



Connecting the dots

How applying the biodiversity and climate Nexus lens can help tackle the dual crisis

Contents

1. Introduction.....	2
2. Climate change and the loss of biodiversity are inseparable threats to humankind and must be addressed together.....	3
3. Sustainable Development Goals interconnectivity and policy coherence	4
4. International framework biodiversity and climate Nexus lens	5
5. Examples of ecosystems biodiversity and climate Nexus considerations	7
5.1 Boreal Forests – World’s largest terrestrial carbon storage	7
5.2 Coral Reefs – Highly climate sensitive biodiversity hotspots	8
5.3 Deserts and grasslands – High carbon sequestration potential often mistaken for a low biodiversity environment	9
5.4 Freshwater ecosystems – High biodiversity ecosystem interacting with climate system	10
6. Key biodiversity and climate Nexus considerations for environmental auditors	11
7. Applying the key biodiversity and climate Nexus considerations in an audit context	12
8. Nexus cases studies – SAI’s Nexus lesson learned.....	13
8.1 Nexus case study Canada – Biodiversity and climate potential of tree planting	13
8.2 Nexus case study Estonia – Preservation of natural values in protected forests	13
8.3 Nexus case study Philippines – Reforestation’s environmental and socio-economic impact	14
8.4 Nexus case study European Court of Auditors – Biodiversity protection in forests	14
8.5 Nexus case study Morocco – Sustainable and economically viable agriculture practices	15
8.6 Nexus case study China – Desertification control and prevention	15
9.0 Additional sources of information	16

1. Introduction

The INTOSAI Working Group on Environmental Auditing (WGEA), established in 1992, aims to increase the expertise in environmental auditing and to enhance environmental governance.

The INTOSAI WGEA's vision of innovative environmental auditing for a common sustainable future is operationalized with projects in thematic areas that are relevant for countries around the world. This report is a direct product of the **Nexus Area: Climate and Biodiversity** work package.

The ~~is~~ purpose of this report is to **increase awareness and understanding of the interconnectedness of biodiversity and climate change among Supreme Audit Institutions (SAIs) and key international stakeholders.**

This document provides:

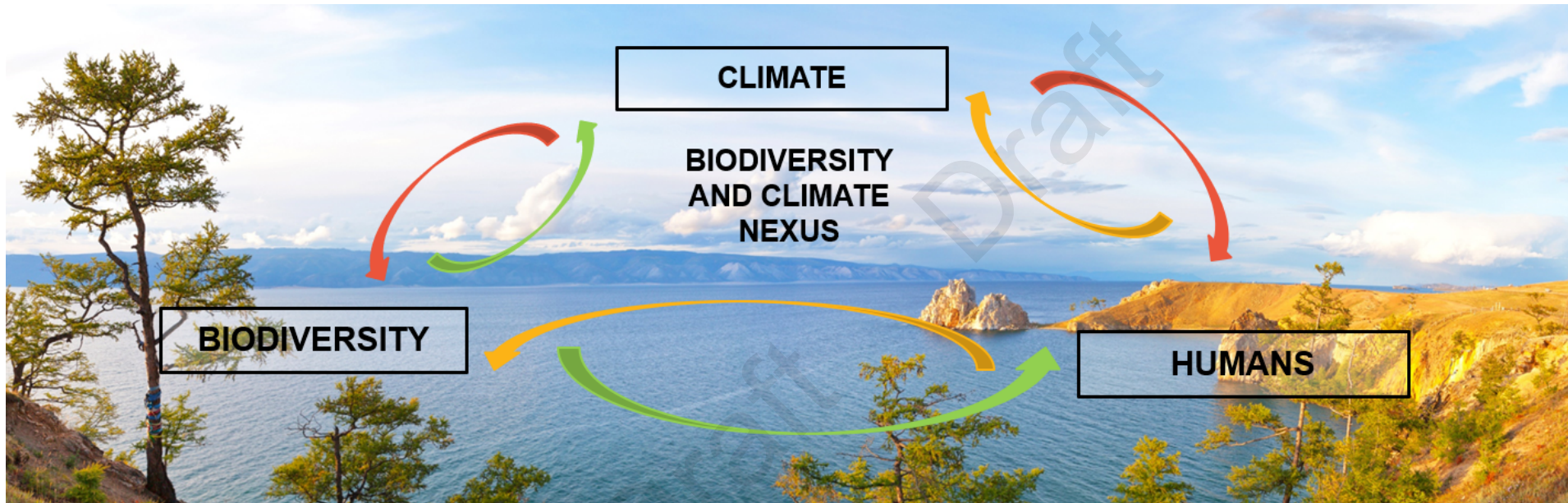
- A summary of the issue and specific challenges posed by the biodiversity-climate change nexus.
- An overview of key international commitments, how they align with the nexus, and how they could be applied as sources of criteria in environmental audits.
- Specific ecosystems and trade-offs along with tips and considerations for auditors when examining biodiversity and climate policy together.
- Case studies that provide examples of how SAIs have audited nexus topics before, to identify lessons learned for the future.

