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Nature-Based Solutions

Grace Isdale, NRM South

Key Messages

1

Nature-based solutions are actions that protect, manage or restore natural ecosystems with the potential to help mitigate and adapt to global warming and benefit biodiversity.

2

There are significant uncertainties regarding the effectiveness of nature-based solutions and concerns over their usage as carbon offsets.

3

Nature-based solutions cannot replace the urgent need to dramatically reduce greenhouse gas emissions to achieve the goals of the Paris Agreement. However, they can contribute to removing the emissions that remain impossible to avoid.

Introduction

To achieve the Paris Agreement goals and limit the global mean temperature increase to well below 2°C, greenhouse gas emissions need to be substantially reduced by 2030 and reach net zero by 2050. More than 140 countries have set net-zero targets, covering about 88% of global emissions. More than 9,000 companies worldwide have joined the United Nations 'Race to Zero' campaign, committing to take action to halve global emissions by 2030[1].

In recent years, nature-based solutions have gained considerable attention as a means to reach these targets and many governments and companies are incorporating them in their net-zero strategies. Some sectors strongly advocate for these solutions while others criticise them.

What are nature-based solutions?

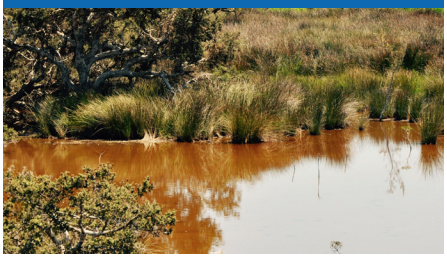
Nature-based solutions refer to actions that manage, protect, and restore ecosystems, including forests, wetlands, oceans, and grasslands.

These solutions could help mitigate global warming as they:

- enhance the capacity of ecosystems to sequester carbon dioxide (CO_2) from the atmosphere, or
- prevent CO_2 emissions associated with the loss or degradation of ecosystems.

