaining and transforming excess nutrients and other pollutants such as heavy metals • Provide particularly important water quality benefits, especially when connected to groundwater or surface water sources, such as rivers and lakes, and used by humans for drinking, swimming, fishing or other activities • Ensure the water quality levels necessary for fish and other wildlife
Fish and Wildlife Habitat	• Provide habitat, breeding ground, foraging and shelter for species of birds, mammals, amphibians, fishes and reptiles • Serve as a unique habitat for some species that cannot survive anywhere else • Provide the migration and breeding grounds upon which migratory birds and several other species rely
Flood Control, Storm-water Management, Disaster Risk Reduction	• Provide flood protection by holding excess water after a storm, and then releasing it slowly • Reduce local and downstream flooding to varying degrees based upon the size, shape, location and soil type of a wetland. Even isolated wetlands can reduce local flooding • Lower severity and slow velocity of flooding by acting as a natural water storage mechanism, especially at a catchment level • In cases of mangroves, provide a natural barrier for coastal communities and whole ecosystems from storm surge, flooding and erosion
Maintaining Ecohydro-logical Connections	• Maintain the intricate connections with groundwater, stream flows and lake and reservoir water levels that are essential for a proper functioning of the ecohydrology • Retain water and provide time for it to filter down into aquifers when connected to underground sources of water • Slowly discharge groundwater to surface waters during periods of low stream flows or lake levels to help maintain minimum water levels • Maintain streams, lakes and reservoirs by releasing stored water directly into these systems
Carbon Storage, Sediment Retention and Nutrient Cycling	• Remove pollutants by trapping sediments and holding them. The slow movement of water through wetlands allows sediments to settle where wetland plants can hold them in place • Protect surface waters from the problems of nutrient overload by removing excess nutrients • Store carbon and help offset GHG emissions, particularly in the case of peatlands
Economic Benefits to Societies	• Replace or supplement 'traditional' built infrastructure such as flood control or water treatment systems, while providing the same services and benefits with much lower costs • Provide numerous agricultural benefits to human communities • In cases of mangroves, sustain rich fisheries and provide critical habitat to a wealth of coastal and marine species

4. Country Examples and Success Stories of Good Wetland Management and Governance

4.1. Ecological Mangrove Restoration as Best Practice in Indonesia

Context & Partnership: The conservation of existing coastal wetlands and restoration of degraded ones is critical for addressing climate change. Although this paper does not deal directly with 'blue carbon' it is important to mention best practice for mangrove restoration.

Mangrove planting is commonly applied for rehabilitation, but a more effective approach is to create the right conditions for mangroves to recover naturally. Known as 'ecological restoration', mangroves restored in this way generally survive and function better (Wetlands International, 2016). Such projects can be developed in a way that supports local enterprise, sustainable development and enhances blue carbon.

Between 1990-2004, on Tanakeke Island (South Sulawesi, Indonesia), 1200 ha of mangroves were converted into aquaculture ponds but became unproductive soon after. Local communities recognised the need to restore the mangroves to enhance fish stocks and for safety and protection against storms. A model of community-based ecological mangrove restoration was developed and tested on 530 ha between 2010–2015. The best practices were further improved and demonstrated to be effective by Wetlands International and its partners in the Ecoshape Consortium.

Overall Objective: To improve the chances of mangrove rehabilitation and establish a sizeable, diverse, functional and self-sustaining mangrove forest that offers benefits for nature and people.

Major Achievements: To date, through a collaboration with local communities on the islands of Sumatra, Java, Sulawesi, Flores and Bali, ca. 3000 ha of degraded coastal areas were restored, where mangroves and other coastal vegetation recovered with a 60–100% survival rate. This contributed to a modest increase in Indonesian mangrove area (Saptono, 2019).

In the most successful community-based projects, natural recovery became apparent within the first year. Hydrological rehabilitation and natural recruitment reached densities of over 2500 seedlings per ha after three years, which is considered a very promising result.

Project's Impact: The project(s) contributed to a recognition of the importance of mangrove ecosystems and the necessity for their restoration. In 2017 the Indonesia Coordinating Minister of Economic Affairs (as a follow-up to Presidential Regulation No. 73/2012 on National Strategy for Mangrove Ecosystem Management) estimated the area of Indonesian Mangrove Management to be 3.49 million ha, of which 1.82 million ha has been degraded and needs rehabilitation. The area of mangrove ecosystems considered to be in good shape is still considerable (1.67 million ha), mostly protected and mainly located in east Kalimantan and Papua. In more densely populated areas, the need for mangrove restoration is urgent and would provide direct benefits from adaptation to the consequences of climate change as well as reduced flood risk. Ecosystem-oriented restoration of mangroves prevents further biodiversity loss and contributes to biodiversity restoration in the coastal wetlands. It also leads to regaining of ecosystem services in sectors such as fisheries and ecotourism.

