Leveraging Nature-Based Solutions to Achieve Climate and Biodiversity Goals

Waterloo Climate Institute Information Brief

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NATURE BASED SOLUTIONS

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ABSTRACT

The world is currently facing multiple, interconnected global environmental crises. Two of these crises are biodiversity loss – the decrease of unique life within an environment - and climate change. These growing challenges threaten ecosystem integrity, function, and resilience, as well as human health, safety, and well-being. Nature-based solutions offer comprehensive and innovative strategies to address these converging crises by protecting, managing, and restoring ecosystems. Examples include wetland restoration, reforestation, marine protected areas, and agroforestry (the intentional integration of trees and shrubs into crop and animal farming systems). This information brief highlights nature-based solutions as effective strategies to help meet global climate change mitigation goals. The implementation of nature-based solutions supports the commitments of the United Nations Framework Convention on Climate Change, the Paris Agreement and the Convention on Biological Diversity. Wider adoption of nature-based solutions will aid in combatting species loss, ecosystem degradation, pollution, and climate-related hazards and disasters, thereby benefitting biodiversity and human well-being.

Key words Nature-based Soltuions; Biodiversity; Indigenous

KEY MESSAGES

- Nature-based solutions (NbS) are essential for meeting international climate and biodiversity commitments, such as the Paris Agreement and the Convention on Biological Diversity. By protecting, managing, and restoring ecosystems, NbS offer a comprehensive approach to addressing global environmental crises.
- Implementing NbS through actions like forest protection, wetland restoration, and sustainable land management can effectively reduce greenhouse gas emissions, enhance ecosystem resilience, and support biodiversity conservation.
- Canada has a unique opportunity to lead in NbS through policy and funding frameworks. By supporting Indigenous-led conservation, integrating green spaces into urban planning, and prioritizing the protection and restoration of peatlands and wetlands, Canada can enhance biodiversity, improve climate adaptation, and achieve its climate mitigation targets for 2030 and 2050.

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INTRODUCTION

Addressing both climate and biodiversity crises while delivering many co-benefits

Nature-based solutions (NbS) are a way of using nature to simultaneously address the climate and biodiversity crises. They represent a fundamental change in addressing global environmental challenges. Rooted in the concept of working with nature rather than against it, NbS harness the natural processes and elements of ecosystems to address pressing issues such as climate change, biodiversity loss, and sustainable development. By integrating natural elements into urban and rural planning, these solutions offer a multifaceted approach that benefits both human and ecological health.

The essence of NbS lies in its versatility and holistic approach. Unlike traditional engineering solutions that often focus on singular objectives, nature-based solutions provide a spectrum of benefits. For example, restoring wetlands not only acts as a natural flood defense but also enhances water quality, provides wildlife habitats, and supports local livelihoods. Similarly, urban green spaces can mitigate heat island effects – when urban areas experience higher temperatures than areas outside themselves - and also improve air quality, and promote physical and mental well-being for city residents.

One of the critical advantages of NbS is their cost-effectiveness and sustainability. Natural systems, when preserved or restored, require less maintenance and investment when compared to human-built infrastructure. Additionally, they possess the ability to adapt and evolve over time, increasing resilience to future environmental changes. This adaptability is crucial in the face of unpredictable climate patterns and extreme weather events.

Furthermore, NbS enhance biodiversity by creating habitats and connecting fragmented ecosystems, which in turn supports species migration and genetic diversity. This interconnection is vital for maintaining ecosystem services that humans rely on, such as pollination, soil fertility, and carbon sequestration (capturing carbon dioxide gases from the atmosphere).

In 2022, the United Nations Environment Assembly (UNEA-5) established the first multi-lateral definition of NbS:

> [N]ature-based solutions are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity…[2]

Nature-based solutions are distinct from "nature-derived solutions", which encompasses renewable energy, such as solar energy, and "nature-inspired solutions", which address material design "modelled on biological processes".[3] While NbS are not equivalent to ecosystem-based approaches (EbA), it is "cognizant of and in harmony with the concept of [EbA] identified under the Convention on Biological Diversity…".[4]

