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Biodiversity and Ecosystem Services Network

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Background Document for the Biodiversity and Ecosystem Services Network Second Caribbean Regional Trialogue:

Integrated Approach to Sustainable Ecosystem Management

The United Nations Development Programme (UNDP) is a global network within the United Nations system dedicated to achieving the Sustainable Development Goals. With a presence in nearly 170 countries and territories, UNDP works to eradicate poverty, reduce inequalities and exclusion, and strengthen democratic governance. UNDP advocates change by connecting countries with the knowledge, experience and resources needed to improve the lives of their people. The organization assists countries in developing policies, acquiring leadership skills, forming partnerships and strengthening institutional capacities and resilience. Across all its activities, UNDP promotes the protection of human rights and fosters the active participation of women to support development outcomes and find sustainable solutions to national and global challenges.

UNDP's Nature Hub is an ambitious and forward-looking response to the current crisis of global biodiversity loss. By mobilizing partners and accelerating action to achieve the targets of the Global Biodiversity Framework by 2030, the Nature Hub places nature at the centre of sustainable development efforts. With its extensive portfolio of projects and its convening power, UNDP collaborates with governments and communities worldwide to promote a more sustainable and equitable future.

The Biodiversity and Ecosystem Services Network (BES-Net) is a flagship initiative of the Nature Hub. Recognizing that the natural world is a vital support system for our societies and economies, BES-Net aims to protect biodiversity and strengthen ecosystem resilience by facilitating dialogue between science, policy and practice. Through its efforts, BES-Net contributes to placing nature at the heart of development, supporting solutions that work for both people and the planet.

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Contents

I. Key Messages

A. The need for transformative change in a time of polycrisis

Current global trends show that the world is facing interconnected and compounding crises in ecological, economic and political systems – a polycrisis. These crises require coordinated responses in the areas of climate change, water, biodiversity, food and health, and their effects are collectively reshaping and threatening the world's future, including that of the Caribbean. Consequences of the polycrisis include:

- Natural ecosystems have declined by 47 per cent on average, with coastal socioecological systems among the most drastically impacted.[1]
- Global freshwater availability per person has decreased by 50 per cent since 1970,[2] leaving one in four people facing "extremely high" levels of water stress and exposing water systems to growing risks from industrial development.[3,4]
- Noncommunicable diseases are now the leading cause of death globally, while zoonotic diseases continue to emerge and re-emerge due to the combination of unsustainable and unhealthy practices in sourcing, growing, trading and consuming other living organisms, compounded by climate change.[5,6]
- Income inequalities have widened sharply, increasing for around 68 per cent of the global population in 2021.[7] The Caribbean remains one of the most unequal regions.[8] In 2024, total billionaire wealth grew three times faster than in 2023, while poverty rates showed little improvement.[9]
- Violence is also increasing.[10,11] In 2024, civilian fatalities in armed conflicts rose by 40 per cent – the third consecutive year of such an increase – and 196 environmental defenders were murdered in 2023.[12,13,14]

These destructive trends underscore the urgent need to address their underlying causes.

According to the recently published ***Thematic Assessment of the Underlying Causes of Biodiversity Loss and the Determinants of Transformative Change and Options for Achieving the 2050 Vision for Biodiversity*** (also known as the Transformative Change Assessment, or TCA), released by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in 2024, the causes are:

1. The disconnection from and domination over nature and people
2. The concentration of power and wealth
3. The prioritization of short-term, individual and material gains[15] (Figure I)

These social patterns are interconnected, mutually reinforcing and coevolving, sustaining the status quo.

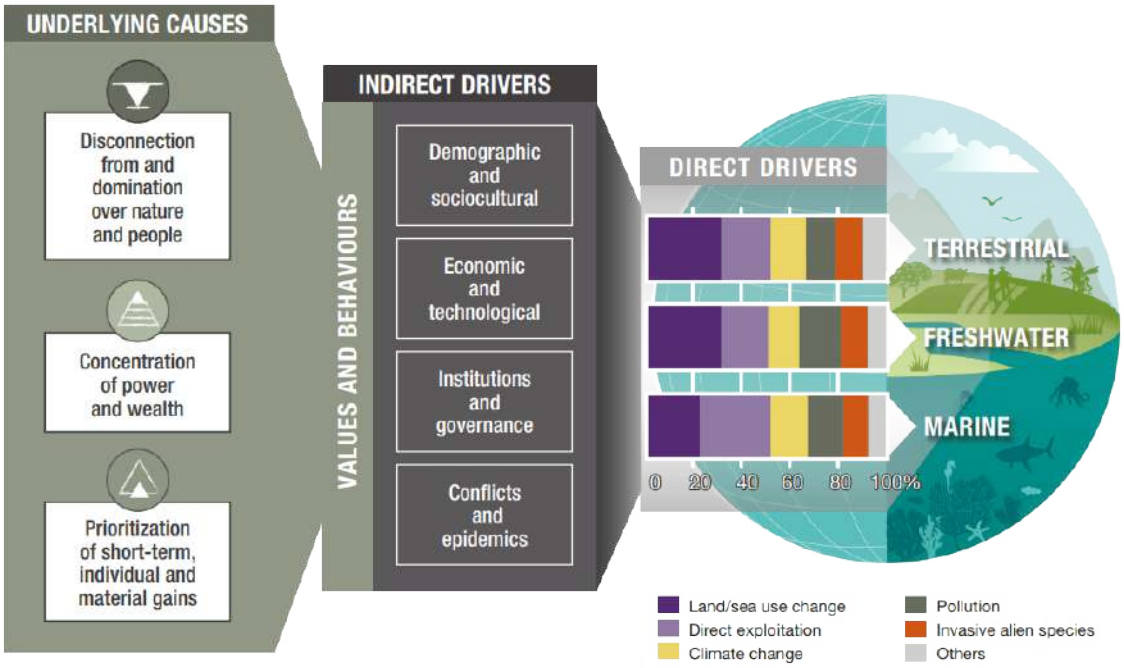


Figure I: Relation among underlying causes, indirect drivers and direct drivers of biodiversity loss and nature's decline (Source: Figure SMP1 of the Summary for Policymakers [SPM] of the TCA[16])

Only transformative change (TC) grounded in and guided by the principles of Equity and Justice, Pluralism and Inclusion, Respectful and Reciprocal Human–Nature Relationships, and Adaptive Learning and Action (Figure II) – as defined by IPBES – can trigger fundamental systemic shifts across the three dimensions required to address the underlying causes of biodiversity loss and nature's decline:

1. The ways of thinking, knowing and seeing (our views)
2. The ways of organizing, regulating and governing (our structures)
3. The ways of doing, behaving and relating (our practices)[17,18]

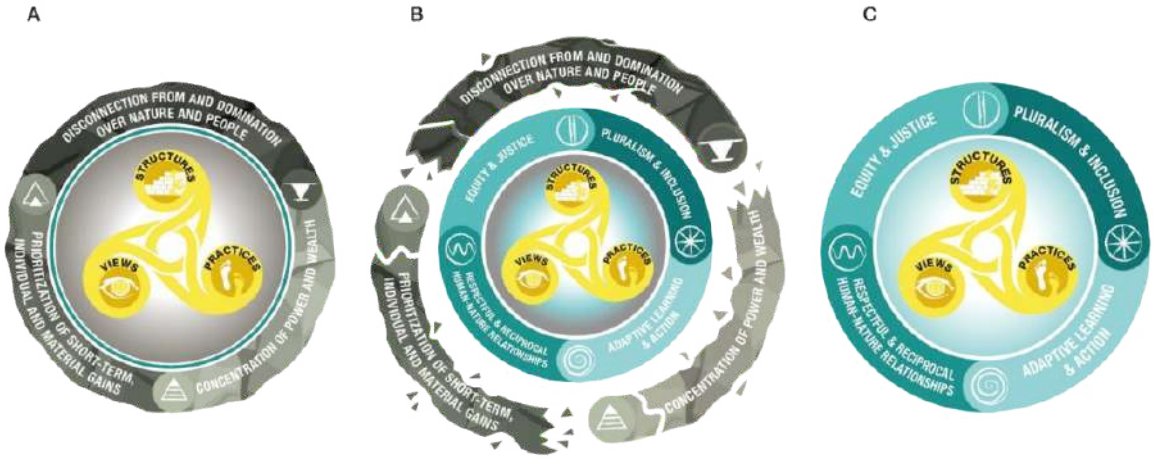


Figure II: A diagram showing the TC framework for a just and sustainable world. Figure A) indicates views, structures and practices (the inner golden spirals) being strongly shaped by the underlying causes of biodiversity loss and nature's decline (solid grey ring). Figure B) shows shifts in views, structures and practices breaking the influence of the underlying causes when they are guided by the four key principles of TC (blue ring). Figure C) illustrates a just and sustainable world, with prevailing views, structures and practices aligned with the principles of TC. This framework can be used by different actor groups to help identify where and how they can promote, accelerate and scale the process of TC towards a just and sustainable world. (Source: Figure 1.8 in Chapter 1 of the TCA[19])

TC can be driven by multiple actors – governments, the private sector, civil society groups, grassroots and social movements, Indigenous Peoples, local communities, and individuals – acting across different scales and within their respective spheres of influence. In many contexts, change towards just and sustainable futures is already underway, as highlighted by the TCA in hundreds of cases globally, but there remains significant potential to enhance the transformative potential of both new and ongoing change initiatives.[20] Visions, approaches, strategies and actions for transformation are diverse and interdependent, shaped by the challenges and barriers cascading from the underlying causes of biodiversity loss and nature's decline (Figure III).

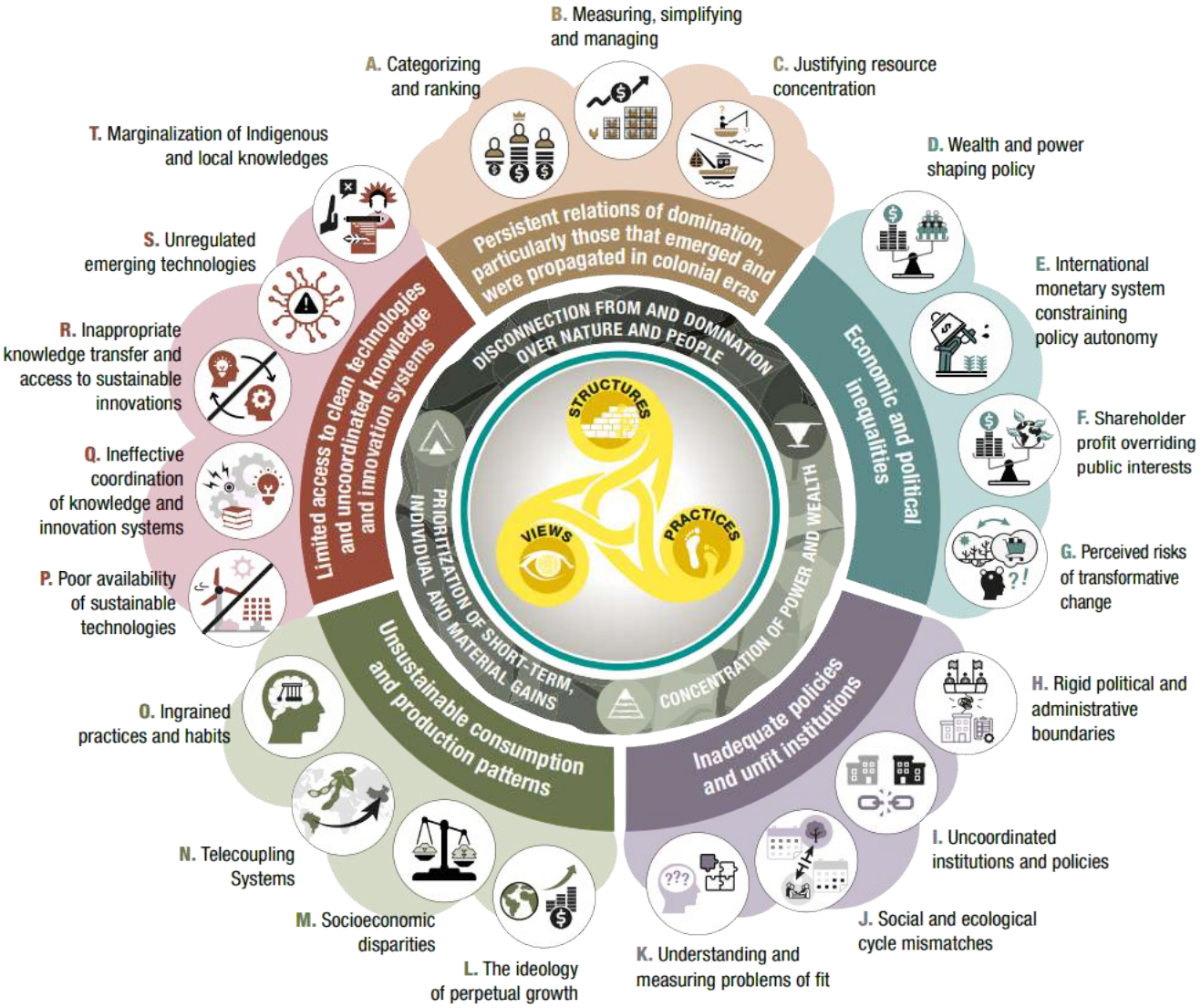


Figure III: A diagram showing the interconnected challenges (identified by the different colours in the figure) and barriers (identified by the different letters) to TC. It illustrates the relationship between the challenges and barriers, which are interrelated through views, structures and practices associated with the underlying causes of biodiversity loss and nature's decline. (Source: Figure SPM3 in the TCA SPM[21])

To guide this process, the TCA summarizes 881 visions across the world. These visions are categorized into five core themes that can help inform and shape transformative change:[22]

» **Regenerative and circular economy:** envisions closed-loop systems where materials are reused and recycled to regenerate ecosystems and support long-term ecological health and sustainability

» **Community rights and empowerment:** advocates the strengthening of local capacities to manage resources, make decisions and shape development trajectories

- **Biodiversity and ecosystem health:** emphasizes the relevance of biodiversity and ecosystem services, calling for biodiversity conservation, ecosystem restoration, and the integration of nature-based solutions and ecosystem-based approaches into development strategies

- **Spiritual reconnection and behavioral change:** promotes appreciation of the intrinsic values of nature through spiritual and ethical values and the adoption of behaviours that nurture a deeper connection to nature and a stronger sense of moral responsibility

- **Innovative business and technology:** encourages the development of products, services and technologies that reduce resource consumption, enhance energy efficiency and support the transition to a low-carbon economy, while improving data management, decision-making and collaboration across sectors to achieve sustainability goals

The TCA also outlines six broad approaches for advancing TC:[23]

- **Systems approach:** connecting change agents and shifting system feedback and interactions

- **Structural approach:** altering economic, social, political and cultural rules through governance interventions, market structures, or community reformation of predominant rules

- **Inner transformation approach:** investing in relational activities that nurture respectful and reciprocal relations with oneself, with other people, and between humans and more-than-human nature, leading to shifts in inner beliefs, values and practices

- **Empowerment approach:** fostering grassroots networks and social movements that balance power relations

- **Science and technology approach:** funding and supporting the development and implementation of research, innovation and technology

- **Knowledge co-creation approach:** investing in opportunities for collaborative sharing and knowledge-building

The TCA proposes five complementary strategies (each with a set of more concrete actions) necessary to ignite TC:[24]

- Conserve and regenerate places of value for nature and people
- Drive systemic change in the sectors most responsible for biodiversity loss and nature's decline
- Transform economic systems for nature and equity
- Transform governance systems to be integrative, inclusive, accountable and adaptive
- Shift societal views and values to recognize the interconnectedness of people and nature

The adaptive integration of these visions, approaches and strategies requires collaboration among diverse actors, ultimately enabling TC to scale across more spaces, higher organizational levels, and different mindsets.[25]

In December 2025, policymakers, scientists, Indigenous Peoples and local communities, and civil society actors from across the Caribbean will convene for a regional Trialogue where the TCA will take centre stage.[26] The TCA will provide a road map to address the underlying causes of biodiversity loss and nature's decline, offering fertile ground for the Trialogue to go beyond surface-level discussion and inspiring deeper conversations on equity, inclusion, structural barriers and transformative possibilities in the Caribbean region.

B. The need to consider the interactions across biodiversity, water, food, health and climate change for an integrated approach to ecosystem management

The IPBES *Thematic Assessment of the Interlinkages among Biodiversity, Water, Food and Health* (Nexus Assessment) is the most comprehensive global synthesis to date that explicitly recognizes the critical importance of the deep interlinkages (i.e. interactions) among biodiversity, water, food, health and climate change for the survival of humanity. The assessment defines such interactions among two or more of these elements, systems and sectors as "nexus" (Figure IV).[27,28]

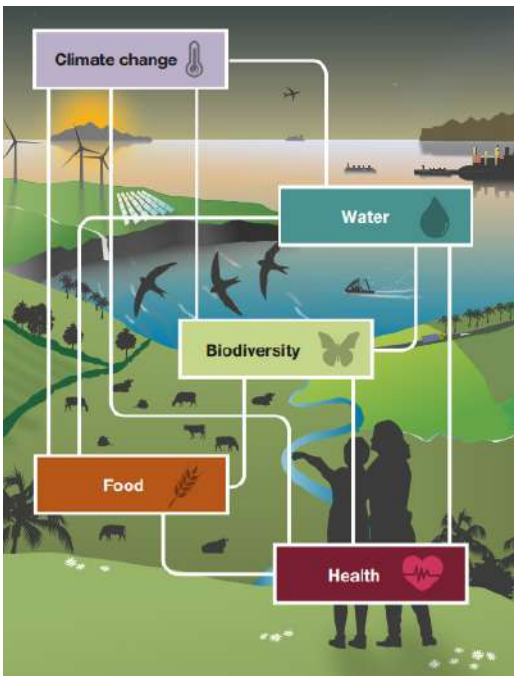


Figure IV: Interlinkages among the nexus elements – biodiversity, water, food, health and climate change (Source: Figure SPM1 of the Nexus Assessment SPM[29])

In the Caribbean, Indigenous Peoples and local communities have long understood and embodied the nexus. For example, Afro-descendants from coastal rural villages in Northeastern Trinidad commonly use herbs for treating and preventing illnesses and different sources of food to balance the effects of temperature changes on their bodies.[30] Similarly, for the Kalinago Peoples from Dominica, the links among ocean winds, currents, water, minerals and biodiversity are considered essential for healthy living.[31]

However, current governance and economic systems often address the nexus elements in isolation, neglecting their interdependence. The Nexus Assessment highlights how businesses-as-usual future scenarios following current trends across these elements will result in overall negative impacts on the nexus (Figure V). For example, a scenario that prioritizes food, despite leading to increasing nutritional health and consumption per capita, could simultaneously have adverse effects on:

- Biodiversity, via pollution and land conversion for unsustainable farming and fishing
- Water, via unsustainable consumption for food production, as well as pollution
- Climate change, via an increase in greenhouse emissions from food production activities[32,33]

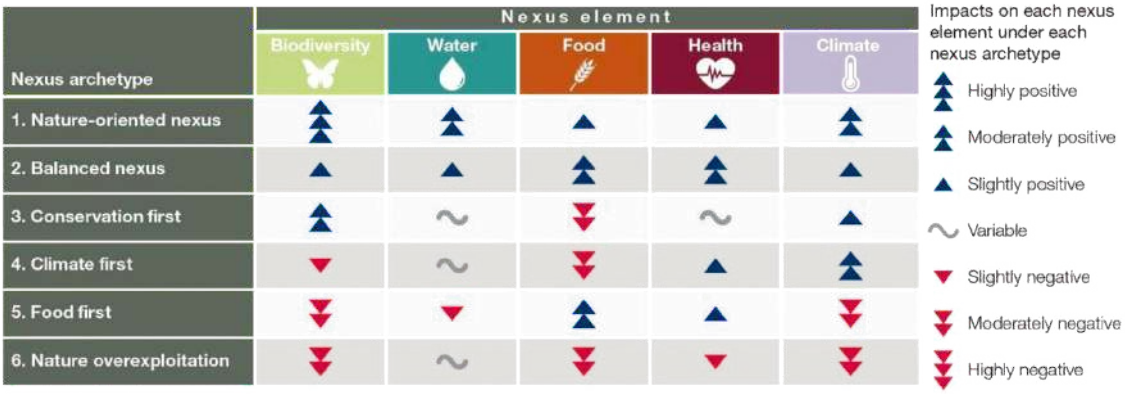


Figure V: Projected impacts of each nexus future scenario on each nexus element. The nature-oriented nexus and balanced nexus scenarios represent different types of sustainability scenarios. Food first and nature overexploitation represent business-as-usual scenarios that assume the continuation of current trends. (Source: Figure SPM5[A] of the Nexus Assessment SPM[34])

Indeed, approaching each of these nexus elements in isolation has resulted in disconnects and unintended consequences that deepen inequalities. For example, one study looked at the changes in agricultural production, consumer expenditure on agricultural products, and land and water use across Latin America and the Caribbean (LAC) under two scenarios: one focusing on climate change mitigation (example of a climate-first scenario) and another focusing on agricultural market integration (example of a food-first scenario). The results showed that these scenarios may result in conflicting effects, as they can generate complex and sometimes non-linear social and environmental repercussions that vary widely across LAC and exacerbate inequalities. These complex dynamics not only emphasize the need to understand the nexus but also show that environmental governance addressing issues via siloed approaches adversely manifests as the indirect and direct drivers – and underlying causes – of biodiversity loss and nature's decline (Figure VI).[36]

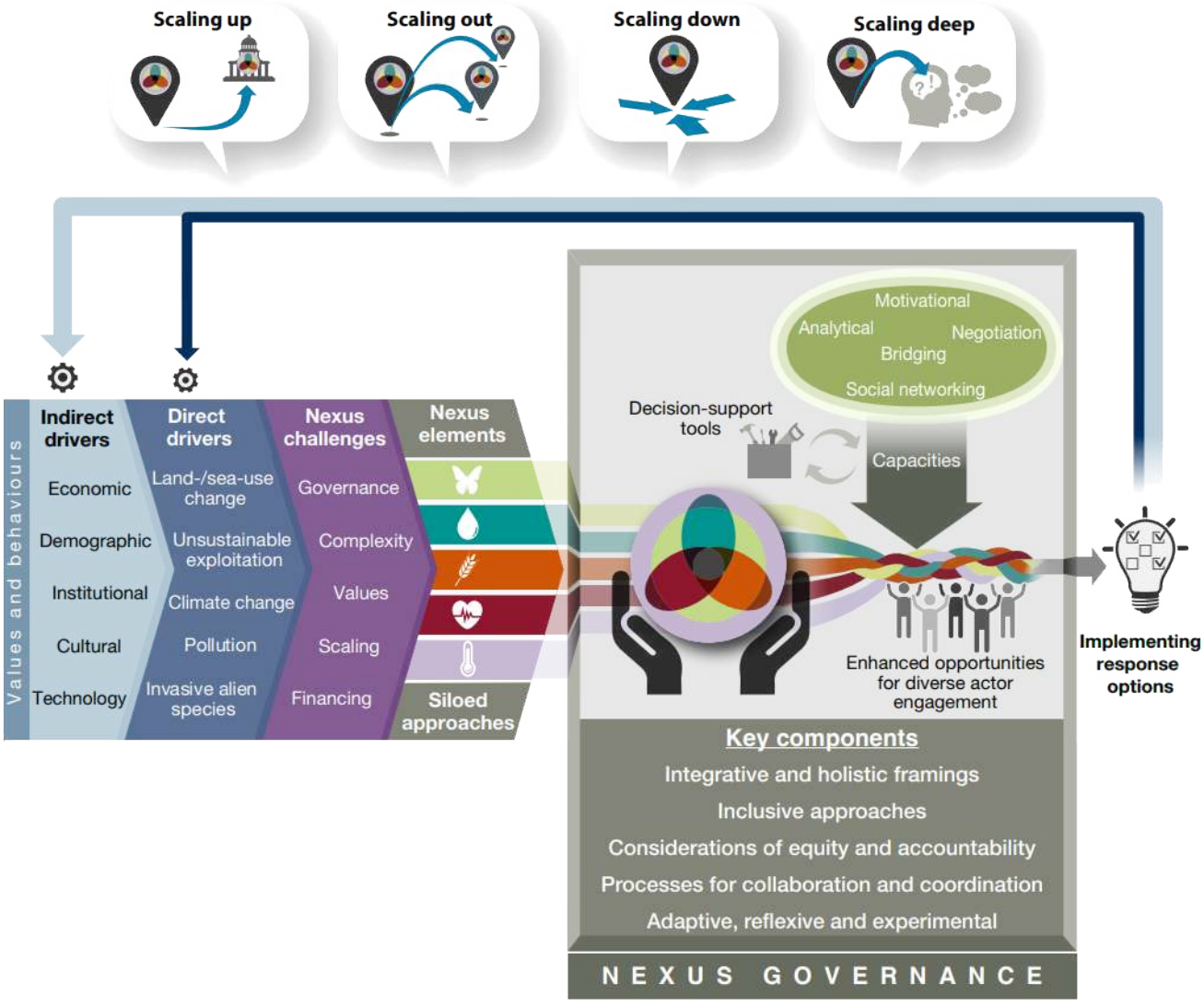


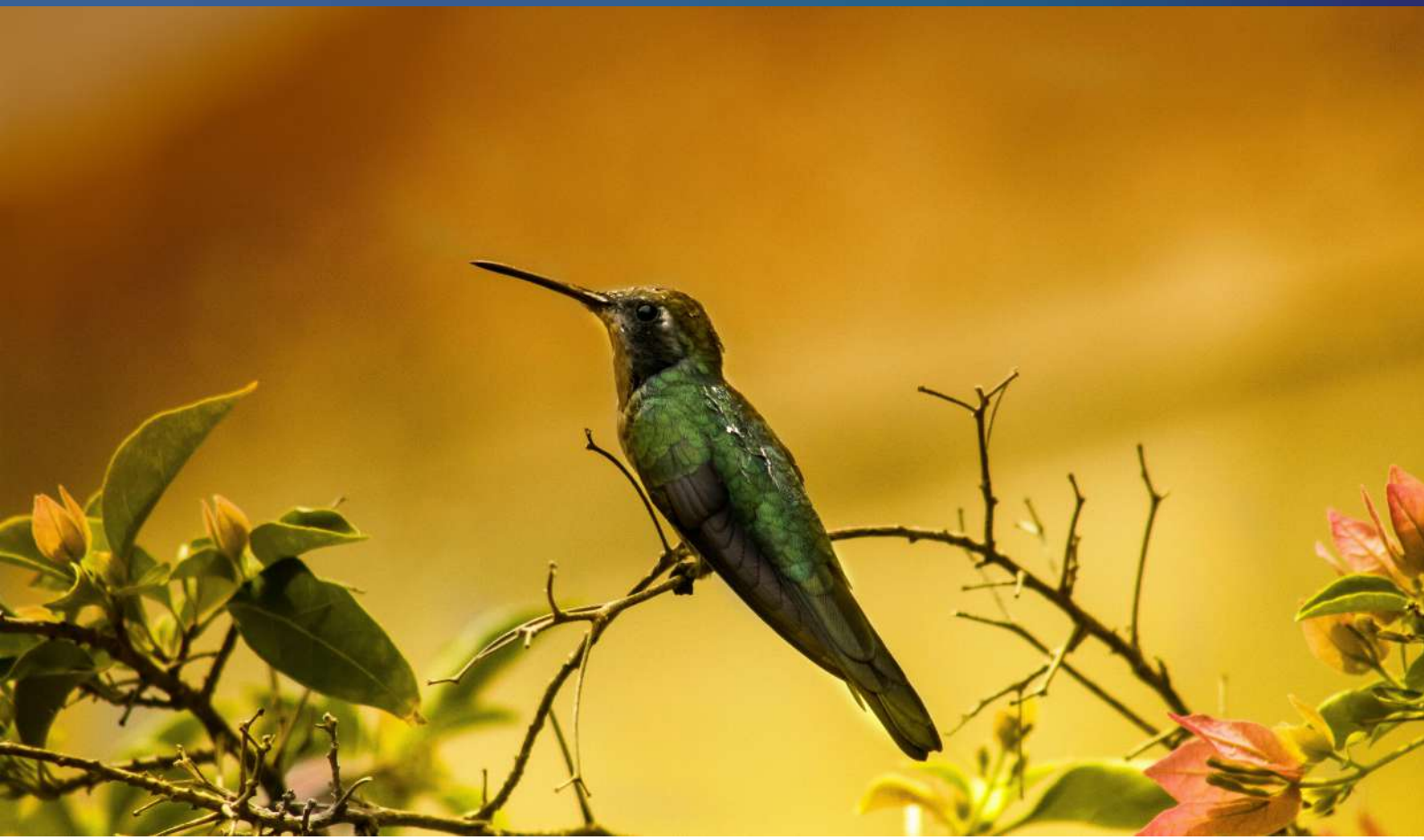
Figure VI: Diagram showing how nexus approaches to governance (or nexus governance) address the challenges associated with governing interactions across multiple elements, including implementing response options to influence the impact of direct and indirect drivers. (Source: Figure SPM11 of the Nexus Assessment SPM[37])