This work is complemented by:

- A literature review on climate – biodiversity Nexus: relationship of climate change mitigation and biodiversity policy measure.
- A bank of audit criteria and questions provides auditors a tool and starting point ~~on for~~ how to approach an audit related to the biodiversity-climate change nexus.
- ~~TBD~~—A link to a podcast recording to explore the Nexus from an environmental auditor's perspective.



2. Climate change and the loss of biodiversity are inseparable threats to humankind and must be addressed together



Climate change and the loss of biodiversity are inseparable threats to humankind and must be addressed together

Biodiversity and climate are interconnected

- ✗ Biodiversity loss can further accelerate climate change by reducing nature’s ability to regulate greenhouse gas emissions and protect against extreme weather events
- ✓ Mitigating climate change can help to conserve biodiversity, while protecting biodiversity and/or reversing biodiversity loss can help to mitigate climate change

Biodiversity is critical for humans

- ✓ Biodiversity is critical for human (individual and communities) wellbeing by providing food, water, air, energy, medicines, genetic resources, materials, cultural or spiritual benefits, etc.

Human activities can impact biodiversity:

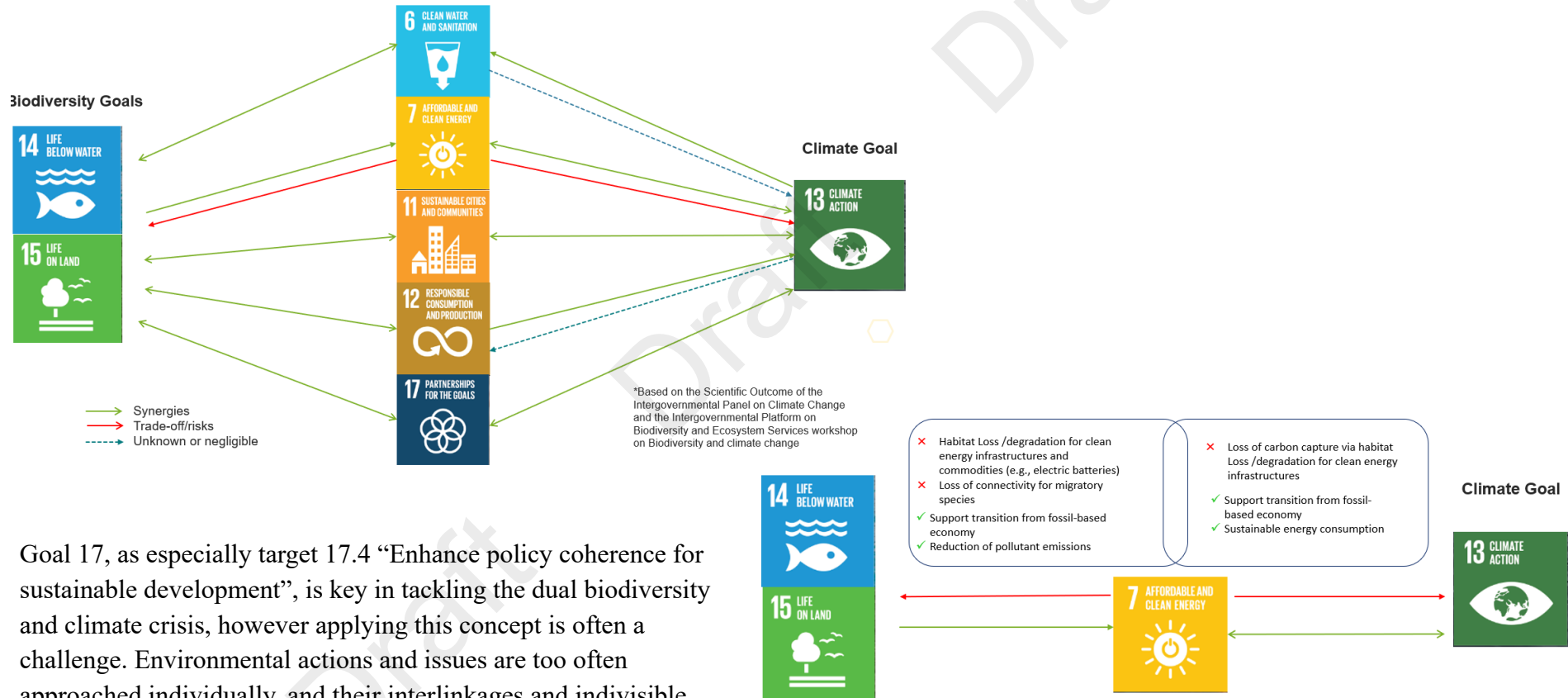
- ✓ Positively via protection, restoration, sustainable practices, etc.
- ✗ Negatively via habitat loss and degradation, pollution, harvesting, etc.

