SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

The Food and Land Use Coalition

October 2021

The integration of biodiversity and climate objectives in land-use policy

SDSN Policy Brief

Strategies and tools to address the integration of nature and climate through a spatial lens

Contents

Headlines

- Integrating strategies for meeting climate and biodiversity objectives is critical so countries and businesses can meet more ambitious objectives with less effort and at lower cost.
- Such integration needs to involve spatial planning to manage competing demands on land (e.g., agriculture, conservation, urbanisation).
- Countries can map their natural stocks of carbon, biodiversity, and ecosystem services using a broad range of science-based tools. By understanding today's land use and drivers for land-use change, countries can plan towards sustainable land use by 2030.
- Spatial planning should be highly transparent, participatory, and iterative to ensure that the needs of local populations, including Indigenous peoples, are understood and incorporated.
- Spatial planning approaches need to be enabled and complemented by economic and financing strategies.
- The IPCC and IPBES can each play a critical role in building the knowledge base for improved policies by systematically considering biodiversity and climate perspectives and by promoting shared work.

About UN SDSN's Food/Land Team

The Food/Land team at the UN Sustainable Development Solutions Network (SDSN) is an interdisciplinary team working across three critical intervention areas related to sustainable food and land systems: 1) Efficient and resilient agricultural systems, 2) Conservation and restoration of biodiversity, and 3) Food security and healthy diets. Through this team, SDSN's work is linked up with and contributes to broader initiatives of the Food and Land Use (FOLU) Coalition. This work draws from SDSN-led and supported initiatives like the Food, Agriculture, Biodiversity, Land-Use, and Energy (FABLE) Consortium that supports countries to develop long-term pathways to transform their food and land systems, the FELD Action Tracker, Nature Map, and related projects on business metrics to align agri-food industries with the Paris Climate Agreement and the Sustainable Development Goals (SDGs).

https://www.foodandlandusecoalition.org/fable/ https://www.feldactiontracker.org

Executive Summary

Addressing the climate-biodiversity nexus requires a strong of their interlinkages.

This brief presents the scientific case for the need to integrate the biodiversity and climate agendas. It outlines practical steps for policymakers to operationalise the 30x30 target (conserving 30% of the Earth's land and sea areas by 2030) and meet the objectives of the Paris Agreement and Sustainable Development Goals.

The impacts of climate change and biodiversity loss are two of the most important global challenges and risks to society as actions taken to mitigate climate change can have either beneficial or harmful effects on biodiversity. For example, bioenergy crops that cover large shares of land can threaten biodiversity and food security. Nature-based solutions (NBS) approaches conserve biodiversity and support climate adaptation strategies, but they can only be effective with bold reductions in human-caused greenhouse gas (GHG) emissions. NBS in support of climate and nature can contribute to the delivery of net zero GHG commitments. Achieving net zero GHG emissions by 2050 will require major changes in the way countries manage the land, coast, and sea, alongside the decarbonisation of the energy, agriculture, land-use change and forestry sectors. It will also require developing clear, ambitious, and fair mitigation policies across all sectors and establishing robust accounting for carbon sinks.

Addressing the climate–biodiversity nexus requires a strong understanding of their interlinkages. Climate change exacerbates risks to biodiversity, while at the same time, ecosystems and their biodiversity play a key role in modulating the fluxes of greenhouse gases and climate adaptation. In addition, businesses rely on nature for resources, operations, supply chain performance, and more. For instance, Finance for Biodiversity (F4B) found that "28% of the global asset base held by development finance institutions is highly dependent on vulnerable forms of nature" (*The Climate–Nature Nexus Implications for the Financial Sector*, 2021).

There are four main advantages to integrated nature–climate policies for the biodiversity community and climate community (Schmidt-Traub et al., 2020).

Benefits for the biodiversity community:

1. It would allow the greatest alignment of national policy mechanisms across the three Rio Conventions without further negotiations and strengthen the political capacity to address the main drivers of land-use change.

2. It would raise the political visibility of nature and sustainable land-management given the significant influence and visibility of the UN Framework Convention on Climate Change (UNFCCC).

3. Projects that contribute to climate mitigation and adaptation through nature conservation and restoration would be eligible for climate finance under the UNFCCC.

4. It would elevate reporting and transparency standards for nature protection due to the UNFCCC's more rigorous requirements in comparison to the Convention on Biological Diversity (CBD).

Benefits for the climate community:

1. Biodiversity accounts for large carbon stocks (peatlands, forests, grasslands). For instance, peatlands are the largest natural terrestrial carbon store, so when damaged they are a major source of greenhouse gas emissions.

2. It would provide an integrated framework for nature-based solutions, as they address climate change while at the same time, provide benefits for biodiversity conservation.

3. Nature is critical for climate adaptation and resilience as effectively preserved ecosystems reduce the risks and impacts of extreme climatic events such as landslides or floods, whose frequency and intensity will be exacerbated by climate change.

4. Flagship species and characteristic megafauna are tools for public support for action on the environment (McGowan et al., 2020).

There are two critical tools to advance this approach: integrated, long-term strategies and a comprehensive spatial planning process.

Countries will need to align ambitious targets and strategies, such as Nationally Determined Contributions (NDCs), coordinated with their long-term low emission development strategies (LTS), mid-century net zero greenhouse gas pledges, and National Biodiversity Strategies and Action Plans (NBSAPs). To successfully implement these joint agendas, we need (i) ambitious economy-wide decarbonisation by 2050 to drastically reduce emissions and increase sinks, (ii) integrated, national long-term strategies, (iii) spatially explicit biodiversity restoration and conservation to inform integrated land-use planning policies, and (iv) poverty eradication and a just transition which places people at the centre of global efforts to transform energy, food and land-use systems to achieve climate, biodiversity, and sustainable development goals.

There are two critical tools to advance this approach: integrated, long-term strategies (FABLE, 2020; FOLU, 2019) and a spatial planning process that involves multiple experts (Jung et al., 2021; Schmidt-Traub et al., 2020) as per Target 1 of the first draft of the Global Biodiversity Framework which calls for spatial planning (CBD, 2021). **Maps and spatial planning are not the only answer, but a necessary step in developing policies that can meet land-use objectives outlined in such maps at the national and local levels.** According to our assessment of 111 updated or second NDCs, no NDC contains spatial data of current or intended land use to meet policy objectives for climate mitigation / adaptation, and biodiversity conservation / restoration that underpin nature-based solutions.

Many countries have extensive maps of biodiversity, ecosystem services, and other land-use, but these maps are less frequently used to guide policymaking and ensure integrated approaches to meeting objectives relating to food security, biodiversity, climate, and other land-use needs. Two countries, China and Costa Rica, have developed comprehensive approaches to spatial planning where their experience might offer lessons for other countries.

The main guiding principles to ensure effective integration of the climate and biodiversity agendas include:

1. By integrating strategies for meeting climate and biodiversity objectives, countries and businesses can meet more ambitious objectives with less effort and at lower cost. Yet, today's climate and biodiversity strategies are rarely integrated.

2. Such integration needs to involve spatial planning to manage competing demands on land (e.g., agriculture, conservation/restoration, infrastructure, urbanisation), as recognised in the draft Global Biodiversity Framework.
3. Countries can map their natural stocks of carbon, biodiversity, and ecosystem services using a broad range of science-based tools. By understanding today's land use and drivers for land-use change, countries can chart a course towards sustainable land use by 2030.
4. Spatial planning should be highly transparent, participatory, and iterative, particularly to ensure that the needs of local populations, including Indigenous peoples, are understood and incorporated. Transparency will help curb illegal land-use change.
5. To enable nature-based solutions at scale and to meet the 30x30 target, national climate and biodiversity strategies under the UNFCCC and CBD should include maps of current land use as well as land use intended by 2030. Many countries, including Costa Rica and China, are already pursuing such approaches, but the policies have yet to be included in NDCs, long-term low emission strategies, and NBSAPs.
6. Spatial planning approaches need to be enabled and complemented by economic and financing strategies, including payments for ecosystem services (PES), natural capital accounting (including augmented systems of national accounts – SEEA), environmental tax reforms, and the repurposing of harmful subsidies.
7. The IPCC and IPBES can each play a critical role in building the knowledge base for improved policies by systematically considering biodiversity and climate perspectives, respectively, and by promoting shared work.

1. How to assess the integration of nature and climate?

This brief outlines practical steps for policymakers to operationalize the 30x30 target and meet the objectives of the Paris Agreement and the Sustainable Development Goals.