In contrast, the Nexus Assessment underlines that sustainable future scenarios in which nature is prioritized and its positive outcomes are balanced across the nexus elements (biodiversity, food, water, health and climate) are attainable (Figure V). These outcomes depend on employing types of environmental governance and decision-making that understand the nexus as an integrated whole (i.e. nexus approaches). Nexus approaches aim to minimize unintended consequences and maximize mutual benefits among the different elements of the nexus.

This is achieved through integrative and comprehensive perspectives, inclusiveness and considerations of equity and accountability to ensure the participation of diverse actors, capacities and tools. Such approaches foster collaboration and coordination, as well as adaptive, reflexive and experimental actions that address the drivers of biodiversity loss and nature's decline (Figure VI).[38,39]

The Nexus Assessment highlights 71 existing nexus actions or response options. Each response option corresponds to one of the five nexus elements (i.e. health response options, biodiversity response options, water response options, food response options and climate change response options). Additionally, each response option falls into one of 10 broad categories: ecosystem conservation, ecosystem restoration, ecosystem management, sustainable consumption, pollution reduction, integrated planning and governance, risk management, rights and equity, finance alignment and others (Figure VII).[40,41]

Figure VII: An organizational wheel showing the 71 response options highlighted in the IPBES Nexus Assessment, falling into 10 broad categories of action (represented by the 10 outer ring colours) and corresponding to five nexus elements (represented by the 5 colours in the inner ring, defined in the legend). (Source: Figure SPM7 of the Nexus Assessment SPM[42])



Reflecting the interactions across elements, the Nexus Assessment showcases that each category of action comprises response options drawn from multiple elements. For example, the health, food, biodiversity and water response options constitute the "rights and equity" category, while climate change, water, food and biodiversity response options form the "ecosystem management" category (Figure VII).

The Nexus Assessment also evaluates the impacts of each nexus response option on the respective nexus elements and identifies which Sustainable Development Goals (SDGs) and Kunming-Montreal Global Biodiversity Framework targets each response option supports.[43] This analysis allows for the identification of response options with an intrinsic nexus approach, i.e. those that deliver balanced positive impacts across the nexus elements and contribute to the international commitments towards sustainability. For example, actions such as "integrated landscape and seascape approaches" under the biodiversity response option,[44] "Indigenous food systems" under the food response option,[45] "water-sensitive urban infrastructure" under the water response option,[46] "integrated watershed-health interventions" under the health response option,[47] and "restoration of coastal and marine ecosystems for carbon sequestration" under the climate change response option[48] have been found to have positive impacts across all five nexus elements while supporting more than five SDGs and five Kunming-Montreal Global Biodiversity Framework targets.

Together, these nexus response options offering balanced benefits for biodiversity, water, food, health, and climate change manifest the five strategies proposed by the TCA. These strategies will serve as a road map to tackle the underlying causes of biodiversity loss and nature's decline and to move towards sustainable futures.[49] Overall, nexus-based governance approaches align with the principles for TC of humanity towards harmonic coexistence with nature, as emphasized by the TCA.

The intersections between nexus approaches and TC – where they mutually reinforce each other – will be instrumental in the Caribbean Regional Trialogue of December 2025. The holistic and integrative lens that the Nexus Assessment provides will foster cross-sectoral and transboundary dialogues in the Trialogue, helping identify common challenges and shared opportunities for transformation towards sustainable future scenarios. Such dialogue will enhance cohesion, collaboration and nexus across sectors, stakeholders, knowledge holders, and countries in the Caribbean region.

C. The need for integrated management with balanced benefits across biodiversity, water, food, health and climate change for TC – An overview of the Caribbean

The United Nations Sustainable Development Cooperation Framework for the English- and Dutch-speaking Caribbean highlighted in 2021 that the SDGs related to the planet (SDG 12: Responsible Production and Consumption; SDG 13: Climate Action; SDG 14: Life Below Water; SDG 15: Life on Land) were under serious threat and not improving across the Caribbean.[50] The direct drivers of biodiversity loss and nature's decline (Figure I) are affecting nature, nature's contributions to people and people's quality of life through their direct impacts on biodiversity, water, food, climate and health. The direct drivers' combined effects (i.e. compounding impacts), especially those related to changes in land and sea use and climate change, impose existential challenges for the Caribbean countries across multiple dimensions, as outlined below:

- The integrity of coastal ecosystems indispensable for Caribbean identities and livelihoods, such as seagrass beds, coral reefs and coastal wetlands, has been particularly compromised.[51,52,53] Data from the Global Wetland Watch estimate that mangrove cover decreased by 7.9 per cent from 1996 to 2020 at an average rate of 21.4 km^2 (0.33 per cent) per year.[54,55] The Caribbean Coastal Marine Productivity Program has also detected changes that indicate potential degradation of the seagrass communities in 43 per cent of the 35 long-term study stations between 1993 and 2007 (and 2012 for some).[56] The ecosystem services of Caribbean seagrass beds, such as coastal protection, have provided a monetary value up to 181 times higher than the costs caused by storms between 2002 and 2023,[57] estimated at $112 billion.[58] In addition, it has been estimated that mangrove and coral reef restoration across the region can return up to 15 times the project costs in shoreline flood risk reduction alone.[59]

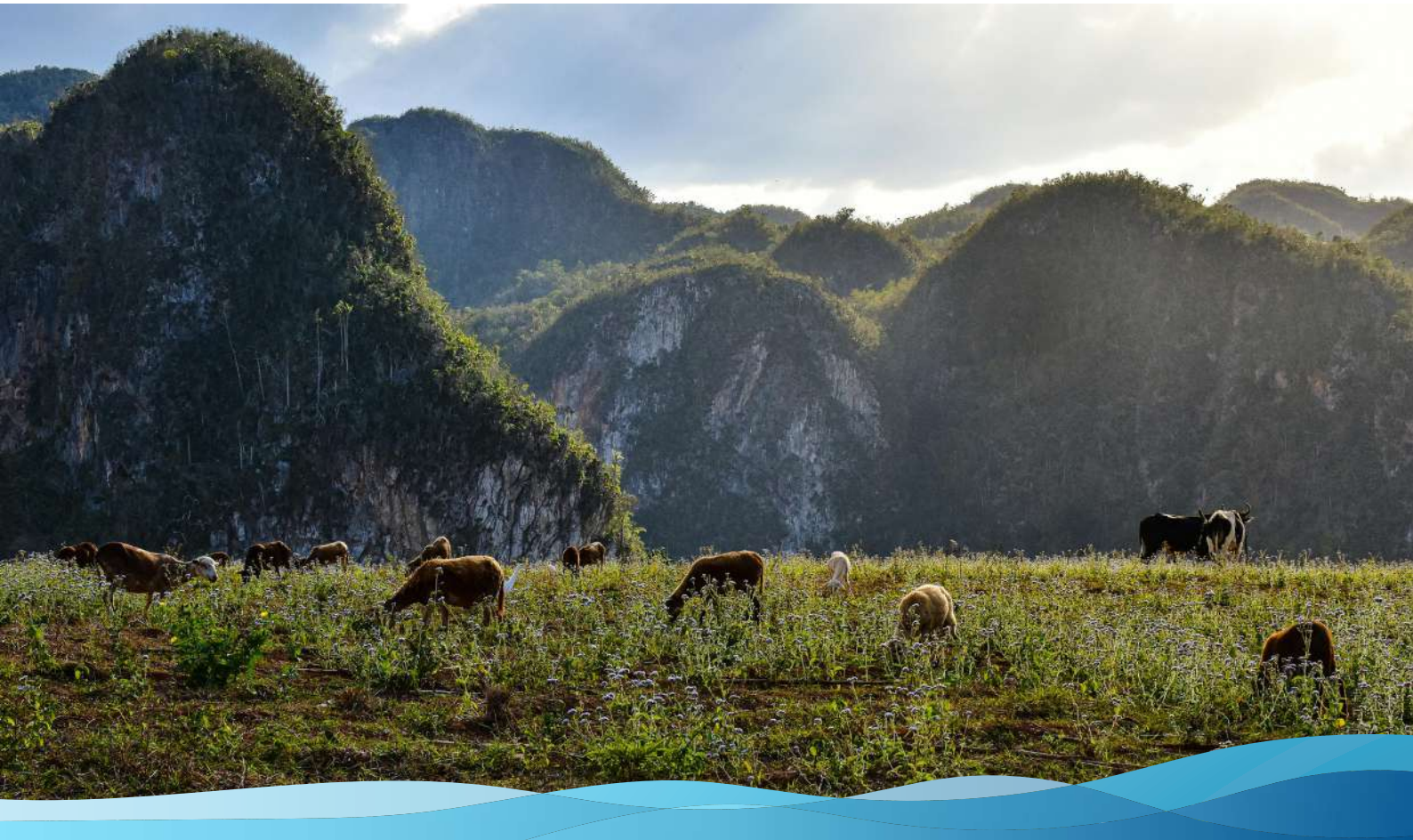
- Water quality and availability have been declining due to the cascading impacts from land use change, pollution and climate change. Estimates suggest that by 2050, a vast part of the region will be under severe water stress. Current trends indicate that the food, energy and water systems are highly unsustainable, unequal and under pressure from the growth of water-intensive activities such as tourism and overconsumption.[60,61]

- Food systems in the Caribbean have inherited colonial extractive patterns of production and consumption, resulting in land-use changes, pollution and overexploitation. These consequences threaten the very stability and resilience of food systems, with climate change exacerbating high vulnerability, fragility and inequality.[62,63] These problems, along with the geographical limitations in land and water availability, have contributed to the regional reliance on food imports.[64]

- Although the region does not contribute significantly to global greenhouse gas (GHG) emissions, it is among the most vulnerable to climate change effects.[65] Rising air and sea temperatures, ocean acidification and intensified natural hazards such as storms and droughts, decreasing rainfall and sea level rise threaten the very existence of the Caribbean, causing significant impacts across all nexus elements.[66]

- Climate change, water and food insecurity, and biodiversity loss combine to aggravate health issues. Increasing floods, droughts, heatwaves and storms aggravate mental illness and distress, the incidence of water and vector-borne diseases, and the risks of noncommunicable diseases. These risks will only add to the already higher-than-average incidence of noncommunicable diseases that the region experiences and to its diet-related mortality rate, which is the highest compared to similar regions.[67,68] In addition, climate change-induced sea level rise and more intense storms are projected to put over one million people in the Caribbean, or around 2 per cent of the regional population, at risk of flooding.[69]

The indirect drivers of biodiversity loss and nature's decline (see Figure I) drive these challenges and form the underlying causes of such decline, shaping how Caribbean societies interact with nature (Figure VII). The dominant views, structures and practices rooted in colonial systems of extraction and the accumulation of wealth and power have resulted in the widespread exploitation of the Caribbean ecosystems and people, thereby increasing the region's vulnerability to the current polycrisis (see Figure III).[70,71,72]



Demographic and sociocultural factors
High urbanization, high mobility and dominant western views, and practices

- The Caribbean region is among the most urbanized regions worldwide, with over 50 per cent of its human population concentrated in urban areas and along the coast.
- Migration to other perceived stronger economies, historically to developed countries in North America and Europe, has been common, but is increasingly shifting towards relocation within the Caribbean (e.g. Trinidad and Tobago, Antigua and Barbuda, the Dominican Republic).
- Western views and practices rooted in colonial models have continued to dominate, despite the region's rich cultural diversity shaped by the blending of Indigenous Peoples with African, Asian and European communities brought through colonial systems.

Economic and technological factors
High economic dependance on external markets and high inequalities

- Although hard-won progress has been achieved, the region continues to face deep inequalities. Wealth, resources and power are concentrated among a few, while financial poverty often disproportionately affects Indigenous, Black and Brown populations and women, leaving them to bear the heaviest burdens of the current polycrisis.
- Economies remain heavily dependent on external markets for revenue and food, and on fossil fuels for energy, and this need is compounded by high levels of debt.
- The widespread adoption of technological solutions such as renewable energy and agroecological practices is constrained by economic pressures and weaknesses in coordinated governance.

Institutions and governance
Geopolitically complex, with challenges in governance, especially of the Caribbean Sea

- The Caribbean is among the most geopolitically complex regions in the world, with several dependent territories under the control of France, the Netherlands, the United Kingdom and the United States.
- Although sovereign governance systems are comprehensive, they largely mirror the structures of former colonial powers and exhibit limited regional interactive mechanisms and weak national intersectoral coordination.
- The governance of the Caribbean Sea presents additional challenges due to its vast expanse and transboundary nature

Conflicts and epidemics
High vulnerability to conflicts and vector-borne and water-borne epidemics

- Political and economic crises in Caribbean countries, rooted in the region's complex geopolitics, are triggering high mobility, which fuels conflicts over resource allocation and land and sea use, contributing to national and regional instability.
- Tensions over the use of the Caribbean Sea for unilateral military actions by a global power, allegedly in response to a drug trafficking crisis, have escalated in the second half of 2025, underscoring the region's vulnerability to external geopolitical forces.
- Epidemics, often stemming from vector-borne and water-borne diseases, represent a serious public health concern across the region, particularly in the context of climate change.

Figure VIII: Indirect drivers of biodiversity loss and nature's decline in the Caribbean region (Sources: Demographic and Sociocultural factors,[73,74,75] Economic and Technological factors,[76,77,78,79,80,81] Institutions and Governance,[82,83,84,85,86] and Conflicts and Epidemics[87,88, 89])

Despite these challenges, the Caribbean people and organizations are by no means powerless. They have increasingly been advancing pathways that address the direct and indirect drivers of biodiversity loss and nature's decline, as illustrated by multiple "bright spot" examples. These pathways, especially if integrated, have the potential to grow people's capacities to tackle the underlying causes of biodiversity loss and nature's decline – and hence ignite transformative change (Figure IX).

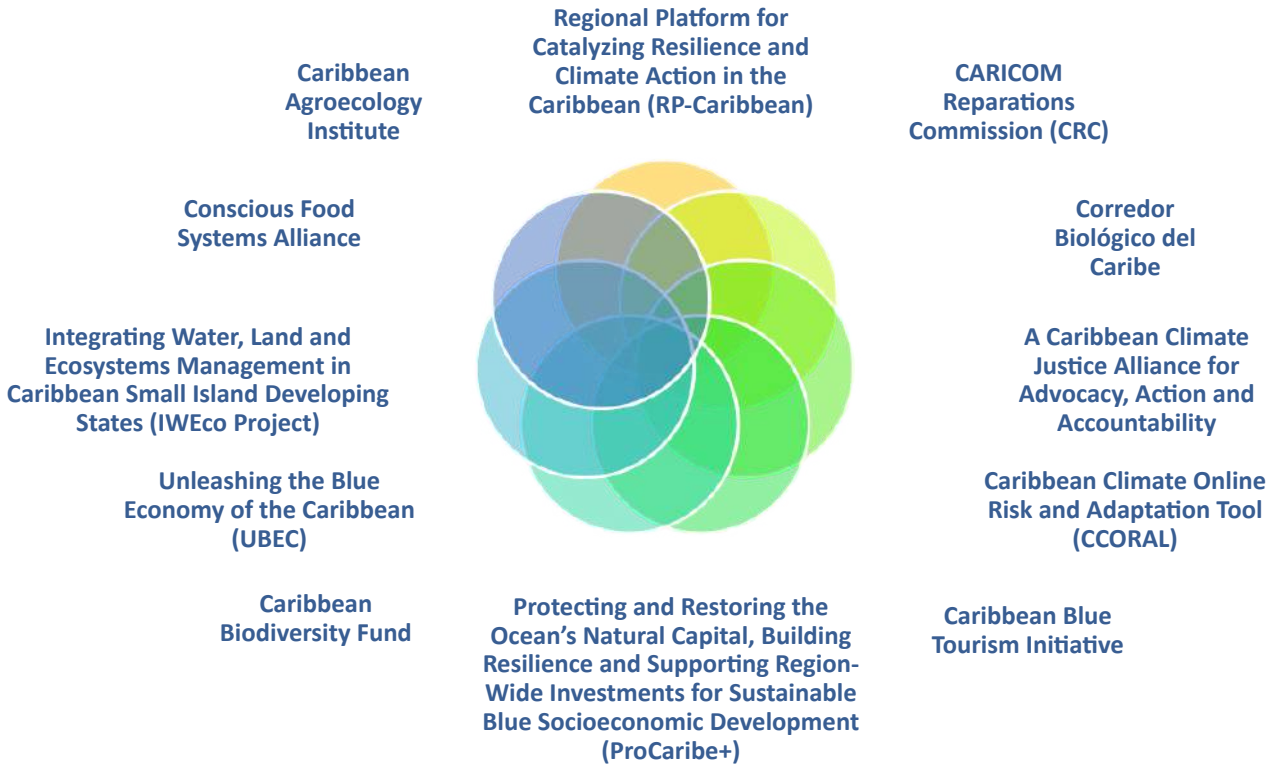


Figure IX: Sample of regional bright spots gathered by the study in the Caribbean

The nexus and transformative potential of three selected bright spot examples is explored below:

Figure X: ProCaribe+: nexus potential

B11 Multilateral environmental agreements **C10 Global cooperation for finance and technology**	» The Ocean Coordination Mechanism, supporting the multi-level nested regional governance framework » Microfinancing schemes for civil society organizations and small- to medium-sized businesses
B13 Natural capital accounting	» Integration of marine and coastal natural capital in nationally determined contributions (NDCs) » Blue carbon quantification of seagrass in Panama
B12 Land and sea planning	» Marine spatial planning in exclusive economic zones, e.g. in the Dominican Republic and Trinidad and Tobago
B01 Area-based conservation **B09 Integrated seascape approach**	» Reinforcement of marine protected areas and other area-based conservation measures, e.g. in Cuba and the Dominican Republic
F09 Reduce plastic pollution **F06 Ecological intensification of aquatic foods** **B09 Integrated seascape approach**	» Seafood traceability and spiny lobster fishing across the Wider Caribbean Region

Figure XI: ProCaribe+: transformative potential

What results are desired?	» A well-protected and restored Caribbean Sea that underpins sustainable and climate-resilient socioeconomic development for the well-being of Caribbean people
What are the initiative's core values, and how do they align with the principles for transformative change?	» Follows the "Sustainable Development Goals wedding cake philosophy", underscoring how economies and societies are embedded within the biosphere and promoting the TC principles of inclusion, justice, equity, adaptive learning and respectful relationships between people and nature
What strategies for transformative change does the initiative contribute to?	» Conserve and regenerate places of value for nature and people by mainstreaming blue economy- and ecosystem-based approaches to development in several pilot sites in the Caribbean » Drive systemic change in sectors contributing to biodiversity loss and nature's decline in the marine ecosystems through the transformation of fishing practices » Transform economic systems for the benefit of nature and equity by promoting a blue economy for sustainable development » Transform governance systems to be integrative, inclusive, accountable and adaptive by streamlining the Ocean Governance Mechanism and the associated National Intersectoral Coordination Mechanisms across the region » Shift societal views and values to recognize interconnectedness between people and nature by promoting an ecosystem-based and blue economy approach to marine conservation and societal development
How does the initiative address the underlying causes of biodiversity loss and nature's decline?	» Aims to mainstream a governance mechanism that fosters inclusion, justice and intersectoral collaboration and cohesion nationally and regionally, addressing the historical fragmentation, misalignments and overlaps in the management of marine ecosystems. » Bases its actions on the philosophy that societies are embedded in the biosphere (SDG wedding cake). » Governance goal and philosophy directly address the disconnection from and domination over nature and people, as well as the concentration of wealth and power » Addresses the prioritization of short-term, individual and material gains through the SDG wedding cake philosophy and by supporting a blue economy in the region

Figure XII: Caribbean Blue Tourism Initiative: nexus potential

B14 Reconnecting people with nature **C07 Sustainable bio-economy**	» Community-based coastal and marine tourism development based on eco-tourism and blue economy principles
C10 Global cooperation for finance and technology	» Unlocking regional and global financial support to exemplary blue tourism initiatives that address local issues to promote sustainable blue tourism

Figure XIII: Caribbean Blue Tourism Initiative: transformative potential

What results are desired?	» Strong collaborative network of resilient, sustainable and inclusive community-based tourism businesses that, supported by the appropriate governance framework, champion the conservation of environmental and cultural values in the Caribbean
What are the initiative's core values, and how do they align with the principles for TC?	» Promotes the TC principles of inclusion, justice, equity, adaptive learning and respectful relationships between people and nature in community-based tourism
What strategies for TC does the initiative contribute to?	» Conserve and regenerate places of value for nature and people by promoting community-based ecotourism in three sites of high importance for nature and people in the Caribbean Drive systemic change in a significant sector (tourism) contributing to biodiversity loss and nature's decline » Transform governance systems to be integrative, inclusive, accountable and adaptive by facilitating the development of an appropriate governance framework that supports community-based ecotourism » Shift societal views and values to recognize interconnectedness of people and nature by promoting an ecotourism approach owned and championed by the local community
How does the initiative address the underlying causes of biodiversity loss and nature's decline?	» Promoting and facilitating local community-based and owned ecotourism and employing a governance framework that fosters equity, justice, inclusiveness and socioenvironmental stewardship directly address the disconnection from and domination over nature and people, as well as the concentration of wealth and power » Supporting the participatory community-based governance of tourism tackles the prioritization of short-term, individual and material gains.