Long-Term Results: (1) Development of best practices in Ecological Mangrove Rehabilitation, where hydrological restoration and ecological enhancement are combined. This includes measures such as strategic breaching of retaining walls, re-creation of tidal creeks, periodic dispersal of mangrove seedlings and a minimal amount of planting. (2) Community-based Ecological Mangrove Restoration has been formally included as a best practice in the South Sulawesi Provincial and Indonesian National Mangrove Strategies. The Ministry of Environment and Forestry recommended this approach for further restoration of 4000 ha of converted mangrove in the Tanjung Panjang Nature Reserve in Gorontalo Province (Wetlands International, n.d.). (3) The total direct cost of rehabilitation for design, implementation, management and monitoring amounted to 1300 USD per ha and is expected to be further reduced when up-scaling. (4) Upscaling to 2000 – 20000 ha is being explored using the Restoration Opportunities Assessment Methodology developed by World Resources Institute and IUCN.

4.2. Strategic Planning and Restoration of Peatlands in Mongolia

Context & Partnership: Mongolia is home to high-altitude peatlands and permafrost, the threats to which are distinct from other types of peatlands. For these types of ecosystems, a shift to the sustainable management of pastures and use of restored peatlands reclaimed from mining activities will have direct, positive impacts. In collaboration with the government of Mongolia and funded by the Asian Development Bank, Wetlands International facilitated the development of a Strategic Plan (2016–17) for peatland conservation and wise use in Mongolia.

Mongolia's peatlands both preserve and depend upon permafrost while regulating water in riverine highland landscapes — a function that prevents desertification and supports livelihoods and biodiversity. The peatlands are also very productive pastures and important carbon stores (Minayeva et al., 2018). During the last 50 years, half of the peatlands and associated permafrost have been lost due to climate change and human impacts from overgrazing, mining, infrastructure development and unsustainable water use (Crump, 2017). The current rapid loss of peatlands and permafrost leads to disasters for people and their cattle during long periods of droughts, as well as significant soil carbon loss and GHG emissions.

Overall Objective: The project was designed to co-develop the policy strategy and supporting frameworks for peatland conservation and wise use in Mongolia.

Major Achievements: In recent years, a comprehensive assessment of peatlands in Mongolia has been undertaken, which includes an inventory and mapping of peatlands and their uses, as well as evaluation of different policies related to peatland management and use in Mongolia.

Project's Impact: The comprehensive assessment undertaken during the project serves as the framework for implementation of peatland conservation and associated fundraising. The Strategic Plan allows Mongolia to define management priorities, which are intended to be reflected in the national action plans referenced in its NDC.

Long-Term Results: The Strategic Plan, which integrates key national conservation strategies and activities related to climate change, identifies the pathway towards sustainable peatlands management in Mongolia, including conservation and restoration (Wetlands International, 2017). Restoration technologies have been tested within the pilot project. The strategic planning approach, in combination with the available peatland restoration experience in the highlands of China, was proposed to BMU's Peatland Programmes and funded in the frame of the International Climate Initiative, to be expanded to other regions and countries with similar peatland related problems, such as countries of Central Asia.

4.3. PeatRus: Reducing Peat Fire and GHG Emission in Central Russia

Context & Partnership: Extensive peat fires in the Moscow region during the summer of 2010 resulted in poor air quality and smog, causing a significant impact on human health and the economy. A partnership was developed to implement one of the largest peatland ecosystem restoration projects in the world. Partners included Wetlands International, the Institute of Forest Science of the Russian Academy of Sciences, the Michael Succow Foundation and the University of Greifswald (the latter two both being part of the Greifswald Mire Centre). The project was a part of the International Climate Initiative led by the German Ministry of Environment, Nature Conservation, Building and Nuclear Safety and managed by the KfW bank, and initiated within the framework of co-operation between the Russian Federation and the Federal Republic of Germany.

Overall Objective: The project aimed to enhance technical capacities for further integration into the governance of peatland rewetting and fire control in Russia.

Major Achievements: The management of almost 100,000 ha of drained peatlands has been improved to prevent fires and reduce GHG emissions. The total amount of emissions reductions achieved by rewetting practices is currently estimated at 320,000 metric tonnes CO_2 eq. per year. Fire prevention further reduces emissions by a similar amount.

Nearly 60,000 ha of drained peatlands benefited from improved water level management and ecosystem restoration. Around 40,000 ha benefited from an improved infrastructure for fire control and monitoring. Restoration costs were about 30 to 100 EUR per ha for ecosystem restoration and 3,000 to 5,000 per ha for infrastructure optimisation.

Project's Impact: Peatlands vulnerable to fire and acting as GHG sources were mapped in eight Russian provinces (320,000 km^2) as a background for better planning and monitoring. New methods of land rehabilitation by ecosystem restoration were introduced and 50 experts and engineers were trained. Emission factors and reporting formats for drained and rewetted peatlands were developed to support reporting by the Russian Federation on its peatland rewetting activity under the UNFCCC. Paludiculture (wet agriculture on restored peatlands) and sustainable management practices have been initiated at several sites.