The need for integrated global strategies to tackle climate change and biodiversity loss are gaining scientific and political prominence. It is necessary to make progress on the joint crises and advocate for transformative change required across sectors to achieve sustainable pathways towards climate, biodiversity, and societal goals. Emerging policy actions on biodiversity and climate are occurring globally, including the G7 policy action commitments to jointly address climate and nature loss in their May 2021 Environment Ministerial Communique, the recent G7 Nature Compact, the G20's Environment Communique in July 2021 with calls for nature-based solutions to address climate change and biodiversity loss, and the Leaders' Pledge for Nature signed by 88 heads of government. The High Ambition Coalition (HAC) which aims to protect at least 30% of land and oceans by 2030 (signed by 72 governments) complements the Leaders' Pledge for Nature, which also aims to reverse biodiversity loss by 2030.

This brief presents the scientific case for the need to integrate the biodiversity (or "nature") and climate agendas, including an analysis of international climate strategies. Discussions surrounding the alignment of the climate change and biodiversity agendas has been promoted for several years, and this brief contributes to the case for better alignment of these crises. We define integration as the degree of programmatic and institutional alignment of national policy mechanisms, including in ways that wouldn't require the negotiation of conventions and associated international statutes or the introduction of new text under the conventions. This brief outlines practical steps for policymakers to operationalise the 30x30 target and meet the objectives of the Paris Agreement and the Sustainable Development Goals.

1.1 Nature and climate are under severe pressure

Actions taken to mitigate climate change can have either beneficial or harmful effects on biodiversity.

Human pressure on biodiversity and climate is consistently increasing. The impacts of climate change and biodiversity loss are two of the most important global challenges and risks to society, as they have the potential for tipping points that could destabilise the earth's system, such as desertification or the collapse of fishing stock (Tittensor et al., 2019). This can result in ecosystems losing their resiliency. Actions taken to mitigate climate change can have either beneficial or harmful effects on biodiversity. For example, bioenergy crops that cover large shares of land can threaten biodiversity and food security (Pörtner, Hans-Otto et al., 2021). Additionally, when nature loss and climate impacts are combined, they can drive the same compounding risks, for instance variable weather and diminished soil quality drive lower crop yields causing the same risk for agribusinesses (*The Climate–Nature Nexus Implications for the Financial Sector*, 2021). Overlooking the inseparable nature of climate, biodiversity, and human well-being could result in unintended devastating consequences.

Human activities have altered 70% of land (Arneth et al., 2019) and are "causing the fabric of life to unravel" (Díaz et al., 2019). Despite global zero deforestation commitments, over 12 million hectares of tree cover was lost in the tropics in 2020 (Seymour, 2021) and 25% of the world's remaining species are now threatened with extinction (OECD, 2021). These losses represent major crises for climate stability, biodiversity conservation, and economic prosperity around the world. Land-use and food systems are major contributors to these joint crises; they can also play a significant part in their resolution, in particular through emissions mitigation (Clark et al., 2020; Griscom et al., 2017; Roe et al., 2019) and ecosystem conservation, including of globally significant carbon stores (Goldstein et al., 2020).

1.2 The role of nature-based solutions and net zero

Achieving net zero GHG emissions by 2050 will require major changes in the way countries manage the land, coast, and sea, alongside the decarbonisation of the energy, agriculture, land-use change and forestry sectors.

As climate change and biodiversity loss continue largely unabated, countries are shifting their focus to the role of nature-based solutions (NBS) in meeting the objectives of the UN Framework Convention on Climate Change (UNFCCC) and Convention on Biological Diversity (CBD). NBS protect, sustainably manage, and restore natural or modified ecosystems to address societal challenges while providing human well-being and biodiversity benefits (*IUCN Global Standard for Nature-Based Solutions*, 2019). NBS can contribute up to a third of emissions reductions needed under the Paris Agreement (Clark et al., 2020; Griscom et al., 2020). Additionally, the UK and the Chinese governments, respectively hosts of the UNFCCC COP26 and CBD COP15, have identified NBS as a critical priority for both meetings. Therefore, the two Presidencies are aligned and can make significant progress on the inclusion of spatial policies in support of NBS as a joint effort.

NBS are a key focus of the climate–biodiversity nexus, in that NBS approaches conserve biodiversity as well as support climate mitigation and adaptation strategies, but they can only be effective with bold reductions in human-caused greenhouse gas emissions. The most effective NBS for climate change are often habitat restoration and expansion which can contribute to the delivery of net zero greenhouse gas commitments (Gregg et al., 2021). Net zero refers to the balance between GHG emissions and removals from the atmosphere. Increasing removals in the context of net zero includes activities such as afforestation and soil carbon sequestration. However, GHG removals should be deployed at a large scale to achieve the Paris Agreement. Achieving net zero GHG emissions by 2050 will require major changes in the way countries manage the land, coast, and sea, alongside the decarbonisation of the energy, agriculture, land-use change and forestry sectors. It will also require developing clear, ambitious, and fair mitigation policies across all sectors, including agriculture, forestry, and land use (AFOLU), and establishing robust accounting for carbon sinks. GHG emissions from the AFOLU sector must be significantly reduced and eventually transformed to net negative CO_2 emissions within this century. NBS is location-specific, and the land sector is critical for addressing climate change, as it is likely to provide the lion's share of negative emissions that are needed to achieve net zero.

1.3 Why is the integration of climate and biodiversity needed?

Finance for Nature found that "28% of the global asset base held by development finance institutions is highly dependent on vulnerable forms of nature.

Biodiversity decline and climate change are becoming increasingly severe and threatening sustainable development and human well-being. The UNFCCC decision "to address the drivers of biodiversity loss, as well as those of climate change and land degradation, in an integrated manner" (1.CP/25, paragraph 15), and strengthen synergies across the conventions is a key next step. Addressing the climate–biodiversity nexus requires a strong understanding of their interlinkages (Table 1). Climate change exacerbates risks to biodiversity, while at the same time, ecosystems and their biodiversity play a key role in modulating the fluxes of greenhouse gases and climate adaptation. Climate change and biodiversity loss pose major threats to human livelihoods, food security, and health, especially to marginalised populations (Pörtner, Hans-Otto et al., 2021). Businesses also depend on nature for resources, operations, supply chain performance, and more. For instance, Finance For Nature found that "28% of the global asset base held by development finance institutions is highly dependent on vulnerable forms of nature" (*The Climate–Nature Nexus Implications for the Financial Sector*, 2021).

There are four main areas in which climate change and biodiversity loss are connected (Deprez et al., 2021). Table 1 presents the main linkages of climate and biodiversity, which can help to reveal a clearer picture of the transformative changes that are necessary to address both challenges in an integrated and coherent manner.

Table 1. Climate-Biodiversity Linkages

1. Climate change and biodiversity loss share root causes

Climate change and biodiversity share root causes due to unsustainable methods of production and consumption that result in land-use changes that are harmful to climate and biodiversity (e.g., deforestation). The first draft of the Global Biodiversity Framework addresses the issue of harmful subsidies, such as those for agriculture and fossil fuels. It calls for redirecting, repurposing, or eliminating incentives that harm biodiversity in a just and sustainable way.

2. Significant overlap between biodiversity hotspots and large land carbon stocks (peatlands, forests, grasslands) to support climate mitigation

Terrestrial and marine ecosystems play a major role in regulating climate, as well as building resilience to climate change. This includes using NBS approaches to mitigate climate change. Governments need high-resolution maps of carbon stocks and biodiversity that identify areas of potential co-benefits for climate mitigation and biodiversity conservation. This requires a deep understanding of how biodiversity benefits overlap with climate benefits (Soto-Navarro et al., 2020).

3. Climate change is one of the largest drivers of biodiversity loss

Climate change is predicted to become the most significant driver of biodiversity loss by the end of the century, with increasing negative impacts on species and ecosystems around the world (CBD). For instance, increasing atmospheric CO_2 concentrations resulting in higher ocean temperatures and ocean acidification are expected to have profound effects on marine ecosystems, such as coral reefs.

4. Understand and avoid trade-offs between strategies

Trade-offs need to be avoided between well intended climate mitigation strategies that negatively impact biodiversity. For example, the widespread use of bioenergy crops to replace fossil fuels may cause severe negative impacts on biodiversity. Another critical issue is the role of agricultural and fossil fuel subsidies that are harmful to biodiversity.

As Table 1 indicates, it is critical to consider climate, biodiversity, and human well-being as coupled systems in order to maximise benefits. A sustainable world needs both a stabilised climate and healthy ecosystems. This is demonstrated as increased atmospheric GHG concentrations lead to increased global mean temperatures, changes in precipitation patterns, increased frequency of extreme weather events, and oxygen depletion and acidification of marine ecosystems, most of which negatively impact biodiversity. Correspondingly, biodiversity loss impacts the climate system through impacts on the nitrogen, carbon, and water cycles. Moreover, climate change is becoming increasingly severe as a direct threat to nature, for instance through high extinction risks on island-like biodiversity hotspots such as mountains, islands, coral reefs and coastal embayments, where ecosystems and species have restricted distributions and are unable to establish themselves in new habitats (Pörtner, Hans-Otto et al., 2021).