Climate change, caused by humans, affects living conditions

- ✗ Increased temperatures and extreme weather events impacts mental and physical health, natural and urban habitats degradation, etc.
- ✓ Nature-based solutions and sustainable agriculture, forestry, industrial, energy and product practices and consumption can reduce carbon footprint
- ✓ Environmental auditors play an important role in making governments accountable

3. Sustainable Development Goals interconnectivity and policy coherence

As members of the United Nations, countries have commonly agreed on Sustainable Development Goals. In 2017, the International Organization of Supreme Audit Institutions adopted the SDGs into its strategic plan. Supreme Audit Institutions (SAIs) can use these Goals, and their targets and indicators, as part of their work including conducting audits their governments’ governance, policy issues and activities. All Goals are interconnected and have potential for some synergies and/or trade-offs.



Goal 17, as especially target 17.4 “Enhance policy coherence for sustainable development”, is key in tackling the dual biodiversity and climate crisis, however applying this concept is often a challenge. Environmental actions and issues are too often approached individually, and their interlinkages and indivisible nature is not well understood. **Strong leadership and whole-of-society approach** are needed to drive progress toward climate commitments. The principal of **leaving no one behind** is also key as issues and potential solutions are assessed, implemented, monitored and audited.

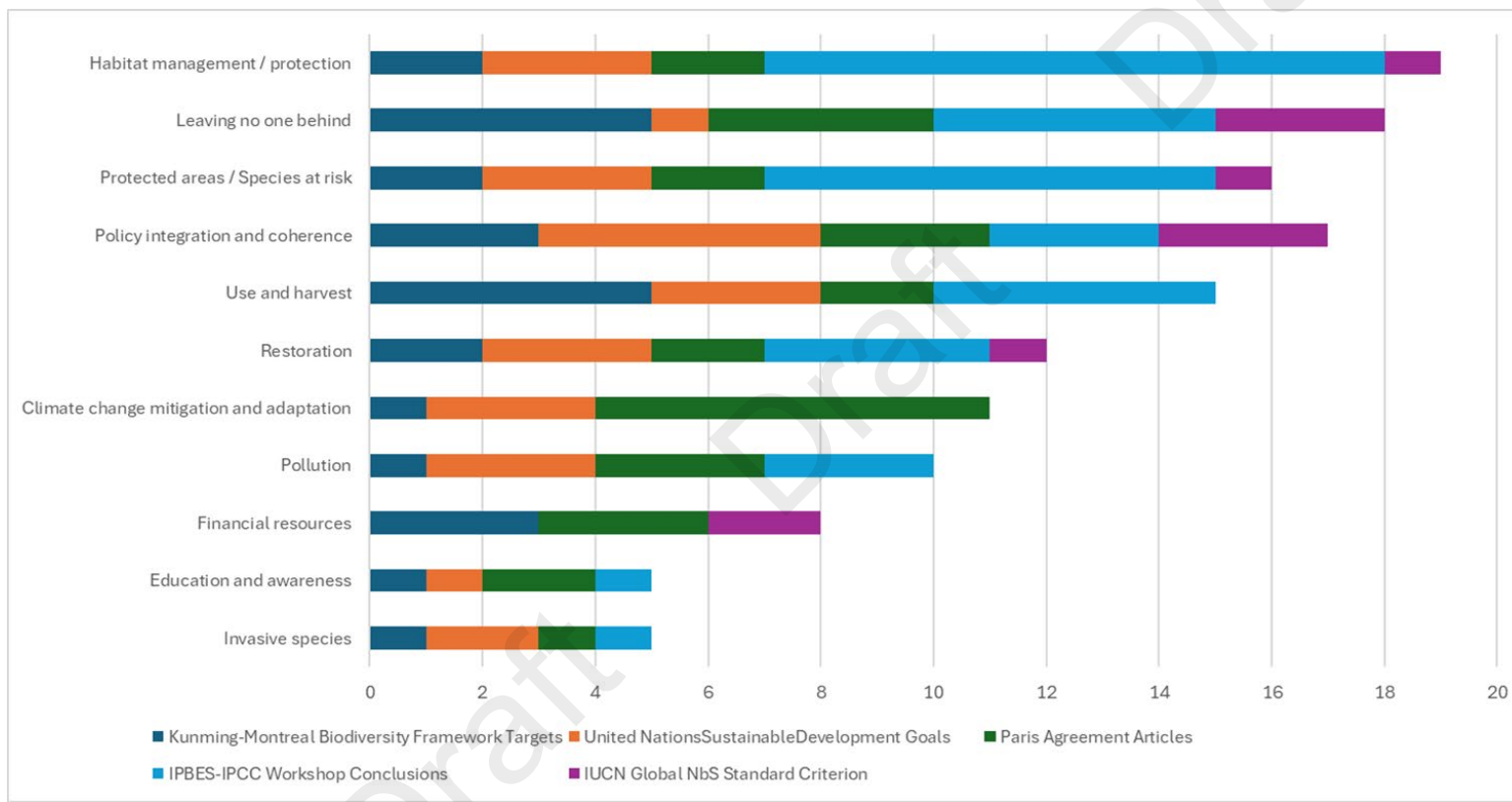
4. International framework biodiversity and climate Nexus lens

Beyond the Sustainable Development Goals, other key international framework and commitments* can help apply the biodiversity and climate Nexus lens as part of environmental audit work related to a vast number of thematic areas. The matrix below maps the most direct connections between potential audits subjects and key international framework and commitments that can be used sources of criteria.

