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JUNE
2022

CLIMATE CHANGE

Science Brief for Target 8 of the Post-2020 Global Biodiversity Framework

TARGET 8 – CLIMATE CHANGE

SCIENCE BRIEFS ON TARGETS, GOALS AND MONITORING IN SUPPORT OF THE POST-2020 GLOBAL BIODIVERSITY FRAMEWORK NEGOTIATIONS

JUNE 2022

Citation:

Secretariat of the Convention on Biological Diversity. Science briefs on targets, goals and monitoring in support of the post-2020 global biodiversity framework negotiations. 2022. CBD/WG2020/4/INF/2/Rev.2.
Available from: https://www.cbd.int/doc/c/c874/6eb7/813f0201cd67299c9eb10a4a/wg2020-04-inf-02-rev-02-en.pdf

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TARGET 8 – CLIMATE CHANGE

Background on the science briefs

The bioDISCOVERY programme of Future Earth and the Secretariat of the Group on Earth Observations Biodiversity Observation Network (GEO BON), convened a group of experts to prepare six briefs to provide scientific support for the negotiations of the post-2020 global biodiversity framework (GBF) at the fourth meeting of the Working Group on the Post-2020 Global Biodiversity Framework in Nairobi, from 21 to 26 June 2022. This includes four briefs on individual Targets 3, 7, 8 and 10; a brief on the GBF monitoring framework; and a brief on the ecosystem area and integrity objectives of the GBF that also addresses Targets 1 and 2 in detail.

The analysis in this brief focuses on the wording and quantitative elements of Target 8, definitions of key terminology, and assessment of the adequacy and availability of indicators for tracking achievement of this target.

This analysis is based on the text of the first draft of the post-2020 global biodiversity framework, CBD/WG2020/3/3 and subsequent negotiations of this text:

> ***Target 8. Minimize the impact of climate change on biodiversity, contribute to mitigation and adaptation through ecosystem-based approaches, contributing at least 10 GtCO$_2$e per year to global mitigation efforts, and ensure that all mitigation and adaptation efforts avoid negative impacts on biodiversity***.

Structure of this brief

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KEY MESSAGES CONCERNING THE CLIMATE CHANGE OBJECTIVES OF TARGET 8

Minimize the impact of climate change on biodiversity

- Keeping climate change to the Paris Agreement objectives of "well below 2°C, and as close as possible to 1.5°C" is essential to achieving the GBF objectives. Even at these levels, climate change will increase extinction risk, cause large shifts in species distributions, alter ecosystem functioning, and compromise nature's contributions to people.
- Improving the resilience of species and ecosystems in the face of climate change is essential. This can be achieved by reducing additional and interacting pressures on biodiversity from land and sea use change, overexploitation, invasive alien species and pollution.
- Spatial planning to protect large areas of intact ecosystems and increase connectivity in multifunctional land and sea-scapes is crucial for climate change adaptation because it will facilitate species range shifts in response to climate change.

Mitigation and adaptation through "ecosystem-based approaches" / "nature-based solutions"

- The conservation and restoration of nature can significantly contribute to climate mitigation. For example, the protection of intact ecosystems and restoration of degraded ecosystems are among the most rapid and cost-effective means of climate mitigation, and can provide a range of other benefits.
- Protecting and restoring natural ecosystems helps species, ecosystems and people to adapt to climate change. For example, protecting and restoring coastal wetlands, mangroves and coral reefs enhances the capacity of socio-ecosystems to adapt to rising sea levels.
- Increasing the integrity of ecosystems used for agriculture, forestry and fisheries, in particular through management practices that reinforce biodiversity, can greatly improve the capacity of these ecosystems and people to adapt to climate change.
- Clear definitions and bounds on ecosystem-based approaches / nature-based solutions for climate are needed to avoid perverse effects on nature and people, and focus should be on measures that provide "wins" for climate, biodiversity and human well-being. Involvement of local actors is essential, taking into account all forms of relevant information, including scientific, cultural and local knowledge, innovations and practices.
- Failure to greatly reduce emissions from all sectors including energy, transport and agriculture will increase climate risks for natural systems and compromise their contributions to mitigation.

Quantitative objective for climate mitigation

- A combination of nature-based solutions / ecosystem-based approaches to mitigation can potentially provide between 5 and 10 $GtCO_2e$ per year mitigation cost-effectively, without compromising production of food and fibre, and with strong safeguards for biodiversity. Achieving these levels of mitigation requires substantial reductions in loss and degradation of natural ecosystems, and large increases in restoration compared to the period 2010-2020. It is essential to note that respecting these safeguards and achieving the high-end estimate of 10 $GtCO_2e$ per year requires ambitious and deep systemic changes in production and consumption, and is broadly consistent with a 5% net gain in natural ecosystems by 2030.
- Setting an ecosystem-based mitigation target in the GBF would be an important complement to goals in the UNFCCC, because it more explicitly stipulates safeguards for biodiversity.

Avoiding negative impacts of mitigation and adaptation efforts on biodiversity

- Competition for land, in particular arising from climate mitigation based on large-scale afforestation and bioenergy production, could be particularly detrimental for biodiversity. Adverse impacts on biodiversity arising from technological measures for adaptation such as construction of dams, seawalls and new irrigation capacity for agriculture should also be avoided.
- Mitigation and adaptation interventions must be well designed and implemented in order to avoid adverse impacts on nature and people, emphasizing equity and social justice.

BACKGROUND ON THE CLIMATE ADAPTATION AND MITIGATION OBJECTIVES OF TARGET 8

1) Relevance for biodiversity, nature's contributions to people and good quality of life

Minimizing the impact of climate change on biodiversity requires prevention of further loss of natural habitats and native species, restoring ecosystems to a natural condition, and sustainable use of natural resources (Pörtner et al. 2021, Costello et al. 2022, Shin et al. 2022). These same actions are critical to ensure biodiversity support of climate mitigation and adaptation (Pörtner et al. 2021).