The three Rio Conventions (UN Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD) and the UN Convention to Combat

Desertification (UNCCD)) already recognise the need for integrating nature and climate, but in practice tend to work in silos (Schmidt-Traub et al., 2020). Climate change and biodiversity loss are closely interconnected and share common drivers caused by human activities that are not well integrated across the conventions. Countries are failing to fulfil global objectives to mitigate the impacts of climate change and biodiversity loss (Diaz et al., 2019), including not fulfilling the biodiversity targets set by the CBD. Greater synergies across the three conventions – as well as with the IPBES, IPCC and the Sustainable Development Goals (SDGs) – could facilitate both halting biodiversity loss and mitigating climate change (Pörtner, Hans-Otto et al., 2021).

There are four main advantages to integrated nature–climate policies for the biodiversity community, and three main advantages for the climate community (Schmidt-Traub et al., 2020).

Benefits for the biodiversity community:

1. It would allow maximum alignment of national policy mechanisms across the three conventions (UNFCCC, CBD, UNCCD) without further negotiations while strengthening the political capacity to address the main drivers of land-use change.

2. It would raise the political visibility of nature and sustainable land-management given the significant influence and visibility of the UNFCCC.

3. Projects that contribute to climate mitigation and adaptation through nature conservation and restoration would be eligible for climate finance under the UNFCCC.

4. It would elevate reporting and transparency standards for nature protection due to the UNFCCC's more rigorous requirements in comparison to the CBD.

Benefits for the climate community:

1. Biodiversity accounts for large carbon stocks (peatlands, forests, grasslands). For instance, peatlands are the largest natural terrestrial carbon store, so when damaged they are a major source of greenhouse gas emissions.

2. It would provide an integrated framework for nature-based solutions, as they help address climate change while at the same time, provide benefits for biodiversity conservation.

3. Nature is critical for climate adaptation and resilience as effectively preserved ecosystems reduce the risks and impacts of extreme climatic events such as landslides or floods, whose frequency and intensity will be exacerbated by climate change.

4. Flagship species and characteristic megafauna are tools for public support for action on the environment, but they must be selected in a systematic manner to serve a specific conservation function (McGowan et al., 2020).

1.4 How to integrate the climate and biodiversity agendas?

Aligning the climate and biodiversity agendas requires collaborative and coordinated action. Countries will need to align ambitious climate and biodiversity action over the short-, medium- and long-term with the submission of updated UNFCCC Nationally Determined Contributions

(NDCs) coordinated with their long-term low emission development strategies (LTS), mid-century net zero greenhouse gas pledges, and National Biodiversity Strategies and Action Plans (NBSAPs). This will require collaborative efforts by actors at various levels, including subnational and national governments, international actors, and non-state actors, like the private sector. To successfully implement these joint agendas, we need (i) ambitious economy-wide decarbonisation by 2050 to drastically reduce emissions, (ii) integrated, national long-term strategies, (iii) spatially explicit biodiversity restoration and conservation strategies to inform integrated land-use planning policies, and (iv) poverty eradication and a just transition which places people at the centre of global efforts to transform energy, food and land-use systems to achieve climate, biodiversity, and sustainable development goals.

The Paris Agreement (Article 4, paragraph 19) calls for Parties to submit LTS to provide information on long-term mitigation targets such as net zero commitments, decarbonisation objectives for crucial sectors and policies. Many countries have put forward commitments to net zero GHG emissions by mid-century, including China, Japan, South Korea, the EU, and the UK. These countries will need integrated strategies to make their energy, land-use, and food systems sustainable over the long-term (FABLE, 2020). This will include significant emissions reductions needed from decarbonising the economy.

Although many countries have access to the necessary spatial data and technical capabilities, political and organisational challenges remain. Complex organisational issues among ministries, such as environment, agriculture, and infrastructure, can cause coordination issues with national land-use maps. For instance, in the European Union, the European Commission establishes agricultural policies and coordinates climate objectives, while forestry and biodiversity plans are decentralised to national or sub-national levels (Schmidt-Traub, 2021).

In Colombia, recent conflicts arose between the Ministry of Agriculture and the Ministry of Environment. The country's National Agricultural Frontier policy and the National Restoration Plan (referenced in the country's updated NDC) have conflicting targets and overlaps exist in areas delineated for agriculture and restoration. These overlaps occurred due to a lack of an integrated spatial planning process. The government arranged a working group, and they are currently in discussions to resolve the conflicts.

These political economy challenges are one of the key reasons why some countries have not effectively integrated biodiversity and climate into national land-use management frameworks. By reconciling these issues, countries can effectively map biodiversity, climate impacts and ecosystem services, incorporate monitoring and evaluation tools and policies, as well as efficiently coordinate essential government ministries. With these changes and increased political willingness, governments can address land ownership and competing land-use issues and the protection of land rights of Indigenous peoples.

To foster greater coherence in national strategies, countries should incorporate maps of current and intended land use in updated NDC and NBSAP strategies under the UNFCCC

and CBD, respectively. This ensures consistency with Target 1 of the first draft Global Biodiversity Framework, and it is necessary to show that achieving the 30x30 target is operational through the use of actionable maps in national strategies (Schmidt-Traub, 2021). **An actionable map describes current or intended land use to meet land-based policy objectives for climate mitigation, climate adaptation, biodiversity conservation, biodiversity restoration, or a combination thereof.** Additionally, the IPCC and IPBES processes play a strong role in strengthening the knowledge base for more ambitious policies, including through the promotion of shared work. To start, LTS and the NDCs ("climate strategies") under the UNFCCC offer a practical mechanism to develop national strategies that integrate both nature and climate, covering commitments taken under each convention. This ensures the strategies are operational. Recent policy actions on nature include the EU's 2030 Biodiversity Strategy and the UK's legally binding species target. We need national coherence within the IPCC and IPBES processes to achieve these goals as well as strong transparency frameworks under the Paris Agreement and the Post 2020 Global Biodiversity Framework (Deprez et al., 2021). This integration can be achieved by the next UNFCCC's Global Stocktake in 2023.

Nature-based solutions, and climate and biodiversity strategies are location-specific so their operationalisation requires spatial planning tools, which is recognised as Target 1 in the first draft Global Biodiversity Framework submitted in 2021 (CBD, 2020). Moreover, land use and land-use change via agriculture, infrastructure, industry, and urbanisation, are some of the largest drivers of biodiversity loss (Díaz et al., 2019), so tackling them to conserve and restore biodiversity requires resolving land uses through a spatial planning lens. These natural climate solutions could provide approximately one-third of the cost-effective mitigation required to stabilise warming to below 2°C (Griscom et al., 2017), which will be at the top of the agenda for the upcoming 2021 COPs.

It is also critical for governments to make significant investments in forest restoration at scale, including through protecting the land and resource rights of Indigenous peoples and rural communities. Forests are an important nature-based solution to the climate crisis and provide key goods and services to the planet and human well-being. When forests and Indigenous communities' resource rights are protected, there is strong evidence that deforestation and biodiversity preservation are reduced at a greater scale globally than when managed by governments alone (Just Rural Transition, 2021). Reliable and systematic forest monitoring is critical to support climate mitigation and other forest benefits (Nesha et al., 2021).

There are two critical tools to integrate nature and climate: integrated, long-term strategies (FABLE, 2020; FOLU, 2019) and a spatial planning process that involves multiple experts and stakeholders (Jung et al., 2021; Schmidt-Traub et al., 2020). **It is critical to note that maps and spatial planning are not the only answer, but a necessary step in developing policies that can meet land-use objectives outlined in these maps at national and local levels**. Countries can complement the spatial planning process with approaches such as: environmental taxes on resource use, economic valuation of ecosystem

services, sustainable financing, and mechanisms for Payment for Ecosystem Services (PES), and practical REDD+ approaches to address deforestation and forest degradation. Most countries lack integrated policies and long-term strategies for sustainable land-use and food systems, which are highly vulnerable to climate change. This has been well documented in the case of countries falling short of 2020 targets to halt biodiversity loss. Integrated policies also require assessments of the trade-offs between climate and biodiversity goals and various interventions.

Countries must submit LTS under the Paris Agreement, which would ideally require high resolution maps to inform decision-making. The maps are not the end-product; they must go through an iterative process as decisions are made about the actual use of the land so that they constantly reflect the actual land use and state of the environment. Here we review the current state of integrated climate strategies, innovative approaches to spatial planning, and tools for integrating nature into climate strategies. We conclude with recommendations for policymakers and practitioners.