International Framework / Potential audit subjects	Habitat management / protection	Restoration	Protected areas / Species at risk	Use and harvest	Invasive species	Pollution	Climate change mitigation and adaptation	Policy integration and coherence	Financial resources	Leaving no one behind	Education and awareness
Kunming-Montreal Biodiversity Framework Targets	✓ 1, 12	✓ 2, 11	✓ 3, 4	✓ 5, 9, 10, 13, 16	✓ 6	✓ 7	✓ 8	✓ 14, 15, 18	✓ 18, 19, 20	✓ 12, 13, 21, 22, 23	✓ 16
United Nations Sustainable Development Goals	✓ 13, 14, 15	✓ 13, 14, 15	✓ 13, 14, 15	✓ 13, 14, 15	✓ 14, 15	✓ 13, 14, 15	✓ 13, 14, 15	✓ 12, 13, 14, 15, 17		✓ 17	✓ 13
Paris Agreement Articles	✓ 2, 8	✓ 2	✓ 2, 8	✓ 2, 5	✓ 2	✓ 2, 4, 7	✓ 2, 3, 4, 6, 7, 8, 10	✓ 2, 4, 6	✓ 2, 5, 6	✓ 2, 3, 6, 7	✓ 6, 12
Workshop Conclusions	✓ 1, 9, 10, 12, 16, 18, 19, 25, 26, 27, 31	✓ 10, 12, 13, 19	✓ 1, 7, 9, 10, 12, 13, 19, 24	✓ 1, 14, 18, 19, 20	✓ 19	✓ 5, 10, 28	✓ All	✓ 31, 32, 33		✓ 30, 32, 33, 34, 35	✓ 39
Global Nature-based Solutions Standard criterion	✓ 3	✓ 3	✓ 3					✓ 3, 4, 6	✓ 2, 4	✓ 1, 5, 8	

*Other framework and commitments that those represented can apply, such as the Taskforce on Nature-related Financial disclosures

Many of the key international framework and commitments can be used to varying degree as source criteria for a vast number of potential biodiversity and climate Nexus audit subject. Depending on the audit subject, these audit source criteria can be leveraged during the course of an audit. For example, they can be used to develop audit questions in the planning phase to determine areas of highest risk, create a series of audit questions in areas to help guide the examination of audit evidence, and guide reporting structure and identify trends. The table below illustrates the degree of connections between potential audits subjects and the key international framework and commitments as identified in the matrix above.



A full suite of potential audits questions has been developed to support audit in key biodiversity and climate Nexus thematic areas. Please see the link for these questions along with their criteria and other helpful Biodiversity and climate Nexus audit tools at the end of this report.

5. Examples of ecosystems biodiversity and climate Nexus considerations

The following examples showcase different ecosystems, including common pressures, as well as the interconnections and potential for some synergies and trade-offs.

5.1 Boreal Forests – World’s largest terrestrial carbon storage

Boreal forests are vital ecosystems and form the largest terrestrial carbon storage on earth. This ecosystem has many anthropomorphic pressures such as logging, renewable energy, bioenergy and wood-based products play as well as carbon pricing and offsets actions.



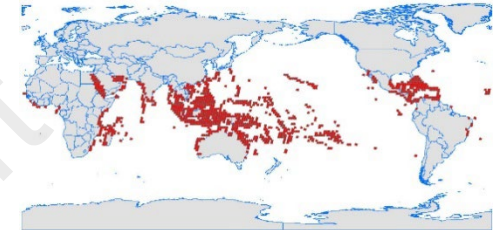
Pressures	Biodiversity	Climate
Logging (i.e., clear cutting)	✗ Habitat Loss /degradation ✗ Loss of connectivity for migratory species ✗ Loss of species (e.g., fungi, insects, birds, mammals)	✗ Emission resulting from logging
Renewable energy (e.g., wind, solar)	✗ Habitat Loss /degradation ✗ Loss of connectivity for migratory species	✓ Support transition from fossil-based economy
Bioenergy and wood products	✗ Habitat Loss /degradation	✓ Support transition from fossil-based economy ✗ Emission resulting from logging
Carbon pricing or offsets	✓ Tree planting ✗ Plantation of monoculture and/or exotic or non-native tree species	✓ Carbon capture

Nexus considerations for environmental auditors

- harvesting practices such as continuous cover, dead wood, and mixed species can benefit biodiversity
- harvest quantities and extraction of biomass technique for renewable energy can threaten biodiversity and carbon balance of forests
- tree planting and forest protection can benefit biodiversity and human health impact in addition to carbon capture
- balancing economic utilisation and biodiversity conservation is a key in sustainable forest management practices

5.2 Coral Reefs – Highly climate sensitive biodiversity hotspots

Whilst climate change mitigation measures greatly support coral reefs by limiting climate change, mitigation measures placed in, or in the vicinity of, ocean ecosystems, might inadvertently negatively affect them. Anthropomorphic pressures on this ecosystem include renewable energy, mining and carbon storage.