Figure XIV: Caribbean Biodiversity Fund: nexus potential

B11 Multilateral environmental agreements **C10 Global cooperation for finance and technology** **F14 Foster gender-transformative approaches**	» Conservation Finance Program: the Caribbean Organizations for a Resilient Environment Project, the Caribbean Regional Architecture for Biodiversity Project and Caribbean Sustainable Finance Architecture » Nature-based economies: the Advancing Circular Economy Facility
B01 Area-based conservation **B04 Ecosystem-based adaptation in rural landscapes** **B06 Restoration of coastal and marine systems** **B09 Integrated landscape and seascape approaches** **C04 Wetland conservation and restoration** **B14 Reconnecting people with nature**	» Ecosystem-based Adaptation Facility restoration, rehabilitation and protection of coastal and marine ecosystems and watersheds across the region » Fostering resilience stewardship and sustainable practices via improved management of the Limón and Redonda lagoons wildlife refuges and nearby areas in Miches, the Dominican Republic; restoration of mangrove ecosystems in Cuba; and restoration of coral reefs in Grenada
C07 Sustainable bioeconomy **H07 Pollution prevention** **F10 Reduce food loss and waste** **F07 Reduce nutrient pollution** **F08 Reduce pesticide pollution** **F09 Reduce plastic pollution**	» Nature-based economies programme supporting non-governmental organizations, academia, public institutions, community-based organizations and small- and medium-sized enterprises in the private sector » Developing circular economy solutions to reduce, prevent and recycle waste polluting coastal and marine ecosystems through the Advancing Circular Economy Facility

Figure XV: Caribbean Biodiversity Fund: transformative potential

What results are desired?	» A Caribbean region where both its natural environment and people thrive
What are the fund's core values, and how do they align with the principles for TC?	» Respect and integrity, aligning with the TC principle of respectful and reciprocal relationships between people and nature
What strategies for TC does the fund contribute to?	» Conserve and regenerate places of value for nature and people by supporting and funding communities' solutions to conservation challenges that advance integrative and ecosystem-based approaches » Drive systemic change in the sectors most responsible for biodiversity loss and nature's decline by channeling financial investments in nature-positive livelihoods and solutions » Transform economic systems for nature and equity by supporting local innovative well-being economies » Shift societal views and values to recognize interconnectedness of people and nature by supporting local actions that can change cultural narratives, promote nature's connectedness, co-create knowledge, change social norms and foster transformative learning
How does the fund address the underlying causes of biodiversity loss and nature's decline?	» Tackling the prioritization of short-term, inidvidual and material gains and the concentration of power and wealth via channelling finances to local organizations and communities embarked in conservation, climate adaptation and nature-based economies » Addressing the disconnection from and domination over nature and people by providing long-term support to initiatives and organizations whose principles align with equity, justice, respect and reciprocity between people and nature

II. Introduction

A. Introducing the Second Caribbean Regional Trialogue

The Trialogue is a multi-stakeholder engagement methodology developed by the Biodiversity and Ecosystem Services Network (BES-Net). Grounded in Theory U and the Multiple Evidence Base (MEB) approach,[90,91] Trialogues facilitate open dialogue, build trust and strengthen collaboration among representatives of science, policy and practice communities, including Indigenous Peoples and local communities. They bring diverse stakeholders together in a multi-day event to combine cooperative gatherings and field-based interactions and adopt a multisensorial and inclusive approach. The gathering aims to foster mutual understanding and learning and to support the identification of common solutions and coordinated actions.[92]

The Second Caribbean Regional Trialogue, to be held in December 2025, will build on the foundations of the First Caribbean Regional Trialogue, held in 2018 with the special thematic focus on the IPBES Assessment on Pollinators, Pollination and Food Production.[93] The upcoming Trialogue will help contextualize and apply the latest IPBES assessments, namely the TCA and the Nexus Assessment, within the Caribbean setting. It will revisit challenges related to biodiversity, climate, food, water and health while supporting the exploration of pathways for transformation towards nature-positive futures.

The key objectives of the 2025 Trialogue are:

- **Contextualize the global knowledge:** reflect on global knowledge, including key findings from the TCA and the Nexus Assessments within the Caribbean's unique ecological, social and economic contexts
- **Promote integrated approaches and nexus thinking:** share insights, lessons learned and ideas to expand nexus approaches and improve biodiversity governance across the region
- **Support transformative potential:** foster dialogue and collaboration that contribute to the conditions for long-term, system-wide shifts towards more sustainable biodiversity management and ecosystem health
- **Co-create action plans:** develop action plans that reflect diverse knowledge systems, stakeholder perspectives and policy contexts tailored to the Caribbean

1. Vision of the Second Caribbean Regional Trialogue: learning from the mangroves

Much like the system thinking offered by IPBES assessments, mangroves offer lessons applicable to increasing resilience and achieving TC. They teach us that resilience comes not only from the visible canopy above but also from the strength of the hidden roots and fertile mud beneath. At the edge of land and sea, mangroves spread their roots into saltwater and mud. They appear tangled, yet their strength lies in that very structure – a web that shelters fish, feeds birds, stores carbon and buffers storms. Mangroves teach us that our well-being (the canopy of leaves) depends on our foundations (the branches, roots, mud and tides). Like the mangrove's own rhythm of shedding, sinking and renewing, sustainability is not linear; it is cyclical.

The Second Caribbean Regional Trialogue draws inspiration from this socioecological system. The event is a space where science, policy and Indigenous and local knowledge meet – not in hierarchy, but in dialogue and complementarity. Similar to mangrove roots intertwining, the Trialogue connects and weaves varying perspectives to strengthen resilience among them. The event will explore TC by going beyond the branches, acknowledging the interlinked effects of roots and mud and tackling deep causes rather than surface symptoms. It will embrace the nexus by acknowledging the interconnections across systems of food, water, health, energy and biodiversity. Like mangroves that link land and sea, solutions work best when they involve an understanding of the whole system.

B. Goals, structure and methodological approach of this document

This document aims to enhance the quality of interactions and discussions among the science, policy and practice communities during the Second Caribbean Regional Trialogue. To achieve this, it provides contextual information and data relevant at the regional and national levels on the TCA and the Nexus Assessment messages. This information is drawn from an extensive desk review of literature and resources conducted by the lead author and three online United Nations volunteers. The sources relate to nexus approaches and TC within the Caribbean context, including scientific publications, , journalistic sources, project reports and resources, policy documents, IPBES resources and international and regional bodies' resources (e.g. the World Bank, Food and Agriculture Organization [FAO], United Nations Environment Programme [UNEP], United Nations Development Programme [UNDP], Caribbean Community [CARICOM], Organisation of Eastern Caribbean States). In addition, conversations were held with key knowledge holders in the region – many of whom are Trialogue participants – throughout the drafting process to incorporate the latest perspectives, supplement the desk review and validate the information presented here.

The document follows the IPBES classification of direct drivers and indirect drivers to explain biodiversity loss and nature's decline (Figure XVI). These drivers reflect the values and behaviours that sustain globally mainstreamed underlying causes (see Figure I). The IPBES typology of drivers shares convergent points and aligns with the International Union for Conservation of Nature (IUCN) Threats Classification System. For example, threats such as "residential and commercial development" and "natural system modifications" (e.g. dam construction) under the IUCN system correspond to "land/sea use changes" in the IPBES classification. Similarly, threats categorized as "biological resource use" and some "natural system modifications" (e.g. water extraction) under the IUCN system align with "direct exploitation" in IPBES.[94] The key distinction, however, is that the IPBES typology classifies these threats in terms of how directly or indirectly they impact nature. Direct drivers have a physical impact on nature, while indirect drivers affect the level, direction, rate or intensity of direct drivers.[95]

DIRECT DRIVERS	Natural	Eruptions, earthquakes, natural climatic variability		
	Anthropogenic	Pollution (emissions, disposal, spill-overs, noise, others)		
		Land/sea use change	Transformations	
			Intensity changes	
		Direct disturbance, exploitation and extraction (of components of nature)		
	Natural-Anthropogenic (interaction)	Manifestation of climate change (e.g., changing temperature and precipitation, frequency and intensity of weather events, sea level change, ocean acidification)		
		Invasive alien species including zoonoses and pest outbreaks		
INDIRECT DRIVERS		Institutions (formal and informal)		
		Economic drivers	Patterns of supply	
			Patterns of production	
			Patterns of consumption	Economic affluence
				Inequality
				Poverty
		Demographic drivers		
		Technological drivers		
		Governance drivers		
		Conflicts and wars		
		Sociocultural and socio-psychological drivers (values, beliefs, norms, education)		
		Health problems as indirect drivers		

Figure XVI: Typology of drivers used by IPBES (Source: Table 1 of Chapter 1 of IPBES Global Assessment[96])

The overall structure of this document follows the format of the SPMs IPBES assessment. Chapter I presents the overarching thematic messages, which are further elaborated in the subsequent chapters. Section A and Section B of Chapter I provide concise overviews of the TCA and the Nexus Assessments, while Section C offers a snapshot of the relations among underlying causes, indirect drivers, direct drivers and pathways with nexus and transformative potentials in the Caribbean.

Chapter II provides background information regarding the context of the Second Caribbean Regional Trialogue, and Chapter III presents the data and findings for the seven Trialogue target countries: Antigua and Barbuda, Cuba, Dominica, the Dominican Republic, Grenada, Guyana, and Trinidad and Tobago. Each country profile is structured as follows:

- **Key message 1** outlines the main direct drivers of biodiversity loss and nature's decline in the countries. Sub-section 1 under each country expands on these drivers, summarizing their relations (see Figure XVI above and Figure I) with the nexus elements (see Chapter I Section B).
- **Key message 2** outlines the main indirect drivers of biodiversity loss and nature's decline in the evaluated countries. Sub-section 2 under each country summarizes the relationships between the indirect and direct drivers, providing evidence on how these relationships perpetuate the underlying causes (Table I).
- **Key message 3** highlights the potential pathways identified through the analysis of direct and indirect drivers, which science, policy and practice communities in the respective countries could pursue to make advancements towards sustainable futures. Sub-section 3 presents examples of "bright spot" projects, initiatives, policies and organizations that contribute to these pathways with nexus and transformative potential (several bright spots are featured for the region; see Chapter I Section C).

Table I: Guiding questions for the compilation of information and elaboration of this document

Questions	Chapters/sections they contribute to
» What are the primary direct drivers of biodiversity loss and nature's decline in the region and its countries? » How do the direct drivers manifest in the region and within countries? » How do the direct drivers impact nexus elements regionally and within countries?	Chapter I Section C Chapter III Sub-section 1 for each country
» How do the direct drivers relate to the indirect drivers regionally and within countries?	Chapter I Section C Chapter III Sub-section 2 for each country
» What initiatives, projects or actions across sectors (e.g. government, private businesses, non-governmental organizations, grassroots/local/Indigenous organizations, social/Indigenous movements, academia) are working to address the direct and indirect drivers, and the underlying causes in line with the TCA and at the intersections of the Nexus Assessment? » How do these initiatives tackle these drivers and the underliying causes?	Chapter I Section C Chapter III Sub-section 3 for each country

The exploration of nexus potential involved identifying which Nexus Assessment response options with benefits across all the nexus elements (see Chapter I Section B) were potentially represented in the bright spots. These include those response options with inconclusive evidence, no evidence or no impact for specific nexus elements but with benefits for the remaining nexus elements. For example, the exploration considers response option "B09: Integrated landscape and seascape approaches", which scored positively across the five nexus elements, as well as response option "W01: Inclusive water education", which scored positively for food and health but was inconclusive for biodiversity, water and climate change. This inclusive approach recognizes that evidence for definitive scoring is likely to become more available and accessible in the future.[97]

The exploration of TC potential used practical guidance provided in Appendix 2 of the TCA SPM for realizing the transformative potential of policies, projects and other initiatives.[98] From this guidance, four critical questions were adopted for each bright spot: 1) What results are desired? 2) What are the bright spot's core values, and how do they align with the principles for TC? 3) What strategies for TC does the bright spot contribute to? and 4) How does the bright spot address the underlying causes of biodiversity loss and nature's decline? The preliminary exploration presented here intends to encourage deeper reflections during the Trialogue beyond what is currently happening and toward how bright spots might evolve into dimensions that they are not yet addressing, unleashing their full transformative potential. In that sense, we might ask ourselves: how can bright spots work across views, practices and structures? How might the principles they are not yet addressing be brought in? How might they incorporate work on complementary strategies? How can this work grow to address additional aspects of the underlying causes?

Chapter IV briefly conveys a conclusive (but evolving) reflection on the opportunities ahead.

1. Mangrove vision: structuring the background document

Mangroves are among the most emblematic ecosystems of the Caribbean. They protect shorelines, nurture biodiversity and sustain livelihoods. Yet beyond their ecological value, they also offer a meaningful way to understand the interconnectedness of social, economic and environmental systems.

In this document, the mangrove serves as a guiding metaphor for interpreting the relationships among the direct and indirect drivers of change, the socioeconomic foundations that influence them and the transformative potential of collective action within each country.

This mangrove metaphor embodies both strengths and vulnerabilities of living systems, illustrating that sustainability depends on the balance among visible and invisible elements and on how societies nurture or neglect their connections with nature.

Table II: The mangrove metaphor

What mangroves teach us	Section name
Branches and leaves show what is visible. The health of branches depends on robust foundations below.	Chapter III Sub-section 1 for each country – Mangrove branches: relationships between the nexus elements and the direct drivers of change in biodiversity and nature
Roots reveal what holds us together: economies, energy choices and urban growth. They can either stabilize or destabilize the system, depending on how inclusive and just they are. Mud contains the deep socioeconomic and cultural foundations of each country: its history, identity, and position within regional and global systems.	Chapter III Sub-section 2 – Mangrove roots anchored in the mud: relationships between the indirect and direct drivers of change in biodiversity and nature
Tides and winds represent the innovations and changes that influence the foundations, building upon common narratives and principles such as equity, justice, Indigenous and local knowledge and innovation.	Chapter III Sub-section 3 for each country – The tides around the mangrove roots and mud: bright spots lighting the path towards TC and nexus approaches
Leaves, branches, roots, mud and tides: linking land and sea	Chapter IV – Learning from the mangroves: emerging opportunities to strengthen collaboration, integration and transformative potential

III. Findings from the seven Caribbean Regional Trialogue participating countries

Chapter III applies the IPBES framework of direct and indirect drivers of biodiversity loss and nature's decline to understand how several different forces interact within Caribbean socioecological systems, perpetuating the underlying causes. These drivers are categorized as pressures on biodiversity. Recognizing them and their dynamic relationships that reinforce the underlying causes opens entry points for action to relieve the pressure.

» In the mangrove metaphor introduced in Chapter II Section B Sub-section 1, relationships between the indirect and direct drivers of biodiversity loss correspond to the mangrove roots that is, they are the economic, cultural and institutional dynamics that shape decisions and are determined by the underlying causes lying in the mud.. The relationships between the nexus and the direct drivers are represented by higher levels as the visible expressions of choices regarding land and sea use, resource extraction and pollution. By understanding both types of drivers and how their interactions manifest the underlying causes, as well as the winds of change and tides of innovation, countries can identify where interventions and cooperation can redirect trajectories towards nature-positive and equitable futures.

A. Antigua and Barbuda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Key data snapshot

Country: archipelago comprising two main islands, Antigua and Barbuda, and several islets, Redonda being the largest.
Location: in the Caribbean Sea approximately 400 km southeast of Puerto Rico. It is the most central of the leeward island chain that starts with the Virgin Islands in the West and ends with Dominica in the South
Maritime Exclusive Economic Zone area: 110,071 km2
Land area: Antigua 280 km^2; Barbuda 160 km2
Coastline length: ~150km
Human population (2024): 93,772
Human Development Index (HDI) (2023): Very High (0.851), ranked 53 out of 193
GDP share (2023): service industries 69% (with tourism being the largest single sector); industry (including construction) 19%; manufacturing 3%; agriculture, forestry and fishing 1.9%

Sources: World Bank data, UNDP HDI Antigua and Barbuda report , National Biodiversity Strategy and Action Plan (NBSAP) (2014–2020), Fourth National Communication to the United Nations Framework Convention on Climate Change

Key messages

- **Main direct driver of biodiversity loss and nature's decline:** land use change, mainly driven by urban expansion, tourism development and agriculture
- **Main indirect drivers of biodiversity loss and nature's decline:** public debt, concentration of population and activities in the coastal areas, high dependence on the global market and external capital for tourism, and pressures for land and water that exacerbate conflicts and inequalities
- **Potential priority pathways to advance toward sustainable futures:** integration of marine and coastal biodiversity conservation into tourism, economic diversification; development of mechanisms to finance conservation, climate resilience and sustainability considering justice and equity; and inclusive decision-making

Key data snapshot

Iconic regions: Body Ponds Watershed, Redonda Island, Codrington Lagoon, coastal plains and mangroves
Protected areas coverage: 21.0% of land area, ~0.3% marine area in 2021
Urban population: ~24% in 2024
Coastal population: ~90% in 2024
Priorities: optimized generation of national wealth, enhanced social cohesion, improved health of the natural environment and sustained historical and cultural assets, and enhanced citizen security

Sources: World Bank Datadata, NBSAP (2014-–2020), Fourth National Communication to the UNFCCC United Nations Framework Convention on Climate Change, Aichi Biodiversity Target 11 Country Dossier: Antigua and Barbuda, 2016-–2020 Medium Term Development Strategy (MTDS)

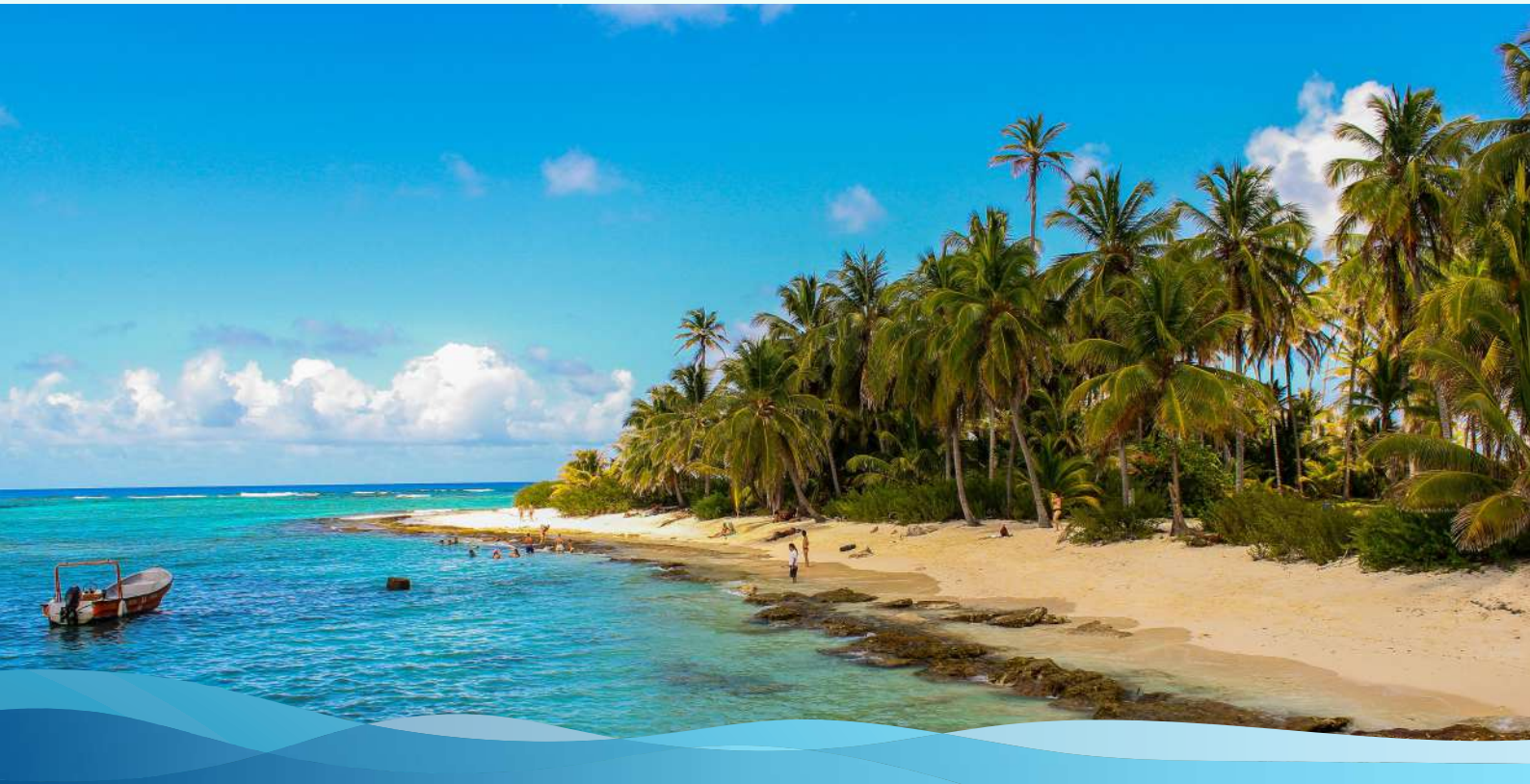
1. Mangrove branches: relationships between the nexus elements and the direct drivers of change in biodiversity and nature (expanding key message 1)

Land use change drives ecosystem loss and degradation, and sea exploitation results in the decline of marine stocks. Resulting issues include pollution, which affects wetlands, coral reefs and food safety, and climate change, which intensifies droughts, hurricanes and disease outbreaks, thus straining water supply and crop production. Additionally, rising sea temperatures decimate coral reefs, greatly reducing healthy marine habitats and the ecosystem services they provide. Invasive species like mongoose, rats and giant African snails also threaten biodiversity, agriculture and human health through predation and disease transmission.

Table III: Cascading effects of the direct drivers of biodiversity loss and nature's decline on nexus elements in Antigua and Barbuda, based on information compiled through desk reviews and consultations with key informants by the main author and three United Nations volunteers.

	Biodiversity	Water	Food	Climate	Health
Land and sea use change	Changes to residential spaces for the domestic, commercial and tourism sectors, as well as unsustainable agriculture and the mining of sand, have caused extensive ecosystem loss, degradation and fragmentation, with most ecosystems currently in decline.[99,100,101,102,103] Centuries of sugarcane and sea-island cotton plantations have caused almost total deforestation of Antigua,[104,105] while current urban and touristic developments affect the ecosystem integrity and health of both islands,[106,107,108,109,110,111] e.g. the Dunnings Dam forest (Key Biodiversity Area) has been cleared.[112]	Changes have continually damaged the small watersheds and very limited freshwater resources of one of the driest countries in the region, reducing their quality and availability.[113] Land clearing for unsustainable farming practices and infrastructure development has drastically reduced the watersheds' capacity to capture rainfall and replenish storage systems.[114]	It is estimated that the historical land conversion to monoculture in Antigua and to overgrazing in Barbuda, as well as the current conversion to urban and tourism areas in both islands, have resulted in decreased soil productivity and loss of organic matter. These changes impact the country's ability to meet growing food demand, resulting in increased food imports.[115,116] Fishing is also impacted by the decline of the nursery grounds found in coastal ecosystems.[117,118]	Land use changes related to urbanization contribute significant GHG emissions, particularly through the demand for fossil fuels for energy and transportation, as well as the conversion of space to landfill for the management of waste.[119]	Land use change to urban and tourism areas drives the rise in noncommunicable disease incidence.[120,121] It has also caused the conversion of space to landfill to cope with the growing generation of waste. The national waste is disposed of at Cooks Landfill, affecting local community's well-being and the Hanson's Bay Flashes wetland.[122]
Direct exploitation	Sand mining transforms coastal ecosystems by destroying dunes and directly reducing sand quantities to the point of converting beaches to rocky coast, thereby increasing beach erosion. This reduces vital space for species such as sea turtles to lay their eggs.[123]	Sand extraction for construction damages groundwater quality and quantity. This, along with the growing water demand by domestic, agricultural and tourism sectors, aggravates saline intrusion that makes aquifers unsuitable for human consumption. Extensive sand mining in the main water-supplying aquifer of Barbuda (Palmetto Point Area) has raised the water table by several feet, exposing the aquifer and causing partial desiccation.[124,125,126]	Population growth and increased demand from the domestic and touristic sectors are challenging food security.[127,128] Although the country is considered "food secure" in terms of domestic supply of seafood protein,[129,130] there is growing concern about overfishing, which can heavily affect people's livelihoods and overall food production since fisheries are a major domestic economic sector.[131]	The GHG profile from 2016 to 2019 shows that energy consumption is the largest contributor, accounting for over 77% of the total emissions from imported fossil fuels for electricity generation and transportation. It is projected that the energy demand is likely to continue on an upward trend.[132] Emissions from waste generation and poor management are another major source.[133]	The growing demand and consumption of water, energy and food by intensive sectors such as tourism, coupled with the decline of ecosystems and their services, drive the rise of prices as well as increasing insecurities and inequalities.[134]