2. Do countries lack integrated strategies that make NBS operational?

Many countries have extensive maps of biodiversity, ecosystem services, and other land use, but these maps are less frequently used to guide policymaking and ensure integrated approaches to meeting objectives relating to food security, biodiversity, climate, and other land-use needs. Essentially, they are not operational. Many countries also lack the practical tools to enforce land-use planning, and so require local projects in the AFOLU sector to both reduce biodiversity loss and reduce anthropogenic emissions. Reviews of national biodiversity and climate strategies show that countries make little use of spatial data that integrates across the Rio Conventions (Cadena et al., 2019; Khan & Schmidt-Traub, 2020). Of the National Biodiversity Strategy Action Plans (NBSAPs) submitted to the CBD, only 15% of NBSAPs include maps that the UNDP considers actionable (Cadena et al., 2019). These definitions have since been updated from UNDP's Cadena et al. (2019) study (Table 1).

Table 2. Categorisation of map types (adapted from Cadena et al., 2019)

Map type	Non-actionable	Potentially actionable	Actionable
Description	Map is **not** useful in isolation, or when combined with other data layers to inform policy.	Map has the **potential** to guide land-use planning if combined with other data layers.	Map provides **sufficient** information on intended land use to **meet land-based policy objectives** for climate mitigation or adaptation, biodiversity conservation or restoration.

Box 1. Examples of non-actionable, potentially actionable, and actionable maps found in the NDCs and NBSAPs

Non-actionable

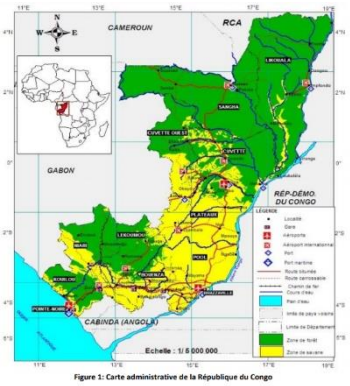


Figure 1: Carte administrative de la République du Congo

Country: Congo (Republic of)
Map title: Administrative map of Congo
Document: NDC

Maps of administrative regions or basic geographic features cannot provide insights into current or intended land-use policies.

Potentially actionable

Country: Colombia
Map title: Aquatic, coastal and marine ecosystems
Document: NBSAP

While maps of key biodiversity areas and ecosystems are useful, they alone do not necessarily inform on or reflect intended policy actions. If combined with additional data layers, it could generate new information making the map operational.

Actionable

Country: Mauritius
Map title: Potential Protected Area Network (green) and the proposed Expansion Zones (yellow)
Document: NBSAP

Maps, such as this from the Mauritius NBSAP, that describe intended land use or allocate land for purposes of meeting specific climate or biodiversity policy objectives are action-oriented and provide sufficient detail policymakers or practitioners to take appropriate action.

According to a study conducted by the Sustainable Development Solutions Network in 2020, only 4% of all NDCs included a map and only one NDC contained a map that could inform land-use planning – the Republic of Moldova (Khan & Schmidt-Traub, 2020) – but it was not in support of nature-based solutions. The definition of an "actionable map" has been updated since this study to address maps of current and intended land use to meet land-based policy objectives (see definition above). We assessed the NDCs and found that out of 111 updated and second NDCs submitted

by 5 October 2021, **none of the NDCs contain an actionable map** (See Annex for details) (Table 2 and 3).

There are eleven countries that have "potentially actionable" maps in their NDCs: Antigua and Barbuda, Argentina, Cabo Verde, Colombia, Guinea, Republic of Moldova, Nicaragua, Nigeria, Sierra Leone, South Sudan, and Zimbabwe. Of those, Antigua and Barbuda, Argentina, Colombia, Guinea, Nicaragua, Nigeria, Sierra Leone, and Zimbabwe are tropical forest countries while the Cabo Verde ecoregion hosts dry forests, and the Republic of Moldova hosts three ecoregions.

• The first NDCs submitted by **Argentina** and **Colombia** in 2016 and 2018 respectively, mentioned the need to map the vulnerabilities and climate risks to better manage climate adaptation. This need is reflected in their updated NDCs submitted in December 2020 which includes potentially actionable maps detailing both countries' vulnerabilities to climate change.a

• **Cabo Verde**'s NDC details how the country is exceedingly vulnerable to climate hazards with 80% of the archipelago's territory highly susceptible to drought. Of these NDCs, only Cabo Verde mentions the need to integrate nature and climate.

• **Nicaragua**'s NDC addresses Indigenous rights to the land and the conservation and restoration of forests within Indigenous lands. This NDC includes a map of the forest conservation areas within Indigenous territories and protected areas.

• **Sierra Leone** has four potentially actionable maps: a land degradation neutrality (LDN) hotspots map, a map of rainfall and warm spell trends, a map of protected areas and conservation areas of Sierra Leone, and expansion of the forest degradation and agricultural land map.

• **Antigua and Barbuda, South Sudan, and Zimbabwe**'s maps are all potentially actionable, addressing projected climate scenarios and vulnerability assessments.

• **Argentina, Colombia, and Cabo Verde**'s maps are for climate vulnerability assessments, and do not necessarily drive mitigation efforts.

None of the NDCs with maps have long-term low emission development strategies (LTS) in place. An important next step would be to develop a LTS that integrates with the NDCs 5-year revision cycle to ensure consistency and help drive climate action in the short-term.

Table 3. Number of maps per type found in select NDCs, 111 NDCs in total

Map type	Number of Maps	Percent of Maps
Actionable maps	0	0%
Potentially actionable maps	24	21.6%
Non-actionable maps	12	10.8%
Number of NDCs with no maps	98	87.0%

Source: Authors' analysis. Some NDCs contain more than one map. Includes updated first NDCs and second NDCs.

Designing and implementing strategies that conserve and restore nature require an iterative spatial planning process to develop actionable maps and a land-use management framework. This applies to NBS projects, which address climate and nature objectives in an integrated and efficient way. It is therefore critical to include maps of intended land use to meet land-based policy objectives for climate and nature in order to meet the long-term goals of the CBD and UNFCCC for terrestrial environments.

3. What lessons can be learned from other countries?

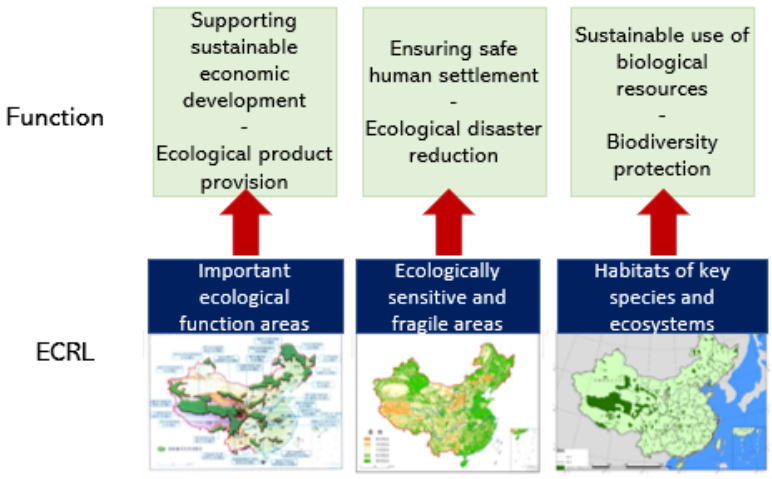
China's Ecological Conservation Redline (ECRL) identifies and protects a quarter of China's landmass for biodiversity conservation, ecosystem services, and disaster risk reduction

While many countries have not explicitly integrated spatial planning into their climate strategies, national-level spatial planning frameworks do exist. Two countries, China and Costa Rica, have developed comprehensive approaches to spatial planning. Their experience might offer lessons for other countries.

I. China

With only 10% of the world's arable land and nearly a fifth of the global population, China is highly vulnerable to environmental shocks. After a precipitous decline in nature in the 1980s and 1990s and the catastrophic Yangtze River flood of 1998, China began developing an integrated spatial planning approach towards managing its land use and protecting nature. Building on existing "redlines" that delineate areas for special protection or management, including agriculture, China's Ecological Conservation Redline (ECRL) identifies and protects a quarter of China's landmass for biodiversity conservation, ecosystem services, and disaster risk reduction. ECRLs include both strictly protected areas that preclude human activities to those that permit some activities, such as agriculture. ECRL boundaries are determined based on high-precision remote sensing imagery, land-use data, and extensive field surveys. The framework is being rolled out to cover at least 25% of the country's territory.

Figure 1: ECRL Categories



Source: Gao Jixi, 2018. CCICED. PowerPoint Presentation (Gao, 2018)

There are four overarching steps to designing an ECRL. First, through a mix of high-resolution mapping and ecosystems services modelling, protected areas important for biodiversity conservation and other priority areas are identified and combined into a proposed ECRL. Second, the proposed ECRL and "redlines" for agriculture, industry, mining, urban areas, and infrastructure are reviewed to ensure coherence and alignment. Third, a similar review process is undertaken to ensure alignment and coherence across provinces and coastal areas. Fourth, and finally, consultations with local governments lead to a revised ECRL that accounts for local development priorities.