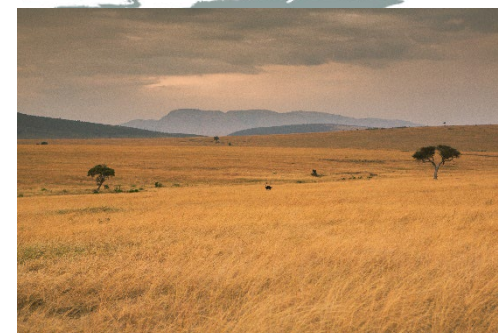
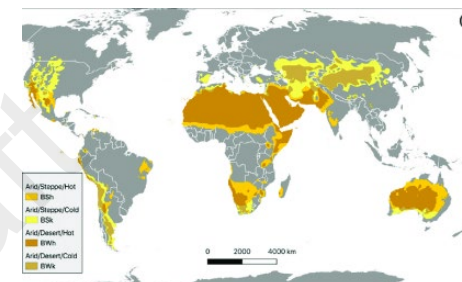
Pressures	Biodiversity	Climate
Wave and tidal power generation	<ul style="list-style-type: none"> ✗ Changes in temperature (increased heat = coral bleaching) ✗ Changes in nutrient levels, leading to increased algal growth ✗ Other unknown and complex interactions with marine ecosystems 	<ul style="list-style-type: none"> ✓ Support transition from fossil-based economy (renewable energy production)
Deep sea mineral mining	<ul style="list-style-type: none"> ✗ Habitat loss / degradation ✗ Other unknown and complex interactions with marine ecosystems 	<ul style="list-style-type: none"> ✓ Support transition from fossil-based economy (rare minerals)
Ocean carbon storage	<ul style="list-style-type: none"> ✗ Impacts on ocean chemistry ✗ Deemed as potentially risky 	<ul style="list-style-type: none"> ✓ Support transition from fossil-based economy (carbon sequestration) ✓ Wind and wave damage protection

Nexus considerations for environmental auditors

- marine ecosystems changes and how it impacts coral reefs through complex interactions is not fully understood
- sustainable management of coral reef is important as a source of food, economy income, as well as protection against rising sea levels and extreme weather event
- ocean-based projects and climate change and mitigation measures should consider the connectivity of ecosystems,

5.3 Deserts and grasslands – High carbon sequestration potential often mistaken for a low biodiversity environment

Deserts/semi-deserts and arid/semi-arid grasslands harbour rich biodiversity and are also home to some of the most vulnerable and marginalized groups. Some of these areas, particularly grasslands, are under high land-use change pressure. Those include land clearing for renewable energy, bioenergy and afforestation



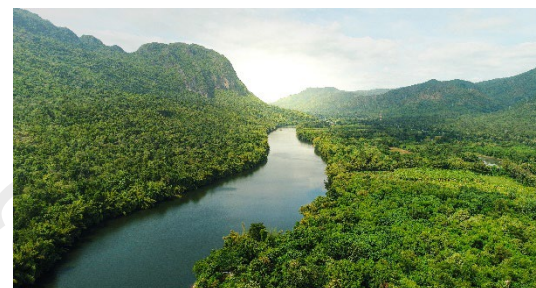
Pressures	Biodiversity	Climate
<p>Land clearing for renewable energy (solar, wind)</p>	<ul style="list-style-type: none"> ✗ Habitat loss and degradation due to erosion ✗ Loss of keystone species, direct animal mortality due to power installations 	<ul style="list-style-type: none"> ✗ Land clearing may affect carbon dynamics or local microclimate ✗ Increased need for water in solar energy production ✓ Support transition from fossil-based economy
<p>Bioenergy production</p>	<ul style="list-style-type: none"> ✗ Loss of keystone species, increased animal mortality 	<ul style="list-style-type: none"> ✓ Support transition from fossil-based economy
<p>Afforestation</p>	<ul style="list-style-type: none"> ✗ Negative impacts on native grassland biodiversity ✓ Positive impacts on degraded land 	<ul style="list-style-type: none"> ✓ Support transition from fossil-based economy

Nexus considerations for environmental auditors

- sustainable management of grasslands, grassland protection, avoided conversion and restoration can yield both climate and biodiversity benefits – they can also help reduce the impact on some of the most vulnerable and marginalized groups of people
- mitigation measures can reduce the environmental impacts caused by renewable energy projects and ensure ecosystem protection
- drylands which are often mistaken as degraded land, thus easily becoming a target for biofuel production or afforestation
- open lands are often ideal for renewable energy installations due to their high wind and solar potential

5.4 Freshwater ecosystems – High biodiversity ecosystem interacting with climate system

Freshwater ecosystems are crucial for supporting global biodiversity and contain a disproportionately high percentage of the world's species and a vast amount of genetic diversity. Anthropomorphic pressures on these ecosystems include solar and hydro power production, agriculture and forestry, as well as shale development.