There is robust evidence that climate change is already impacting biodiversity and ecosystem processes in marine, terrestrial and freshwater realms and that these impacts are projected to substantially increase over the coming decades (Arneth et al. 2020, Pörtner et al. 2021, IPCC 2022a; see Appendix – Figure 1 for a summary). A significant portion of marine, aquatic and terrestrial species may face risk of extinction during this century as a result of climate change (Arneth et al. 2020, IPCC 2022a). Further, such impacts will interact with other drivers of change in biodiversity and ecosystem services (this is also critical in terms of relevance of this target to other targets, and vice versa). Finally, **climate change is projected to overtake the pace of other drivers of biodiversity loss in the next few decades in some regions, even in low greenhouse gas emissions scenarios** such as RCP 2.6 by 2050 (Arneth et al. 2020, IPCC 2022a).

The benefits of conserving and restoring biodiversity in the context of climate change are multiple (Arneth et al. 2021, Mori 2020, Mori et al. 2021, Pörtner et al. 2021, Shin et al. 2022, IPCC 2022a):

- Significant carbon is stored in soils, sediments and living biomass in terrestrial, coastal, and marine ecosystems, and release of this carbon into the atmosphere, which is amplified through biodiversity loss, needs to be minimized.
- The capture of greenhouse gases by living organisms from the atmosphere and water reduces climate forcing (e.g., warming), and increases these carbon stores (e.g., potential in global forests; Mori et al. 2021, Pörtner et al. 2021). Terrestrial ecosystem CO_2 uptake is large, and is key in climate change mitigation scenarios (Arneth et al. 2020, IPCC 2022a, IPCC 2022b). How ecosystems transfer carbon into the sedimentary stores is complex and involves many uncertainties, particularly in relation to long term storage, which is essential for effective mitigation (IPCC 2022a).
- **Ecosystems generate multiple contributions of nature to people, in addition to their climate-related benefits. Target actions must thus be designed to suit local ecological and social conditions, with explicit involvement of local communities to co-design and implement actions that assure co-benefits for climate mitigation, climate adaptation and nature's contributions to people**, and to prevent potential negative impacts (Pörtner et al. 2021).

Protecting biodiversity and avoiding dangerous climate change are complementary within the mandates of the Convention on Biological Diversity (CBD) (this biodiversity framework), and the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC)—and both are intended to help countries deliver a good quality of life for all people under the UN Sustainable Development Goals (SDGs). Target framing must address these joint policy spheres to assure a multiple benefits approach—ideally, with "win-win-win" delivery of biodiversity gains, support of climate mitigation and adaptation, and benefits to people that are equitably delivered.

2) Target formulation, numerical elements, indicators and impacts on SDGs

Target 8 was analysed in this brief by breaking it down into its individual components. This is similar to the approach used for the Aichi Target analyses in the Global Biodiversity Outlooks 4 and 5, as well as the "one-pager" summaries of the GBF goals, milestones and targets (CBD/WG2020/3/INF/3).

➢ ***Minimize negative impacts of climate change on biodiversity***

Climate change impacts on species occur at a range of scales (from genes and individuals to populations), at habitat and ecosystem scales, they may occur through changes in interspecies interactions (e.g., competition, predation or disease), and through community composition (Scheffers et al. 2016), ecosystem function and ecosystem structure (See Appendix – Figure 1; Arneth et al. 2020; Pörtner et al. 2021). **Other anthropogenic pressures and direct drivers—including land/sea-use change, direct exploitation of organisms, pollution and invasive alien species—interact with climate change, often aggravating climate change impacts on biodiversity and ecosystem function and may collectively create large-scale regime shifts that are very difficult to reverse** (Arneth et al. 2020, Pörtner et al. 2021, IPCC 2022a). It follows that such drivers must be addressed in addition to attention to climate change.

Further, **conservation actions need to be made more 'climate smart'** (e.g., Arafeh-Dalmau et al. 2021, Pörtner et al. 2021, Brito-Morales 2022); in part through increasingly applying climate change vulnerability assessments of species, ecosystems and protected areas; but also addressing non-climate (interacting) drivers (see above, and below). **Static biodiversity conservation targets that do not take climate change scenarios into account will fall far short of achieving their objectives over the next few decades** (Arneth et al. 2020). One of the challenges is that the nature of climate impacts on biodiversity and ecosystem services is projected to lead to 'no analog' challenges (e.g., novel plant and animal interactions and communities) in biodiversity conservation, effectively requiring flexible, adaptable, evidence-based and dynamic approaches to conservation planning (Arneth et al. 2020). Such conservation actions would include attention to other (often interactive) drivers—for example, in marine and coastal areas, coordinated actions also addressing non climate stressors such as overfishing and direct damage to reefs. Finally, such actions must also be more culturally informed, societally inclusive and adaptive processes; avoiding the creation of so-called 'winners' and 'losers'—with a strong emphasis on social equity and justice (Pörtner et al. 2021).

➢ ***Contribute to mitigation and adaptation through ecosystem-based approaches***

<u>"Contribute to mitigation and adaptation"</u> – Ecosystem-based approaches can contribute to both mitigation and adaptation (e.g., Pörtner et al. 202, Shin et al. 2022; Smith et al. 2022, Appendix – Figures 3, 4 & 5); although, as indicated elsewhere in the brief, such approaches must be carefully designed and implemented, based on up-to-date evidence. Figure 5 in the Appendix (from Smith et al. 2022) shows a summary of impacts of a range of climate mitigation and adaptation practices based on land and ocean management that differ substantially in their benefits for climate mitigation and adaptation potential, as well as effects on biodiversity.

For example, **restoration and reduced losses of coastal wetlands could provide 0.3-3 $GtCO_2e$ yr^{-1} of climate mitigation, increase adaptive capacity for 100's of millions of people and benefit biodiversity** (See Appendix – Figure 5). Conversely, **afforestation could potentially provide high mitigation contributions if designed and managed carefully, but if done at scales needed to achieve these high contributions afforestation would likely have large negative impacts on biodiversity, little benefit in terms of climate adaptation capacity and compromise food security** (Pörtner et al. 2021, Shin et al. 2022, Smith et al. 2022, Appendix – Figure 5). In particular, monoculture tree plantations are of little benefit or even detrimental for biodiversity and do not provide significant adaptation benefits, and large-scale planting of trees in grasslands may often negatively impact biodiversity and ecosystem services, and may not provide sought after climate mitigation benefits (Pörtner et al. 2021).