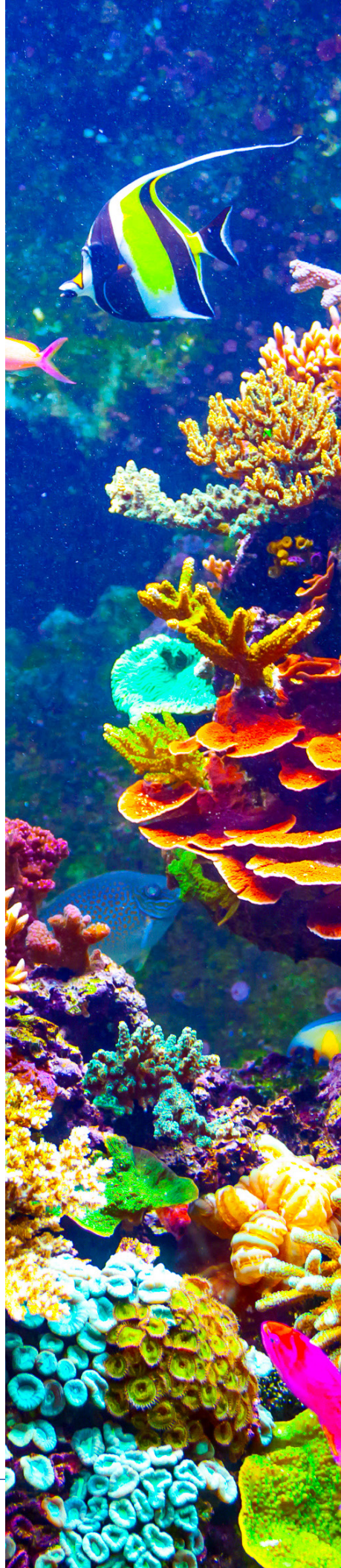
While NbS present cost-effective and sustainable options, their success depends on appropriate knowledge and expertise. Key knowledge areas include ecology, hydrology, climate science, environmental engineering, social sciences, and local and Indigenous knowledge systems. Policymakers and practitioners should invest in capacity-building to fully harness the potential of NbS, ensuring that they are designed and implemented effectively. This capacity-building should focus on interdisciplinary training, stakeholder engagement techniques, project management skills, monitoring and evaluation methods, and adaptive management approaches. Additionally, developing expertise in policy frameworks, funding mechanisms, and cross-sector collaboration is crucial for the successful implementation of NbS.

Definitions

Nature-derived solutions: Practices or technologies that directly utilize natural materials, processes, or systems to address societal challenges. These solutions are extracted or adapted from nature with minimal modification.

Nature-inspired solutions: Innovations or approaches that mimic natural processes or structures but may not directly use natural elements. These solutions are designed based on principles observed in nature but often implemented using synthetic materials or engineered systems.

Ecosystem-based approaches: Strategies that work with and enhance entire ecosystems to address environmental and societal issues. These approaches focus on maintaining or restoring the health and functionality of whole ecosystems rather than isolated components.



ANALYSIS

NbS in International Law: An Overview of Key Instruments

The main global agreements that identify NbS as solutions with the potential to tackle climate and biodiversity are:

1. the United Nations Framework Convention on Climate Change (UNFCCC),
2. the subsequent Paris Agreement; and the
3. the Convention on Biologial Diversity (CBD);

The United Nations Framework Convention on Climate Change, established in 1992, sets the stage for global cooperation on climate action. Within this framework, NbS are recognized for their potential to enhance carbon sequestration and climate change resilience. For example, the conservation and restoration of forests are highlighted as critical strategies for reducing greenhouse gas emissions.

The subsequent Paris Agreement of 2015 further reinforces the recognition of NbS by explicitly acknowledging the importance of "sinks and reservoirs of greenhouse gases" and promoting ecosystem-based approaches in its Nationally Determined Contributions (NDCs). Natural sinks and reservoirs, such as forests, oceans, and wetlands, play a crucial role in absorbing and storing carbon dioxide from the atmosphere, making them key components of NbS for climate change mitigation. NDCs are country-specific climate action plans that outline how each nation intends to reduce its greenhouse gas emissions and adapt to climate change impacts. Countries are encouraged to include NbS in their climate action plans, leveraging natural processes to achieve carbon neutrality - capturing the same amount of carbon that is emitted - and enhance adaptive capacity. For example, an ecosystem-based approach included in an NDC might involve the restoration of mangrove forests along coastlines, which not only sequesters carbon but also provides natural protection against storm surges and sea-level rise.