Pressures	Biodiversity	Climate
Solar energy production (floating PV)	<ul style="list-style-type: none"> ✗ Water pollution (chemicals, heat) ✗ Disturbance to bird species ✗ Impacts of light penetration to water 	<ul style="list-style-type: none"> ✓ Support transition from fossil-based economy
Hydropower dams	<ul style="list-style-type: none"> ✗ Negative impacts on fish migration ✗ Loss of habitat connectivity ✗ Changes in water timing, flow, oxygen and sediment content = negative impacts on aquatic biodiversity 	<ul style="list-style-type: none"> ✓ Support transition from fossil-based economy
Agriculture and forest management	<ul style="list-style-type: none"> ✗ Agricultural runoff and/or increased use of nitrogen for forest management = negative impacts on aquatic biodiversity ✓ Erosion control practices = improve biodiversity 	<ul style="list-style-type: none"> ✓ Carbon capture (afforestation; agricultural practices)
Shale development	<ul style="list-style-type: none"> ✗ Unknown impacts on biodiversity, habitat fragmentation, cumulative effects 	<ul style="list-style-type: none"> ✓ Potential for replacement of coal with natural gas plants to meet short-term climate targets

Nexus considerations for environmental auditors

- sustainable freshwater management can have significant benefits:
 - biodiversity conservation
 - help to avoid or reduce emissions by acting as a carbon sink
 - natural inland water flows can prevent floods and draughts and prevent increase of pathogens and human disease
 - economic impacts related to recreational activities
- protection of forests around freshwater from degradation can also help reduce soil erosion, protect water resources, and conserve biodiversity in the watershed, while afforestation may lead to increased water use and reductions in streamflow.

6. Key biodiversity and climate Nexus considerations for environmental auditors

Globally, governments are considering, implementing and are encouraged to take and contribute to local, regional and worldwide initiatives to achieving sustainable development and preventing catastrophic consequences for future generations. Governments at all levels need to lead by example and apply the biodiversity and climate Nexus lens, as well as their impact on human quality of life as they are making policy decisions. Environmental auditors can play an important role in making governments and authorities accountable. Many considerations can be integrated as par of audits to help support global movements to reduce biodiversity loss, climate change impacts and inequality.

Environmental auditors are considering and encouraged to

Government are considering and encouraged to

- Apply the Nexus lens as they select and implement governmental action and policies
- Use Nature-based solutions to address societal challenges
- Maintain and adopt sustainable agriculture and forestry and infrastructure practices
- Increase the production of renewable energy and transition to low-carbon economy
- Apply a whole-of-society approach and seek global and local action

Holistic scope

Adopt the Nexus lens to promote mutually reinforcing practices and action

- Depart from narrow audit approaches or governance sector towards larger understanding of system risks and system change
- Prioritize pressing issues and areas of governmental (in)effectiveness
- Consider short and long time outcomes and recommendations

Data and evidence driven

Promote sustainable practices and governmental actions:

- Use data and solid evidence (e.g., data analytics, artificial intelligence)
- Monitor progress and alignment to national targets (e.g., Paris Agreement, Montreal biodiversity convention, SDGs)
- Conduct and recommend value for money assessment

Continuous learning

Promote innovation and continuous improvement:

- Celebrate successes and promote transparency of failures and challenges as learning opportunities
- Use of improvement cycle as measures and action are planned, implemented, measured and monitored, and course corrected