Interventions focusing on climate mitigation can have positive synergies with adaptation, as well as benefiting biodiversity. The IPCC SRCCL report (IPCC 2019) for example, shows five options with large mitigation potential, and a further five with moderate mitigation potential that have either limited or no adverse impacts on other land challenges. These include improving carbon uptake potential through avoided conversion of natural land, and restoration; as well as improving yields through sustainable managing agricultural and forest lands (IPCC 2019, 2022a, 2022b, Smith et al. 2022). The latter also holds co-benefits for climate adaptation, as well-informed sustainable management of managed ecosystems can help improve the resilience of the agricultural and forestry sectors under future climate change (Pörtner et al. 2021; and see, for example, Hall 2019 and Mastretta-Yanes et al. 2018, demonstrating how genetic diversity provides a clear benefit in resilience and multiple benefits in livestock and domesticated plants and their wild relatives respectively).

Pörtner et al. (2021) provide numerous examples of nature-based solutions that can contribute to climate adaptation. These nature-based interventions typically come with important co-benefits for biodiversity and a wide range of ecosystem services, and many also help reduce risk in the face of uncertainty. Pörtner et al. found that "nature-based measures often focus on maintaining and restoring genetic and species diversity and abundance, or on preserving, restoring or creating healthy ecosystems." They also concluded that "**diversification of agricultural land use types, the genetic variety of crops, and tree species helps spread risk. Such diversification can make social-ecological systems more resilient to climate change and increase genetic, species and habitat diversity**. Current economic incentives within agriculture, forestry and fisheries, however, do not promote such diversification and fail to reflect the multiple ecosystem services that contribute to human well-being."

"Through ecosystem-based approaches" – There has been considerable debate during the negotiations of the GBF about the use of "ecosystem-based approaches", "nature-based solutions" and other terminology. This brief uses the terms "ecosystem-based approaches", "nature-based solutions", and for climate adaptation, "ecosystem-based adaptation" interchangeably, but acknowledges that they must be defined with clear safeguards for nature and people, and that these terms have different histories of use that colour their perception. The use of these terms in this target and the need for clear definitions are discussed briefly below, but there is not a strong scientific case for prioritizing one particular terminology.

The terms "ecosystem-based adaptation (EbA)", "ecosystem-based approaches" and "nature-based solutions (NbS)" have gained frequent usage in the context of employing ecosystems to mitigate climate change and/or increase the capacity of nature and people to adapt to climate change (Nalau and Verrall 2021; Pörtner et al. 2021). EbA and NbS are used even more broadly to refer to measures that address a range of challenges including food security, disaster risk and exposure, infrastructure, amongst others (Appendix – Figure 2, see section on indicators below). These terms are part of a larger set of terminology with similar, but not identical, meanings including "natural climate solutions" (e.g., Griscolm et al. 2017).

The term "nature-based solutions (NbS)", was formally adopted at UNEA-5 (2022, UNEP/EA.5/Res.5) and defined as "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 and resilience and biodiversity benefits." The resolution also calls for implementations of nature-based solutions to safeguard the rights of communities and indigenous peoples. The concept and use of NbS is controversial, including in the context of climate adaptation and mitigation, since NbS is sometimes used to refer to climate mitigation and adaptation solutions without adequate safeguards for biodiversity (Nesshöver et al. 2017, Seddon et al. 2020). In addition, NbS definitions often do not clearly specify the role of local communities in design and implementation (Seddon et al. 2020, UNEP & IUCN 2021, Welden et al. 2021). This has been addressed in the UNEA definition. EbA and NbS share much in common, but EbA more explicitly places an emphasis on participatory, local scale climate adaptation strategies that take into account social, economic and cultural benefits for local communities (CBD 2009).

"Ecosystem-based approaches" are defined as "the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way" and is an integral part of CBD terminology (CBD SBSTTA 2007). The implementation of ecosystem approaches has encountered a number of challenges (CBD SBSTTA 2007, Waylen et al. 2014), and while it rapidly gained usage in the scientific literature in the 1990's and early 2000's its use has waned considerably since (Waylen et al. 2014). The concept of "ecosystem approaches" has been interpreted and applied in widely different ways (CBD SBSTTA 2007, De Lucia 2015, Waylen et al. 2014,) and is "elusive, unstable and, importantly, contested" making it "susceptible to discursive capture by competing narratives" (De Lucia 2015). Thus, the term "ecosystem-based approaches" faces many of the same challenges as NbS, and must be carefully defined in the context of climate adaptation and mitigation strategies if it is used in the wording of Target 8.

- ***Contribute at least 10 GtCO_2e per year to global mitigation efforts***

Setting an ecosystem-based mitigation target in the GBF would be an important complement to climate mitigation goals in the UNFCCC, because it explicitly stipulates safeguards for biodiversity. In particular, treatment of the land-use sector under the 2015 Paris Agreement raises two major concerns. First, the climate convention lacks sufficient safeguards for biodiversity and should move towards greater recognition of governance, biodiversity conservation and a rights-based approach as fundamental enabling conditions (Korwin et al. 2015, Rockström et al. 2021). For example, several land-based measures that have been promoted in the name of climate mitigation can have very large negative impacts on biodiversity if poorly planned, poorly implemented or deployed at too large scales (Pörtner et al. 2021, Smith et al. 2022, Appendix – Figure 5, and see previous and following sections). Second, a carbon sequestration target supported by ecosystem-based solutions is only effective in mitigating climate change when accompanied by full emission reductions in all sectors of the economy, as the ability of natural systems to sequester carbon permanently is undermined by additional emissions (Pörtner et al. 2021, Smith et al. 2022). To meet the Paris Agreement target of warming below 2°C, the vast majority of mitigation efforts must come from swift and ambitious reductions in fossil fuel emissions (Pörtner et al. 2021, Smith et al. 2022, IPCC 2022b).