The Convention on Biological Diversity (CBD), which also emerged from the 1992 Earth Summit, underscores the role of NbS in preserving and sustainably managing biodiversity. The CBD's Aichi Targets (2010-2020) explicitly called for the restoration of at least 15% of degraded ecosystems, highlighting Nature-based solutions as a means to enhance ecosystem resilience and services.

In addition, the Kunming-Montreal Global Biodiversity Framework (2022) builds on this foundation, setting ambitious goals for 2030 and 2050. For example, the framework promotes the integration of NbS in agriculture, forestry, and fisheries to ensure ecosystem health and productivity. It further emphasizes the conservation, restoration, and sustainable use of biodiversity, with NbS playing a central role in achieving these targets. This information brief focuses on how nature-based solutions can be used to meet both the Paris Agreement and Global Biodiversity Framework targets.

- The Paris Agreement target is to limit "global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C".[5]

The Global Biodiversity Framework has a 2030 mission and 2050 vision, and 23 corresponding targets. The 2050 vision "is a world of living in harmony with nature".[6]

The 2030 mission is as follows:

- To take urgent action to halt and reverse biodiversity loss to put nature on a path to recovery for the benefit of people and planet by conserving and sustainably using biodiversity and by ensuring the fair and equitable sharing of benefits from the use and genetic resources, while providing the necessary means of implementation.[7]

Nature-Based Solutions for Climate Mitigation and Adaptation

1. CLIMATE MITIGATION: USING NATURE-BASED SOLUTIONS TO REDUCE GREENHOUSE GAS EMISSIONS

Carbon sinks: Nature-based solutions contribute significantly to climate mitigation by sequestering carbon through the conservation and restoration of forests, wetlands, grasslands, and marine ecosystems. These natural systems act as effective carbon sinks, reducing greenhouse gases in the atmosphere and mitigating the impacts of climate change.

However, depending on their use and management, terrestrial ecosystems can be both a sink and a source of greenhouse gas (GHG) emissions. For example, the Intergovernmental Panel on Climate Change (IPCC) reported that activities related to agriculture, forestry and other land use (AFOLU) accounted for 22% of global GHG emissions in 2019.[8] Nevertheless, AFOLU options can provide important mitigation benefits. These benefits include:

1. Carbon sequestration through reforestation and afforestation
2. Improved soil carbon storage through sustainable agricultural practices
3. Reduced emissions from deforestation and forest degradation
4. Enhanced carbon storage in harvested wood products
5. Bioenergy production to replace fossil fuels

For instance, agroforestry practices, which integrate trees into agricultural landscapes, can significantly increase carbon sequestration while also improving soil health and biodiversity. Similarly, adopting conservation tillage in farming can enhance soil carbon storage and reduce emissions from agricultural operations.

The IPCC reports that "[c]onservation, improved management and restoration of forests and other ecosystems offer the largest share of economic mitigation potential".[9] Non-forested ecosystems, including freshwater wetlands, grasslands and coastal ecosystems also have significant mitigation potential. The ocean is also a large emission sink, having sequestered "more than 25% of excess carbon dioxide emitted into the atmosphere since the mid 1990s".[10]

2. CLIMATE ADAPTATION: NATURE-BASED SOLUTIONS SUPPORT CLIMATE RESILIENCE IN COMMUNITIES

Nature provides solutions for climate adaptation by (1) reducing physical exposure to the extreme weather events and landscape changes due to climate change; (2) reducing ecosystem sensitivity; and (3) supporting adaptive capacity to climate change.[11] Adaptive capacity in this context refers to the ability of ecosystems, species, and human communities to adjust to climate change, moderate potential damages, take advantage of opportunities, or cope with consequences. This is distinct from the broader concept of climate adaptation, as it specifically focuses on enhancing the inherent flexibility and resilience of natural and social systems to respond to changing conditions. These types of nature-based solutions are often referred to as EbA (ecosystem-based adaptation).