The ECRL is an emerging policy framework in China to integrate ecological conservation and sustainable management with economic growth, but challenges remain. Reconciling these challenges (e.g., governance and enforcement issues) is a massive but necessary undertaking, and once resolved the ECRL could hold important lessons for other countries. ECRL implementation has triggered the need to align the spatial planning policy frameworks for agriculture, urban development, and infrastructure development. This integration is important for meeting China's biodiversity objectives under the CBD and for achieving carbon neutrality before 2060 under the UNFCCC.

While highly specific to China's governance, ECRL offers two key lessons for other countries (Schmidt-Traub et al., 2020). First, is the importance of mapping nature. Many countries have the capacity to map nature, or have access to freely available maps, which are critical for identifying and protecting priority areas for nature and climate. Second, is the importance of a robust consultation process to validate the maps. Such validation processes are critical for ensuring acceptability, in particular when comparing maps of nature with questions around land rights.

II. Costa Rica

Almost 30% of land in Costa Rica is under a conservation status, including biological resources, national parks, wildlife refuges, protection water zones, forest reserves, wetlands, and marine reserves.

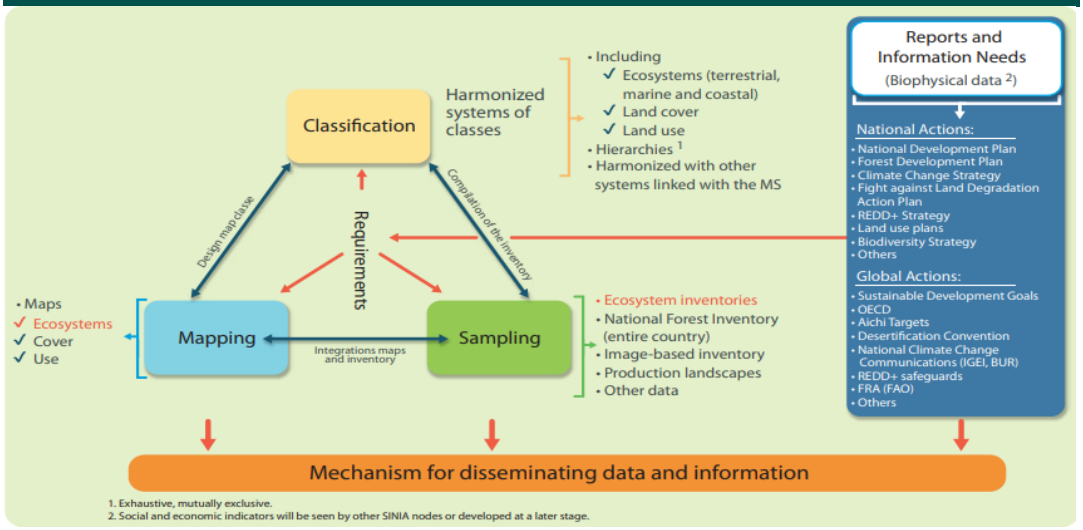
In the 1980s Costa Rica was facing a similar precipitous decline in nature. It had lost a significant share of its forest cover largely due to agricultural expansion (Beita & Murillo, 2020). The government has since successfully combatted this decline through several key policies including a world-renowned payments for ecosystems services (PES) system and implementation of reducing emissions from deforestation and forest degradation (REDD+) (FOLU, 2019; Wallbott et al., 2019). The government has also established protected areas and ecological corridors, as well as municipal land management plans that ensure that the implementation of these two measures is coherent and in line with other development objectives (Morales Zumbado & Valverde Agüero, 2020).

Costa Rica has a three-pronged approach to land conservation: protected areas, ecological corridors and sustainable management, with different levels of permitted human use depending on the protection level (Morales Zumbado & Valverde Agüero, 2020). Almost 30% of land in Costa Rica is under a conservation status, including biological resources, national

parks, wildlife refuges, protection water zones, forest reserves, wetlands, and marine reserves (Beita & Murillo).

While successful at this time, these policies could have been more effective with the inclusion of an overarching spatially explicit system to monitor forests, agriculture, and biodiversity jointly (FAO, 2020). To bridge this gap, in 2015, the government began working with a range of institutions across the public and private sectors, and with the support of the Food and Agriculture Organisation (FAO), to develop the "*Sistema Nacional de Monitoreo de la Cobertura y Uso de la Tierra y Ecosistemas*" (SIMOCUTE), which will allow for the integrated monitoring of land use, land cover, and ecosystems (FAO, 2020). SIMOCUTE aims to strengthen national capacities to monitor natural, agricultural and biodiversity resources to support decision-making and raise the level of ambition for climate action. SIMOCUTE is currently being developed by the Ministry of Environment and Energy and the Ministry of Agriculture and Livestock. It will be implemented through inter-institutional coordination with over 40 institutions, and it is a multi-purpose system allowing for the monitoring of natural ecosystems, and agricultural and biodiversity resources (FAO, 2020). The system also allows for transparency and data-sharing as it shares the same geodatabase with other tools, such as Monitoring Land Use Change Within Production Landscapes (MOCUPP), a specialised tool to verify compliance with the Forest Law in production landscapes with commodities for export (Sasa et al., 2017). This allows for the centralisation of highly important satellite information for the country. Once operational, the system should support more informed decision-making on land use through enhanced data, improved data management, and harmonised land use, land-use cover, and ecosystems indicators and metrics (FAO, 2020).

Figure 2: Monitoring System on Land and Ecosystem Cover and Use (SIMOCUTE) – Ministerial Directive DM-417-2015



Source: (Sasa et al., 2017)

While not yet fully operational, SIMOCUTE offers an important lesson in the importance of integrated monitoring systems. Costa Rica is known for its conservation policies, yet even well designed and implemented

policies need to be monitored for consistency. In 2018, Costa Rica shared lessons with Ecuador on forest monitoring systems and forest fires. The countries identified synergies and potential South–South cooperation. Systems like SIMOCUTE offer one possibility for establishing effective, integrated monitoring systems for land use to support policy decisions.

4. What tools exist for integrating nature and climate?

As discussed in Section 3, some countries including China and Costa Rica have instituted integrated land-use management frameworks to meet biodiversity and climate objectives, improve the management of ecosystem services, and preserve natural capital. These frameworks are needed to achieve climate and biodiversity objectives to address six key focus areas (Table 5).

As hardly any NDCs under the Paris Agreement contain or refer to geographic analyses to inform policy and meet international objectives, countries need freely available tools to support national-level spatial analyses to develop comprehensive frameworks. Fortunately, freely available tools exist to access high-resolution satellite data and monitor land-use change.

For instance, **Global Forest Watch** is an online platform that provides data and monitoring tools for forests. This tool has been used by governments to address forest protection, deforestation, and by Indigenous communities to protect their homeland (FOLU, 2019).

The **Land and Carbon Lab** is a new initiative that will use land and carbon monitoring to catalyse the land-based actions, policies, incentives, and governance reforms needed to meet the goals of the Paris Agreement. This tool will combine ground data, satellite data and other cutting-edge technologies to monitor all the world's lands, natural ecosystems, working lands and associated carbon stocks and flows.

Lastly, the recently launched **Nature Map** tool combines high-resolution data on biodiversity, natural carbon stocks, and ecosystem services to support countries in integrating nature and climate in their decision-making and to promote nature-based solutions. All these tools still need to be coupled with integrated, national long-term strategies to achieve sustainable pathways for climate and biodiversity objectives

Table 5. Key focus areas addressed by integrated land-use management

1	**Setting ambitious and operational post-2020 CBD targets**
The conservation and restoration of nature is place-based, so targets must be spatially explicit at local and national levels (Locke et al., 2019). High-resolution spatial data is needed to define operational post-2020 targets for nature. These targets should be set in collaboration with experts and stakeholder groups, including Indigenous communities.	
2	**Promote nature-based solutions and zero-deforestation supply chains**
Businesses need national policy frameworks to design NBS initiatives and promote zero-deforestation supply chains. Maps and spatial policies can guide investments to generate the greatest benefits and uncover unsustainable business practices, as well as leakage from NBS.	
3	**Establish carbon markets**
As per Article 6 of the Paris Agreement, carbon markets can play an important role in driving the transition towards net zero emissions, particularly for forestry and the land-use sector. Reducing greenhouse gas emission from land use requires effective policies across several areas (agriculture, forestry, infrastructure, etc.) and country-wide approaches to avoid the risk of "leakage". For these reasons, countries need jurisdictional carbon markets, which in turn require integrated maps of soil carbon, biomass carbon, and other co-benefits, such as biodiversity and ecosystem services.	
4	**Greening infrastructure investments**
Well-executed infrastructure investments can promote sustainable development, but poorly executed infrastructure can destroy natural capital. To understand and manage the long-term biodiversity and ecosystem services impacts of infrastructure investments, countries need spatial land-use management programmes along the lines of China's Ecological Conservation Redline. These maps and supporting policy frameworks should be integrated into countries' climate and biodiversity strategies under the two conventions.	
5	**Leveraging private finance for NBS projects**
With increased access to funding, it will become an important incentive to mobilising country action on more ambitious and integrated climate and biodiversity strategies, through NBS approaches. The success of NBS projects often depends on the policy environment, which is outside the control of the project investors. Integrated land-use management strategies backed by high-resolution maps can reduce this policy risk for project owners and thereby help leverage for-profit, philanthropic, and concessional finance for NBS projects.	
6	**Monitoring reporting and verification (MRV)**
Publicly available maps promote transparency (e.g., to avoid conflicts between biodiversity objectives and concessions for mining and timber) and help ensure that industry-led initiatives, such as zero-deforestation supply chains, can help meet national sustainable development objectives. They also enable MRV through remote sensing data.	