The wording of Target 8 in the first draft of the GBF includes a contribution of ecosystem-based approaches of at least 10 $GtCO_2e$ per year to global mitigation efforts (see also Appendix – Figure 2). This is a very ambitious target, corresponding to approximately one half of the total amount of carbon dioxide currently absorbed by natural systems on land and at sea, and comprising one fifth of the annual mitigation effort called for by the Paris Agreement, to be achieved through natural solutions. **The most recent scientific evidence is in agreement that ambitious implementation of ecosystem approaches / nature-based solutions can potentially contribute 5 $GtCO_2e$ per year to climate mitigation efforts with very ambitious efforts for conservation and restoration, as well as in making production and consumption far more sustainable. This could potentially reach 10 $GtCO_2e$ per year with extremely ambitious efforts** (see below, and also Target 10 brief). All of the studies below include the constraints that the ecosystem approaches / nature-based solutions are cost-effective, do not compromise food security, and have strong safeguards for biodiversity. Most of these measures have benefits for biodiversity. **An important caveat is that these solutions are sensitive to climate change: failure to greatly reduce emissions from all sectors including energy, transport and agriculture will increase climate risks for natural systems and greatly limit their contributions to mitigation and could potentially turn them into a source rather than a sink for carbon** (Pörtner et al. 2021).

- IPCC (2022b) – "The projected economic mitigation potential of AFOLU {Agriculture, Forestry and Other Land Use} options between 2020 and 2050, at costs below USD100 $tCO_2\text{-eq}^{-1}$, is 8-14 $GtCO_2\text{-eq yr}^{-1}$ (high confidence). 30-50% of this potential is available at less than USD20/tCO_2e and could be upscaled in the near term across most regions (high confidence). The largest share of this economic potential [4.2-7.4 $GtCO_2e\ yr^{-1}$] comes from the conservation, improved management, and restoration of forests and other ecosystems (coastal wetlands, peatlands, savannas and grasslands), with reduced deforestation in tropical regions having the highest total mitigation."

- Girardin et al. (2021) – "Solutions that avoid emissions ramp up quickly — by 2025 — and absorb carbon while avoiding emissions at a rate of 10 gigatonnes of CO_2 {equivalent} per year (Gt CO_2 yr^{-1})" (See Appendix – Figure 4). This scenario includes the constraints that it is cost-effective; ensures adequate global production of food and wood-based products; involves sufficient biodiversity conservation; and respects land-tenure rights.

- United Nations Environment Programme and International Union for Conservation of Nature (2021) – "A cautious interpretation of the existing evidence, taking account of associated uncertainties and the time needed to deploy safeguards, indicates that by 2030, nature-based solutions implemented across all ecosystems can deliver emission reductions and removals of at least 5 $GtCO_2e$ per year, of a maximum estimate of 11.7 $GtCO_2e$ per year. By 2050, this rises to at least 10 GtCO2e per year, of a maximum estimate of 18 GtCO2e per year." Based on the analysis of Griscolm et al. (2017), Roe et al. (2021), Girardin et al. (2021, see above), McKinsey (2021) and Wilkinson (2020).

- Pörtner et al. (2021) and Smith et al. (2022) – A wide range of nature-based solutions have large climate mitigation and adaptation potential and include benefits for biodiversity. These are summarized in Appendix – Figure 5. Fully implemented across ocean and land systems including both natural and managed ecosystems, the combined mitigation potential of these measures is greater than 5 $GtCO_2e$ per year.

- Strassburg et al. (2020) – "We find that restoring 15% of converted lands in priority areas could avoid 60% of expected extinctions while sequestering 299 gigatonnes of CO_2—30% of the total CO_2 increase in the atmosphere since the Industrial Revolution." This level of restoration of converted land by 2050 is roughly what is needed to achieve Goal A and is equivalent to 10.8 $GtCO_2e$ per year between 2023 and 2050.

Achieving the ambitious mitigation potentials from NbS will require transformative changes that are very similar to those required to achieve the ambitious net gains in ecosystem integrity and area in Goal A, as well as a wide range of other Sustainable Development Goals (Soergel et al. 2021, Leadley et al. 2022). Deep, systemic changes in production and consumption will be needed in addition to strong protection and restoration measures, especially to achieve the higher end of the NbS potential. These changes include large reductions in food loss and food waste, rapid shifts towards more sustainable diets and sustainable intensification of agriculture, especially in those areas with large yield gaps (Appendix – Figure 5, Leadley et al. 2022).

➢ ***Mitigation and adaptation efforts avoid negative impacts on biodiversity***

Both adaptation and mitigation interventions may, if poorly planned and/or implemented, negatively impact biodiversity - and they can, for example, have significantly different impacts on biodiversity depending on the type of intervention. For example, in the case of adaptation, the development of Urban Green Spaces is likely to have very different implications for biodiversity as opposed to engineering solutions such as flood mitigation infrastructure (Pörtner et al. 2021). It is thus essential to understand different categories or typologies of such measures, as well as their implications for biodiversity if designed and/or implemented in a particular way (for example, Table 4.1 from Pörtner et al. 2021 shows different risks and opportunities associated with particular adaptation interventions - including the role of financial incentives and disincentives). Further, in the case of both adaptation and mitigation measures, such interventions should not negatively impact human well-being – issues of social equity and justice are paramount; and the emphasis should be on avoiding creating winners or losers with such measures (for example, expansion of protected areas as an adaptive measure for conservation that dispossesses a local community of either land, or access to key ecosystem services of such land) (Lunstrum 2015, Pörtner et al. 2021).

The three points outlined in the first section of this brief are critical to ensure that solutions are fully based on locally relevant ecosystem criteria, and, further, that secondary or cascading impacts are not negative for either natural systems or for people. For example, commercial non-native forestry to maximize wood growth and carbon capture may (if neither planned nor implemented properly) be detrimental to native biodiversity, change natural dynamics catastrophically (e.g., fires) and/or may cease to support native biota used in food, medicines and cultural practices – thus cannot be considered a 'nature-based solution' under this Target.

Actions must be 'future-proofed' and forward-looking, to consider their function and viability in future decades (e.g., in 20, 30, and even 50 years) – climate migration, changing natural processes (e.g., rainfall, fire regimes, ocean currents, etc.) should be considered, amongst other potentially confounding factors (Liz et al. 2022; Pörtner et al. 2021; van Kerkhoff et al. 2019).