	Biodiversity	Water	Food	Climate	Health
Pollution	Pollution from agrochemicals and untreated solid and liquid waste from tourism and households particularly affects coastal ecosystems.[135,136,137]	Untreated liquid and solid waste lowers water quality.[138,139] The single utility company covering the entire country spends considerable resources to rid polluted groundwater supplies of chemical substances, including those that may be leaching from the Cooks Landfill.[140]	It is estimated that plastic pollution reduced fisheries revenue by 9.2% in 2019: 5.8% due to time lost clearing nets, 2.8% due to discarded catch, 0.3% due to net repairs and 0.2% due to fouling incidents.[141] Pollution from agrochemicals and solid and liquid waste from tourism and households affects agriculture and fisheries.[142]	In 2022, Antigua and Barbuda was a medium emitter of carbon dioxide compared to the rest of the region: per capita emissions were slightly higher than those of Cuba, higher than those of Grenada and Dominica, and lower than those of Guyana and Trinidad and Tobago.[143] The main GHGs the country emits are carbon dioxide from energy production and consumption and methane from waste.[144]	Inconclusive Evidence
Climate change	Coral reefs and seagrass ecosystem health are declining due to land use change and pollution. The ecosystems are also aggravated by climate change-induced higher sea temperatures and stronger tropical weather systems.[145,146,147,148]	More severe and frequent dry periods impact the country's very limited water resources and exacerbate water insecurity. There is an increased reliance on desalination for a freshwater supply, which increases the demand for energy from fossil fuel, and hence, GHG emissions, likely encouraging the cycle and making water more expensive.[149,150,151,152]	The effects of climate change (particularly rain variability, severe droughts and intensive heat) have made farmers vary their seasonal crops, invest in available agrotechnology and change farming techniques.[153]	There is an increasing trend in the annual mean temperature, hurricane intensity and frequency of warm nights and days, while there is a decreasing trend in cool days and nights and annual rainfall.[154,155]	Increased flooding creates favourable conditions for the breeding of malaria and dengue vectors, enabling the spread of waterborne and vector-borne diseases.[156]
Invasive species	There are 12 concerning invasive species in the country, including mongoose and rats, which prey on native mammal, bird and reptile populations.[157]	Lemongrass affects the watershed's ability to capture water from precipitation, as it increases run-off and reduces infiltration rates.[158]	Lionfish consume a large variety of juvenile marine fish and crustaceans, impacting the future generation of commercial species and reducing the food sources available for them.[159]	No Evidence Found	Feral livestock pose risks of transmitting pathogens to humans and wildlife.[160]



2. Mangrove roots anchored in the mud: relationships between the indirect and direct drivers of change to biodiversity and nature (expanding key message 2)

Table IV: Relationships between the indirect and direct drivers of change to biodiversity and nature in Antigua and Barbuda

Demographic and Sociocultural Factors	Economic and Technological Factors	Institutions and Governance	Conflicts and Epidemics
Although Antigua and Barbuda has one of the lowest urbanization rates in the region (24.4%), the human population is concentrated on Antigua, and more specifically in the capital, St. John's, at a very high density (213 people/km2).[161] The country has a net immigration from other Caribbean countries due to its tourism development and high living standards. This influx results in high population concentration in coastal areas, putting pressure on space and resources.[162] Housing demand has, therefore, become a major issue shaping land use.[163,164]	The country has a primarily service-based economy reliant on tourism and foreign capital and is highly vulnerable to global market shocks derived from the current polycrisis. For example, between 2004 and 2022, national gross domestic product (GDP) dropped and government debt spiked as a result of the 2008 financial crisis, a severe drought in 2013, hurricanes Irma and Maria in 2017 and COVID-19 in 2020.[165]	Environmental governance is mainly anchored in the Department of Environment under the Ministry of Health, Wellness and the Environment, which acts as the National Focal Point for the Convention on Biological Diversity and has four main programmes in accordance with the Environmental Protection and Management Act (EPMA), 2019: Climate Change (Adaptation, Mitigation and Capacity Building); Biodiversity; Pollution; and Monitoring, Evaluation and Data Management.[166] The Department of the Blue Economy under the Ministry of Social and Urban Transformation aims to plan the blue economy. Both departments aim to coordinate their mandates across government ministries, departments and other stakeholders. However, this intersectoral coordination remains challenging. Although the legislative framework is comprehensive and aligned with CARICOM environmental strategies, it could benefit from reviews to improve coverage, especially in the ocean governance space.[167]	The country is politically stable with no armed conflicts. However, social conflicts have emerged around environmental resource use and land use tenure. The ongoing struggle of Barbadians to maintain their historical communal rights in face of constant pressure favouring capitalist privatization and eviction is an example of these conflicts rooted in the prioritization of materialistic and individualistic interests.[168,169,170,171]
The country's cultural relationship with nature is particularly evident in marine and coastal resource management, wherein communities maintain traditional knowledge about sustainable use practices. Cultural identity is closely linked to environmental stewardship and community-based conservation approaches.[172,173] Tourism has contributed to rising per capita resource consumption and waste generation.[174] It has also shifted dietary patterns towards imported processed foods and caused challenges in water, energy and food sustainability. Dependence on imported and price-volatile foods exposes households to nutritional and economic vulnerability.[175]	Antigua and Barbuda leverages technology primarily in the tourism and utilities sectors via the adoption of digital and clean technologies. Agricultural technology adoption remains limited but supported by national policies aiming to modernize production.[176] The country has emerging innovation systems, with growing interest in sustainable tourism technologies, clean energy and digital services. Public–private partnerships and regional cooperative frameworks support innovation, although investment levels remain constrained compared to larger economies.[177]	Land tenure systems combine State-owned and private property rights in Antigua. Property rights are generally formalized through legal title deeds, but tenure security varies, especially in informal settlements.[178] Barbuda differs from Antigua and the rest of the Caribbean in that the land tenure is communal due to its unsuitability for agriculture, which prevented extensive colonial settlement and monoculture implementation on the island. The former African slaves were left to fend for themselves, creating the grounds for a solid communal tenure based on livestock grazing, fishing and subsistence agriculture initially that eventually formalized through the 2007 Barbuda Land Act.[179] However, this communal tenure system is constantly threatened in favour of capitalist interests.[180,181,182]	The country faced significant challenges during COVID19 as tourism was significantly affected, i.e. the economy shrank by 18% while public debt jumped from 82% of GDP to 98%.[183]

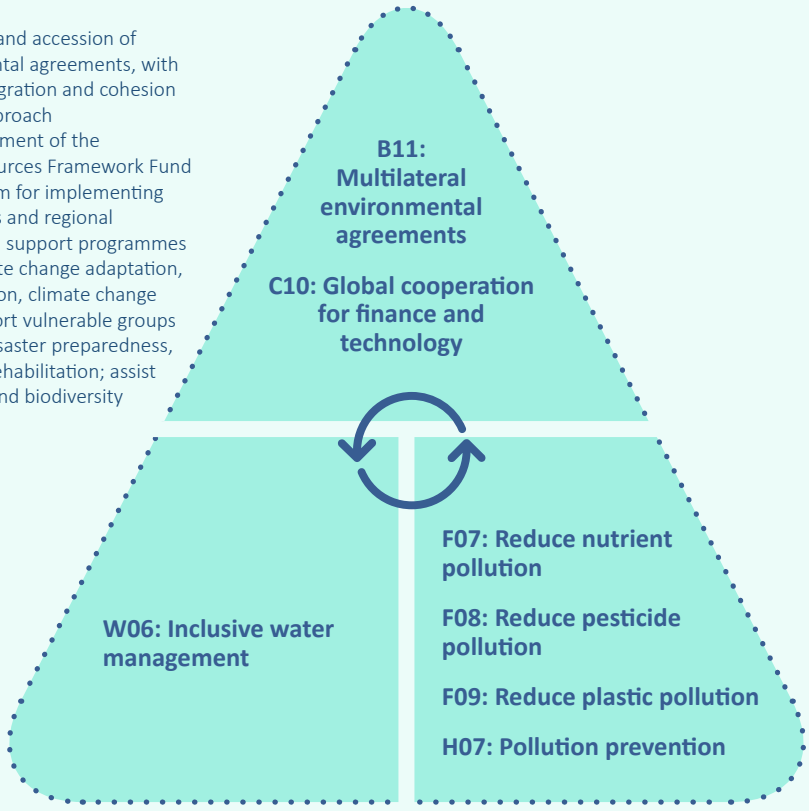
3. The tides around the mangrove roots and mud: bright spots lighting the path towards TC and nexus approaches (expanding key message 3)

Table V: Bright spots lighting the path towards TC and nexus approaches

Priority pathways	Projects/initiatives/ institutions	National policies	Regional policies/ projects
Integration of marine and coastal biodiversity conservation into tourism	- Global Environment Facility Adaptation Fund Watershed and Coastal Adaptation Project -Antiguan Racer Conservation	- Environmental Protection and Management Act (EPMA) of 2019	- PROCARIBE+ - Wave Attenuation: Natural Solutions with Elkhorn Coral (WANSEC)
Economic diversification			- Caribbean Biodiversity Fund
Development of mechanisms to finance conservation, climate resilience and sustainability considering justice and equity	- Wave Attenuation: Natural Solutions with Elkhorn Coral (WANSEC)	- Environmental Protection and Management Act (EPMA) of 2019	- PROCARIBE+ - Caribbean Biodiversity Fund
Inclusive decision-making	- Environmental Awareness Group - Barbuda Council	- Environmental Protection and Management Act (EPMA) of 2019	

Figure XVII: Exploring potential nexus responses of the EPMA

- Article 90: Negotiation and accession of multilateral environmental agreements, with a focus on regional integration and cohesion and a cross-sectoral approach
- Part XII on the establishment of the Sustainable Island Resources Framework Fund as a financial mechanism for implementing multilateral agreements and regional environmental projects; support programmes and measures for climate change adaptation, climate change mitigation, climate change loss and damage; support vulnerable groups and communities for disaster preparedness, disaster recovery and rehabilitation; assist protected areas; and fund biodiversity conservation



- Articles 60 to 62: Establishment of water resources, Watershed and Wetlands Management Committee, Declaration of Protected Watersheds and Declaration of Important Wetlands
- Prioritize public and local participation in decision-making, showing signs of potential inclusiveness in the process of water management

- Part V on Pollution Control
- Pollution control permits for any person or entity discharging pollutants into the air, land or water
- Pollution charges and penalties for non-compliance
- Director of the Department of Environment can order the immediate cessation of pollutant discharges that pose an imminent danger to health or the environment

Figure XVIII: Exploring the TC potential of the EPMA

What results are desired?	» Sustainable environmental protection and management of natural resources » Responsible administration of the environment » Achievement of Antigua and Barbuda's environmental treaty obligations » Implementation of financial mechanisms that satisfy the activities to reach the above-mentioned results
What are the Act's core values, and how do they align with the principles for TC?	» The Act is based on the principles of sustainable development, conservation and protection of ecosystems and their biodiversity, aligning with the TC principle of respectful and reciprocal relationships between people and nature. It is also based on public participation in and transparency of the decision-making process, as well as access to justice, thereby aligning with the TC principles of inclusion, pluralism, equity and justice.
What strategies for TC does the Act contribute to?	» Conserve and regenerate places of value to nature and people by enhancing the legal, regulatory and institutional framework for environmental management and by establishing an integrated system for the sound and sustainable management of the environment for the benefit of present and future generations » Drive systemic change in the sectors most responsible for biodiversity loss and nature's decline by providing preventive and remedial measures for the control and mitigation of all forms of environmental degradation » Transform economic systems in favour of nature and equity by establishing a framework for the sustainable financing of conservation and environmental management » Transform governance systems to be integrative, inclusive, accountable and adaptive by integrating environmental protection policy into the sectoral and regional economic and social development policies, promoting public participation in and transparency of decision-making, and outlining the principles for the negotiation and implementation of multilateral agreements » Shift societal views and values to recognize interconnectedness of people and nature by promoting and encouraging better understanding and appreciation of the environment among all people
How does the Act address the underlying causes of biodiversity loss and nature's decline?	» Has the potential to address the disconnection from and domination over nature and people by promoting the rights and obligations of the State, municipalities, jurisdictions and persons with respect to environmental protection and safeguarding nature and people's health » Potentially addresses the prioritization of short-term, individual and material gains by providing an integrated legislative framework that prevents and remediates environmentally harmful practices, prioritizing sustainable development for present and future generations

B. Cuba

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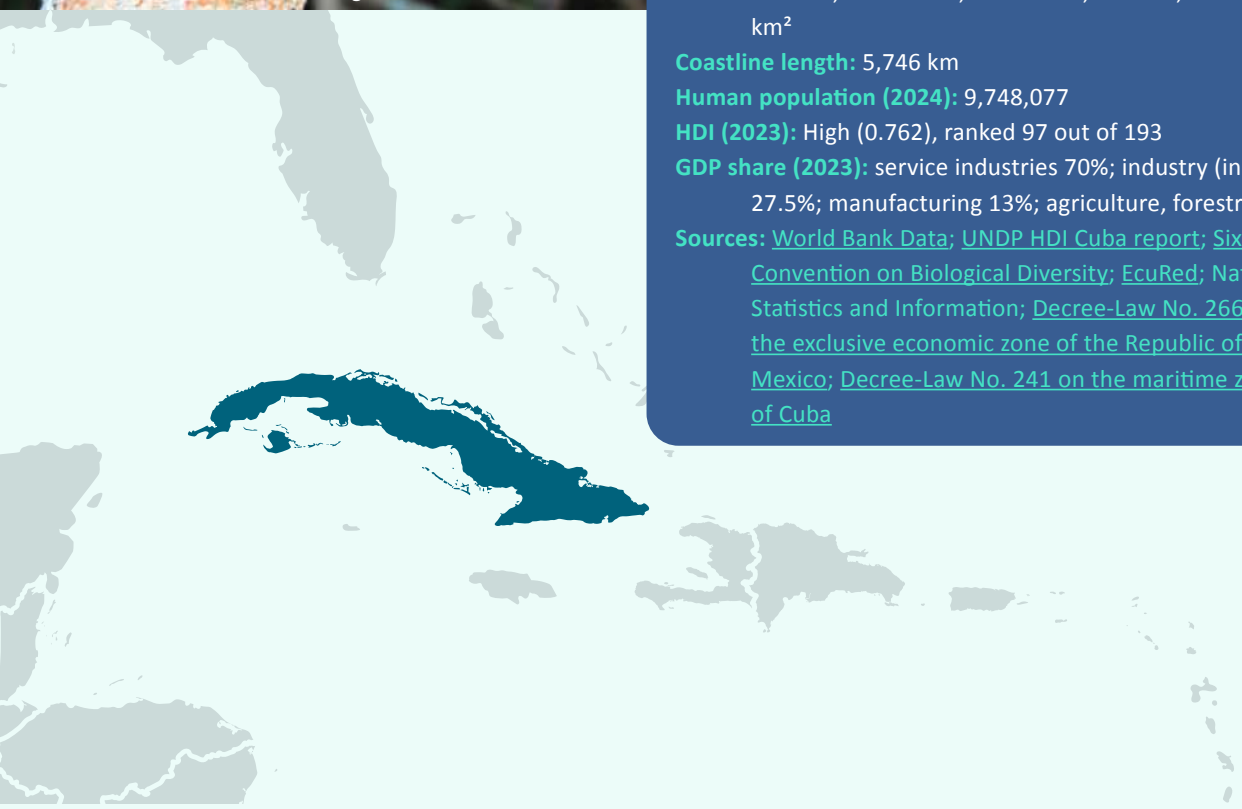


Key data snapshot

Country: largest archipelago of the Caribbean with two major islands – Cuba and Isla de la Juventud – and around 4,000 islets grouped into four major sub-archipelagos: Los Colorados, Sabana-Camagüey, Los Canarreos and Jardines de la Reina

Location: in the north-western Caribbean at the confluence of the Atlantic Ocean, Caribbean Sea and the Gulf of Mexico; to the east of the Yucatan Peninsula (Mexico); to the south of Florida and The Bahamas; to the west of Hispaniola (Haiti and the Dominican Republic) and to the north of Jamaica and the Cayman Islands

Maritime Exclusive Economic Zone area: 350,751 km2

Land area: 109,884.01 km²; Cuba ~104,338 km²; Isla de la Juventud ~2,419 km²

Coastline length: 5,746 km

Human population (2024): 9,748,077

HDI (2023): High (0.762), ranked 97 out of 193

GDP share (2023): service industries 70%; industry (including construction) 27.5%; manufacturing 13%; agriculture, forestry and fishing 1.3%

Sources: World Bank Data; UNDP HDI Cuba report; Sixth Report to the Convention on Biological Diversity; EcuRed; National Office of Statistics and Information; Decree-Law No. 266 on the outer limits of the exclusive economic zone of the Republic of Cuba in the Gulf of Mexico; Decree-Law No. 241 on the maritime zones of the Republic of Cuba

Key messages

» **Main direct driver of biodiversity loss and nature's decline:** land use change, mainly driven by urbanization, agriculture and infrastructure development

» **Main indirect drivers of biodiversity loss and nature's decline:** low public awareness of the importance of the biological diversity, insufficient harmonization of biodiversity conservation and sustainable use objectives within the country's development policies and strategies, inadequate economic valuation of ecosystem services and their inclusion in accounting frameworks, insufficient implementation of financial solutions, and long-lasting US sanctions.

» **Potential priority pathways to advance toward sustainable futures:** expansion of renewable energy and increase energy efficiency; strengthening governance inclusiveness, descentralization and accountabitly; mainstreaming biodiversity considerations into territorial planning; increase the resilience of ecosystems and communities to climate change; productive restructuring with science and technological innovation; and sustainable financial mechanisms

1. Mangrove branches: relationships between the nexus elements and the direct drivers of change in biodiversity and nature (expanding key message 1)

Key data snapshot

Iconic regions: the four major sub-archipelagos: Los Colorados, Sabana-Camagüey, Los Canarreos and Jardines de la Reina; the main mountains range: Guaniguanico, Guamuhaya, Sierra Maestra and Nipe-Sagua-Baracoa; Zapata Swamp; the fourteen national Parks.
Protected areas coverage: ~16% of land area, ~23% of marine area in 2022
Urban population: ~78% in 2024
Coastal population: ~80% in 2024
Priorities: strengthening socialism and democracy through institutional consolidation, popular participation, national defence and sovereign international engagement; driving inclusive economic growth, productive diversification and global competitiveness; enhancing infrastructure and investment in strategic sectors (energy sector being an urgent priority); advancing science and technology through skilled talent, institutional innovation and technological sovereignty; promoting environmental sustainability through resource protection, improved environmental quality and climate change adaptation; ensuring equitable human development through social justice, constitutional rights and the reduction of inequalities
Sources: Sixth Report to the Convention on Biological Diversity, 2030 National Economic and Social Development Plan, 1stFirst National SDG Voluntary Report 2021 , Plan of the National Protected Areas System 2023 – 2030

Land use changes have transformed ecosystems, compromising water quality and aquifer recharge. For example, food security is compromised by soil erosion, salinization and overexploited fisheries, leading to a reliance on imports. Pollution from industrial waste, sewage, agrochemicals and thedomestic sector contaminates rivers, coastal zones and marine ecosystems, thereby threatening food chains and public health. Additionally, climate change exacerbates coastal erosion, coral bleaching, drought and agricultural losses, with rising temperatures and sea levels increasing vulnerability for over half the population living in coastal areas. Finally, invasive species – from predatory catfish and feral mammals to disease vectors like *Aedes* mosquitoes – further disrupt ecosystems and heighten health risks, including risk ofarbovirus outbreaks.

Table VI: Cascading effects of the direct drivers of biodiversity loss and nature's decline on nexus elements in Cuba, based on information compiled through desk review and consultations with key informants by the main author and three United Nations volunteers

	Biodiversity	Water	Food	Climate	Health
Land and sea use change	Land and sea use change in Cuba – e.g. colonial plantations, logging, construction of railways and ports, extensive livestock farming and urbanization – has largely transformed ecosystems and their species.[184,185,186,187] In 1960s, only between 40% to 20% of native forest remained.[188,189,190,191] In 2015, land use in the country was distributed as follows: 53% natural ecosystems, 40% agricultural lands, 1% inland waterbodies and 0.6% urban areas.[192] Tourism and mining are also driving ecosystem declines.[193,194,195,196]	Land and sea use change has extensively affected aquifer recharge and water quality, while intensive dam construction has significantly reduced the water flow towards estuaries and coastal areas.[197,198,199,200,201]	Land and sea use change, especially related to colonial sugarcane monoculture and the intensive agricultural Soviet model, have caused extensive soil erosion (nearly half of the agricultural land in Cuba), acidification, salinization (about 14% of the agricultural land), drainage issues and compaction that lower the national and local capacities for food production,[202,203,204] contributing to the need to import over 50% of the nation's food.[205]	Urbanization and industry-led use changes are the major contributors to the country's GHG emissions, followed by agriculture, specifically the pig sector. Gross and net emissions have steadily declined in the past five years, especially industrial emissions, due to the profound economic and financial crisis.[206,207]	Inconclusive evidence

	Biodiversity	Water	Food	Climate	Health
Direct exploitation	The capture, collection, use, and illegal trade of wildlife species (mainly birds, lizards and cacti) negatively impacts native, endemic, and threatened populations, as well as causes modifications to habitats.[208,209,210,211,212,213]	The natural limitations of Cuba's water bodies, as well as the intensive use by productive sectors,[214,215] present significant challenges for water security. The annual per capita water availability has decreased by about 98% between 1774 and 2012,[216] while over 5% of the population received water via trucks in 2024.[217]	Currently, 20% of Cuba's fisheries are fully exploited, 74% are overexploited, and 5% have collapsed.[218] Shark and ray landings have also steadily declined.[219] The widespread over-extraction of groundwater for agricultural irrigation aggravates soil and groundwater salinization, significantly impacting food production.[220]	Fossil fuels comprise more than 70% of the country's energy production, although their use and production have declined due to the deterioration of infrastructure and lack of sustained investment.[221,222,223] The country has been implementing an energy transition strategy that seeks to increase the share of renewable energy, particularly photovoltaic solar power, to 24% by 2030. This reflects national commitments to reduce dependence on imported fossil fuels and enhance energy resilience.[224]	Nickel extraction in the form of open-pit mines causes respiratory and skin diseases in nearby communities, e.g. in Moa.[225,226]
Pollution	Extensive pollution affecting ecosystems comes from the country's domestic sewage, industrial waste and agricultural runoff, although agrochemical pollution appears to be relatively lower than in other regions.[227] The peri-urban ecosystems are heavily impacted by chronic pollution; oil, heavy metals, organic matter and pesticides were detected in sea-bottom animals, marine sediments and water in the Havana Bay in the early 2000s,[228] pollution from diverse sources in water bodies across Havana,[229,230] potentially facilitating heavy metal accumulation in endemic fish.[231]	Bodies of freshwater are heavily impacted by sewage and pollution. Almendares River, the longest river in Havana, receives the sewage of 42,000 inhabitants.[232] Industrial pollution, such as that from "Los Guaos" quarry in Santiago de Cuba, has also visibly polluted the surface waters and aquifer by increasing sedimentation and erosion that result in silting.[233]	A recent study found pharmaceutical contaminants from commonly consumed medications (e.g. analgesics, stimulants, antihypertensives, and antibiotics) in La Paila (Almendares River) and Baños del San Juan (San Juan River), western Cuba. These substances have the potential to affect the food chain.[234]	From 2016–2022, gross and net GHG emissions declined by 20% and 56%, respectively, due to poor infrastructure and a lack of cash to afford fuel imports. Methane emissions dominate the 2022 profile, primarily due to increased solid waste pollution.[235,236]	Domestic waste is a major public health crisis affecting communities across the country, with dumping sites across cities continually growing since the post-2020 fuel crisis, and an increased incidence of vector-borne and bacterial diseases.[237,238]
Climate change	Coastal erosion is aggravated, with an average of 1.2 m of coastal recession per year, and around 59% of beaches are eroded.[239] There is increasing coral bleaching and coral disease, with 70% of assessed reefs deteriorated in 2014.[240,241] Most of the territory – comprising flat and low-height areas – is projected to experience a 50% reduction in potential species richness under mitigation and high emission climate change scenarios.[242]	More severe droughts, growing water demand, and reduced water storage capacity in dams due to high sedimentation and erosive processes are all reducing national water security.[243]	There is reduced yield and productivity in the agricultural sector, with an increasing incidence of diseases and water problems, which are projected to worsen.[244,245]	The climate is becoming hotter, drier and more extreme. The annual average temperature is predicted to increase. Rainfall in the wet season is predicted to decrease by 10%, while the sea level is estimated to rise between 29.3 and 95.0 cm between 2050 and 2100.[246,247]	With over 57% of the Cuban population residing in coastal zones, the nation is highly vulnerable to the impacts of climate change. An estimated 1.5 million people (excluding the city of Havana) live in 262 settlements threatened by flooding.[248]
Invasive species	Invasive mammals, plants and fish have been identified as main drivers of vertebrate and vegetation decline.[249,250] For example, catfish are voracious predators contributing to the decline of native freshwater fish, and while feral cats feed on solenodon, hutias and native birds.[251,252]	Invasive aquatic plant species (e.g. water lettuce and hydrilla) cover whole water bodies, blocking sunlight penetration below water surfaces and reducing oxygen diffusion.[253,254]	Although many species were introduced for human consumption, they have caused unintended consequences, e.g. the Asian water buffalo has become a problem in some areas, damaging agriculture ecosystems and hosting tuberculosis and brucellosis, which can pass to cattle.[255]	No Evidence Found	The most prominent case of invasive species is the disease vector *Aedes* mosquito due to its role in spreading arboviruses (i.e. dengue, chikungunya, Zika and Oropouche). Currently, the simultaneous incidence and transmission of dengue, chikungunya and Oropouche is causing a health emergency.[256,257]

2. Mangrove roots anchored in the mud: relationships between the indirect and direct drivers of change to biodiversity and nature (expanding key message 2)

Table VII: Relationships between the indirect and direct drivers of change to biodiversity and nature in Cuba