Long-Term Results: (1) The abandoned and drained peatlands are concentrated in the central part of the most densely populated area of Russia's European territory. Their ecological restoration has had significant benefits for the local populations who live mainly in large cities. In July to August 2010 during massive peat fires, an additional 50,000 deaths were registered against the average mortality in the European part of Russia. As a result of the project, approximately 30 million people are no longer exposed to the smoke and smog, with a corresponding reduction of respiratory and cardiovascular problems. The project received a UNFCCC Momentum for Change award in recognition for its positive impact on global health. (2) Other benefits include the reduction of firefighting costs and rise in economic value of local real estate, as well as improved conditions for tourism and recreation. (3) The commercial opportunities for wetland crops, such as reeds, peat mosses, alder and willow are being tested in the project on a small scale.

5. Policy Recommendations for UNFCCC Parties

We recommend that active wetland conservation and restoration are used as low-regret, high-benefit means for countries to meet the mitigation targets laid out in their NDCs. Wetlands are found across the globe and yet are often overlooked for their important role in the carbon cycle. Clear guidance and good data will help Parties to the UNFCCC properly value wetlands for their capacity to reduce emissions and store carbon, while simultaneously serving as an integral tool in their climate adaptation strategies.

The following recommendations will guide Parties towards effective integration of wetlands into their portfolio of climate actions.

Wetlands as effective tools in NDC delivery

It is recommended that:

- countries implement land-use policies such as active conservation of existing wetlands, rewetting of drained peatlands or restoration of degraded mangroves to avoid or reduce emissions. These policies need to be designed so as to lead to measures that prevent or reduce the impact of drivers of wetland loss such as conversion for agriculture, urbanisation, aquaculture or coastal development.

- wetland management is included consistently as part of a portfolio of measures to reduce atmospheric GHG emissions alongside mitigation measures across sectors outside of land use, such as energy and transport.

Focus on key opportunities

It is recommended that:

- active conservation of intact wetlands, particularly across permafrost and tropical regions, be given priority, recognising that these landscapes hold vast stores of carbon. The Cuvette Centrale Peatlands of the Congo Basin, for instance, is estimated to hold over 30 gigatonnes of carbon.

- restoration of degraded peatlands be prioritised, as this action can achieve reductions that may make up at least 5% of global anthropogenic CO_2 emissions. It is recommended that countries be encouraged to calculate what contribution these restorations can make to their own GHG footprints.

- policies such as National Adaptation Plans (NAPs), National Biodiversity Strategies and Action Plans (NBSAPs), commitments to the Bonn Challenge, marine spatial planning or hydrological management be cross-referenced and assessed for synergies with NDCs, as they may also help to decrease emissions or enhance sinks from wetlands.

Cost and benefits

It is recommended that:

- wetlands be included in NDCs to enable multiple co-benefits to be realised, such as flood risk management, water quality improvement, biodiversity recovery, securing migratory pathways, food production and sustainable community livelihoods. This contributes to disaster risk reduction and contributes to building long-term resilience. As such, wetlands should be considered in any analysis of cost and benefits.

- cost-benefit analyses of wetland projects take a comprehensive view and incorporate the socio-economic contribution of projects to sustainable livelihoods, food security and community resilience within water catchments and river basins, both upstream and downstream. Many examples show that wetland restoration — especially peatlands restoration — is a cost-effective way of optimising a country's social and environmental management.

Practicalities of including wetlands in NDCs

It is recommended that:

- countries include wetland management targets in their NDC portfolio and develop a Measurement, Reporting and Verification (MRV) methodology for their emissions and carbon stock changes.
- Parties undertake clear reporting with regards to implementation of climate actions involving wetlands and reporting on targets identified in NDCs in line with the Paris Agreement. There are several authoritative methods that can be used:
    - Extensive UNFCCC guidance and Common Reporting Format (CRF) Tables exist to facilitate the reporting in a very sophisticated way.
    - The *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands* provides tiered methods to estimate carbon stock and stock difference with varying levels of sophistication to suit country capacities and contexts.
    - The FAO peatland monitoring guidelines (2020) provide a clear monitoring and assessment framework.
    - This can be supplemented with auditing evidence from carbon credit projects (for example, under the Voluntary Carbon Standard (VCS) mechanism).
- The detail of transfer of carbon between countries for the Paris Agreement (Article 6, carbon markets) is still under negotiation at the time of writing.
- There is a global need to develop an evidence base of estimated and recorded emissions and sequestrations from wetlands and organic soils, as well as land cover classes and land cover change. These inventories need data such as soil type, climate zone, wetland type, size, vegetation composition and management practices in addition to the GHG budgets. The land cover classes should include information on the land use to claim positive or negative changes to the relevant stakeholders. These knowledge gaps need urgent attention.

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