➢ **Linkages to other targets**

Target 8 has direct co-benefits and interactions in 14 out of the 21 action targets of the GBF, notwithstanding a range of indirect links (see below). Examples include:

Target 10 – increase in production land and sea-scapes has been facilitated by fossil fuel-based energy that clear-cuts forests and trawls, dredges and mines the seabed. Managing all production scapes for sustainability, preventing further habitat loss and halting damaging methods will immediately reduce greenhouse gas emissions (as well as a range of other co-benefits).

Target 18 - the removal of financial subsidies to fossil fuels, commercial agriculture and commercial fisheries, among other sectors, would reduce fossil fuel emissions, and in some cases such as fishing, reduce pressure and help restore fisheries, supporting mitigation and adaptation.

Indicators for a range of targets indirectly contribute to Target 8 (for example, T1, T2 and T3, implemented with an eye to multiple benefits, could both support biodiversity conservation and benefits in response to climate (adaptation and/or mitigation). However, to maximize the contribution that actions under these targets make to "minimizing the impact of climate change on biodiversity", a stronger emphasis needs to be placed on indicators which explicitly account for the impact that resulting changes in the area, connectivity and integrity of natural ecosystems are expected to have on the capacity of landscapes and seascapes to retain biodiversity in the face of climate change (see Indicators section below).

3) Indicators

➢ ***Indicators in GBF monitoring framework***

Headline in bold, component indicators in plain and *complementary indicators in italics (pre-SBSTTA 24)*

8.0.1 National [net] green-house[emissions] [gas inventories] from land use and land use change [by land use and land use change category, subcategory, [and]natural/modified]

8.1.1 Number of countries with NDCs, long-term strategies, national adaptation plans and adaptation communications that reflect biodiversity (based on information from UNFCCC and SDG 13.2.1)

8.2.1. Total climate regulation services provided by ecosystems by ecosystem type (System of Environmental Economic Accounts)

8.3.1 Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030 which include biodiversity (based on SDG 13.2.1)

t8.1. Above-ground biomass stock in forest (tonnes/ha)

t8.2. Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030 (SDG indicator 13.1.2)

t8.3. Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies (SDG indicator 13.1.3)

t8.4. Number of least developed countries and small island developing States with NDCs, long-term strategies, national adaptation plans, strategies as reported in adaptation communications and national communications (SDG indicator 13.b.1)

➢ ***Comments on indicators and possible additional indicators***

None of the indicators listed for Target 8 in the draft monitoring framework explicitly addresses the extent to which actions enhancing the area, connectivity and integrity of natural ecosystems will "minimize the impact of climate change on biodiversity". Conversely, this critically important relationship is currently addressed by only one of the many indicators listed for Goal A and Targets 1, 2 and 3—i.e., the Bioclimatic Ecosystem Resilience Index (BERI; Ferrier et al. 2020), listed as a complementary indicator for Goal A and Target 2. At the recent SBSTTA sessions in Geneva, a proposal was made to also include the BERI as a headline indicator for Target 8 (Appendix 2 of CBD/SBSTTA/REC/24/2) which would go a long way towards filling this gap, at least for terrestrial systems.

4) Linkages to other relevant international agreements, bodies and monitoring efforts

Those policies and monitoring efforts described here are selected as those with the most immediate relevant linkages. They are by no means exhaustive, and are all international in scale. Strong recognition also needs to be given to interventions at local, national and regional scales where climate-biodiversity multiple benefits are realized through innovative design and proper implementation.

The international measures include the journey from the 2015 Paris Agreement to the 2021 Glasgow COP; where the latter effectively had the aim of making the Paris Agreement fully operational. More specifically, the 2021 Glasgow Climate Pact, amongst other measures, strengthened efforts to build resilience to climate change, to curb greenhouse gas emissions, and (in theory) to provide the necessary finance for both. As well as an effective statement of renewed commitment, Glasgow laid the ground for a collective agreement to reduce the gap between existing emission reduction plans and what is required to reduce emissions, to limit to 1.5 degrees. Glasgow effectively served as the first concrete call in this arena to phase out both coal power and inefficient subsidies for fossil fuels (received with some reluctance on the part of some member states). Finally, and critically for the GBF process and the focus of this brief, it constituted the first clear recognition of the role of nature in climate mitigation and adaptation (driven in part by IPCC-IPBES report, Pörtner et al. 2021).

Additional relevant international agreements include: i) the Strategic Plan for Biodiversity 2011-2020 and ongoing preparation for the post-2020 global biodiversity framework is of critical importance here – this brief effectively forms part of this process, ii) the Sendai Framework for Disaster Risk Reduction is integrated into targets and indicators (see t8.2 & 8.3.1) and iii), the 2030 Agenda for Sustainable Development, links to both component and complementary indicators, amongst others (see section on Linkages to Other Targets above).

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TARGET 8—CLIMATE OBJECTIVES – APPENDIX

Figure 1: Examples of future projected impacts of climate change and CO_2 on biodiversity and ecosystem processes (Source: Arneth *et al.* 2020; reproduced with permission of the authors)