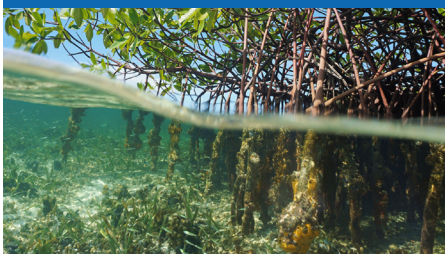
Types of Nature-based Solutions

Artificial wetlands



Agroforestry

Restoring mangroves



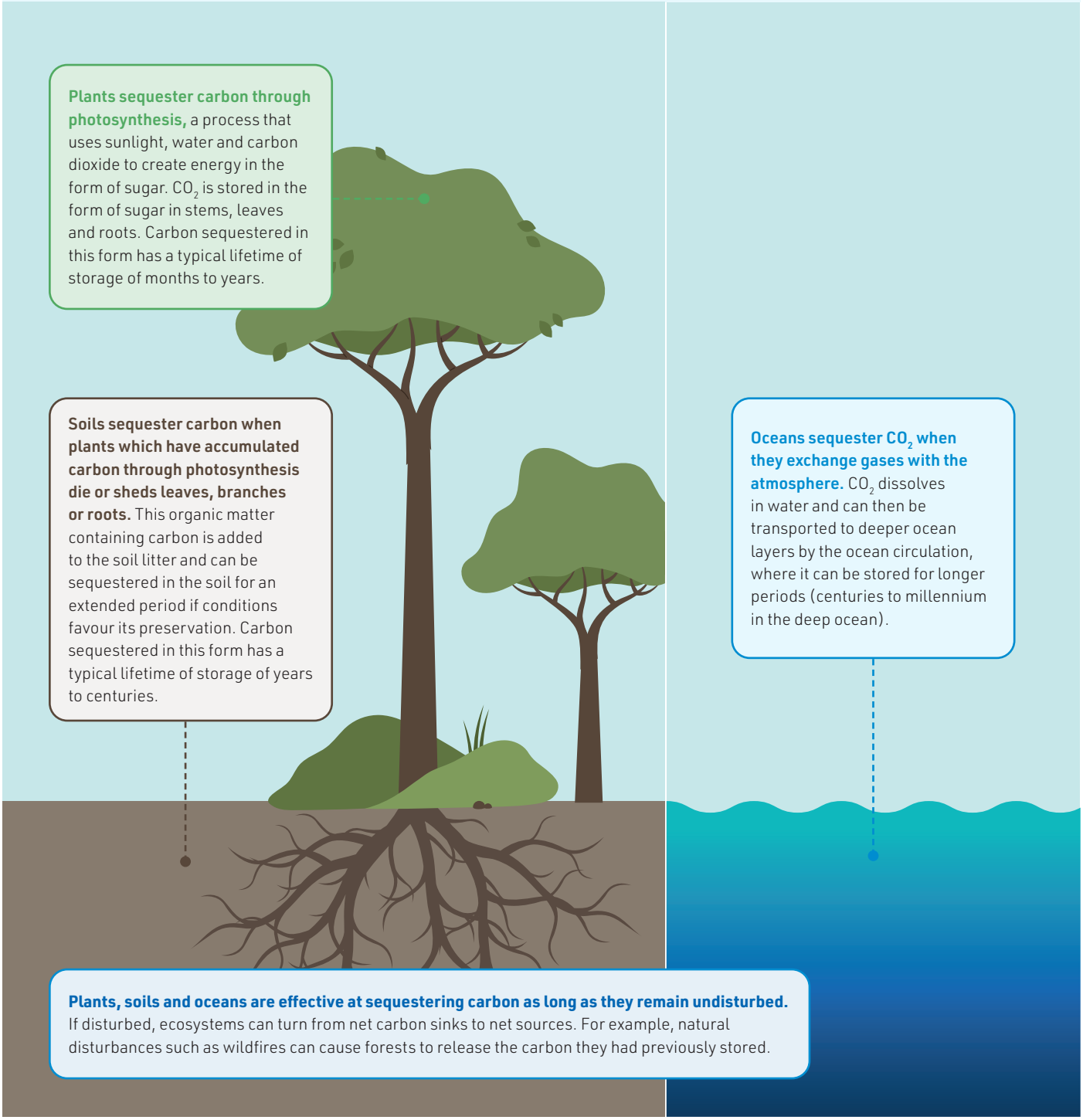
Stopping deforestation

Protecting wetlands

Restoring seagrass meadows

Explainer box - what is carbon sequestration?

Carbon sequestration is the process of capturing, removing and storing CO_2 from the Earth's atmosphere in plants, soil and oceans. It is an important process of the carbon cycle.



Nature-based solutions can be classified into four categories[2]:

1. **Ecosystem protection:** involves the protection of natural habitats from degradation or destruction so that they continue sequestering carbon. This does not reduce atmospheric CO_2, but it does help avoid further increases that would result from ecosystem degradation. Examples include stopping deforestation, reducing land clearing and protecting wetlands.
2. **Ecosystem restoration:** aims to restore degraded ecosystems. Once restored, these ecosystems store CO_2, becoming net carbon sinks. Examples include re-foresting previously cleared land, re-wetting drained peatlands and restoring mangroves or seagrass meadows.
3. **Sustainable land management practices:** involves the adoption of agricultural methods that sequester more carbon in vegetation and soils than conventional farming. Examples include agroforestry which combines trees with livestock and crops on the same area of land.
4. **Ecosystem creation:** involves building new ecosystems that absorb and store carbon. Examples include tree-planting in regions not previously forested or the creation of artificial wetlands.

We note that these are all environmentally worthy ambitions with valuable outcomes. However, we focus here on whether these nature-based solutions mitigate global warming.

How much CO_2 can nature-based solutions save?

In terms of carbon, several studies have suggested a mitigation potential of somewhere between 5 billion tonnes of CO_2 and 10 billion tonnes of CO_2 per year by 2030[3,4]. Most of the nature-based solutions included in these estimations are terrestrial, as there is substantially more terrestrial than marine research on the potential scale, risks and uncertainties of nature-based solutions.

These estimates are highly uncertain because nature-based solutions are vulnerable to very rapid natural or human disturbances which could cause ecosystems to release the carbon previously stored[5]. It is very important therefore to separate potential estimates from what could be achievable.

Regardless of the exact figure, a large gap remains between the mitigation potential of nature-based solutions of 5-10 billion tonnes of CO_2 per year by 2030 and the current emissions via human activity of around 35 billion tonnes of CO_2[6] each year.

However, it is important to recognise that even a small contribution can be valuable, especially when nature-based solutions have other co-benefits such as biodiversity enhancement and climate risk reduction.