Nature-based solutions reduce exposure to the impacts of climate change, including extreme weather events and landscape changes, by protecting ecosystems and infrastructure from various climate-related hazards. This reduction in exposure helps communities and natural systems better withstand the effects of a changing climate. Specifically, NbS can protect against erosion, flooding, and sea-level rise, while also moderating urban heat waves, managing storm water, and sustaining natural resources in dry or variable climates.[12] For example, natural coastal habitats (i.e., sea grass and kelp beds) can significantly reduce wave height, whereas forests can protect communities from soil erosion and inland flooding.[13]

Nature-based solutions can reduce ecosystem sensitivity and increase ecosystem resiliency by maintaining biodiversity and healthy ecosystems. Ecosystem resiliency is a necessary feature for NbS to be effective.[14] For example, grasslands often do not receive as much attention for climate action as forests, but they might be more reliable as carbon sinks. This is because forests are increasingly at risk from drought and wildfires.[15] Ecosystem sensitivity can be managed by protecting ecosystem integrity (i.e., controlling pollution, invasive species, overexploitation). In addition, It is also important to conserve and improve biodiversity, which helps ecosystems bounce back from climate change impacts.[16]

Adaptive capacity: Biodiversity is important for ecosystem resiliency because it provides adaptive capacity, specifically by "safeguarding the evolutionary potential of ecosystems" and species.[17] Examples and specific details for this section are similar to the first two sections.

3. NATURE-BASED SOLUTIONS OFFER OPPORTUNITIES FOR CLIMATE ACTION

The IPCC 2023 Synthesis Report provides the following as nature-based opportunities (land, water, food) to scale up climate action with medium to high feasibility and to harness synergies between mitigation and adaptation:

1. Climate adaptation

- Improved cropland management
- Efficient water use and water resource management
- Biodiversity management and ecosystem connectivity
- Agroforestry
- Sustainable aquaculture and fisheries
- Forest-based adaptation
- Integrated coastal zone management

2. Climate mitigation

- Reduce conversion of natural ecosystems
- Carbon sequestration in agriculture
- Ecosystem restoration, afforestation, reforestation
- Shift to sustainable healthy diets
- Improved sustainable forest management
- Reduce methane and N20 in agriculture
- Reduce food loss and waste[19]

Nature-Based Solutions for Biodiversity Conservation

Biological diversity (or biodiversity) is "the variability among living organisms" and includes diversity within species, between species and of ecosystems.[20] As mentioned above, biodiversity is an important feature for climate adaptation and ecosystem resiliency.

According to the IPCC, maintaining biodiversity resilience and critical ecosystem services at a global scale will require States to collectively conserve 30% to 50% of Earth's land, freshwater and ocean areas.[21] Similarly, one of the Global Biodiversity Framework's best-known targets is Target 3 (conserve 30% of land, waters and seas). According to Seddon and others, commenting on the value of NbS before the adoption of the GBF, "NbS differ from traditional biodiversity conservation and management approaches" in that it aims to address societal goals such as poverty alleviation and socio-economic development.[22] However, "to be resilient (and hence sustainable), NbS must be implemented in such a way as to support biodiversity and people".[23]

NATURE-BASED SOLUTIONS IMPLIMENTATION CONSIDERATIONS

Nature-based solutions offer a holistic approach to resolving the growing challenges of climate change and related threats to biodiversity, livelihoods, and food and water security

NATURE-BASED SOLUTIONS IN SUPPORT OF CLIMATE MITIGATION

1. Regulations and policies for natural resource industries like forestry should require practices grounded in science and ecosystem-based management.

2. International and national policy and funding frameworks should support Indigenous-led conservation initiatives to significantly enhance biodiversity and ecosystem resilience.

3. Policy and programs must protect and restore peatlands and wetlands to function as critical carbon sinks and biodiversity hotspots.

CONSIDERATIONS

for implementing nature-based solutions in support of climate mitigation

1. Regulations and policies for natural resource industries like forestry should require practices grounded in science and ecosystem-based management.

Climate mitigation policy, particularly in regions with large forestry sectors, must be grounded in "sound ecosystem and biodiversity science" to avoid reliance and investment in monoculture – growing a single tree species - and low diversity plantations.[24] "Fast-growing monocultures sequester carbon rapidly, but they may not maximize carbon storage in the long term as they are vulnerable to disease, pests and climate extremes…Moreover, when plantations are harvested…much of the stored carbon is returned to the atmosphere".[25]

Ecosystem-based management (EBM) is a type of nature-based solutions that addresses the problem of forest monocultures and has been applied in British Columbia's forestry sector. British Columbia defines EBM as "an adaptive approach to managing human activities that seeks to ensure the coexistence of health[y], fully functioning ecosystems and human communities".[26] EBM has been successfully implemented in the Great Bear Rainforest and on Haida Gwaii.[27] Examples of EBM policy include utilizing adaptive management principles, and balancing biodiversity interests, among others, with the needs of industry and local economies.