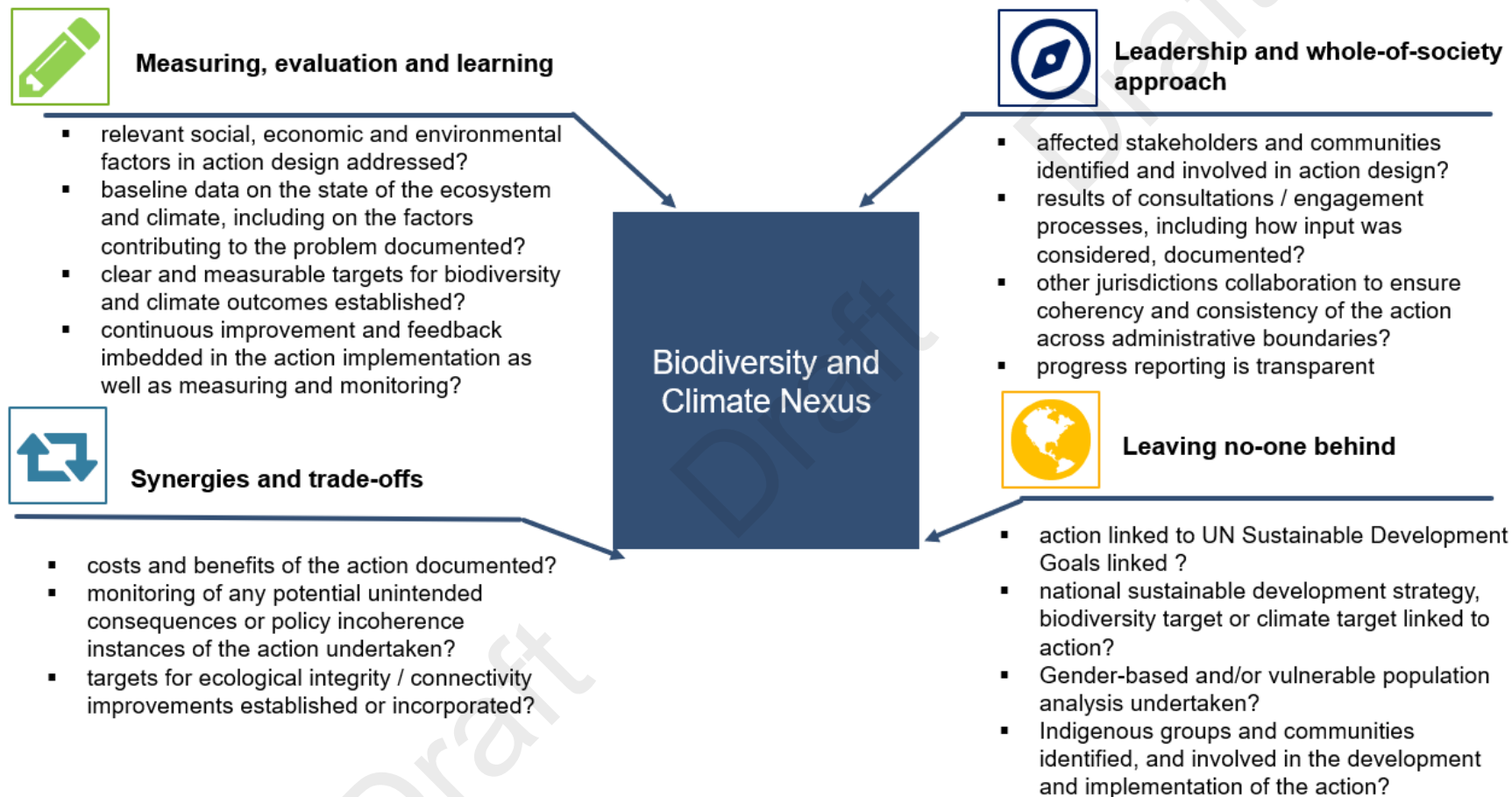
Leave no-one behind


Promote effective actions through whole-of-society and leaving no one behind principle:

- Encourage collaboration and horizontal approaches with multiple level of government and stakeholders (e.g., scientists, policymakers, NGOs, private sector)
- Pay particular attention to how Indigenous people, vulnerable population and local communities are considered as they providing valuable insights related to problem and solution identification

7. Applying the key biodiversity and climate Nexus considerations in an audit context

As environmental auditors are applying those key considerations as part of their audit work, they can use the following potential audit questions to guide their planning, examination and reporting approaches.



 [A full suite of potential audits questions has been developed to support audit in key biodiversity and climate Nexus thematic areas. Please see the link for these questions, their criteria, along with other helpful Biodiversity and climate Nexus audit tools at the end of this report.](#)

8. Nexus cases studies – SAI’s Nexus lesson learned

8.1 Nexus case study Canada – Biodiversity and climate potential of tree planting



In 2020, the Canadian government announced a 10 years and \$3.2 billion program to plant to two billion trees. The objectives of this effort were to capture carbon to reduce greenhouse gas emissions, enhance biodiversity, and support human well-being.



Audit objective: To determine if the tree planting program is designed and implemented adequately.



Nexus lesson learned

The Nexus lenses helped support the government accountability related to carbon capture, biodiversity and habitat-related benefits of a tree planting program over the long term. These efforts contribute to Canada’s biodiversity and climate goals.

Findings

+/- 15% of the total trees planted were monoculture sites. These single-species plantings do not support biodiversity and other benefits as more diverse plantings would.

The program did not provide to all planting partners :

- financial incentives
- key information, such as habitat and species range maps to undertake habitat restoration.

The program was unlikely to achieve its emission reduction and is predicted to be a carbon generator until 2031

8.2 Nexus case study Estonia – Preservation of natural values in protected forests



In Estonia, forest harvesting is main reason for biodiversity loss in forests. For example, the Estonian forest bird composite index showed the decline of forest birds by 30% between 1983 and 2018.



Audit objective To determine whether forest harvesting in protected areas ensured the preservation of the natural values for which these areas had been created.



Nexus lesson learned

This important audit concluded that the authorities had not ensured the protection of protected forests and their natural values. With the added nexus lens, then audit could have also assess the carbon emission associated with the loss and deterioration of the protected forested area.