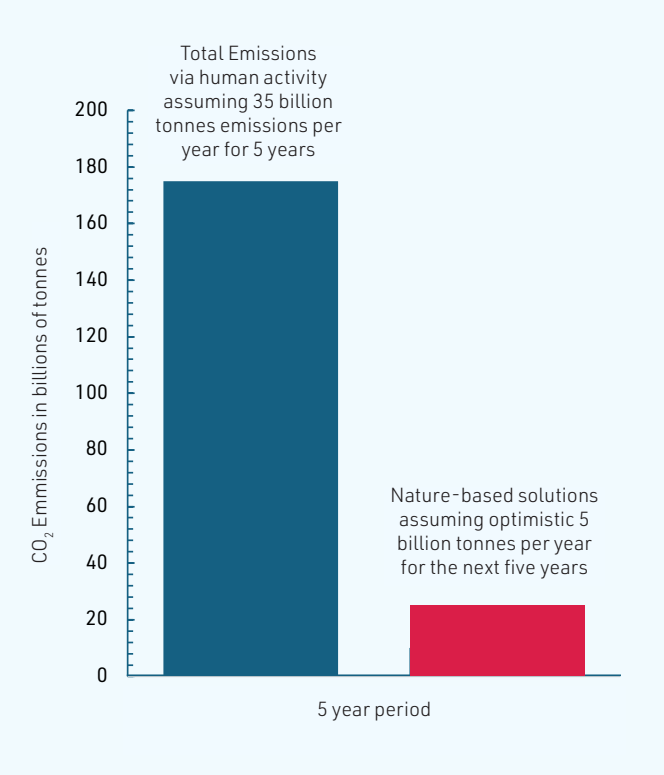


Figure 1 Approximate global emissions of carbon dioxide over the next 5 years and the mitigation potential over the same five years. Both estimates are uncertain, but present reasonable scenarios.

How fast and for how long do nature -based solutions store carbon?

Carbon storage in nature-based solutions varies significantly depending on the ecosystem type. The amount of carbon stored, as well as the rate and duration of storage depend on various factors specific to the way different ecosystems function.

Coastal ecosystems such as mangroves and seagrass meadows store carbon 27 to 56 times faster than tropical rainforests, which usually take decades to accumulate and store significant carbon[7,8]. However, mangroves and seagrass meadows are restricted to coastal areas, meaning they could store less carbon overall compared to forests, which can cover large areas.

The duration of storage also varies significantly between these ecosystems. Mangroves and seagrass could potentially store carbon for thousands of years in their sediments[9,10,] while storage in forests could be limited to the lifetime of trees, which is of decades or century. This storage duration could potentially be extended if wood is harvested and built into structures such as houses, effectively locking up carbon but these are still short-term compared to the storage lifetime of carbon stored in fossil fuels which are many millions of years.

However, there are large uncertainties surrounding the duration of storage nature-based solutions can actually achieve, because these solutions are particularly vulnerable to disturbances. Natural and human disturbances can damage ecosystems, reducing the longevity of their carbon storage.

- Natural disturbances: droughts, wildfires and pest outbreaks can cause forests to release the carbon they had previously stored back into the atmosphere[5]. For example, a major fire can return decades worth of carbon uptake in a matter of days. Additionally, marine heatwaves, tropical cyclones and storms can physically damage mangroves and seagrass meadows and disrupt their sediments, leading to carbon loss[5].

These disturbances are expected to become more frequent with climate change, potentially turning ecosystems into a net source of carbon.

- Human disturbances: pollution, land-use changes and unsustainable management practices can affect ecosystems. Deforestation can lead forests to release the carbon they had stored. Excavation and logging can disturb mangroves sediments leading to carbon loss. Similarly, pollution from agriculture, boats and propellers as well as land developments can physically damage seagrass meadows, releasing carbon.

Overall, carbon storage in nature-based solutions is influenced by a complex interplay of ecological, environmental and human-related factors bringing a lot of uncertainties surrounding their mitigation potential.

Given natural and human disturbances, nature-based solutions may only provide short-term carbon storage. In comparison, oil and gas fields contain carbon that is hundreds of millions of years old. No nature-based solution can replace the long-term storage of carbon provided by oil and gas reserves[5]. It is important to prevent mining and burning fossil fuels which releases carbon from its reserves, rather than finding uncertain strategies to remove the carbon from the atmosphere after it has been emitted.