Demographic and sociocultural factors	Economic and technological factors	Institutions and governance	Conflicts and epidemics
Because Cuba has a negative population growth rate (-0.4%),[258] the population has peaked and is facing accelerated demographic aging. 24.4% of the population is over 60, while there is high population concentration in urban areas, particularly the capital Havana.[259] Cuba experiences the typical net emigration of the region, but in the past three years, mumbers have risen (reaching 1,011,269 emigrants in 2023), with most of the people leaving the country being young people.[260] These trends significantly affect the country across sectors, especially in food production and the delivery of public services. The continuous deterioration of the economic situation is fuelling emigration and well-being issues.[261]	Cuba's economic performance and environmental management capacities are also significantly affected by longstanding financial and trade restrictions imposed by the United States (US economic and financial blockade), which limit access to credit, technologies, equipment, and some essential goods. These constraints interact with domestic economic challenges and influence investment levels in environmental infrastructure, water systems, conservation activities and ecosystem management. However, the country has shown limited but growing investment focused on energy and tourism. The country has also promoted trade diversification and bilateral agreements to offset trade restrictions.[262,263,264,265,266]	Cuba has a comprehensive environmental policy framework, including a national biodiversity program aligned with international agreements. Cuba´s environmental policy is overseen by the Ministry of Science, Technology and Environment (Spanish acronym CITMA), which acts as the National Focal Point for the Convention on Biological Diversity.[267] The recent environmental law approved in 2022 (Law No. 150) – subject of an extensive consultation process –emphasizes the cross-sectoral and decentralized nature of environmental governance, and makes bold steps to leigitimize the constitutional right to a healthy and balanced environment.[268,269]	Cuba faces socio-economic pressures—including demographic aging, the emigration of young people, and rising inequalities—which influence resource availability, local service delivery, and environmental management capacities.[270]
Cuban society demonstrates a strong cultural connection to nature, rooted in traditional ecological knowledge, especially in agroecology practices that have evolved since the "special period" in the 1990s after the collapse of the communist bloc, representing a transition toward sustainable farming methods.[271] The agroecological and permaculture movements have grown more than in other regions, due to the lower availability of resources that the US economic and financial blockade forced on the country.[272] The average population is experiencing daily limitations in food and resources as well as an energy crisis, i.e. load shedding with regular power outages and nation-wide blackouts.[273,274,275] These factors represent low consumption and a small ecological footprint globally.[276]	Cuba leads the region in agroecological methods, combining low-input sustainable techniques with gradual mechanization. The transition from industrial agriculture towards agroecology has been irregular, reflecting systemic contradictions that hinder food security and peasants' autonomy.[277,278] Recently, the Government approved a Decree on Agroecology that formalizes the three-decade-old agroecology movement.[279] Innovation in green technology is visible in water management, solar energy and low-impact farming techniques, reflected in the country's commitment to increase the share of renewable energy to 24% by 2030.[280,281,282] Cuba allocates State resources to research and development with an emphasis on biotechnology, agriculture and environmental sciences, although funding, technology and knowledge transfer remain limited.[283,284]	Land tenure in Cuba is characterized by State ownership, with usufructuary rights granted to individuals and cooperatives for agricultural production. This system, while limiting private property rights, aims to ensure equitable land access and support State planning objectives. However, it has also resulted in a large percentage of unused cultivable land, not necessarily creating equitable land opportunities for food production.[285] Contradictions exist between policies from different sectors, e.g. afforestation actions to increase the forest cover for climate mitigation purposes often attempt to convert non-forest natural ecosystems into forestry plantations, threatening such ecosystems.[286,287]	Cuba is currently experiencing a complex and challenging health emergency of simultaneous epidemics of dengue, chikungunya and Oropouche. These epidemics are related to the intersections between unsustainable urbanization, modes of consumption, the waste management crisis that the country is experiencing, the climate change, and the financial strains from the US economic and financial blockade.[288,289,290,291]

3. The tides around the mangrove roots and mud: bright spots lighting the path towards TC and nexus approaches (expanding key message 3)

Table VIII: Bright spots lighting the path towards TC and nexus approaches in Cuba

Priority pathways	Projects/initiatives/ institutions	National policies	Regional policies/ projects
Expansion of renewable energy and increase energy efficiency	- CRICKET CIC: Caribbean Research and Innovation Collaboration for Knowledge Exchange and Transfer Community Interest Company	- Tarea Vida: State Plan to face climate change - National Strategy for Energy Transition in Cuba	
Strengthening governance inclusiveness, decentralization and accountability	- Centro de Intercambio y Referencia de Iniciativa Comunitaria - Finca Tierra Brava - ReglaSOUL community programme - CRICKET CIC: Caribbean Research and Innovation Collaboration for Knowledge Exchange and Transfer Community Interest Company	- Law No. 150	- CAI: Caribbean Agroecology Institute
Mainstreaming biodiversity considerations into territorial planning	- Finca Marta - Finca Tierra Brava - Permaculture movement - Rama Viva Community Project - Finca del Medio - ReglaSOUL community programme - CRICKET CIC: Caribbean Research and Innovation Collaboration for Knowledge Exchange and Transfer Community Interest Company	- Law No. 150	- CAI: Caribbean Agroecology Institute
Increase the resilience of ecosystems and communities to climate change	- AdaptHabana-National Adaptation Plan for the Havana Coastal Zone in Cuba - Mi Costa- Coastal Resilience to Climate Change in Cuba through Ecosystem Based Adaptation	- Tarea Vida: State Plan to face climate change - National Strategy for Energy Transition in Cuba	- CAI: Caribbean Agroecology Institute
Productive restructuring with science and technological innovation	- Finca Marta - Finca Tierra Brava - Finca del Medio - CRICKET CIC: Caribbean Research and Innovation Collaboration for Knowledge Exchange and Transfer Community Interest Company		- CAI: Caribbean Agroecology Institute - Caribbean Biodiversity Fund
Securing sustainable financial mechanisms	- The Biodiversity Finance Initiative (BIOFIN) in Cuba - Caribbean Debt Conversion		- BIOFIN - Caribbean Biodiversity Fund

(a) *Exploring potential nexus responses of BIOFIN in Cuba*

The BIOFIN initiative is an example of C10 Global Cooperation for finance and technology. By realigning expenditure, delivering better expenditure and avoiding future expenditure while also generating revenue, BIOFIN supports the design and implementation of a national Biodiversity Finance Plan that will reduce the biodiversity financial gap – that is, the difference between how much is currently being spent on biodiversity and how much is needed to meet the country's biodiversity goals.[292]

Figure XIX: Exploring the TC potential of BIOFIN in Cuba

What results are desired?	» Reduce the biodiversity financial gap in Cuba by over 70%
What are the initiative's core values, and how do they align with the principles for TC?	» Aligns with the TC principle of inclusion and pluralism by applying a cross-sectoral and inclusive approach with a focus on local communities and gender

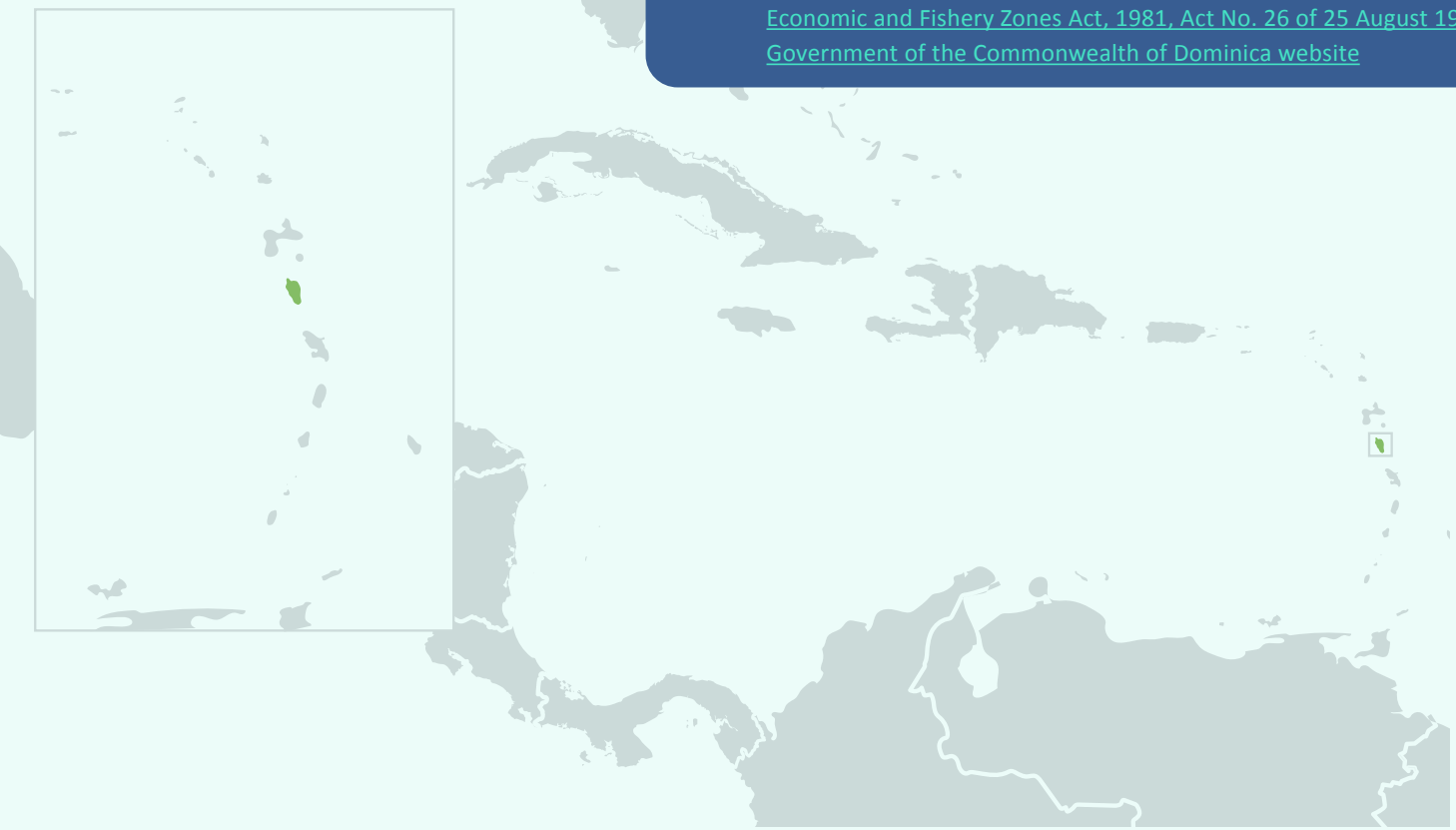
What strategies for TC does the initiative contribute to?	» Driving systemic change in the sectors most responsible for biodiversity loss and nature's decline by introducing new financial tools that have the potential to regulate sectors like mining (e.g. biodiversity offsets), tourism (e.g. foreign tourist levy for biodiversity) and agriculture (e.g. tax reduction for agrobiodiversity practices) » Transforming economic systems for nature and equity by helping transform the country's financial system to be able to fund solutions that address biodiversity challenges (e.g. introduction of green banking, insurance against environmental risks or a specific national budget for the climate change plan, reform of the current environmental fund)
How does the initiative address the underlying causes of biodiversity loss and nature's decline?	» Has the potential to partially address the prioritization of short-term, individualistic and material gains by designing financial solutions for biodiversity conservation challenges, following equity and justice principles.

C. Dominica

Key data snapshot

Country: single-island country
Location: between the French islands of Guadeloupe to the north and Martinique to the south
Maritime Exclusive Economic Zone area: 28,593 km²
Land area: 751 km²
Coastline length: 148 km
Human population (2024): 66,205
HDI (2023): High (0.761), ranked 98 out of 193
GDP share (2024): service industries 56.9%; industry (including construction) 13.9%; agriculture, forestry and fishing 12.2%; manufacturing 5%

Sources: World Bank data; UNDP HDI Dominica report, NBSAP 2014–2020; DOM767 Newspaper, Territorial Sea, Contiguous Zone, Exclusive Economic and Fishery Zones Act, 1981, Act No. 26 of 25 August 1981; Government of the Commonwealth of Dominica website



Key messages

- **Main direct drivers of biodiversity loss and nature's decline:** land use change, mainly driven by agriculture, urbanization and tourism and climate change
- **Main indirect drivers of biodiversity loss and nature's decline:** economic development overriding needs for biodiversity conservation and Indigenous and local knowledge and livelihoods, weak legislative frameworks, a tendency to centralized governance and the absence of an integrated development process
- **Potential priority pathways to advance toward sustainable futures:** strengthening community-based resource management; investing in health and environmental monitoring capacities; integrating climate adaptation and biodiversity conservation across all sectors; and empowering Indigenous Peoples and local communities

1. Mangrove branches: relationships between the nexus elements and the direct drivers of change in biodiversity and nature (expanding key message 1)


© Peter Zika

Key data snapshot

Iconic regions: Morne Trois Pitons National Park, Champagne Beach, Scotts Head
Protected areas coverage: ~27% of land area
Urban population: ~ 72%
Coastal population: >50%
Priorities: promoting food security and self-sufficiency through climate-resilient agriculture and fisheries development; enhancing the resilience of ecosystems and the sustainable use of natural resources; enhancing infrastructure resilience; promoting sustainable human settlements and communities; implementing adequate, sustainable and resilient social protection systems; implementing a comprehensive risk management framework and pursuing the low-carbon development pathway; and encouraging economic empowerment and innovations through sustainable climate financing

Sources: National Biodiversity Strategy and Action PlanNBSAP 2014-–2020, Protected Areas Information System, National Resilience Development Strategy Dominica 2030

Land use changes have caused significant deforestation and watershed damage in Dominica. Water quality and availability are threatened by siltation, agrochemical runoff and poor waste management, while food security remains fragile due to high import dependence and climate-sensitive agriculture. Pollution from quarry waste, livestock farming and sewage contaminates rivers and coastal areas, increasing health risks. Climate change amplifies these problems by causing more intense hurricanes, droughts and sea level rise, leading to ecosystem damage, agricultural losses and severe health emergencies, as seen during Hurricane Maria. Invasive species such as Mediterranean seagrass, the giant African snail, and ***Aedes*** mosquitoes further disrupt ecosystems, agriculture and public health.

Table IX: Cascading effects of the direct drivers of biodiversity loss and nature's decline on nexus elements in Dominica, based on information compiled through desk review and consultations with key informants by the main author and three United Nations volunteers

Direct Driver	Biodiversity	Water	Food	Climate	Health
Land and sea use change	Land and sea use changes for agricultural and urban expansion, quarrying and tourism have extensively affected natural ecosystems.[293] For example, over the last 23 years, forest cover has declined from 75% to 66%,[294] while coastal pelagic fish populations have declined due to high sedimentation inputs from quarrying.[295]	Land use changes cause watershed degradation that reduces water quality and availability, especially in dry seasons.[296] For example, the Roseau River suffers from seasonal extreme turbidity, and the river intake must be closed to prevent silt from entering supply lines.[297]	Despite the crop diversity achieved in the country after the fall of the banana industry,[298] imports comprise up to 90% of all food consumed, fuelled by the growing changes in land and sea use towards tourism development.[299,300]	GHG emissions from 2005 to 2017 are primarily due to energy consumption from land use change to agricultural, residential and commercial uses, although changes to forestry substantially offset carbon dioxide emissions.[301]	No evidence found
Direct exploitation	The unsustainable harvesting of timber and non-timber forest products and marine resources negatively affect ecosystems and species populations.[302,303]	Water quality has declined due to siltation and sedimentation from quarrying and tree removal, which result in watershed degradation.[304]	Local fishers have cited silt and sedimentation entering coastal waters from quarrying operations as the causes of declines in jacks, mackerel and scads caught by seine nets.[305]	Fuel combustion for energy supply is among the largest contributors to GHG emissions in the country.[306]	Health risks are increased due to air pollution from quarrying activities such as blasting.[307]

Direct Driver	Biodiversity	Water	Food	Climate	Health
Pollution	By 2001, an estimated 90% of quarry waste was disposed of on beachfronts, leading to sedimentation of reefs and depletion of fish resources.[308] Agrochemical pollution through runoff and aerial application is a serious threat to terrestrial and marine biodiversity.[309,310]	Agriculture, including livestock farming and its resulting sewage, contaminates freshwater sources.[311]	Inconclusive evidence	The main GHG sources in the country include methane and nitrous oxide emissions from waste-sector landfill sites, areas of open dumping, and burning of waste. However, reductions in emissions have been noted due to improved industrial and domestic wastewater handling.[312]	Tap water is predominantly sourced from rivers and streams, posing a health risk if contaminated. High rodent populations, which contribute to the spread of contamination and diseases, have been attributed to poor waste management.[313]
Climate change	Since 2000, the country has experienced four major tropical storms that have impacted the natural ecosystem. As a result of these storms, 90–95% of trees were defoliated, and Hurricane Maria in 2017 caused major watershed damage.[314] Hurricanes also increase the risk of introduction and spread of invasive species, e.g. the iguana and Cuban tree frog, whose spread was facilitated by Hurricane Maria. The iguana and tree frog arrived on the island as transport stowaways from Portsmouth and Woodbridge Bay Port, respectively.[315]	Altered rainfall patterns and extreme events affect water availability and quality.[316]	Food security is a major threat to the island as the food sector is highly sensitive to climate change, temperature and precipitation variability and extremes, hurricanes, flooding, drought, sea level rise, and soil erosion. For example, in 2010, drought resulted in an 18% loss of GDP from agricultural production.[317]	Climate change is causing sea level rise, more frequent droughts and rising air and water temperatures. While it will cause rainfall to decrease, it will also increase the likelihood of very intense, isolated rain events. The frequency of category 4 and 5 hurricanes is expected to increase by 25%–30%.[318]	Climate change effects, especially hurricanes, are a major health emergency. For example, Category 5 Hurricane Maria resulted in 65 human fatalities and US$1.37 billion in damages.[319]
Invasive species	Species such as Mediterranean seagrass displace native seagrass species, dominating seagrass communities.[320]	No evidence found	Black sigatoka disease attacks banana and banana-like crops. The giant African snail is a major agricultural pest, feeding on important crops like banana and cocoa.[321]		*Aedes* mosquitoes are a persistent health problem due to the vector-borne diseases they spread, e.g. dengue.[322]

2. Mangrove roots anchored in the mud: relationships between the indirect and direct drivers of change to biodiversity and nature (expanding key message 2)

Table X: Relationships between the indirect and direct drivers of change to biodiversity and nature in Dominica

Demographic and Sociocultural Factors	Economic and Technological Factors	Institutions and Governance	Conflicts and Epidemics
The country has a population density of 95 people/km^2, with 72% in urban areas, primarily concentrated around Roseau and coastal areas.[323] This density and distribution create localized environmental pressures. Coastal zone development around the capital, Roseau, agricultural expansion into forested areas and infrastructure challenges due to mountainous terrain contribute to habitat fragmentation and erosion risks. The country faces continuous emigration due to limited economic opportunities and climate vulnerability.[324]	Dominica trades primarily in bananas, citrus, seafood and emerging agricultural products. Imports are mainly foodstuffs, fuel and machinery. Foreign investment mostly targets agriculture, tourism and infrastructure rehabilitation following natural disasters.[325] The country has a small open economy that is highly vulnerable to external shocks and natural phenomena (i.e. volcanoes, hurricanes),[326] which has caused a very high public debt; between 2018 and 2023, the public debt was more than the GDP.[327]	Environmental governance is distributed among three main ministries. The Ministry of Agriculture, Fisheries, Blue and Green Economy – which acts as the National Focal Point for the Convention on Biological Diversity – and the Ministry of Finance, Economic Development, Climate Resilience and Social Security oversee different and overlapping aspects of sustainable development.[328] The Ministry of Environment, Rural Modernisation, Kalinago Upliftment and Constituency Empowerment oversees Kalinago and forestry affairs, serving as a bridge between the Kalinago council that represents its territory and the central government. However, Kalinago representation in decision-making remains insufficient.[329] Dominica is experiencing a process of policy and legislative framework updating to reflect its priorities, i.e. the Climate Resilience Act and National Forest Policy 2022. However, a policy on traditional Indigenous knowledge, central to their identity, is still lagging behind.[330]	Dominica remains politically stable without armed conflicts but faces resource-based conflict, heightened by climate change impacts on land and water. Intercommunity conflicts may occur over access to scarce resources, exacerbated by natural disasters. Social conflicts are mostly environmental in nature, related to resource management decisions and disaster response distribution.[331] Disruption of conservation efforts occurs during disaster recovery phases when emergency priorities overshadow conservation. Displacement is mostly climate-induced rather than conflict-driven.[332]
Indigenous traditional practices, particularly of the Kalinago people, incorporate sustainable land and resource management, reflecting a profound connection to local natural landscapes.[333,334,335] However, the Kalinago are a vulnerable group with higher-than-average food insecurity and financial poverty rates, linked to the colonial legacies of environmental devastation and cultural struggle for recognition and respect.[336,337,338] Food security has also driven the introduction of invasive species.[339]	Local research focuses on integrating traditional knowledge with technological innovation to enhance resilience, but financial constraints limit this integration, as does the tendency towards centralized governance.[340] After Hurricane Maria, the government announced a plan to be the world's first climate-resilient nation, for which the legislative and policy body is in process. The plan targets the geothermal capacity on the island as a sustainable source of renewable energy.[341] However, there are concerns over the potential negative impacts on biodiversity.[342]	The country relies primarily on private ownership with some customary land use systems, especially in rural and Indigenous communities. Customary rights recognized for common lands and traditional resource areas coexist with formal State-administered land titles. Kalinago land rights are safeguarded by the Kalinago Territory Act of 1903 but are often challenged by land use and climate pressures,[343] e.g. the communities feel excluded from the environmental decision-making and planning for their territory.[344]	The island´s rich biodiversity poses potential zoonotic risks, although surveillance helps prevent outbreaks. Persistent challenges with vector-borne diseases like dengue exist; climate change impacts exacerbate these trends by altering vector habitats.[345] Habitat disturbance and extreme weather events influence vector populations and disease transmission dynamics. Health emergencies have shifted resource allocation priorities, and environmental programmes have seen reduced operational capacity during COVID-19 and disaster response periods.[346]

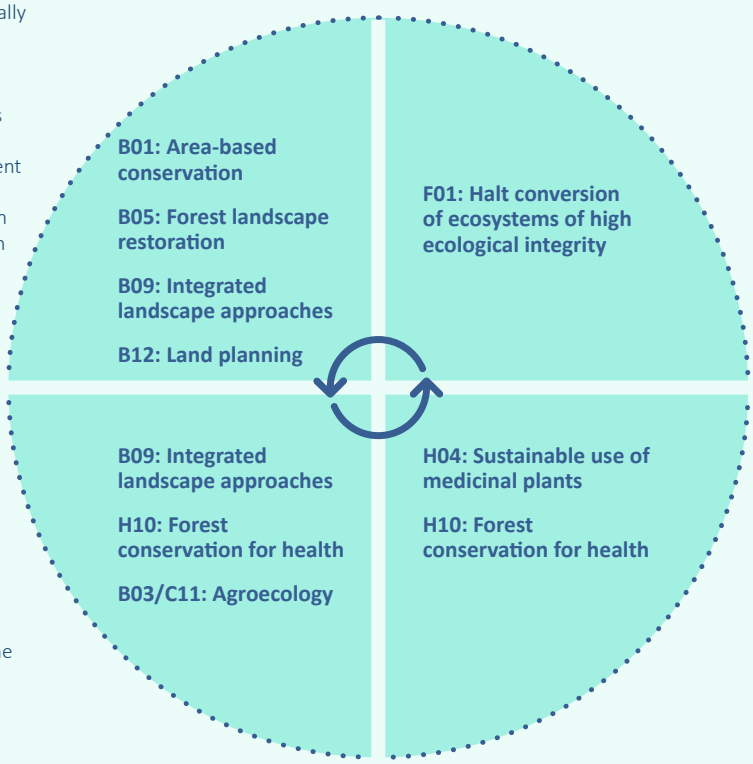
3. The tides around the mangrove roots and mud: bright spots lighting the path towards TC and nexus approaches (expanding key message 3)

Table XI: Bright spots lighting the path towards TC and nexus approaches in Dominica

Priority pathways	Projects/initiatives/institutions	National policies	Regional policies/ projects
Strengthening community-based resource management	- Strengthening Resilience of Agricultural Lands and Forests in Dominica in the Aftermath of Hurricane Maria - Building and strengthening resilience to Climate change impacts in the Tarreau community through Management of Bush Fires - Enhancing Biodiversity and food security and improving ecosystem health in the Castle Bruce district through Apiculture - Strengthening Capacity and Empowering Civil Society for Environment through SGP Grantees Network	- National Forest Policy 2022	- PROCARIBE+ - Caribbean Biodiversity Fund
Investment in health and environmental monitoring capacities			
Integrating climate adaptation and biodiversity conservation across all sectors	- Strengthening Resilience of Agricultural Lands and Forests in Dominica in the Aftermath of Hurricane Maria	- National Forest Policy 2022 - Climate Resilience Act	- A Caribbean Climate Justice Alliance for advocacy, action and accountability
Empowerment of Indigenous Peoples and local communities	- Supporting Kalinago Women in Turmeric Production and Processing to build resilience and enhance livelihoods		- United Nations Education, Scientific and Cultural Organization's (UNESCO) Local and Indigenous Knowledge Systems Programme-Caribbean

Figure XX: Exploring potential nexus responses of the National Forest Policy 2022

- Strategy i.1: conserving ecologically functional areas of all forest ecosystems found on both State and private lands (including ecological corridors, buffer areas and critically threatened areas)
- Strategy ii.2: improving the current management of forested areas designated as protected areas on State lands through the adoption of management plans and a formal definition of buffer zones
- Strategy iii.6: supporting the sustainable development of nature-based tourism on all forested lands complying with biodiversity objectives and ecosystem-based approaches



- Strategy iii.1: ensuring the sustainable extraction of forest resources (including timber, game animals and other non-timber products)
- Strategy iii.3: managing access to genetic resources, protecting intellectual property rights and ensuring fair benefits from the use of genetic forest resources