5. Guiding principles for policymakers

In 2021, the UNFCCC and CBD COPs offer a rare opportunity to jointly progress on the integration of nature and climate. Just as the biodiversity and climate crises are interconnected, so are the solutions. A lack of integration can lead to counterproductive policies and hinder achieving both climate and biodiversity goals. Additionally, such policies must coincide with the local projects on-the-ground within the AFOLU sector. The

principles outlined in this brief are not all-encompassing and should be viewed as a first step to developing strong policies that meet land-based objectives. They will require additional levers to fully realise the necessary integration of nature and climate agendas, and spatial planning and actionable maps can become a tool for policy design and implementation at national and local levels.

The main guiding principles to ensure effective integration of the climate and biodiversity agendas include:

1. By integrating strategies for meeting climate and biodiversity objectives, countries and businesses can meet more ambitious objectives with less effort and at lower cost. Yet, today's climate and biodiversity strategies are rarely integrated.

2. Such integration needs to involve spatial planning to manage competing demands on land (e.g., agriculture, conservation/restoration, infrastructure, urbanisation), as recognised in the draft Global Biodiversity Framework.

3. Countries can map their natural stocks of carbon, biodiversity, and ecosystem services using a broad range of science-based tools. By understanding today's land use and drivers for land-use change, countries can chart a course towards sustainable land use by 2030.

4. Such spatial planning should be highly transparent, participatory, and iterative, particularly to ensure that the needs of local populations (including Indigenous peoples) are understood and incorporated. Transparency will help curb illegal land-use change.

5. To enable nature-based solutions at scale and to meet the 30x30 target, national climate and biodiversity strategies under the UNFCCC and CBD should include maps of current land use as well as land use intended by 2030. Many countries, including Costa Rica and China, are already pursuing such approaches, but the policies have yet to be included in NDCs, long-term low emission strategies, and NBSAPs.

6. Spatial planning approaches need to be enabled and complemented by economic and financing strategies, including payments for ecosystem services (PES), natural capital accounting (including augmented systems of national accounts – SEEA), environmental tax reforms, and the repurposing of harmful subsidies.

7. The IPCC and IPBES can each play a critical role in building the knowledge base for improved policies, by systematically considering biodiversity and climate perspectives, respectively, and by promoting shared work.

The guiding principles demonstrate the need to accelerate action to align climate and biodiversity objectives at the national and international level going forward. Countries need to consider coordinated action, reporting, and synergies and trade-offs ahead of the COP15 and COP26, and beyond, which should be completed ahead of the Global Stocktake in 2023

.

Acknowledgements

This policy brief was developed with support from the Norwegian Climate and Forest Initiative (NICFI) and World Resources Institute (WRI).

Recommended citation

Khan, M., Poncet, J., Schmidt-Traub, G. The integration of biodiversity and climate objectives in land-use policy. SDSN Policy Brief September 2021. Paris: Sustainable Development Solutions Network (SDSN).

References

Arneth, A., Barbosa, H., Benton, T., Calvin, K., Calvo, E., Connors, S., Cowie, A., & Zommers, Z. (2019). *Climate Change and Land. IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.* Intergovernmental Panel on Climate Change.

Beita, C. M., & Murillo, L. F. S. (2020). "Ecological Regional Planning in Costa Rica: An Approach to Protected Areas and Environmental Services". In R. R. Thakur, A. K. Dutt, S. K. Thakur, & G. M. Pomeroy (Eds.), *Urban and Regional Planning and Development: 20th Century Forms and 21st Century Transformations* (pp. 129–136). Springer International Publishing. https://doi.org/10.1007/978-3-030-31776-8_8

Cadena, M., Supples, C., Ervin, J., Marigo, M., Monakhova, M., Raine, P., & Virnig, A. (2019). *Nature is counting on us: Mapping progress to achieve the Aichi Biodiversity Targets*. United Nations Development Programme.

Convention of Biological Diversity (CBD). (2020). *Zero draft of the post-2020 Global Biodiversity Framework. CBD/WG2020/2/3*. Convention of Biological Diversity. https://www.cbd.int/doc/c/d0f3/aca0/d42fa469029f5a4d69f4da8e/post2020-prep-01-01-en.pdf

CBD. (2021). *First draft of the post-2020 Global Biodiversity Framework. CBD/WG2020/3/3.* Convention of Biological Diversity. https://www.cbd.int/doc/c/914a/eca3/24ad42235033f031badf61b1/wg2020-03-03-en.pdf

Clark, M. A., Domingo, N. G., Colgan, K., Thakrar, S. K., Tilman, D., Lynch, J., Azevedo, I. L., & Hill, J. D. (2020). "Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets". *Science*, *370*(6517), 705–708.

Deprez, A., Rankovic, A., Landry, J., Treyer, S., Vallejo, L., & Waisman, H. (2021). *Aligning high climate and biodiversity ambitions in 2021 and beyond: Why, what, and how?* Institute of Sustainable Development and International Relations (IDDRI).

Díaz, S., Settele, J., Brondízio, E. S., Ngo, H. T., Agard, J., Arneth, A., Balvanera, P., Brauman, K. A., Butchart, S. H. M., Chan, K. M. A., Garibaldi, L. A., Ichii, K., Liu, J., Subramanian, S. M., Midgley, G. F., Miloslavich, P., Molnár, Z., Obura, D., Pfaff, A., … Zayas, C. N. (2019). "Pervasive human-driven decline of life on Earth points to the need for transformative change". *Science*, *366*(6471), eaax3100. https://doi.org/10.1126/science.aax3100

Food, Agriculture, Biodiversity, Land-Use and Energy (FABLE) Consortium. (2020). *Pathways to Sustainable Land-Use and Food Systems. 2020 Report of the FABLE Consortium.* Laxenburg and Paris: International Institute for Applied Systems Analysis (IIASA) and Sustainable Development Solutions Network (SDSN). https://doi.org/10.22022/ESM/12-2020.16896

Food and Agriculture Organization (FAO). (2020). *FAO - SFM Case Detail: Costa Rica's progress in developing a national land-use, land cover and ecosystems monitoring system*. FAO. http://www.fao.org/sustainable-forest-management/toolbox/cases/case-detail/en/c/1392469/

Food and Land Use Coalition (FOLU). (2019). *Growing Better: Ten Critical Transitions to Transform Food and Land Use*. FOLU. https://www.foodandlandusecoalition.org/global-report/

Gao, J. (2018, November). *China's Ecological Conservation Redline (ECR) and its significance for biodiversity conservation*. China Council for International Cooperation on Environment and Development.

Goldstein, A., Turner, W. R., Spawn, S. A., Anderson-Teixeira, K. J., Cook-Patton, S., Fargione, J., Gibbs, H. K., Griscom, B., Hewson, J. H., Howard, J. F., Ledezma, J. C., Page, S., Koh, L. P., Rockström, J., Sanderman, J., & Hole, D. G. (2020). "Protecting irrecoverable carbon in Earth's ecosystems". *Nature Climate Change*, *10*(4), 287–295. https://doi.org/10.1038/s41558-020-0738-8

Gregg, R., Elias, J., Crosher, I., Muto, P., & Morecroft, M. (2021). *Carbon storage and sequestration by habitat: A review of the evidence (second edition)*. Natural England Research Reports NERR094. http://publications.naturalengland.org.uk/publication/5419124441481216

Griscom, B. W., Adams, J., Ellis, P. W., Houghton, R. A., Lomax, G., Miteva, D. A., Schlesinger, W. H., Shoch, D., Siikamäki, J. V., Smith, P., Woodbury, P., Zganjar, C., Blackman, A., Campari, J., Conant, R. T., Delgado, C., Elias, P., Gopalakrishna, T., Hamsik, M. R., … Fargione, J. (2017). "Natural climate solutions". *Proceedings of the National Academy of Sciences*, *114*(44), 11645–11650. https://doi.org/10.1073/pnas.1710465114

Griscom, B. W., Busch, J., Cook-Patton, S. C., Ellis, P. W., Funk, J., Leavitt, S. M., Lomax, G., Turner, W. R., Chapman, M., Engelmann, J., Gurwick, N. P., Landis, E., Lawrence, D., Malhi, Y., Schindler Murray, L., Navarrete, D., Roe, S., Scull, S., Smith, P., … Worthington, T. (2020). "National mitigation potential from natural climate solutions in the tropics". *Philosophical Transactions of the Royal Society B: Biological Sciences*, *375*(1794), 20190126. https://doi.org/10.1098/rstb.2019.0126

International Union for Conservation of Nature (IUCN). (2019). *IUCN Global Standard for Nature-based Solutions*. IUCN. https://www.iucn.org/theme/ecosystem-management/our-work/iucn-global-standard-nature-based-solutions

Jung, M., Arnell, A., De Lamo, X., Garcia-Rangel, S., Lewis, M., Mark, J., Merow, C., & Miles, L. (2021). "Areas of global importance for conserving terrestrial biodiversity, carbon, and water". *Nature Ecology & Evolution*. https://doi.org/10.1038/s41559-021-01528-7

Just Rural Transition. (2021). *Land Tenure in a Just Rural Transition: Restoring our Relationships to Land and Natural Resources*. Policy Brief.