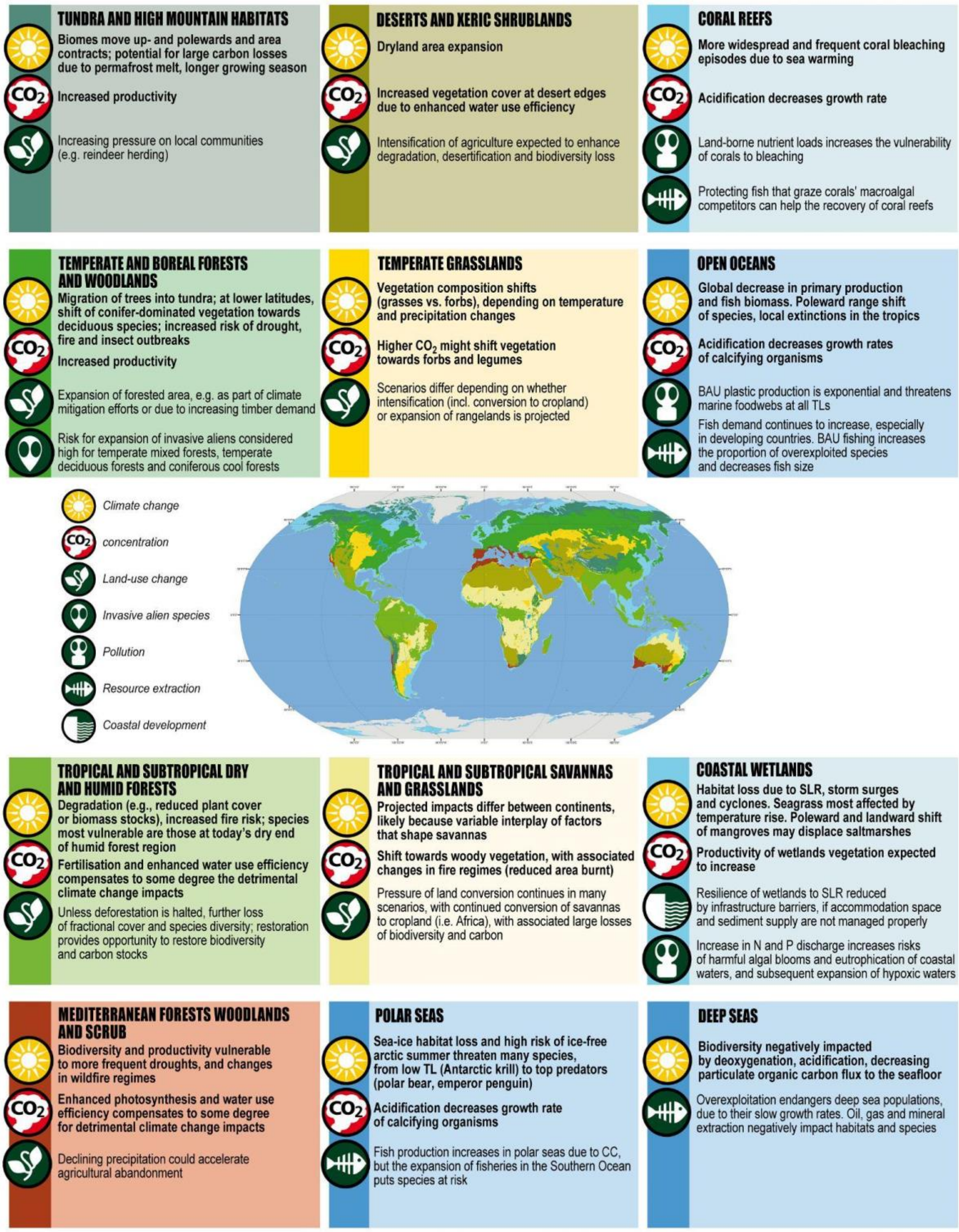

Figure 2: "Nature-based solutions" aid adaptation to, and mitigate against the effects of, climate change while restoring and protecting biodiversity. (Source: E. Archer, pers. communication)

Nature-based solutions

Actions	Terrestrial	Freshwater	Marine
Protect biodiversity	Protect native forests, bush, and grasslands	Stop pollution and sedimentation into streams, rivers, ponds, lakes.	Ban seabed trawling and dredging
	Control introduction and spread of invasive species and pests		
Reconnect habitats and populations	Use riverbank and hedgerow corridors to connect protected native habitats		Restrict fragmentation of habitats by coastal development and seabed trawling and dredging
	Reduce habitat and species loss outside protected areas to add species dispersal (corridors)		
Living with nature	Environmentally sustainable agriculture, tourism, and other land and freshwater uses		Environmentally sustainable aquaculture, fisheries, tourism,
Restoration and recovery	Rehabilitate old mines, quarries and industrial lands	Stabilise riverbanks. Remove weirs and artificial barriers to fish migration.	Ban removal marine life and habitat fishing in selected areas to allow passive recovery of habitats, natural population structure, and food webs
Rewilding	Reintroduce extirpated native species		
Reduce erosion, soil loss,	Plant forests and controlling grazing to enable uplands to absorb rainfall and reduce flash-floods		Protect sand-dune systems from erosion due to human and farm animal trampling.
Control flooding	. Set aside land for saltmarshes and mangroves to buffer against river and seawater flooding. Link estuarine and upriver protected areas to provide more wildlife habitat and absorb storm surges and floods.		
Urban development	Concentrate development to more cost efficiently manage transport and waste management infrastructure	Limit upland development to protect freshwater quality.	Ban construction in areas at risk of sea level rise and associated storm surges.
Greenhouse gas mitigation	Reforestation (especially mangroves); Revegetation; Fewer farm mammals	Repair and expand wetlands to capture and deposit carbon in soils.	Limit seabed disturbance by trawling and dredging that releases CO_2 and CH_4. Eliminate harmful fishery subsidies.
	Reduce use of fossil fuels and reapply subsidies to renewable energy sources.		
Carbon sequestration	Allow biodiversity to flourish and capture CO_2 from the air and sequester it in biomass, soils and sediments.		
	Manage forestry to maximise in situ food web biomass.	Rebuild fisheries to maximise in situ food web biomass.	
Social	Communicate information on the benefits of adaptation measures to the public		
Political and economic	Provide leadership and governance of mitigation and adaptation measures, including through regulations and economic incentives that guide the transition to a low carbon emission economy		
Scientific	Rapidly release and explain monitoring data to society so that the public and policy makers are informed of trends in biodiversity and related factors, including climate variables, extreme weather-related events, threatened and invasive species, natural habitats, and their relationships.		
	Conduct research to improve understanding of cause-effect relationships regarding environmental factors and biodiversity trends, including in nature conservation, forestry, agriculture, fisheries, and food production sectors, and improve projections of consequences of management action and inaction.		

Figure 3. Co-benefits of biodiversity protection and restoration for climate mitigation (Source: Shin et al*.* 2022; Pörtner et al. 2021).