- Strategy ii.2: implementing a "no net loss of forest" policy that prioritizes stopping or revising all ongoing deleterious developments and investments to avoid losses and conversion of primary forest or ecologically sensitive forest vegetation areas
- Strategy iii.4: supporting traditional, subsistence and small-scale extractive uses of forests and cottage industries that are legal, sustainable and compatible with conservation objectives, especially those that are capable of bringing livelihood benefits to local and Indigenous communities
- Strategy iii.5: promoting forestry contribution to food security through sustainable agroforestry and supporting initiatives forthe development of organic agriculture

Figure XXI: Exploring the TC potential of the National Forest Policy 2022

What results are desired?	» The effective management of Dominica's forests so that they remain healthy, forest cover is increased and the people of Dominica benefit from their ecological, economic and sociocultural value in a sustainable manner
What are the policy's core values, and how do they align with the principles for TC?	» The belief that forests and natural resources are vital for the social, economic and cultural well-being of the country, and that all Dominicans have the right to well-managed forest and wildlife resources but also have the duty to ensure that natural resources are properly protected, valued and used sustainably » The belief that mutual interests and efforts of all cross-sectoral stakeholders should bring benefits to those whose livelihoods depend on the use of natural resources, with the overarching principles of empowerment, collaboration and participation, as well as intergenerational equity. These align with the TC principle of equity and justice » Values align with the TC principle of respectful and reciprocal relationship between people and nature as well as equity and justice
What strategies for TC does the policy contribute to?	» Conserving and regenerating places of value to nature and people by conserving ecologically functional areas of all forest ecosystems, restructuring and realigning legislation and coordination mechanisms to ensure sustainable governance and strengthen the legal protection for forested lands » Driving systemic change in the sectors most responsible for biodiversity loss and nature's decline by ensuring the sustainable extraction of forest resources, with a focus on supporting those traditional small-scale extractive uses that benefit local and Indigenous Peoples, promoting forestry contributions to food security through sustainable agroforestry and supporting initiatives for organic agriculture development, and ensuring equitable and effective participation of the private sector and civil society » Transforming governance systems to be integrative, inclusive, accountable and adaptive by ensuring that all decision-making is integrated and multidisciplinary
How does the project address the underlying causes of biodiversity loss and nature's decline?	» The policy has the potential to address the concentration of wealth and power through two of its focus areas: ensuring that benefits from forest goods and services are equitably distributed, and ensuring equitable and effective participation of the private sector and civil society in forest governance

D. Dominican Republic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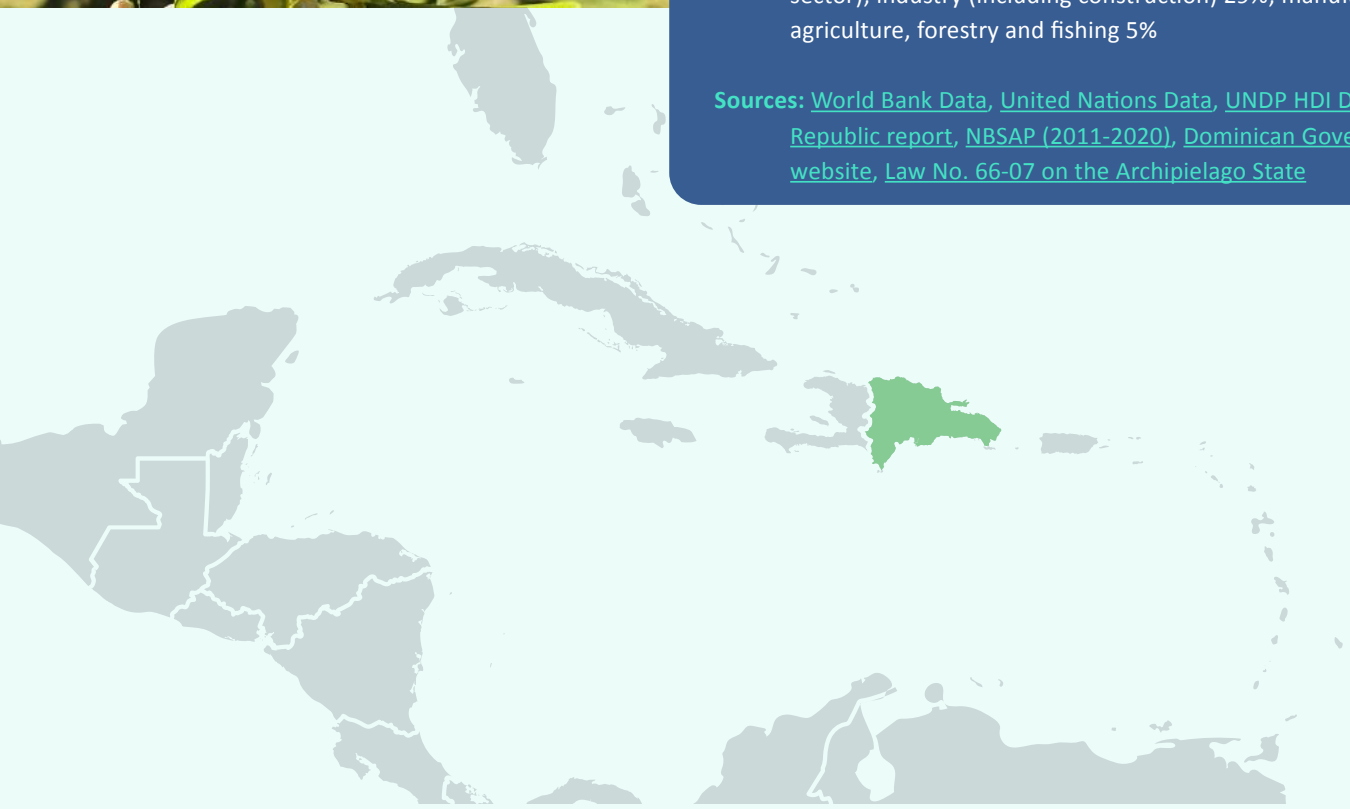
Key data snapshot

Country: eastern two thirds of the island of Hispaniola and 141 islets
Location: between the Caribbean Sea in the south and the North Atlantic Ocean in the north, and Haiti in the east and Puerto Rico in the west (separated by the Mona Passage)
Maritime Exclusive Economic Zone area: 49,709 km2
Land area: 48,670.82 km²
Coastline length: 1,576 km
Human population (2024): 11.3 million
HDI (2023): High (0.776), ranked 89 out of 193
GDP share (2024): service industries 60% (with tourism as the largest single sector); industry (including construction) 29%; manufacturing 12%; agriculture, forestry and fishing 5%

Sources: World Bank Data, United Nations Data, UNDP HDI Dominincan Republic report, NBSAP (2011-2020), Dominican Government's website, Law No. 66-07 on the Archipielago State



Key messages

» **Main direct driver of biodiversity loss and nature's decline:** land and sea use change, mainly driven by agriculture (shifting agriculture, agro-industry farming, agro-industry livestock farming and nomadic grazing), urban expansion and tourism development.

» **Main indirect drivers of biodiversity loss and nature's decline:** inequality reflected in cheap labour and vulnerable groups' dependence on natural resource extraction, land insecurity and a conflicting tenure system, governance and institutional limitations in environmental management, harmful government subsidies favouring the sectors most responsible for nature's decline, and increased exposure to social conflicts derived from inequality, with aggravated impacts in Haitian migrant communities

» **Potential priority pathways to advance toward sustainable futures:** strenghtening intersectoral and inclusive decision-making and governance; reforming land tenure system to guarantee legal security and equity; mainstreaming local traditional ecological knowledge; and tackling inequality

1. Mangrove branches: relationships between the nexus elements and the direct drivers of change in biodiversity and nature (expanding key message 1)

Key data snapshot

Iconic regions: Barahona Peninsula, Bahoruco Sierra, Enriquillo Lake, Los Haitises, Samaná Peninsula, Central Mountain Range
Protected areas coverage: 26.5% of land area, 9.3% of marine area
Urban population: ~84% in 2024
Coastal population: ~70% in 2024
Priorities: a State with efficient and transparent institutions, serving a responsible and participatory citizenry, that guarantees security and promotes development and peaceful coexistence; a cohesive society, with equal opportunities and low levels of poverty and inequality; an innovative and sustainable economy, with a productive structure that generates high and sustained growth with decent employment, and integrates competitively into the global economy; sustainable environmental management, with proper adaptation to climate change

Sources: NBSAP (2011-2020), Website of the Dominican Government, The 30x30 Preliminary Report, National Ecosystem Assessment-Scoping Report 2023, United Nations Data, National Development Strategy 2010-2030

Land use changes – driven by agriculture, mining, tourism and urban expansion – have caused widespread deforestation, mangrove and coral reef loss and increased pollution, affecting biodiversity, water availability, food production, climate resilience and public health. Direct exploitation, such as logging, fuelled by domestic and cross-border demand, contributes to endemic species' risk of extinction. Pollution from agrochemicals, plastics and untreated waste – mainly from farming, mining and urban activities – contaminates ecosystems and food chains. Climate change, intensified by fossil fuel dependence and unsustainable land and sea use, alters agroclimatic zones and increases disease risks. Invasive species, often linked to degraded habitats and agricultural practices, disrupt native ecosystems, reduce crop yields and spread vector-borne diseases.

Table XII: Cascading effects of the direct drivers of biodiversity loss and nature's decline on nexus elements in the Dominican Republic, based on information compiled through desk review and consultations with key informants by the main author and three United Nations volunteers

	Biodiversity	Water	Food	Climate	Health
Land and sea use change	Changes in land use for agriculture, urbanization, tourism and mining have severely impacted ecosystems.[347,348] Only 1.2% of intact forest remains in the country,[349,350] and mangrove extent declined by 27% between 1969 and 2012.[351]	Changes in land use favouring the unsustainable expansion of tourism, agriculture, livestock industry, mining and urban areas have reduced freshwater availability at the national level.[352,353] The per capita annual freshwater availability has decreased by 84% since 1920. By 2030, the country will likely be in hydric stress, with very low per capita freshwater availability.[354]	Although decades-long steady economic growth through land conversion has advanced food and nutritional securities – e.g. the domestic market supplied more than 95% of the staples consumed in 2017–[355] land conversion affects food in the long-term by aggravating soil erosion and infertility and contributing to declines in pollinator populations.[356,357,358]	Increasing urbanization, construction of roads and use of transport are major causes of GHG emissions in the country.[359,360,361,362,363] Extensive livestock farming is a main source of ammoniac emissions.[364]	Although development through land conversion has reduced financial poverty, it has increased vulnerability to infectious and noncommunicable diseases, e.g. malaria incidence and risk have sharply increased with tourism development in the south-easternmost province.[365] Diets have also changed towards unhealthy ultraprocessed food.[366,367,368]

	Biodiversity	Water	Food	Climate	Health
Direct exploitation	Firewood and charcoal demand for households, small businesses and exports contributes to intact forest loss.[369,370,371] Bycatch and direct use (e.g. for food) contribute to rising risks for marine species (e.g. turtles, sea cows, fish, sea cucumbers).[372,373,374]	Increased consumption from urban areas, agriculture and tourism has put Ozama Nizao, the watershed that supplies the metropolitan area of Santo Domingo, under hydric stress, with very low water availability. Yaque del Norte is also experiencing low water availability.[375]	There has been a decline in fish stocks, particularly of commercially and recreationally important billfish species. Yellowfin tuna and blue and white marlin are some of the overfished species documented, although it has been estimated that less than 25% of the fish come from overexploited populations.[376]	Increasing demand for energy drives carbon dioxide, methane and nitrous oxide and sulfur oxide emissions from burning fossil fuels and firewood, as well as from transport.[377,378,379,380] The use of fertilizers contributes to ammoniac emissions.[381]	No evidence found
Pollution	Agrochemical accumulation is a major long-term issue.[382] Pesticides banned for over 20 years have been found in the feathers of 31 bird individuals from five common species.[383] Agrochemicals and waste largely contribute to the degradation of coral reefs and seagrasses.[384,385]	89% of waste goes untreated to waterways and soil. Landfill lixiviates reach freshwater bodies and seawater, decreasing their quality. Aquifers in Santo Domingo and the east of the country are particularly affected by increasing faecal and nutrient pollution. Approximately 22 m^3 of septic residuals reach water bodies every second.[386]	There is documented accumulation and magnification of agrochemicals and heavy metals along the food chain, including dangerous concentrations of cadmium found in main crops at the Jaragua–Bahoruco–Enriquillo Biosphere Reserve.[387] There are also concerning concentrations of heavy metals in rice fields in Monseñor Nouel and Sánchez Ramírez Provinces.[388,389]	GHG emissions in the country have increased in correlation with the economic growth that it has steadily experienced.[390,391,392,393]	Concentrations of sulfur dioxide and nitrous oxide from industrial, agricultural and urban activities around Santo Domingo in 2013 were above the Dominican environmental norm.[394] Reports of intoxication are frequent due to the widespread uncontrolled use and sale of highly toxic pesticides.[395]
Climate change	Coral reefs, including coral species and fishes, have been declining from combined climate change effects, including stronger hurricanes, increasing disease levels and bleaching events.[396,397,398]	Increasing heat and intensity of dry seasons, and the related increasing vulnerability to and risks of fires, heighten the demand for and consumption of water across sectors and urban areas while reinforcing the impacts from land use changes, representing a significant challenge to water security.[399,400]	Higher frequency and intensity of extreme weather are resulting in the agroclimatic zones moving to higher altitudes and contributing to decreased soil quality and productivity. There are documented increases in diseases and plagues, e.g. African swine fever affecting banana and cocoa crops.[401,402,403,404]	Projections indicate that temperatures, frequency of extreme weather, and fires will increase, while precipitation in the dry season will decrease by 50%, and annual precipitation by 17%.[405]	Between 2016 and 2017, the costs of floods and hurricanes represented 8.2% of public spending in the country, straining the public health system.[406] Increasing incidences of vector-borne and waterborne infections (e.g. from *Escherichia coli* and *Pseudomonas*) are a major public health concern.[407,408,409]
Invasive species	The National Strategy on Exotic Invasive Species outlines 138 invasive species in the country.[410] Mammals like ferrets, mice and rats are particularly impactful. For example, rats could be competing with birds for food and nests, while also feeding on bird eggs and chicks in Bahoruco.[411]	Introduced by the increasing nutrient pollution from agriculture and livestock farming, the water hyacinth (*Pontederia crassipes*) has covered freshwater bodies, impeding water flow and changing water quality.[412]	Although some species were introduced for consumption, several others affect food production, e.g. 6 bacteria, 19 fungi, 5 nematodes and around 20 arthropods affect agriculture.[413] Human consumption has been used as a management measure to control populations, e.g. lionfish and feral pigs and goats.[414,415]	No evidence found	Some species like mosquitoes from the genus *Aedes* are a major public health issue because they transmit dengue, Zika and chikungunya viruses, with cases of dengue related to unplanned urban growth and climate change.[416]

2. Mangrove roots anchored in the mud: relationships between the indirect and direct drivers of change to biodiversity and nature (expanding key message 2)

Table XIII: Relationships between the indirect and direct drivers of change to biodiversity and nature in the Dominican Republic

Demographic and Sociocultural Factors	Economic and Technological Factors	Institutions and Governance	Conflicts and Epidemics
The country has among the highest regional proportions of urban population and density (225 people/km^2), with urban expansion driven by population growth and continuous migration from rural areas.[417] This situation fuels land use change across urban and rural areas and conflicting land tenure schemes in rural areas.[418] Population concentration, along with tourism in coastal areas, intensifies habitat fragmentation and loss, pollution, and vulnerability to climate change.[419]	Tourism has largely contributed to consistent economic growth (4–7% per year) in the past four decades, which has driven urbanization, resulting in middle-class expansion and a significant reduction of poverty.[420,421] However, inequalities are still high (e.g. the Gini coefficient fell from 0.50 in 2000 to 0.40 in 2021), and sectors like tourism and mining are dominated by foreign companies, while agriculture is dominated by large landowners that hold most of the land. Supply chain integration with the United States through free trade zones has created employment but also increased environmental pressures through industrial activities and the promotion of unsustainable patterns of consumption.[422,423]	The environmental policy framework centres on the Ministry of Environment and Natural Resources, established in 2000, which oversees biodiversity conservation, protected areas management and environmental impact assessments. It acts as the National Focal Point for the Convention on Biological Diversity.[424] Laws and policies cover all the direct drivers, but monitoring, implementation and coordination still face challenges, e.g. the General Law on the Environment and Natural Resources (Law 64-00) states that environmental impact assessments are mandatory for large projects (i.e. highways, chemical factories or dams), but enforcement is not consistent. Limited intersectoral coordination and funding hamper implementation and monitoring.[425, 426]	The concentration of land properties in an elite class, and the lack of clarity in tenure, creates conflicts around boundaries, ownership and use, e.g. in the Ébano Verde Scientific Reserveand in national parks Los Haitises, Valle Nuevo and Jaragua.[427,428] Policies promoting foreign investment in mining and tourism projects, and the execution of such projects, have created tensions,[429] e.g. the case of Loma Miranda, which reached national public debate.[430] Conflicts around land use and direct exploitation are contentious and a major challenge for the country, especially with regard to the exploitation and discrimination of Haitian migrants.[431,432,433]
Although local and traditional knowledge and practices that are often biodiversity-friendly persist, modern unsustainable approaches dominate. They tend towards a higher ecological footprint; are driven by an increasing demand for food, water, and energy; and are linked to changes in lifestyles (e.g. diets, preferences), especially in urban areas.[434,435,436]	The adoption of renewable energy technologies is increasing, especially under the commitment of reducing GHG emissions by 27% by 2030 under the Paris Agreement, but infrastructure and financial constraints limit their expansion.[437,438] Adoption of modern agricultural technologies is expanding but uneven, concentrated in large-scale monoculture plantations for exports. Research and development investment remains significantly below regional and global averages. Limited university–industry collaboration constrains green technology innovation and environmental research capacity.[439,440]	Land tenure insecurity is a major issue; most land is unregistered (75% in 2012) and concentrated in the hands of a few owners.[441,442,443] Impoverished rural populations often lack land or own small plots. Dominicans claim land within national parks and lease it to Haitian migrants, who cultivate short-cycle crops and live in extreme poverty. The law recognizes continuous occupation as a condition for land tenure, which lessors use to their advantage, exploiting Haitian migrants. This system contributes to environmental degradation and shifts responsibility for land use, especially as Haitian labour fills gaps left by rural youth migration.[444,445,446,447,448]	Vector-borne diseases are a persistent public health issue that climate change and habitat loss and degradation exacerbate, leaving communities more vulnerable to emergent and re-emergent diseases.[449,450]

3. The tides around the mangrove roots and mud: bright spots lighting the path towards TC and nexus approaches (expanding key message 3)

Table XIV: Bright spots lighting the path towards TC and nexus approaches in the Dominican Republic

Priority pathways	Projects/initiatives/organizations	National policies	Regional policies/ projects
Strengthening intersectoral and inclusive decision-making and governance	- National Ecosystem Assessment – Dominican Republic (NEA-RD) - Dominican Platform of Biodiversity and Ecosystem Services (PDBES in Spanish) - Community-based adaptation in coastal areas of Hato Mayor province - Biodiversidad en Paisajes Productivos - Biodiversity Finance Initiative-RD - National Biodiversity Strategy and Action Plan Update - Grupo Jaragua	- Nationally Determined Contribution (NDC) - National Development Strategy 2030 - Plan Nacional de Adaptación al Cambio Climático - National Biodiversity Strategy and Action Plan (2011-2020)	- The Ocean Coordination Mechanism - Caribbean BLUE Economy Finance (Caribbean BLUEFin) Project - Caribbean Biodiversity Fund - Biodiversity and Business
Reforming land tenure system to guarantee legal security and equity			
Mainstreaming local traditional ecological knowledge	- ILK Indigenous and Local Knowledge Movement (ILK_Move) - Dominican Platform of Biodiversity and Ecosystem Services (PDBES in Spanish)		- United Nations Education, Scientific and Cultural Organization's (UNESCO) Local and Indigenous Knowledge Systems Programme-Caribbean
Tackling inequalities	- Biodiversity in Productive Landscapes		- Caribbean Biodiversity Fund - Biodiversity and Business

(a) *Exploring potential nexus responses of NEA-RD*

Rather than representing nexus responses, NEA-RD represents the road map for applying nexus approaches. NEARD characterizes indirect and direct drivers of change and identifies and convenes key actors, giving it the potential to facilitate the understanding of nexus elements and interactions at the national scale. It can encourage the coordination of strategic actions to implement nexus response options following a nexus governance approach with an emphasis on inclusion, collaboration, reflection and equity.[451]

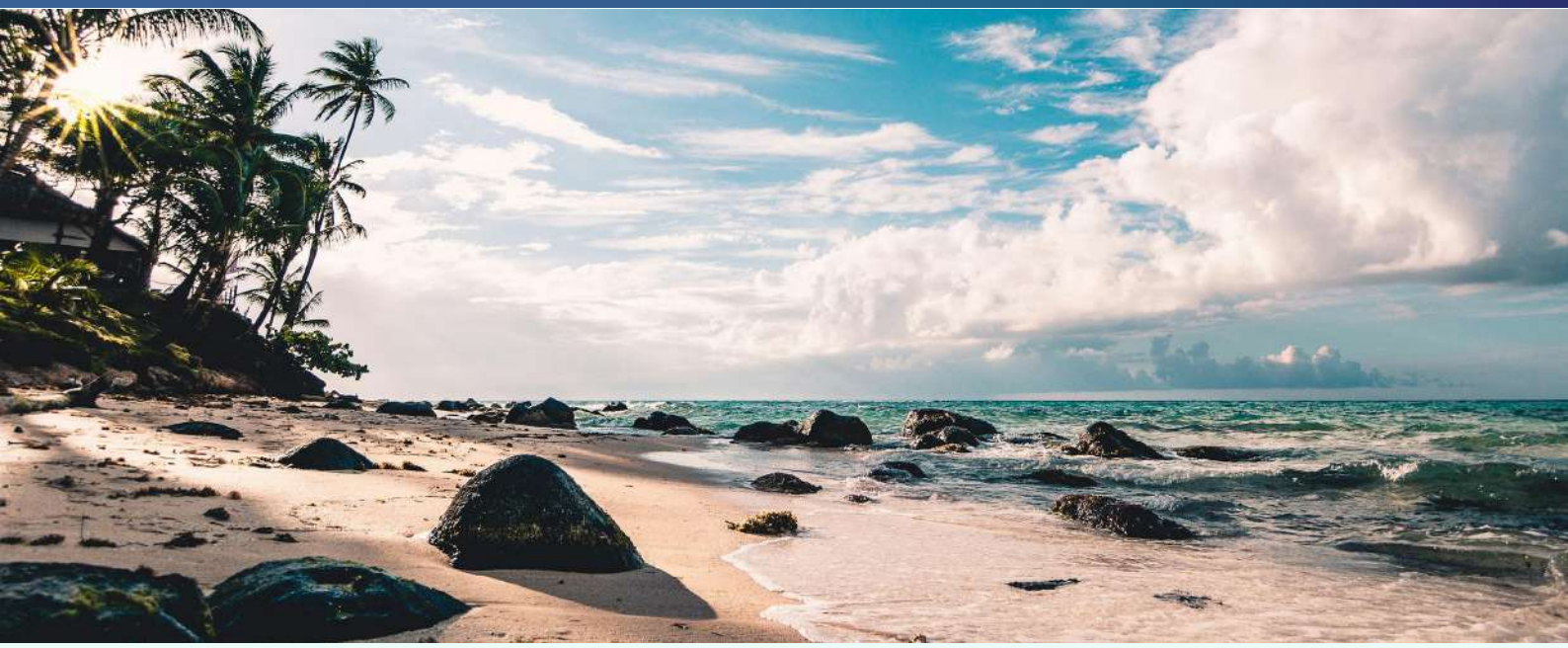


Figure XXII: Exploring the TC potential of NEA-RD

What results are desired?	» A critical evaluation of the trends in ecosystems and their services at the national level
What are the project's core values, and how do they align with the principles for TC?	» Prioritizes the participation of women and disadvantaged local people who are often marginalized from decision-making processes and the sharing of benefits, aligning with the principles for TC of inclusion and pluralism, and equity and justice » Considers people as part of nature, aligning with the principle of respectful and reciprocal relationships between people and nature » Considers temporal and spatial variability of interactions between people and nature in the assessment, aligning with the principle of adaptive learning and action
What strategies for TC does the project contribute to?	» Conserve and regenerate places of value for nature and people by considering diverse values in the assessment of ecosystems and their services » Shift societal views and values to recognize interconnectedness between people and nature by developing an assessment process that fosters transformative learning among stakeholders, co-creates knowledge on nature and its values, and develops a communication strategy that promotes connectedness between people and nature and has the potential to shift cultural narratives » Transform governance systems to be integrative, inclusive, accountable and adaptive by promoting integrated governance and working towards securing multilateral action through the assessment process
How does the project address the underlying causes of biodiversity loss and nature's decline?	» Fostering a deeper understanding of ecosystem trends and their linkages to human well-being, and promoting policies and practices that consider these interactions can address the underlying problems of disconnection from and domination over nature, and prioritization of individual, material and short-term gains » Using a collaborative, inclusive and pluralistic approach to the assessment that prioritizes marginalized groups and recommends policies and practices with a justice lens, can partially address the underlying problem of the concentration of power

E. Grenada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Key data snapshot

Country: comprises the main island, Grenada, and many smaller islands and islets, of which Carriacou and Petite Martinique are the largest

Location: southernmost island in the Antillean archipelago and the Windward Island group of the Lesser Antilles, north of Trinidad and Tobago and south of the Grenadines

Maritime Exclusive Economic Zone area: 27,426 km2

Land area: 344 km²; Grenada 133 km2, Carriacou 34 km2, Petite Martinique 2.3 km2

Coastline length: 121 km

Human population (2024): 117,207; island of Grenada 110,000

HDI (2023): High (0.791), ranked 80 out of 193

GDP share (2024): service industries 65.2%; agriculture, forestry and fishing 2.7%; industry (including construction) 14.8%

Sources: National Ecosystem Assessment Grenada 2023, World Bank Data, UNDP HDI Grenada report, Government of Grenada's website

Key messages

Main direct drivers of biodiversity loss and nature's decline: land and sea use change, mainly driven by tourism, agriculture and urban expansion, and climate change

Main indirect drivers of biodiversity loss and nature's decline: public debt, reliance on external markets for tourism and agriculture, increasing concentration of population in the coastal low-lying areas, social inequalities, inadequate local resource management and weak institutional capacity

Potential priority pathways to advance toward sustainable futures: strengthening cross-sectoral high-level governance, and transparent and inclusive decision-making; revising and improving national policies and plans to ensure their practicality and effectiveness; formalizing land rights; and adopting financial mechanisms that avoid harmful subsidies for long-term support to circular and nature-positive economies

1. Mangrove branches: relationships between the nexus elements and the direct drivers of change in biodiversity and nature (expanding key message 1)


© Dan Schofield

Key data snapshot

Iconic regions: Grand Etang Lake, Annandale Waterfalls, Mount St. Catherine volcano, Kick 'em Jenny underwater volcano
Protected areas coverage: ~9% of land area, ~0.12% of marine area
Urban population: ~37% in 2024
Coastal population: ~90% in 2024
Priorities: promoting equity and well-being through empowered communities and accessible social support; ensuring justice, security and institutional strength through strategic public sector cooperation; boosting competitiveness by developing talent, innovation and investment-friendly environments; enhancing infrastructure and preserving ecology to support regional connectivity and environmental health; building adaptive capacity and implementing robust strategies for climate change and disaster management

Sources: National Ecosystem Assessment Grenada 2023, Protected Planet-Grenada, World Bank Data, Grenada, Carriacou and Petite Martinique Strategic Development Plan 2030

Land and sea use change drives habitat loss, erosion and decreased water and soil quality, while overharvesting of marine and terrestrial species threatens biodiversity and food security. Pollution from waste, chemicals and plastics impacts water sources, fisheries and public health. Climate change intensifies droughts, hurricanes and marine acidification, thereby disrupting agriculture and increasing health risks. Invasive species such as lionfish, ***Sargassum*** and the Indian mongoose can degrade habitats, harm native wildlife and pose public health threats through disease transmission and toxic emissions.