Khan, M., & Schmidt-Traub, G. (2020). *Use of spatial information in national climate strategies. An analysis of Nationally Determined Contributions (NDCs)* [SDSN Working Paper]. Sustainable Development Solutions Network. https://resources.unsdsn.org/use-of-spatial-information-in-national-climate-strategies

Locke, H., Ellis, E. C., Venter, O., Schuster, R., Ma, K., Shen, X., Woodley, S., Kingston, N., Bhola, N., & Strassburg, B. B. (2019). "Three Global Conditions for Biodiversity Conservation and Sustainable Use: An implementation framework". *National Science Review*. https://doi.org/10.1093/nsr/nwz136

McGowan, J., Beaumont, L. J., Smith, R. J., Chauvenet, A. L. M., Harcourt, R., Atkinson, S. C., Mittermeier, J. C., Esperon-Rodriguez, M., Baumgartner, J. B., Beattie, A., Dudaniec, R. Y., Grenyer, R., Nipperess, D. A., Stow, A., & Possingham, H. P. (2020). "Conservation prioritization can resolve the flagship species conundrum". *Nature Communications*, *11*(1), 994. https://doi.org/10.1038/s41467-020-14554-z

Morales Zumbado, F., & Valverde Agüero, J. (2020). Connectivity, ecosystem services and Nature-based Solutions in land-use planning in Costa Rica. In C. Groves (Ed.), *Guidelines for conserving connectivity through ecological networks and corridors* (pp. 98–99). International Union for Conservation of Nature (IUCN). https://doi.org/10.2305/IUCN.CH.2020.PAG.30.en

Nesha, M. K., Herold, M., Sy, V. D., Duchelle, A. E., Martius, C., Branthomme, A., Garzuglia, M., Jonsson, O., & Pekkarinen, A. (2021). An assessment of data sources, data quality and changes in national forest monitoring capacities in the Global Forest Resources Assessment 2005–2020. *Environmental Research Letters*, *16*(5), 054029. https://doi.org/10.1088/1748-9326/abd81b

Organisation for Economic Cooperation and Development (OECD). (2021). *Biodiversity, Natural Capital and the Economy: A Policy Guide for Finance, Economic and Environment Ministers*. OECD Environment Policy Paper No. 26.

Pörtner, Hans-Otto, Scholes, Robert J., Agard, John, Archer, Emma, Bai, Xuemei, Barnes, David, Burrows, Michael, Chan, Lena, Cheung, Wai Lung (William), Diamond, Sarah, Donatti, Camila, Duarte, Carlos, Eisenhauer, Nico, Foden, Wendy, Gasalla, Maria A., Handa, Collins, Hickler, Thomas, Hoegh-Guldberg, Ove, Ichii, Kazuhito, … Ngo, Hien. (2021). *IPBES-IPCC co-sponsored workshop report synopsis on biodiversity and climate change* (Version 1). Zenodo. https://doi.org/10.5281/ZENODO.4782538

Roe, S., Streck, C., Obersteiner, M., Frank, S., Griscom, B., Drouet, L., Fricko, O., Gusti, M., Harris, N., Hasegawa, T., Hausfather, Z., Havlík, P., House, J., Nabuurs, G.-J., Popp, A., Sánchez, M. J. S., Sanderman, J., Smith, P., Stehfest, E., & Lawrence, D. (2019). "Contribution of the land sector to a 1.5 °C world". *Nature Climate Change*, *9*(11), 817–828. https://doi.org/10.1038/s41558-019-0591-9

Sasa, K., González, A., Fernández, J., Pena, M., Aguilar, A., Girot, P., & Orozco, A. L. (2017). *Monitoring Land Use Change Within Production Landscapes (MOCUPP)*. https://www.undp.org/content/dam/gp-commodities/docs/UNDP-GCP-Costa%20Rica%20MOCUPP%20EN%202017.pdf?download

Schmidt-Traub, G. (2021). "National climate and biodiversity strategies are hamstrung by a lack of maps". *Nature Ecology & Evolution*. https://doi.org/10.1038/s41559-021-01533-w

Schmidt-Traub, G., Locke, H., Gao, J., Ouyang, Z., Adams, J., Li, L., Sala, E., Shaw, M. R., Troëng, S., Xu, J., Zhu, C., Zou, C., Ma, T., & Wei, F. (2020). "Integrating Climate, Biodiversity, and Sustainable Land Use Strategies: Innovations from China". *National Science Review*, nwaa139. https://doi.org/10.1093/nsr/nwaa139

Seymour, F. (2021). *2021 Must Be a Turning Point for Forests. 2020 Data Shows Us Why*. World Resources Institute. https://www.wri.org/insights/2021-must-be-turning-point-forests-2020-data-shows-us-why

Soto-Navarro, C., Ravilious, C., Arnell, A., de Lamo, X., Harfoot, M., Hill, S. L. L., Wearn, O. R., Santoro, M., Bouvet, A., Mermoz, S., Le Toan, T., Xia, J., Liu, S.,

Yuan, W., Spawn, S. A., Gibbs, H. K., Ferrier, S., Harwood, T., Alkemade, R., … Kapos, V. (2020). "Mapping co-benefits for carbon storage and biodiversity to inform conservation policy and action". *Philosophical Transactions of the Royal Society B: Biological Sciences*, *375*(1794), 20190128. https://doi.org/10.1098/rstb.2019.0128

Finance for Biodiversity Initiative (F4B). (2021).*The Climate-Nature Nexus Implications for the Financial Sector*. F4B. https://a1be08a4-d8fb-4c22-9e4a-2b2f4cb7e41d.filesusr.com/ugd/643e85_276c8cfee51d4bca97c082bb64e8058a.pdf

Tittensor, D. P., Beger, M., Boerder, K., Boyce, D. G., Cavanagh, R. D., Cosandey-Godin, A., Crespo, G. O., Dunn, D. C., Ghiffary, W., Grant, S. M., Hannah, L., Halpin, P. N., Harfoot, M., Heaslip, S. G., Jeffery, N. W., Kingston, N., Lotze, H. K., McGowan, J., McLeod, E., … Worm, B. (2019). "Integrating climate adaptation and biodiversity conservation in the global ocean". *Science Advances*, *5*(11), eaay9969. https://doi.org/10.1126/sciadv.aay9969

Wallbott, L., Siciliano, G., & Lederer, M. (2019). "Beyond PES and REDD+: Costa Rica on the way to climate-smart landscape management?" *Ecology and Society*, *24*(1). https://doi.org/10.5751/ES-10476-240124

Annex

Table A1. Map categorisation and associated policy objectives in selected NDCs

Country	Map Name	Map Type	Policy commitments or actions
Antigua and Barbuda	Figure 2: Projected Sea Level Rise in 2080, RCP 8.5	Potentially actionable	Highlighted cells show lands impacted by sea level rise under a business as usual (RCP 8.5) climate scenario. The intensity of colour within the cell corresponds to value of assets that will be impacted.
Argentina	Figure 5: Map of the main vulnerabilities of the Argentine Republic to the adverse effects of climate change. (Specific elaboration for the Adaptation Communication, based on PNAyM 2019 and other sources.)	Potentially actionable	Figure 5 presents a map that reflects the main vulnerabilities of the Argentine Republic, which is used as a source, especially in the PNAyM preparation process, as well as those that arise of the Convention.
Colombia	Figure 3: Climate change threat map in Colombia. Prepared with data from the TCNCC, 2017. Figure 4: Map of vulnerability due to climate change in Colombia. Prepared with data from the TCNCC, 2017. Figure 5: Climate change risk map for Colombia. Prepared with data from the TCNCC, 2017. Annex A2: Hazard, vulnerability and risk maps at departmental level in Colombia *(Three maps categorised as potentially actionable as no policy commitments)*	Potentially actionable	Colombia has sought to deepen the understanding of its vulnerability and risk to climate change. This has been done through initiatives such as the vulnerability and risk analysis to climate change of the floodplains of the Magdalena-Cauca macro-basin (IDEAM -TNCCC 1); and the vulnerability and risk analysis to climate change carried out by the Ministry of Agriculture and Rural Development and the Food and Agriculture Organization of the United Nations (FAO), with the support of IDEAM5. This has allowed the construction of better-quality hazard, vulnerability, and risk maps.
Cape Verde (Cabo Verde)	Figure 2: Map of the susceptibility to selected climate hazards in a high-risk scenario, per island, 2014/2021 Figure 3: Map of areas potentially reducing GHG emissions through deployment of renewable energies and through natural carbon sequestration in vegetative cover and protected areas, per islands, 2021.	Potentially actionable	Since Cabo Verde's ratification of the UN Framework Convention on Climate Change (UNFCCC) in 1995, these climate vulnerabilities have been studied and are being monitored. Although limited in resources, the Government has since spared no efforts to reduce the nation's overall vulnerabilities and exposure to disaster and to cope with climate change, as can be seen by the following selection of milestone documents produced under the auspices of the Ministry of