	Post-2020 Action targets for 2030		Biodiversity measures (& corresponding sections in the main text)	Climate change mitigation
Reducing threats to biodiversity	T1	Biodiversity-inclusive spatial planning addressing land/sea use change, retaining intact & wilderness areas	Avoiding deforestation (2.1)	+
			Avoiding degradation of permafrost areas (2.1)	+
	T2	Restoration of at least 20% of degraded ecosystems, ensured connectivity & focus on priority areas	Reforestation, avoiding forests degradation (2.1)	+
			Coastal restoration (2.1)	+
			Restoring degraded semi-arid ecosystems (2.1)	?
			Restoring inland wetlands (2.1)	?
			Biodiversity offsets (2.1)	+
	T3	Well connected & effective system of protected areas, at least 30% of the planet	Expanding networks of protected areas & corridors (2.2)	++
	T4	Recovery & conservation of species of fauna & flora	Rewilding with large terrestrial mammals (2.3)	?
			Rebuilding marine megafauna (2.3)	+
	T5	Sustainable, legal & safe harvesting, trade & use of wild species	Sustainable fishing (2.4)	+
	T6	Prevention & reduced rate of introductions, control or eradication of invasive alien species		
	T7	Reduced pollution from all sources, including excess nutrients, pesticides, plastic waste	Reducing pollution from excess nutrients (2.5)	+
	T8	Impacts of climate change on biodiversity minimized, contributions to climate change mitigation, adaptation		++
Meeting people's needs	T9	Ensured benefits, incl. food security, medicines, & livelihoods, through sustainable management of wild species	Sustainable harvesting of wild species (2.4)	+
	T10	All areas under agriculture, aquaculture & forestry are managed sustainably, through biodiversity conservation & sustainable use & increased productivity & resilience	Biodiversity-friendly agricultural systems (2.6)	+
			Intensive vs less intensive agriculture (2.6)	+
			Combatting woody plant encroachment (2.6)	?
	T11	Contribution to regulation of air quality, hazards & extreme events & quality & quantity of water	(2)	?
	T12	Increased area of, access to, & benefits from green/blue spaces for health & well-being in urban areas	Increasing benefits from biodiversity & green/blue spaces in urban areas (2.7)	+
	T13	Ensured access to & the fair & equitable sharing of benefits from genetic resources & traditional knowledge		
Tools & solutions	T14	Biodiversity values integrated into policies, regulations, planning, development, poverty reduction, accounts & assessments	Mainstreaming biodiversity (2.8)	+
	T15	Dependencies & impacts on biodiversity assessed in all businesses, negative impacts halved	Sustainable food production & supply chains (2.4)	+
	T16	People are informed & enabled to make responsible choices, to halve the waste & reduce overconsumption where relevant	Sustainable consumption patterns (2.9)	+
	T17	Preventing, managing or controlling potential adverse impacts of biotechnology on biodiversity & human health		
	T18	Redirect, repurpose, reform or eliminate incentives harmful for biodiversity in a just & equitable way	Eliminating incentives harmful for biodiversity (2.10)	+
	T19	Increasing financial resources & flows to developing countries, ensured capacity-building, technology transfer & science cooperation		?
	T20	Relevant knowledge, incl. ILK, guides the management of biodiversity by promoting awareness, education & research		
	T21	Equitable & effective participation in decision-making by IPLCs, respecting their rights over lands, territories & resources		

Contribution to climate change mitigation

- Significantly positive, strong scientific evidence
- Potentially positive, incomplete evidence & quantification
- Unresolved, lack of evidence, system-dependent, tradeoffs
- Indirect positive
- Loose or non-existent link
- Negative, strong scientific evidence

Reliability of the mitigation outcome

++ High
\+ Medium
? Unresolved, lack of evidence

Figure 4. Potential global mitigation potential (avoided emissions and sequestration) from nature-based solutions (Source: Girardin et al. 2021)