Table XV: Cascading effects of the direct drivers of biodiversity loss and nature's decline on nexus elements in Grenada, based on information compiled through desk review and consultations with key informants by the main author and three United Nations volunteers

	Biodiversity	Water	Food	Climate	Health
Land and sea use change	Habitat degradation and loss are by far the largest threats to ecosystems in the country. They are mostly caused by agriculture, land development for tourism, sand mining, urban expansion and maritime vessel traffic. Coastal species, e.g. turtles and freshwater species whose life cycles depend on migration between the sea and freshwater streams, and privately owned offshore islets are particularly vulnerable to these land and sea use changes.[452,453,454,455,456]	Land use changes related to agriculture (e.g. plantations and overgrazing), beach sand mining and physical development for touristic and residential purposes have intensified erosive processes and, consequently, sediment run-off has increased, affecting freshwater bodies and marine environments.[457]	Changes related to infrastructure development, overgrazing and inappropriate agricultural practices are the main contributors to land degradation, which results in decreasing soil fertility and productivity. For example, 11% of the island of Grenada is eroded, and most of Carriacou's land is of poor quality. This degradation, along with use changes to a service-based economy, has contributed to the increasing reliance on food imports, i.e. over 70% of the food consumed in the country is imported.[458,459,460]	Land use changes related to urban expansion and infrastructure (i.e. road transport) accounted for 41% of the total GHG emissions in 2000, and 35% of emissions in 2014.[461]	Grenadian people's identify relies on the use of and interaction with the islands' natural ecosystems; hence, the degradation and loss of integrity of ecosystems are affecting the values that maintain the well-being of Grenadians.[462]

	Biodiversity	Water	Food	Climate	Health
Direct exploitation	Unsustainable harvesting practices likely threaten coastal and forest fauna.[463] For example, harvesting white sea urchin and their eggs was banned in 1995 after the species' population collapsed from increasing harvest for local and export demand.[464] Harvesting seabirds, their eggs and their chicks is common and extends to accessible offshore islands.[465]	There is increasing water demand in the dry season from tourism (and related services), agriculture and urban areas. Rising demand, combined with insufficient natural reservoirs, water loss from aging infrastructure and decreasing availability due to the impacts of land use changes and climate change, put significant pressure on public water security.[466,467]	There are concerns regarding the overfishing of pelagic species since the introduction of Fish Aggregating Devices – floating wooden structures with hanging nets to attract fish – in the 1990s. Non-fish species (e.g. Caribbean spiny lobster, queen conch and white sea urchins) may also be under threat of overharvesting.[468]	Fossil fuel combustion for increasing energy demands, i.e. electricity and transport, is the biggest contributor to GHG emissions.[469,470]	Rabies, leptospirosis, infectious bronchitis and blood parasites have been reported among domesticated and wild mammals and birds. Overharvesting of plant species (e.g. white cedar) decreases the instrumental and cultural values of ecosystems, affecting people's well-being.[471]
Pollution	Sea currents and winds bring plastic and hydrocarbon waste to Grenadian coasts, while most of the population's waste goes to Perseverance, an open landfill close to the sea. A large proportion (i.e. 15% of municipal waste and 30% of plastic bottle waste) ends up as litter, affecting biodiversity.[472] For example, there have been reports of dead Brown Noddies due to entanglement with plastic waste after attempting to use it for nest construction.[473]	Sewage, hydrocarbons, sediments, nutrients, pesticides and other toxic chemicals, solid waste and plastics affect catchment areas, freshwater bodies and seas.[474,475] The country's single landfill seems to be leaking into the river system,[476] and the majority of the beaches across the south-western coast of Grenada – with the highest urban population concentration – have faecal levels above the recommended limits.[477]	It is estimated that plastic waste reduced fisheries' revenue by 3.7% in 2019: 1.9% in time lost clearing nets, 1.2% in dumped catch, 0.6% in net repairs and 0.1% in fouling incidents.[478] Chemical degradation results in decreasing soil fertility and organic matter content in parts of St. David's, St. George's, St. Mark's and St. John's in the island of Grenada. Acidification of soils, caused by the use of biocides and fertilizers, affects over 860 ha of croplands (about 7% of the cultivated area in Grenada).[479,480]	GHG emissions have consistently increased from 2000 to 2013. This general trend is due to increasing fuel combustion to meet the energy demand from increasing urbanization and service industries, as well as increasing waste and industrial processes. [481,482]	Average fine particulate matter concentration in urban areas in 2010 and 2019 more than doubled the World Health Organization limit on air quality, with slightly lower values than Trinidad and Tobago and Guyana, but higher than Dominica, the Dominican Republic, and Antigua and Barbuda.[483]
Climate change	Grenadian citizens and residents agree that climate change is the greatest threat to natural ecosystems, as it exacerbates the impacts of existing unsustainable patterns of resource extraction, consumption and production. Rising ocean temperatures and increased acidification induce decreases in carbonate precipitation, which significantly affects coral reefs. [484, 485]	The rising frequency and intensity of droughts are increasing the use of freshwater, and hence, intensifying water security challenges, which is a major concern for the country's population. Carriacou and Petite Martinique have been severely impacted due to the very low storage capacity of water catchments.[486]	Grenadians are particularly concerned about the effects of climate change on agriculture and food supply. The 2009 to 2010 droughts contributed to a 150% increase in bushfires, affecting farms, and hence, cultivation and production.[487] More intense hurricanes also exacerbate the decline in food production. Hurricane Emily in 2005 provoked a sharp drop in the contribution of agriculture, fisheries and forestry to GDP.[488]	Temperatures are projected to increase, while total rainfall is projected to decrease. The percentage of hot days is projected to increase substantially. Tropical storms are projected to decrease in frequency but increase in intensity by the end of the century.[489,490]	There is a potential for emerging zoonotic diseases and increases in vector-borne diseases due to higher temperatures and extreme rainfall.[491] More intense storms cause major losses and stress to people (i.e. injuries, losing homes, experiencing emergencies). Hurricane Beryl in 2024 affected 39% of the total population.[492]
Invasive species	*Sargassum* and lionfish have had notable impacts on coastal ecosystems, while the Indian mongoose is a major threat to birds in forests. Livestock are a primary driver of degraded habitat on offshore islands.[493]	The decomposition of massive blooms of *Sargassum* changes seawater quality, causing eutrophication and oxygen depletion whose effects cascade into the life cycles of other species.[494]	Livestock and wild game have enriched the country's food diversity, but with unintended consequences. For example, livestock transform island landscapes through grazing.[495] *Sargassum* blooms affect fisheries by reducing the number, size and diversity of catches, reducing sea visibility and accessibility to landing sites, and damaging the gear.[496,497]	Inconclusive evidence	The Indian mongoose is a common reservoir of a European strain of rabies virus also detected in dogs, cats and goats.[498] *Sargassum* releases toxic hydrogen sulfide when decomposing, making accumulations of it a public health hazard.

2. Mangrove roots anchored in the mud: relationships between the indirect and direct drivers of change in biodiversity and nature (expanding key message 2)

Table XVI: Relationships between the indirect and direct drivers of change in biodiversity and nature in Grenada

Demographic and Sociocultural Factors	Economic and Technological Factors	Institutions and Governance	Conflicts and Epidemics
Although the extent of urbanization in Grenada is less than that of neighbouring countries (e.g. Trinidad and Tobago), the population has slowly but consistently grown over the last decade, with urban concentration focused along the coasts and consistent rural-urban migration.[499] Land and freshwater availability are very limited to the extent that Carriacou and Petite Martinique's human populations depend on rainwater collection and water desalination. The combination of increasing consumption of food, water and materials characterizes transitions to upper-middle incomes and a small open economy, and climate change accelerates environmental degradation, land use changes and overexploitation.[500,501,502]	The country has the typical macroeconomic structure of a small island developing state with limited economic diversification (i.e. in tourism and related service industries, nutmeg, cocoa and fish exports). It has high vulnerability to external shocks and trade deficit (i.e. from importing fossil fuels, food and manufactured goods). Although tourism revenue can be used to protect biodiversity, the sector puts tremendous pressure on ecosystems. Income distribution exhibits moderate inequality levels typical of Caribbean states (e.g. Gini estimated at 0.43 in 2018), with regional disparities between the urban St. George´s area and rural peoples, unequal pressures on natural resources, and social impacts from the drivers of nature's decline.[503,504,505]	Several government ministries share environmental responsibilities. The Ministry of Climate Resilience, the Environment and Renewable Energy now leads conservation and sustainability efforts and acts as the National Focal Point for the Convention on Biological Diversity, while other ministries retain limited roles. Although this structure has potential for cross-sectoral mainstreaming, it has resulted in fragmentation and reduced efficacy. The country has a comprehensive policy framework. Some policies take an ecosystem approach, while others focus on the technical and administrative needs for building capacity in specific issue areas affected by environmental threats and stressors. Their implementation could be improved with a systematic revision of their effectiveness.[506]	Grenada experiences resource-based conflicts emerging from coastal access rights, fishing territories and land use competitions between tourism development and local communities. Social conflicts occasionally arise from justice issues, particularly regarding tourism development impacts on local communities. Intercommunity conflicts over natural resources are limited but include disputes over marine fishing grounds, coastal access rights and watershed management responsibilities. These conflicts typically involve fishing communities, tourism operators and agricultural users competing for limited coastal and freshwater resources.[507]
The country's natural ecosystems, and the products and services they provide, are an essential part of the Grenadian people's identity, particularly regarding food products and aesthetic beauty. However, economic development, urban growth and conversion to a major service-based economy have led to a shift towards a diet with more imported food. Economic pressures related to government debt, the devastating impacts of hurricanes and overreliance on external markets often override conservation considerations in local decision-making processes.[508]	The adoption of sustainable technologies and innovative systems to improve climate resilience in agricultural and energy sectors is still insufficient, although it is a priority for the Strategic Development Plan 2030.[509] The country has pledged to reduce GHG emissions by 40% by 2030, taking 2010 emissions as a baseline. However, in 2018, the number of registered vehicles was 51% higher than in 2010, making the mitigation measures from the first NDC insufficient to reach the 20% reduction target set by 2025 or achieve further reductions by 2030. Adoption of geothermal energy is still being explored as an alternative to maintaining dependence on imported fossil fuels.[510]	Although policies exist and there is potential for cross-sectoral governance approaches, land tenure is a major issue driving land and freshwater degradation, overexploitation and reduced resilience. Family land tenure is not legally recognized, while farmers enter informal tenure arrangements, where women farmers are less likely to own land and have tenure documents. There are outdated land registries, and access to productive land is difficult, as is access to credits – especially for women – given the lack of tenure documentation. Environmental problems are aggravated when agricultural land is urbanized, and farmers must move to marginal lands, often near or in forested watershed areas.[511]	Grenada faces major health challenges, including the COVID-19 pandemic, which disrupted tourism and conservation funding, and ongoing vector-borne diseases such as dengue, chikungunya and Zika. Limited surveillance affects zoonotic disease tracking, while climate change worsens public health risks by altering vector habitats and stressing sanitation systems. Environmental changes such as shifting rainfall, coastal degradation and freshwater pressures contribute to disease emergence.[512]

3. The tides around the mangrove roots and mud: bright spots lighting the path towards TC and nexus approaches (expanding key message 3)

Table XVII: Bright spots lighting the path towards TC and nexus approaches in Grenada

Priority pathways	Projects/initiatives/ institutions	National policies	Regional policies/ projects
Strengthening cross-sectoral high-level governance and transparent and inclusive decision-making	- Ridge-to-Reef project - Grenada Water Stakeholder Platform (G-WaSP)	-Grenada, Carriacou and Petite Martinique Strategic Development Plan 2030	-PROCARIBE+ -CSOs for disaster resilience: empowering civil society and local communities to build resilience to hurricanes and climate extremes in the Eastern Caribbean -UBEC: Unleashing the Blue Economy of the Caribbean -IWECo: Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States
Revising and improving national policies	-National Ecosystem Assessment Grenada 2023		
Formalizing land rights			
Adoption of financial mechanisms that avoid harmful subsidies for long-term support to circular and nature-positive economies		-Grenada, Carriacou and Petite Martinique Strategic Development Plan 2030	-PROCARIBE+ - Caribbean Biodiversity Fund -UBEC

(a) *Exploring potential nexus responses of the Grenada National Ecosystem Assessment 2023*

The Grenada National Ecosystem Assessment's process and outputs have explored the nexus context in Grenada, characterizing indirect and direct drivers of change, identifying and convening governance actors, and understanding nexus elements and interactions (in Chapters 2 to 4). As part of its recommendations, it has co-created visions, aligned values among actors consulted (in Chapter 6: Scenarios and pathways to a sustainable future [Grenada Greens, Grenada Goes, and Grenada Grows Scenarios]) and identified response options, assessing their synergies and trade-offs as well as their enabling conditions and barriers (in Chapter 5: Supporting, enhancing and amplifying ecosystem services for the economic and social well-being of Grenadians). It therefore constitutes a reference for the present and future implementation and scaling of nexus approaches in Grenada and the Caribbean region.

Figure XXIII: Exploring the TC potential of the Grenada National Ecosystem Assessment 2023

What results are desired?	» A detailed assessment of the state, trends and challenges of ecosystems and the services they provide across Grenada, as well as the existing capacity – administrative, technical and societal – to address the environmental challenges » Detailed recommendations of response options for the maximization of ecosystem services returns for the people of Grenada, potentially influencing Grenada's current and future capacity to adapt to local, regional and global environmental change
What are the project's core values, and how do they align with the principles for TC?	» Integration of scientific knowledge of various kinds, and traditional and local knowledge – which is often marginalized from decision-making processes – aligning with the principles for TC of inclusion and pluralism, and equity and justice. » Alignment with the principle of respectful and reciprocal relationships between people and nature through its conceptual framework on the diverse values of nature's contributions to people
What strategies for TC does the project contribute to?	» Conserve and regenerate places of value for nature and people by considering diverse values in the assessment of the ecosystem and its services and giving recommendations based on this assessment » Shift societal views and values to recognize the interconnectedness of people and nature by developing an assessment process that fosters transformative learning among stakeholders, co-creates knowledge on nature and its values, and develops a communication strategy that promotes nature connectedness and has the potential to influence society and government » Transform governance systems to be integrative, inclusive, accountable and adaptive by promoting integrated governance and working towards securing multilateral action through the assessment process
How does the project address the underlying causes of biodiversity loss and nature's decline?	» By fostering a deeper understanding of ecosystem trends and their linkages to human well-being, and promoting policies and practices that consider these interactions it can address the underlying problems of disconnection from and domination over nature, and prioritization of individual, material and short-term gains. By using a collaborative, inclusive and pluralistic approach to the assessment that prioritizes marginalized groups, and recommending policies and practices with a justice lens, it can partially addressing the underlying problem of the concentration of power

F. Co-operative Republic of Guyana

Key data snapshot

Country: continental territory with ~365 islands concentrated at the mouth of the Essequibo River

Location: on the Northern coast of South America, bordered to the east by the Republic of Suriname, to the south by Federative Republic of Brazil, to the west by the Bolivarian Republic of Venezuela and the north by the Atlantic Ocean

Maritime Exclusive Economic Zone area: 138,240 km2

Land area: 214,970 km²

Coastline length: 459 km

Human population (2024): 831,087

HDI (2023): High (0.776), ranked 89 out of 193

GDP share (2024): oil and gas 65%; industry (including construction) 18.6%; agriculture, forestry, and fishing 8%; mining 5%

Sources: Guyana Lands and Surveys Commission`s Fact Page on Guyana, World Bank Data, UNDP HDI Guyana report, United Nations Data, Bureau of Statistics

Key messages

» **Main direct drivers of biodiversity loss and nature's decline:** land and sea use change and pollution mainly driven by the mining industry and the expansion of population and urban areas, including the development of associated infrastructure, such as road construction

» **Main indirect drivers of biodiversity loss and nature's decline:** unsustainable urban expansion, economic dependence on extractive industries, ambiguity of the land and resource rights of Indigenous Peoples, racial and ethnic inequalities, and governance and institutional limitations in environmental management

» **Potential priority pathways to advance towards sustainable futures:** enhancing environmental governance; strengthening the land and resource rights of the Indigenous Peoples; balancing economic activities with conservation and social justice; and blending resilience and justice in biodiversity protection frameworks and urban and rural planning

1. Mangrove branches: relationships between the nexus elements and the direct drivers of change in biodiversity and nature elements (expanding key message 1)

KEY DATA SNAPSHOT

Iconic regions: Kanuku mountains, Rupununi savannah, Shell coast, the Essequibo river
Protected areas coverage: ~8.4% of land area
Urban population: ~27% in 2024
Coastal population: ~90% in 2024
Priorities: advancing low-carbon development through forest-based carbon credits, sustainable forestry, and low-impact mining; accelerating energy transition using low-emission sources (i.e. gas, water and sunlight); supporting Amerindian and hinterland development via land titling, digital access and carbon credit funding; strengthening resilience in agriculture, infrastructure, water resources and public health for climate adaptation; promoting sustainable urban planning; conserving biodiversity through the expansion of protected areas, nature-based solutions and community engagement; implementation of a circular economy

Sources: World Bank Data, Low Carbon Development Strategy (LCDS) 2030

Land use changes cause habitat loss and water pollution while also threatening food security and public health. Pollution from mining and agriculture especially affects ecosystems and communities, as the tailings and mercury used in gold amalgamation pass on to water sources and further on in the food chain, representing a significant threat to environmental and human health. Urban demand is driving the rising consumption of wildlife and fisheries. Climate change intensifies these pressures through rising temperatures, sea level rise and unpredictable rainfall, impacting agriculture and increasing disease risks. Invasive species further disrupt ecosystems and pose health threats, although their behaviour and impacts are under-documented. The recent development of the offshore oil and gas industry, although promising for its income generation, has sustainability risks; however, documentation of impacts is ongoing.

Table XVIII: Cascading effects of the direct drivers of biodiversity loss and nature's decline on nexus elements in Guyana, based on information compiled through desk review and consultations with key informants by the main author and three United Nations volunteers

	Biodiversity	Water	Food	Climate	Health
Land and sea use change	Although Guyana has among the lowest deforestation rates (less than 1%) and the highest forest covers (about 85%) in the world,[513,514,515] mining, population, urban and commercial expansion – concentrated in the low coastal plain – drive increasing change in land use.[516,517,518,519] Mining accounted for 85% of all deforestation in the country between 2001 and 2012, and 74% between 2018 and 2022.[520] The construction of the Linden-Lethem road has impacted freshwater ecosystems in the North Rupununi,[521] and the construction of wharfs has affected mangrove ecosystems.[522,523]	Changes in land use due to mining, agriculture and urbanization increase erosion and sedimentation in water bodies, drastically changing the water quality and availability.[524]	Changes in land use affect the abundance of freshwater fish, reptiles and wild meat. They lead to decreased populations of freshwater fish and river turtles, which particularly affects the Makushi and Wapichan Peoples whose diets depend on freshwater animals.[525,526,527] Indigenous agricultural practices are also threatened by mining, agricultural plantations and forestry operations that exclude them from working their ancestral lands.[528] Changes in sea use focusing on oil and gas raise concerns about fish stocks and contribute to diets transitioning towards fast and ultraprocessed foods.[529,530]	Deforestation and degradation caused by mining and forestry are major sources of GHG emissions. Medium and large-scale mining, as well as timber production, were the highest carbon dioxide emitters in the country between 2018 and 2022.[531,532] Recent development of offshore oil and gas can significantly increase GHG emissions, although natural gas for electricity supply is prioritized to mitigate carbon dioxide releases.[533,534]	Land use changes that increase mining often come with increasing prevalence of zoonotic, sexually transmitted and pollution-related diseases, and impacts to collective and individual mental well-being for miners and communities.[535] Changes to urban use have come with high vulnerability to flooding, waterborne disease outbreaks, heat waves, water and food insecurity, and damage to the built environment.[536] Changes to the oil and gas sector bring concerns over the long-term effects on public health, despite the increasing income that they generate.[537]

	Biodiversity	Water	Food	Climate	Health
Direct exploitation	There are rising concerns regarding the overfishing of shrimp, seabob, and sharks and overhunting due to increased demand from urban centres for wild meat (although hunting for wildlife meat practiced by Indigenous Peoples is generally considered sustainable).[538,539,540] Five out of 13 species traded are classified as vulnerable to extinction, and species not hunted before (e.g. the giant anteater) are now targeted given traditional species' declines.[541,542,543,544,545] The pet trade is threatening endangered bird species, e.g. of the Red Siskin and Sun Parakeet.[546,547]	The water demand from mining, agriculture (e.g. rice and sugarcane plantations), increasing urban populations, and more recently, oil and gas industry development, may seriously reduce freshwater availability.[548]	The demand for wild meat in coastal urban centres has steadily increased. Estimates indicate that the trade volumes could increase tenfold by 2033 compared to 2023, leading to the overhunting and the substantial decline of wild game populations.[549,550,551] Sea overexploitation, as a main export sector, has caused declines in shrimp catch, while prawn fisheries are considered overexploited.[552]	The timber industry is a significant contributor to carbon emissions. Timber harvesting constituted 40% of Guyana's land carbon dioxide emissions between 2001 and 2012.[553]	Trade of birds for the domestic market (e.g. songbirds) and exports (e.g. macaws and parrots) can pose risks related to the spread of avian influenza to humans and the poultry sector.[554] The handling, transportation and preservation of wild meat also pose zoonotic risks that should be considered and prevented.[555]
Pollution	Sparse studies suggest that there are likely high levels of mercury contamination across the Guiana shield from its use in mining,[556,557] affecting fish, mammal and reptile populations in the hinterland areas.[558] Agrochemical concentrations linked to rice production have been found in water bodies in coastal Pomeroon-Supenaam (Region 2), with signs of algae overgrowth.[559] There is a risk of oil pollution from spills and no proper waste management, threatening coastal and marine ecosystems and their species, with special concern for the effects on the Shell Beach Protected Area.[560,561]	There is serious water pollution from mining, e.g. the devastating cyanide spill into Omai and Essequibo rivers from the largest gold mine operated by Omai Gold Mines Corp. in August 1995. There is also extensive use of toxic agrochemicals in agricultural plantations, and industrial and domestic waste.[562,563,564] Concerning levels of heavy metals have been found in urban domestic water sources.[565] There is an increasing risk of contamination of seawater from oil spills and platform or shipping accidents.[566,567,568]	Analyses have found that Indigenous peoples whose animal food intake relies on freshwater fishes and are located closer to artisanal gold mines have higher concentrations of mercury in their hair, showing the accumulation and potential magnification along the food chain.[569]	97% of Guyana's electricity generation comes from burning fossil fuels. In 2022, the country was a medium per capita carbon emitter, lower than Trinidad and Tobago but higher than most of the other countries of the Caribbean.[570,571,572]	Intoxication from mercury and pesticides is concerning. High mercury concentrations have been found in Indigenous communities close to mining sites with diets reliant on freshwater fishes, although there is no clarity on health effects and how the communities and miners might be adapting to or mitigating the effects.[573,574] There was a high rate of suicides among male farmers between 2000 and 2013 via the ingestion of pesticides, which are readily available for farmers.[575]
Climate change	Rising temperatures, more intense dry seasons, more frequent dry spells, and changing rainfall patterns are making species like the jaguar and tapir shift their habitat ranges, as well as increasing the probabilities of uncontrolled fires that injure or kill individuals of species like the giant anteater and the capybara.[576,577]	Sea level rise will result in seawater intrusion into rivers and aquifers, raising the water table and increasing the salination of both rivers and aquifers, with the salination being more severe in the aquifers. It is estimated that salt water will intrude into the recharge zones for a distance of 1–2.5 km. The increase in temperatures will mean lower flows during the dry season, resulting in greater salt water intrusion into the rivers.[578]	Unpredictable and erratic climate patterns have significant impacts on agricultural production and farmers.[579] Key crops like cassava, eddo, sweet potato and plantain have suffered yield losses and price increases due to both flooding and dry spells.[580] Lower quality and quantity of rice harvests due to increasing incidences of diseases and weeds have resulted in more use of agrochemicalsand shifting fire regimes for agriculture and hunting by the Wapichan and Macushi peoples.[581,582,583]	Inconclusive evidence	Although more compilation and data integration are needed, several health concerns are projected to worsen, including: dengue and malaria, other infections (e.g. schistosomiasis, chagas, leishmaniasis and diarrheal diseases), waterborne diseases, and respiratory issues.[584,585,586] Climate change impacts and the government's national responses to them affect people differently based on the existing racial and ethnic inequalities inherited from the colonial period.[587,588,589]