Findings

Lack of reliable and up-to-date information:

- total area under protection
- extent of tree harvesting in the protected forests
- cumulative effects of forest harvesting relative to the protection objectives

- Multiple tree harvesting permits had resulted in large clear cut areas
- condition of several local species, including plants and animals was declining
- Subsidies were not being used to compensate for harvesting restrictions and were being even after clear cutting

8.3 Nexus case study Philippines – Reforestation’s environmental and socio-economic impact



The Philippine government’s National Greening Program, launched in 2011, aimed to reforest denuded lands, promote biodiversity, and contribute to climate change mitigation, food security, and poverty reduction. Initially targeting 1.5 million hectares by 2016, the program was extended to 2028 with an ambitious goal of reforesting an additional 7.1 million hectares.



Audit objective

To evaluate the environmental and socio-economic impact of the National Greening Program, and its adherence to established procedures.



Nexus lesson learned

This audit recognized the important contributions to socio-economic and reforestation efforts, while also highlighting the need for environmental sustainability - including monitoring over the long term.

Findings

The drive to rapidly achieve targets led to detrimental consequences, including:

- Targets beyond agencies’ capacity to implement resulted in rushed and inefficient implementation.
- Projects were initiated without proper surveys, mapping or planning.
- Complexities and issues around land tenure

Use of fast-growing exotic tree species, instead of indigenous species, raised ecological concerns (biodiversity loss, invasive species)

Inadequate monitoring and post-planting maintenance led to lower survival for planted trees

8.4 Nexus case study European Court of Auditors – Biodiversity protection in forests



Sustainable management practices are key to maintaining biodiversity and addressing climate change in forests. Funding for forested areas from the EU budget is focussed on support for conservation measures and support for planting and restoring woodland.



Audit objective:

To examine whether EU action supports biodiversity protection and addresses climate change in EU forests.



Nexus lesson learned

While the EU is increasingly addressing forests in its climate change policies, efforts to improve the focus of woodland climate adaptation strategies have been hampered by a lack of knowledge and information

Findings

- The quality of the conservation measures for forest habitats covered by the Habitats and Birds Directives continues to be problematic.
- Issues such as adapting forests to climate change and setting ecological boundaries on the use of forests for energy are less well developed than the Renewable Energy Directive and the LULUCF Regulation.

Rules and procedures do not guarantee greater biodiversity and resilience to climate change.

- The legislative proposals gave Member States more flexibility in the design of forestry support schemes and did not address these weaknesses.
- The common EU monitoring system did not measure the biodiversity and climate change effects of forestry measures.

8.54 Nexus case study Morocco – Sustainable and economically viable agriculture practices



In 2023, Sai Morocco effectively and efficiently used the national greenhouse gas inventory system to conduct an exhaustive comparison between the expected emissions forecasts and actual emissions from agriculture practices.



Audit objective:

To evaluate of the measures undertaken by the government to reduce greenhouse gas emissions by 42% by 2030.



Nexus lesson learned

This important audit highlights the linkages between climate, agriculture and economic development. The nexus concept can be applied to assess the connectivity between climate and biodiversity, but also other potential synergies and trade-offs.

Findings

- mitigation measures are not sufficient to be able to achieve the emission objective by 2030
- agricultural sector was continuing to display an overall upward trend, which risks hindering the achievement of the expected emissions objective

Audit concluded that there was a persistent imbalance between crops that allow carbon sequestration and crops that emits greenhouse gas

Audit recommended to improve the mitigation measures and monitoring of agriculture practices

8.6 Nexus case study China – Desertification control and prevention



China is one of the countries with the largest area of desertification in the world. After years of continuous exploration, positive results have been achieved in sand control and prevention by using "grass grid". This is a widely used sand control method in China and selected as one of the 500 Best Environmental Protection Practices by the United Nations.



Audit objective:

To examine whether there are any issues such as substandard project quality and inadequate post-construction maintenance and management in the "grass grid" sand control.



Nexus lesson learned

This audit confirms the significant role of "grass grid" sand control in improving the local ecological environment and protecting biodiversity and also emphasizes the importance of monitoring and continuously strengthening maintenance and management.

Findings

In some areas, the quality of materials such as wheat straw and rice straw used to make grass grids is subpar, with problems such as mold or insufficient toughness, which affects the service life and sand fixation effect of the grass grids.

In some areas, inadequate maintenance and management has resulted in low survival rates and poor growth of sand-fixing plants, affecting the stability of the grass grids and biodiversity.

[For more information on these audits please consult the WGEA audit database \(https://wgea.org/audit-database/\).](https://wgea.org/audit-database/)

9.0 Additional sources of information



**Literature review on climate - biodiversity
Nexus: relationship of climate change
mitigation and biodiversity policy measure**

Link to be added



**Nexus 2025 Podcast
recording**

Link to be added



**List of environmental audit questions for
environmental auditor based on the SDGs,
Kunming-Montreal Convention, Paris Agreement
and IPBES-IPCC workshop conclusions**

Link to be added