The Posidonia australis seagrass meadow in Australia's Shark Bay on Aug. 7, 2019.Rachel Austin / The University of Western Australia. Image Source: https://www.nbcnews.com/science/science-news/worlds-largest-plant-vast-seagrass-meadow-

Co-benefits of nature-based solutions

Some nature-based solutions can help adapt to the impacts of climate change by reducing exposure to climate hazards[11]. For example, mangroves store carbon but also help protect against floods and storm surges. Similarly, restoring and protecting forests can lower flood risks, soil erosion and landslides. Nature-based solutions can also help communities adapt to climate change by providing shade and cooling, securing freshwater supply, increasing crop yields in a drier climate, and providing diverse sources of income[11]. Some nature-based solutions also help sustain biodiversity by enhancing the health of natural habitats.

There are therefore many co-benefits of nature-based solutions, even if they can only provide a small or short-term benefit to mitigating global warming.

Concerns around nature-based solutions

An increasing number of companies seeking to reach net-zero are turning to nature-based solutions to offset their carbon emissions[5]. To achieve net-zero commitments, companies can:

- decrease their emissions as much as possible to close to zero, or
- emit carbon but cancel out those emissions using nature-based solutions, or
- do a combination of both activities.

Offsetting carbon emissions involves buying carbon offsets, i.e. certificates that are issued when carbon is removed or prevented from entering the atmosphere through various environmental projects. For example, if a company emits one tonne of CO_2, it can purchase a carbon offset generated by a nature-based project such as a reforestation project, which removes an equivalent amount of CO_2. This approach allows companies to claim "net zero" or "an emissions reduction" while still actually emitting CO_2.

For nature-based solutions to make a genuine contribution to reducing global warming, the nature-based solution needs to actually reduce the amount of CO_2 in the atmosphere.

By burning fossil fuels, companies release carbon that is millions of years old. To compensate these emissions, nature-based solutions need to remove and store CO_2 for centuries or millennia. However, CO_2 sequestered using nature-based solutions may have a storage timescale of years, decades or perhaps a century, because many of them are particularly vulnerable to external disturbances[12]. Some of this is by design – a company might plant a forest with plans to harvest the wood after 30 years. This may be a good business decision, but it does not mitigate global warming unless the wood is used in some way that avoids the carbon being emitted. Any co-benefits such as biodiversity benefits or local climate adaptation are also lost when forests are harvested.

Restoration of threatened temperate coastal wetland, Grace Isdale NRM South.

Another problem with nature-based solutions relates to constraints on land area and tree growth which limit the capacity of nature-based solutions to offset fossil fuel emissions[13]. Some land areas well-suited for large-scale forestation are used for agriculture which risks food security if now replaced by forests.

Given these limitations, claiming a trajectory towards net zero via use of nature-based solutions without cutting actual emissions to close to zero is at severe risk of "green-washing". A good rule of thumb is to assess a company's trajectory towards net-zero in terms of total Scope 1, Scope 2 and Scope 3 emissions, which represent a company's direct and indirect emissions. These actual emissions need to be drastically reduced if there is an aim of reaching net zero by 2050. Any fraction of mitigation achieved via offsetting needs to be made explicit.

Looking forward ...

Nature-based solutions can contribute towards some mitigation of global warming by harnessing the natural capacity of ecosystems to absorb CO_2. These approaches can also provide adaptation benefits for communities and support biodiversity.

However, while there are exemplar projects, particularly projects that protect ecosystems and therefore avoid additional emissions, the amount of CO_2 that projects could remove and retain from the atmosphere is dwarfed by human emissions of CO_2. Further, the length of time these projects will actually remove CO_2 from the atmosphere is highly variable and none remove it to a timescale that approximate the natural timescales of coal and gas storage in natural reservoirs[5].

Uncertainties regarding the vulnerability of nature-based solutions to external disturbances, including direct disturbance associated with climate extremes, and limited land and ocean areas to develop long-term storage capacity highlight that approaches to offset CO_2 emissions via nature-based solutions are unlikely to be more than a small fraction of any mitigation strategy.

Fundamentally, achieving the Paris climate goals requires first and foremost a far-reaching and rapid reduction in greenhouse gas emissions and urgent action to decarbonise our economies. Eliminating CO_2 emissions from all sectors is obviously challenging,but nature-based solutions should only be implemented in addition to deep and rapid fossil-fuel emission reductions to help remove the emissions that remain impossible to avoid.

Restoring Native Vegetation For Malleefowl Habitat - Greening Australia. Image Source: https://www.greeningaustralia.org.au/restoring-native-vegetation-for-malleefowl-habitat/

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