2. International and national policy and funding frameworks should support Indigenous-led conservation initiatives to significantly enhance biodiversity and ecosystem resilience

Indigenous communities possess invaluable traditional ecological knowledge essential for sustainable ecosystem management.[28] Policies should be developed to support Indigenous-led conservation projects through legal recognition, partnership opportunities, and adequate funding.[29] Examples include land stewardship programs and community-managed protected areas, which have demonstrated effective preservation and restoration of ecosystems. The Tla-o-qui-aht Tribal Parks on Vancouver Island, Canada, are an example which have been established by the Tla-o-qui-aht First Nation to manage their traditional territories according to their cultural values.[30] These parks serve as a model of Indigenous-led conservation, combining traditional ecological knowledge with modern conservation practices. Canada has a unique opportunity to lead in this area by fully embracing and supporting Indigenous-led conservation initiatives. By doing so, Canada can set a global standard for reconciliation in environmental stewardship, demonstrating how Indigenous wisdom and leadership can drive effective, culturally-responsive conservation efforts that benefit both people and nature.

3. Policy and programs must protect and restore peatlands and wetlands to function as critical carbon sinks and biodiversity hotspots.

Peatlands and wetlands play a crucial role in carbon sequestration, water purification, and flood regulation.[31] To safeguard these vital ecosystems, policies should prioritize their protection and restoration by enforcing more stringent regulations against drainage and development and by funding large-scale restoration projects.[32] Examples include comprehensive wetland restoration initiatives and conservation easements specifically designed to preserve peatlands. An exemplary initiative is the Great Bear Rainforest Agreement in British Columbia, Canada, which protects over 6.4 million hectares of temperate rainforest, including significant areas of wetlands and peatlands. This agreement, resulting from collaboration between Indigenous communities, government, environmentalists, and industry, demonstrates the potential for comprehensive ecosystem protection.[33]

However, Canada's overall approach to wetland and peatland conservation remains inconsistent across provinces. While some regions like Ontario have implemented no-net-loss policies, others lack robust protection frameworks. To truly lead in this area, Canada needs to develop a coherent national strategy for wetland and peatland conservation, backed by strong federal legislation and funding mechanisms. Such a strategy should include comprehensive wetland restoration initiatives and conservation easements specifically designed to preserve peatlands, helping to maintain the ecological integrity and resilience of these unique habitats.

These measures will help maintain the ecological integrity and resilience of these unique habitats.

CONCLUSION

Nature based solutions offer a holistic approach to resolving the growing challenges of climate change and related threats to biodiversity, livelihoods, and food and water security. This information brief has outlined the power of NbS as a tool for carbon sequestration, sustainable agriculture, reducing greenhouse gas emissions, and increased protection from floods, droughts, and wildfires, among many others. The adoption of NbS is supported by key international legal instruments, including UNFCCC, CBD, and the Global Biodiversity Framework. Importantly, NbS can be used to meet the Paris Agreement target to limit the global temperature increase, and Global Biodiversity Framework Targets for living in harmony with nature. Canada has significant potential for scaling up the implementation of NbS that foster healthy communities while preserving natural heritage throughout the country's vast and diverse ecosystems, including wetlands, peatlands, grasslands, coastlines, and forests. By leveraging the benefits and capabilities of nature, NbS support ecosystem and community resilience in the face of the climate emergency and mass species extinction and will support Canada's efforts to meet its 2030 and 2050 climate change mitigation targets. To fully realize this potential, Canada should develop a comprehensive National Nature-based Solutions Strategy, aligning with Global Biodiversity Framework. This strategy should include robust policy mechanisms for integrating NbS into climate action plans, biodiversity conservation efforts, and urban planning. Specifically, Canada could strengthen its approach by implementing a national "no net loss" policy for critical ecosystems, similar to the European Union's No Net Loss Initiative, and by establishing a dedicated NbS fund to support large-scale implementation projects across the country. Additionally, Canada should enhance its existing Impact Assessment Act to explicitly require the consideration of NbS alternatives in all major development projects, ensuring that natural capital is properly valued in decision-making processes.

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