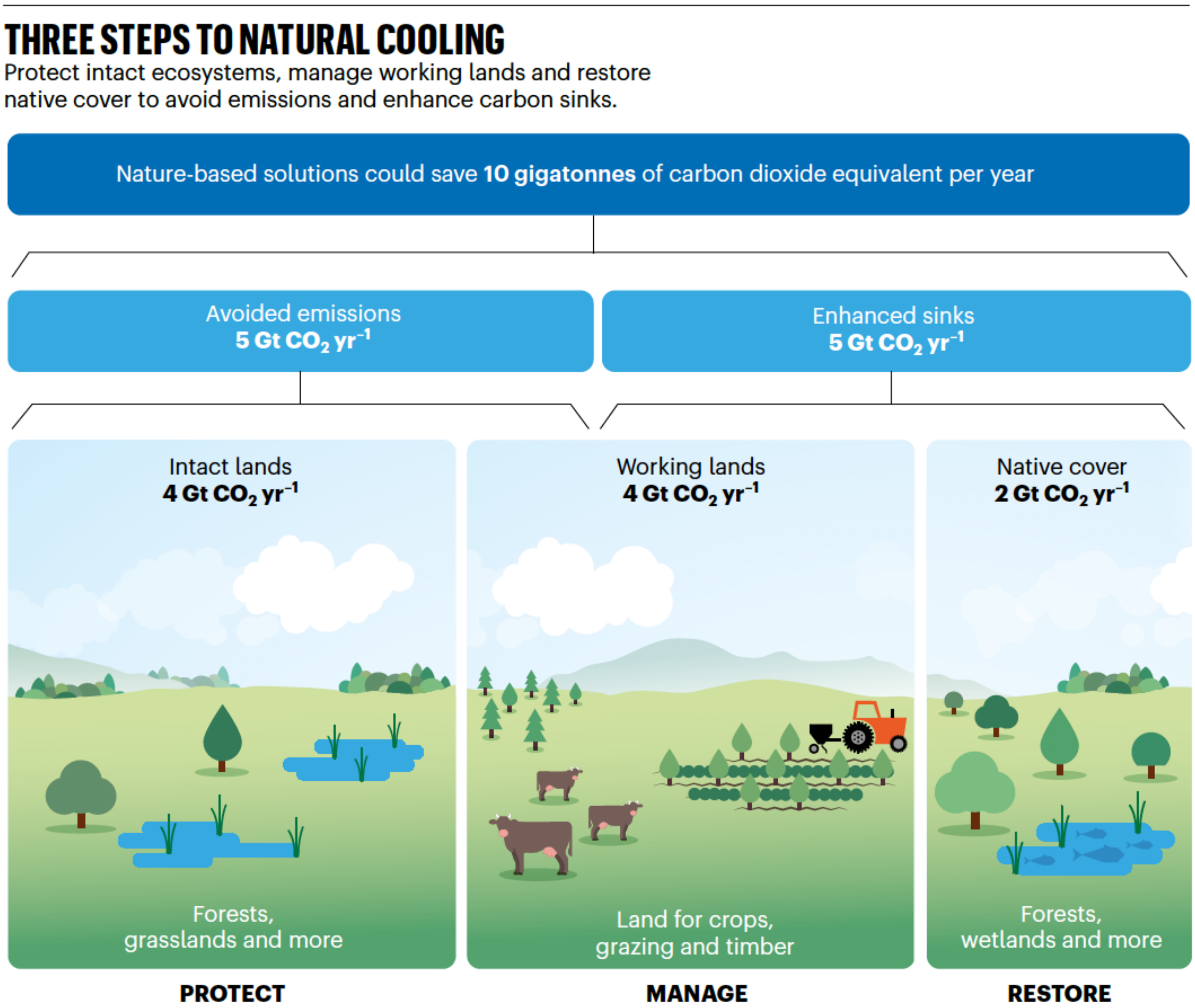

Figure 5. Estimates of climate mitigation potential and biodiversity co-benefits or trade-offs of a wide range of ocean- and land-based mitigation options. (Source: Smith et al. 2022).

Practice	Mitigation potential	Adaptation potential (estimated number of people more resilient to climate change from intervention)	Biodiversity impact (positive unless otherwise stated)	Summary/synopsis of overall expected impact
(a) Ocean				
Carbon storage in seabed	0.5–2.0 Gt $CO_2e\ yr^{-1}$	No global estimates	Low	
Costal and marine ecosystems	0.5-1.38 Gt $CO_2e\ yr^{-1}$	No global estimates	Medium/High	
Fisheries, aquaculture and dietary shifts	0.48–1.24 Gt $CO_2e\ yr^{-1}$	No global estimates	Medium/High	
Ocean-based renewable energy	0.76–5.4 Gt $CO_2e\ yr^{-1}$	No global estimates	Low	
(b) Land				
Increased food productivity	>13 Gt $CO_2e\ yr^{-1}$	>163 million people	High[1] or Low[2]	
Improved cropland management	1.4–2.3 Gt $CO_2e\ yr^{-1}$	>25 million people	Medium	
Improved grazing land management	1.4–1.8 Gt $CO_2e\ yr^{-1}$	1–25 million people	Medium	
Improved livestock management	0.2–2.4 Gt $CO_2e\ yr^{-1}$	1–25 million people	Medium	
Agroforestry	0.1–5.7 Gt $C_22e\ yr^{-1}$	2300 million people	High	
Agricultural diversification	> 0	>25 million people	High	
Reduced grassland conversion to cropland	0.03–0.7 Gt $CO_2e\ yr^{-1}$	No global estimates	High[3]	
Integrated water management	0.1–0.72 Gt $CO_2e\ yr^{-1}$	250 million people	Medium	
Improved and sustainable forest management	0.4–2.1 Gt $CO_2e\ yr^{-1}$	> 25 million people	High	
Reduced deforestation and degradation	0.4–5.8 Gt $CO_2e\ yr^{-1}$	1–25 million people	High	
Reforestation and forest restoration	1.5–10.1 Gt $CO_2e\ yr^{-1}$	>25 million people	High	
Afforestation	See Reforestation	No global estimates	Negative/low positive[4]	
Increased soil organic carbon content	0.4–8.6 Gt $CO_2e\ yr^{-1}$	Up to 3200 million people	Medium	
Reduced soil erosion	Source of 1.36–3.67 to sink of 0.44–3.67 Gt $CO_2e\ yr^{-1}$	Up to 3200 million people	Low	
Biochar addition to soil	0.03–6.6 Gt $CO_2e\ yr^{-1}$	Up to 3200 million people; but potential negative (unquantified) impacts if arable land used for feedstock production	Low[5]	
Fire management	0.48–8.1 Gt $CO_2e\ yr^{-1}$	> 5.8 million people affected by wildfire; max. 0.5 million deaths per year by smoke	Low	
Management of invasive species / encroachment	No global estimates	No global estimates	High	
Restoration and reduced conversion of coastal wetlands	0.3–3.1 Gt $CO_2e\ yr^{-1}$	up to 93–310 million people	High	

Restoration and reduced conversion of peatlands	0.6–2.0 Gt CCO_2e yr^{-1}	No global estimates	High	
Biodiversity conservation	0.9 Gt CO_2e-e yr^{-1}	Likely many millions	High	
Enhanced weathering of minerals	0.5–4.0 Gt CO_2e yr^{-1}	No global estimates	Insufficient data to make judgement	
Bioenergy and BECCS	0.4–11.3 Gt CO_2e yr^{-1}	Potentially large negative consequences from competition for arable land and water.	Negative/low positive[4]	
On-shore wind	Depends on what energy source is substituted	No global estimates	Low	
Solar panels on land	Depends on what energy source is substituted[6]			
(c) Demand changes (related to land)				
Dietary change	0.7–8.0 Gt CO_2e yr^{-1} (land)	No global estimates	High[7]	
Reduced post-harvest losses	4.5 Gt CO_2e yr^{-1}	320–400 million people	Medium/High	
Reduced food waste (consumer or retailer)	0.8–4.5 Gt CO_2e yr^{-1}	No global estimates	Medium/High	
Management of supply chains	No global estimates	>100 million	Medium[8]	
Enhanced urban food systems	No global estimates	No global estimates	Medium	

Mitigation potential · Adaptation potential · Possible adaptation potential · Negative impacts on biodiversity · Positive impacts on biodiversity

1. If achieved through sustainable intensification;
2. If achieved through increased agricultural inputs;
3. If conversion takes place in (semi-)natural grassland;
4. If small spatial scale and (for bioenergy) second generation bioenergy crops;
5. Low if biochar is sourced from forest ecosystems, application can be beneficial to soils locally;
6. See Creutzig et al. (2017) for a recent summary of energy potentials;
7. Due to land sparing;
8. Related to increased eco-labelling, which drives consumer purchases towards more ecosystem-friendly foods.

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