			Agriculture and Environment: • First (1994–2004) and Second (2004–2014) National Action Plan for the Environment; • First National Inventory Report on GHG (1995), 20 years after national Independence; • First (2000), Second (2010) and Third (2017) National Communication (NC) to the UNFCCC; • First National Programme of Action for Adaptation to Climate Change (NAPA) 2008–2012
Congo (Republic of)	Figure 1: Administrative map of the Republic of Congo	Non-actionable	N/A
Guinea	Figure SEQ: Natural regions and departments of Guinea Figure 1: Land-use map for Guinea 2014 Figure 2: Stratification – forest loss between 2015 and 2020 for Guinea	Potentially actionable (Fig 1, 2) Non-actionable (Figure SEQ) – *only looks at historical deforestation rates. Does not show what the government intends to do*	In Guinea, the main cause of emissions from forest degradation is the consumption of wood energy, which includes fuelwood and charcoal. The National Climate Change Strategy calls for the introduction of at least 1 million improved stoves by 2030 and the deployment of butane gas, and "assumes that this will halve the amount of fuelwood extracted from the forest" (SNCC, 2019). Urgent action is needed for the implementation of this goal and are included in the NDC.
Moldova (Republic of)	Figure 3.2-1: Projected CMIP5 21 GCMs ensemble annual mean air temperature, °C development throughout the Republic of Moldova Figure 3.2-2: Projected CMIP5 21 GCMs Ensemble Annual Precipitation, (mm), change throughout the Republic of Moldova. Figure 3.2-3: Changes in HTC indices as projected by CMIP5 21 Multi – Model Ensemble for the Vegetation Period throughout the Republic of Moldova.	Potentially actionable (all)	The Republic of Moldova is more likely to be affected by three types of climate impacts (based on the figures): temperature increases; changes in precipitation regimes; and increased climate aridity, which are associated with the frequency and intensity amplification of extreme weather events, such as heatwaves and frost, floods, storms with heavy rains and hail, severe droughts. These conclusions are drawn based on the projected climate change scenarios, accompanied by a number of impact, risk and vulnerability assessments undertaken within the National Communications, along with other various assessments carried out at project level, covering national, sub-national and geographic magnitude. This work defines the basis for establishing mid- and long-term

			priorities of adaptation planning, action and investments, along with the monitoring of the effectiveness of planned and implemented adaptation.
Myanmar	Figure 1: Map of Myanmar Figure 5. RE Projects with Pre-Feasibility Assessments, Feasibility Assessments, Ongoing Figure 6. Potential RE Projects (Hydro, Solar, Floating Solar and Wind) for the NDC	Non-actionable (all)	Ministry of Electricity and Energy (MOEE) has a pipeline of ongoing investments in renewable energy-based projects that are expected to generate 1268.25MW in solar power and wind power by 2030. It should be noted that several of these tenders were just recently announced by the Government as prioritised actions in its COVID-19 Economic Response Plan (CERP)
Nicaragua	Figure 5 Conservation of forests within Indigenous Territories and Protected Areas	Potentially actionable	Nicaragua received the approval of the Forest Carbon Cooperative Fund, through which rural communities and indigenous peoples living in the forests of the Caribbean Coast, Bosawás and Indio Maíz will reduce deforestation and forest degradation, reducing emissions by approximately 11 million tons of carbon dioxide and will receive positive incentives for 55 million dollars in five years. Nicaragua will implement interventions that contribute to supporting Indigenous communities and producers with capacities, technical assistance, inputs and solid financial and market incentives for the sustainable intensification of their livelihoods oriented to the restoration and conservation of natural resources and forests in their farms and territories. These interventions are: 1) establishment of agroforestry systems; 2) establishment of silvopastoral systems; 3) management of natural regeneration; 4) community forest management; 5) commercial reforestation and 6) improved forest governance.
Nigeria	Figure 2: Spatial variation in relative climate change vulnerability (Source: second national communication 2013)	Potentially actionable *(map is very blurry)*	The government has determined vulnerability across Nigeria's geographical regions, focusing on three principal determinants of vulnerability: adaptive capacity,

			sensitivity and exposure. Climate change is thought to be a contributing factor to the deteriorating security situation observed in parts of the country. The impact of these changes without adaptation could cost between 6% and 30% of Nigeria's GDP by 2050. Following the 2012 floods, affecting 7 million people, the Nigeria Emergency Management Agency (NEMA) and international partners prepared a capacity assessment of climate change risks and potential disaster risk reduction policy responses. The focus was on the agriculture sector and water resource management. Further work on the DRR has been conducted in the context of the National Adaptation Plan Framework.
Papua New Guinea	Figure 1: Map of Papua New Guinea. (Source CCDA; Title on map: Land Use Base Map)	Non-actionable	N/A
Sierra Leone	Figure 1: Administrative map of Sierra Leone (Source: GoSL 2018) Figure 2: Regions of the SLCLC (Source: WABiCC 2018) Figure 4: 90th percentile rainfall (top) and Warm spell day (bottom) trend in Sierra Leone Figure 9: LDN hotspots (Source: GoSL, 2018) Figure 10: River basins of Sierra Leone (Source: reproduced with permission from the Ministry of Water Resources/ASI (2015)) Figure 11: Protected and conservation areas of Sierra Leone (UNEP 2015) Figure 12: Expansion of the forest degradation (left) and agricultural land (right)	Non-actionable (Fig. 1, 2,10) Potentially actionable (Fig. 4, 9, 11, 12)	Sierra Leone will adopt appropriate technologies for running large-scale management of agricultural and forestry residue, manure, household kitchen and garden waste, and biosolids (organic solids from treated sewage). Technologies and tools for reducing food waste by improving value chains, and new REDD+ initiatives targeting established protected and community conservation areas will be adopted. Skills transfer for developing a national forest inventory and forest management information system will also be promoted. In 2017, Sierra Leone revised its National Biodiversity Strategy and Action Plan (NBSAP) to assess the status of biodiversity, including forest resources, and propose action plans for sustainable management. Sierra Leone's vision on mitigation is drawn on the LECRDS, with the objective to achieve GHG emission reductions in priority sectors through well targeted programmes of activities and projects, including through the implementation of REDD+ (Reducing

			Deforestation and Forest Degradation) programmes, which can deliver significant mitigation and adaptation co-benefits in Sierra Leone.
Solomon Islands	Figure 1: Map of Solomon Islands	Non-actionable	N/A
South Sudan	Figure 1: Map of South Sudan Figure 3: Projected change in precipitation in South Sudan, 1960–2039 Figure 4: Projected changed in temperature in South Sudan, 1960–2039 Figure 6: Climate change vulnerability index, 2017	Non-actionable (Fig. 1) Potentially actionable (Fig. 3, 4, 6)	N/A
Suriname	Figure 1: Courtesy SBB	Non-actionable	N/A
Zimbabwe	Figure 1: Spatial distribution of Zimbabwe average temperature increase for the periods of 2020–2040 (panel 1), 2041–2060 (panel 2) and 2061–2080 (panel 3) under RCP 8.5 Figure 2: Spatial distribution of Zimbabwe mean annual Climate Research Unit (CRU) rainfall for the periods of 2020–2040 (panel 1), 2041–2060 (panel 2) and 2061–2080 (panel 3) under RCP 8.5	Potentially actionable	At this stage and for the summative purposes of this high-level NDC report, Zimbabwe is initially focusing on four high-level priority adaptation measures, namely to: develop, implement and scale-up climate smart agriculture solutions and strengthen agricultural value chains and markets; enhance early warning and climate-related disaster risk reduction systems (including information management systems); ensure climate resilient infrastructure designs and development; and develop and promote resilient and sustainable water resources management.