	Biodiversity	Water	Food	Climate	Health
Invasive species	Species like antelope grass and the giant African snail have spread extensively, although more documentation is needed.[590]	Antelope grass clogs waterways in agricultural lands, and water hyacinth covers water bodies.[591]	Farmers have reported that the antelope grass blocks drainage and irrigation canals of agricultural land and affects crop production. The giant African snail is also considered an issue since it feeds on vegetables and root crops.[592]	No evidence was found	Some of the most prevalent invasive species are a public health issue as they carry viruses, e.g. *Aedes* mosquitoes. Africanized European bees have caused the deaths of several people through allergic reactions to their stings.[593,594]

2. Mangrove roots anchored in the mud: relationships between the indirect and direct drivers of change in biodiversity and nature (expanding key message 2)

Table XIX: Relationships between the indirect and direct drivers of change in biodiversity and nature in Guyana

Demographic and Sociocultural Factors	Economic and Technological Factors	Institutions and Governance	Conflicts and Epidemics
Although urbanization in Guyana is low compared to the rest of the region and Caribbean islands (27% in 2024 against 82% in LAC), it is increasing.[595] Of particular concern is the concentration of human populations in the narrow low coastal plain, whose history of land use related to urbanization and monoculture plantations have exacerbated its vulnerability to flooding.[596] Migration towards the hinterlands has increased as mining and agriculture opportunities open, and there has also been a migration trend to North America.[597] This phenomenon drives higher demands for resources, food, trade, energy and space, and the introduction of exotic species, intensifying the direct drivers of biodiversity loss and nature's decline.	The country's economy has long relied on extractive industries of gold and bauxite, as well as the colonial monoculture agriculture of rice and sugar. Since the first offshore oil production in 2019, its GDP has soared (with growth rates over 47% in 2022 and 33% in 2023), becoming the fastest-growing economy in the region but still dependent on the export of raw materials. Foreign investment, hence, has surged in the energy sector. The extractive industries, monoculture agriculture and the infrastructure linked to market access have put pressure on the ecosystems and the people that depend on them, usually those marginalized groups and Indigenous Peoples.[598,599,600] The COVID-19 pandemic, the Russian-Ukrainian war and climate change have reduced agricultural production, increasing food prices and affecting the overall economy and livelihoods. The Government has responded to these issues by applying measures to support agricultural production, including fertilizer subsidies and tax relief on farm inputs, influencing direct drivers like land use change and pollution.[601]	The Ministry of Natural Resources, newly transformed in 2016, develops, implements and oversees policies for the responsible use of natural resources while fostering environmental conservation and green economy. It has three commissions on gold, forestry and mining, and an upcoming one on oil and gas. The Environmental Protection Agency acts as the National Focal Point for the Convention on Biological Diversity, being a separate body under the Office of the President that oversees and regulates environmental activities, along with the Protected Areas Commission and the Guyana Wildlife Conservation and Management Commission. These institutions, however, have limited capacity to enforce and monitor policies. They also experience high fragmentation, which hampers their abilities to prevent or mitigate environmental risks, e.g. activities in extractive industries.[602,603,604,605] The National Toshaos Council represents Guyana's Indigenous Peoples, having the mandate to protect Indigenous rights, cultures, well-being and nature. However, its effective power in shaping and informing the national policies and plans remains limited.[606,607]	Colonial legacies contribute to tensions and ethno-racialized marginalization and inequalities, undermining just conservation and environmental governance and exacerbating the effects of the direct drivers of biodiversity loss and nature's decline. A major transboundary conflict rooted in colonial times is the longstanding territorial dispute with Venezuela over the Essequibo region, which has intensified since the discovery of massive offshore oil and gas reserves in Guyana.[608] This territorial dispute creates uncertainty, security issues and political instability that affect long-term environmental planning and investment in conservation infrastructure within the disputed regions, conservation monitoring and enforcement activities in border areas, international cooperation on regional conservation, and environmental governance effectiveness.

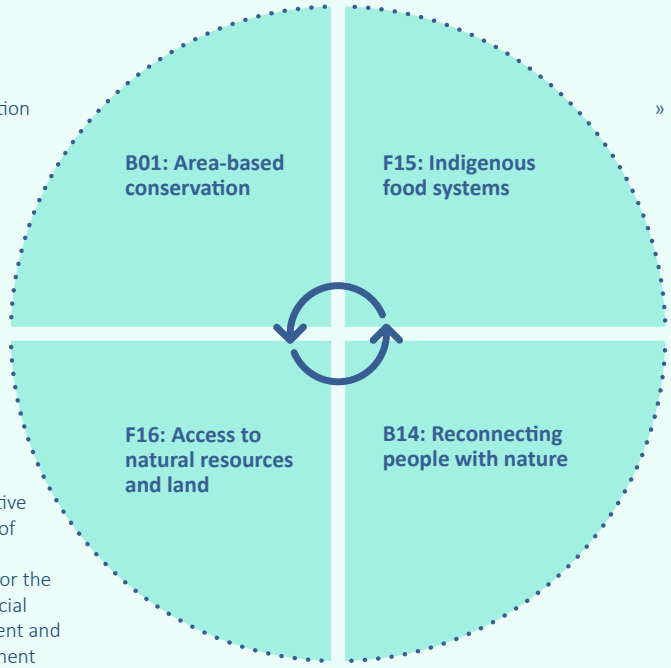
Demographic and Sociocultural Factors	Economic and Technological Factors	Institutions and Governance	Conflicts and Epidemics
The country's postcolonial demographic structure and sociocultural relations with nature have prevalent Dutch/ British colonial legacies determined by the positions that different ethno-racial groups occupied in the highly racialized colonial hierarchy, with Indo-Guyanese being the dominant group in government and business, although substantial "mixing" and nuances exist. Indigenous Peoples, who form nine different groups, persistently advocate the preservation of their lifestyles, culture and land rights, while adapting to the land and sea use changes, climate change, and increasing contact with migrant miners, hunters, tourists, etc. Although the country's Amerindian Act 2006 gives land titles to Amerindian villages and establishes that concessions must seek formal prior informed consent from the titled communities, there are reports of mining concessions not complying with these procedures, resulting in conflicts over rights.[609,610,611,612,613] Resource tenure is also problematic due to the ambiguity of the Act in terms of resources included in the title, e.g. surface water.[614]	Oil and large-scale mining operations utilize advanced extraction technologies, whereas rural agriculture relies on traditional techniques, and small- to medium-scale mining still relies on the use of mercury for the extraction of gold. The LCDS – which was a pioneering strategy at the time it was elaborated in 2009 – in its revised 2024 version, articulates the need for an energy transition that harnesses the country's gas resources (e.g. Gas-to-Energy Project), hydropower (e.g. Amaila Falls Hydropower Project) and sunlight (e.g. GuySol Project).[615] Despite the LCDS initiatives, government investment in research and innovation across all sectors is low compared to that of private companies in extractive industries. The LCDS has, nonetheless, articulated investments in pilot projects for sustainable agriculture and small-scale renewable energy in rural areas.[616,617]	Guyana has a solid policy and legislative framework on paper, covering most of the direct drivers (except for invasive species), but there are conflicts between legislation and industry. Although the LCDS is commendable for its focus on climate adaptation and forest protection and its broad remit across sectors, its implementation is still limited. Tensions between the expansion of extractive industries and conservation are increasing, and the framing of activities like shifting agriculture and the use of fire, for example, remains problematic. These activities exacerbate the marginalization of Indigenous Peoples and those who directly depend on natural resources while prioritizing corporate interests in logging, mining and, more recently, forest protection through carbon credits.[618,619,620,621]	Guyana faces public health challenges, including a higher-than-average infant mortality rate and health service gaps in the hinterland areas. Epidemics such as vector-borne diseases (e.g. malaria, dengue and chikungunya) are influenced by land use changes and climate change. The expansion of extractive industries and associated infrastructure development creates new disease transmission pathways through the increased contact between humans and wildlife in stages of rising stress and immunodepression.[622,623]

3. The tides around the mangrove roots and mud: bright spots lighting the path towards TC and nexus approaches (expanding key message 3)

Table XX: Bright spots lighting the path towards TC and nexus approaches in Guyana

Priority pathways	Projects/initiatives/organizations	National policies	Regional policies/ projects
Enhancing environmental governance	-Governance and Rights outputs under the SWM Sustainable Wildlife Management Programme -ASL II: Securing a living Amazon through landscape connectivity in Southern Guyana -South Rupununi Conservation Society -Iwokrama International Centre for Rain Forest Conservation and Development	- National Inland Fisheries Policy and amendments to the Fisheries Act and the Aquaculture Bill supported by the SWM Programme	-The Ocean Coordination Mechanism -BE-CLME+: Promoting National Blue Economy Priorities Through Marine Spatial Planning in the Caribbean Large Marine Ecosystem Plus
Strengthening the land and resource rights of the Indigenous Peoples	-Wapichan Wiizi Wildlife Management Plan supported by the SWM Programme -Governance and Rights outputs under the SWM Sustainable Wildlife Management Programme -North Rupununi Wetlands Fisheries Co-Management Plan supported by SWM Programme -South Rupununi Conservation Society -Iwokrama International Centre for Rain Forest Conservation and Development - South and North Rupununi District Councils	- National Inland Fisheries Policy and amendments to the Fisheries Act and the Aquaculture Bill supported by the SWM Programme -Low Carbon Development Strategy 2030	-United Nations Education, Scientific and Cultural Organization's (UNESCO) Local and Indigenous Knowledge Systems Programme-Caribbean
Balancing economic activities with conservation and social justice	-Wapichan Wiizi Wildlife Management Plan supported by the SWM Programme - North Rupununi Wetlands Fisheries Co-Management Plan supported by SWM Programme -Mainstreaming Biodiversity in Mining Project -ASL II -South Rupununi Conservation Society -Iwokrama International Centre for Rain Forest Conservation and Development	-Low Carbon Development Strategy 2030	-PROCARIBE+ -BE-CLME+ -CSIDS SOILCARE Phase 2- Caribbean Small Islands Developing States (SIDS) multi-country soil management initiative for integrated Landscape Restoration and climate-resilient food systems
Blending resilience and justice into biodiversity protection frameworks and urban and rural planning	-Zoonotic risk prevention and management through One Health approach supported by SWM Programme and Ministry of Health	-Low Carbon Development Strategy 2030	

Figure XXIV: Exploring potential nexus responses of the Wapichan Wiizi Wildlife Management Plan



- Community conservation zones across villages

- Work to reduce dependency on wildlife for food and develop alternative sources of protein

- Process of capacitation and empowerment for the effective understanding and exercise of people's rights
- Process of empowerement for the effective lobbying of the official recognition of co-management and the inclusion of co-management principles in the Wildlife Act

- Comprehensive awareness strategy for community members, especially the youth, to embrace the importance of wildlife for the Wapichan's culture and way of life

Figure XXV: Exploring the TC potential of the Wapichan Wiizi Wildlife Management Plan

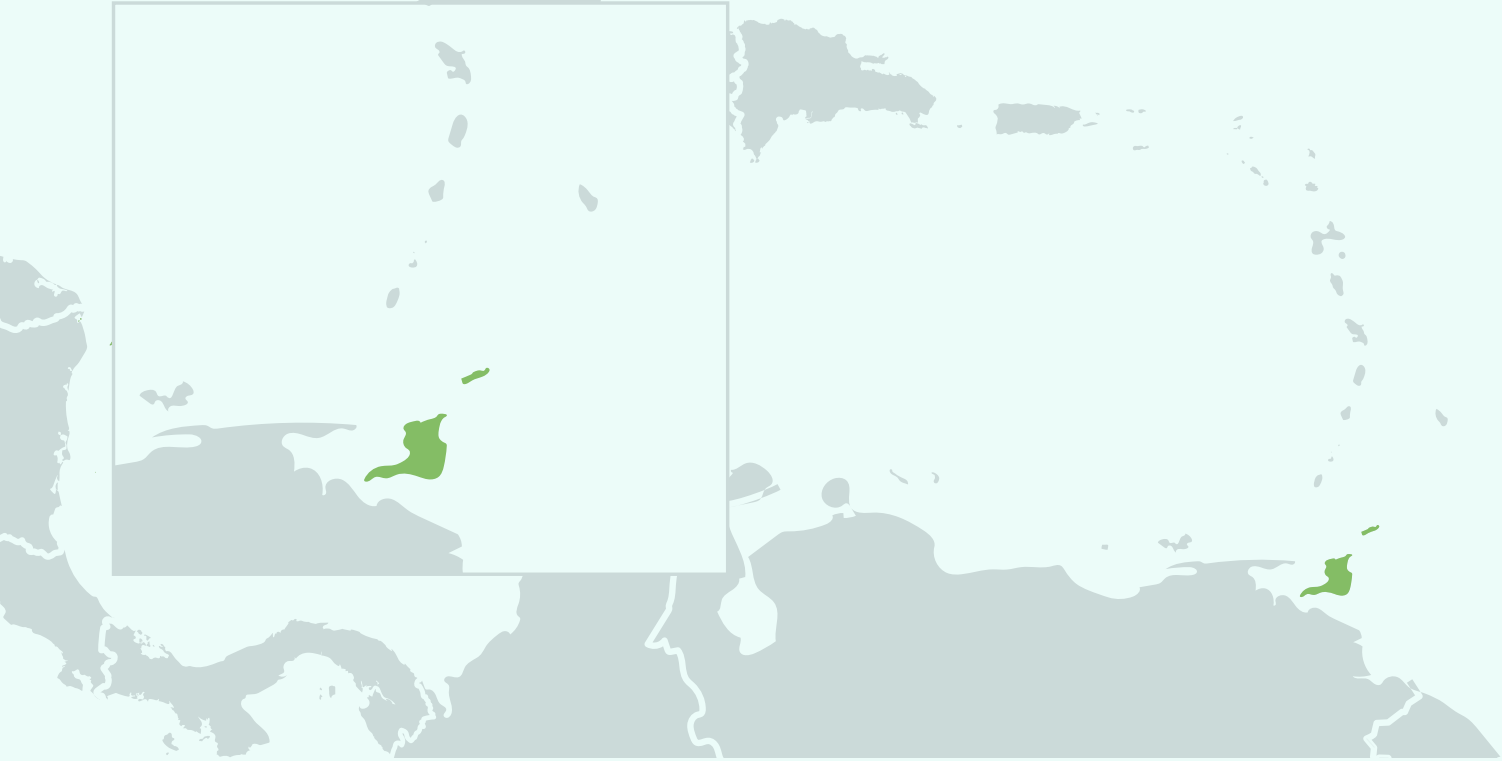
What results are desired?	» Development of an overarching framework for past, ongoing and future actions towards the sustainable use and conservation of wildlife in the Wapichan Wiizi (i.e. the traditional territory of the Wapichan people in Guyana)
What are the plan's core values, and how do they align with the principles for TC?	» The recognition that wildlife is a key element of Wapichan's livelihoods, culture, values and beliefs, being part of the Wapichan People's identity aligns with the TC principle of respectful and reciprocal relationships between people and nature » Follows the principles of inclusion and pluralism by undergoing extensive consultations with community members across 21 communities and relevant stakeholders (e.g. government commissions) » Fits into the wider vision wherein Wapichan Wiizi is legally recognized and its people empowered to protect their natural environment, aligning with the principle of equity and justice
What strategies for TC does the plan contribute to?	» Conserve and regenerate places of value for nature and people by articulating the needed actions to ensure that Wapichan Wiizi is conserved based on the Wapichan's values, conserving their biocultural heritage and identity and creating community conservation areas » Drive systemic change in the sectors most responsible for biodiversity loss and nature's decline by implementing a system to monitor activities like hunting and mining, setting village-level rules that guide the use of wildlife and empowering community members and leaders to take responsibility in the sustainable use of wildlife » Transform governance systems to be integrative, inclusive, accountable and adaptive by strengthening the central role of Toshaos (village councils) in the management of wildlife, consolidating the local civil society network and ensuring that the youth are trained to become efficient local leaders » Ensure that all the above stakeholders are better capacitated to lobby for the legal recognition of their ancestral territories and the effective exercise of their rights » Shift societal views and values to recognize the interconnectedness of people and nature by ensuring the preservation and continuity of the Wapichan cultural identity, where nature is embedded in and facilitates the co-creation of knowledge between different knowledge systems (the Wapichan People's worldview and the Western scientific view) to inform management practices
How does the plan address the underlying causes of biodiversity loss and nature's decline?	» Elaborating a management plan that harnesses the importance of wildlife for the identity and survival of the Wapichan people can address the disconnection from and domination over nature. » Advocating the full legal recognition of the Wapichan Wiizi and promoting and harnessing the Wapichan culture and governance can address the concentration of power and wealth » Honouring the principle of "Thinking together for those coming behind us", embodying the vision for sustainable futures in the Wapichan Wiizi tackles the prioritization of short-term, individualistic and material gains

H. Trinidad and Tobago

Key data snapshot

Country: archipelago with two major islands, Trinidad and Tobago
Location: in the Southern Caribbean Sea, 11 km northeast of Venezuela, south of Grenada
Maritime Exclusive Economic Zone area: 75,000 km2
Land area: 5,126 km2
Coastline length: 704 km
Human population (2024): 1.4 million
HDI (2023): Very High (0.807), ranked 72 out of 193
GDP share (2021): service industries 55%; industry (including construction) 39%; manufacturing 18%; oil and gas sector 8%

Sources: World Bank Data, UNDP HDI Trinidad and Tobago report, Ministry of Planning, Economic Affairs and Development's website



Key Messages

» **Main direct driver of biodiversity loss and nature's decline:** land and sea use change, primarily driven by agriculture, urbanization and industrial expansion in the energy sector

» **Main indirect drivers of biodiversity loss and nature's decline:** unsustainable urban expansion, economic dependence on petrochemicals, governance challenges and social-health crises altering resource use patterns

» **Potential priority pathways to advance towards sustainable futures:** integrated land use planning; economic diversification to reduce reliance on fossil fuels; strengthening of environmental governance; and the incorporation of social and environmental justice, pluralism, health and well-being in environmental planning

1. Mangrove branches: relationships between the nexus elements and the direct drivers of change in biodiversity and nature elements (expanding key message 1)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Key data snapshot

Iconic regions: Nariva Swamp, Caroni Swamp, Arima Valley including the ASA Wright Nature Centre, Buccoo Reef/Bon Accord Lagoon, Northern Range mountains, Gulf of Paria, Matura/Grand Riviere, Tobago Main Ridge Forest Reserve

Protected areas coverage: 38% of land area, 22% of marine area

Urban population: ~54% in 2024

Coastal population: ~70% in 2024

Priorities: ensuring a just and inclusive society through improved social services, access to housing and healthcare, support for families, promotion of healthy lifestyles, and a modern, relevant education system; establishing a just and citizen-centred society through efficient public services and updated legal and law enforcement systems; developing a modern, efficient and accessible infrastructure system; maintaining macroeconomic stability while fostering entrepreneurship, attracting investment and trade and enhancing export competitiveness; strengthening environmental governance through improved resource management, a reduced carbon footprint, a climate vulnerability assessment and comprehensive waste and pollution control

Sources: World Bank Data, National Development Strategy (2016-–2030), National Biodiversity Strategy Action Plan (2017-2022), Sixth National Report to the Convention on Biological Diversity

Land and sea use changes cause significant declines across all the nexus elements. Industrial development and food processing increase food imports and reduce local food diversity, while unsustainable farming practices degrade soils and pollinator populations. Direct exploitation, including overhunting, overfishing and the wildlife trade, threatens native species and reduces the availability and quality of local food while also increasing risks of zoonotic diseases. Pollution from oil and gas, agriculture, mining and urban waste contaminates water, food and air, posing significant health risks and reducing agricultural yields. Climate change, largely driven by fossil fuel industries and urbanization, intensifies extreme weather, alters hydrological patterns and increases heat-related health impacts. Invasive species, often introduced or spread by trade and ecosystem disturbance, disrupt native habitats, reduce agricultural productivity and increase disease risks for both people and wildlife.

Table XXI: Cascading effects of the direct drivers of biodiversity loss and nature's decline on nexus elements in Trinidad and Tobago, based on information compiled through desk review and consultations with key informants by the main author and three United Nations volunteers

	Biodiversity	Water	Food	Climate	Health
Land and sea use change	Changes in land and sea use for urban and industrial expansions, agriculture and aquaculture, and quarrying have extensively driven declines in species populations and ecosystem extent.[618,619,620] The extent of forests declined by 12% between 1970 and 2010.[621]	Changes in space for agriculture, industrial and mining sectors and urban expansion have caused declines in freshwater and seawater quality (e.g. in the watershed along the west coast) and availability (e.g. in Simla, Verdant Vale, the Northern Range, Acono village, and Guanapo, Arima).[622,623,624,625,626,627]	The combination of urban and industrial development has caused declines in the quality and availability of local seafood, game meat and plant products.[628,629] Food imports mostly from the United States have increased, leading to improved availability but limiting food quality, stability, diversity and accessibility.[630] There have been declines in pollinator populations and local food diversity and production due to limited diversification and unsustainable agricultural practices.[631,632,633]	The country is among the world's highest per capita carbon dioxide emitters and the highest in the Caribbean due to land and sea use changes related to the oil and gas industry and urban development.[634,635,636] Its urban centres are considered heat islands, especially the most populated and industrialized western and south-western portions.[637,638]	Although infrastructure development has increased access to, availability of and quality of public health services, most industrialized and urbanized areas are at higher risk of heat accumulation and heat-related impacts.[639,640] There has been a documented decline in the well-being of local communities due to the loss of ecosystem services, e.g. mangroves in Tobago and montane forests in Trinidad.[641,642]
Direct exploitation	Direct extraction and exploitation of water, minerals and fossil fuels – linked to land and sea use changes – has impacted the integrity of ecosystems, while species exploitation affects species populations.[643,644] Pet trade drives population decline, with over 191 species of wild birds, invertebrates, mammals and reptiles identified in the trade between January 2016 and January 2022.[645,646]	Although urbanization improves access to water for households, renewable internal freshwater resources per capita have been decreasing due to increasing demand for consumption (a decrease of 20% between 1997 and 2011). The country has among the highest relative per capita freshwater extraction levels in the region.[647]	There is decreased diversity and nutritional quality of food, along with decreased availability of local food due to overhunting and overfishing. These practices have contributed to the decline of red brocket deer, lappe, brown shrimp and tiger shark.[648,649,650]	Energy demands for electricity, transportation and industrial processes are the major sources of GHG emissions, driven by the exploitation of oil and gas.[651,652,653]	The cascading effects derived from the extraction of resources (e.g. oil, stone) affect communities' well-being.[654,655,656,657] There is an increasing risk of zoonotic outbreaks of viruses that are already present in domestic and farming animals and wildlife, as well as injuries for humans and animals.[658]
Pollution	Entire ecosystems are affected by pollution from the oil and gas industry, urban waste and emissions from vehicles, quarrying, and chemicals used in agricultural practices.[659,660,661,662] Agrochemicals are a major factor driving the decline of bee species, and pollution from oil spills, factories and urban areas affects coral reefs.[663,664,665]	There have been declines in the quality of freshwater and seawater due to the intensification of sediment runoff and accumulation, resulting in increasing pollution from human and livestock faecal matter, urban waste, toxic pollutants (e.g. heavy metals, hydrocarbons, nitrates) from agriculture and industrial and mining sectors.[666,667,668,669,670]	Alarming concentrations of carcinogenic pollutants have been identified in seafood, as well as toxic concentrations of heavy metals in sharks.[671,672] Increasing chemical pollution is reducing long-term agricultural yields by directly changing soil parameters and indirectly driving the decline of key crop pollinators.[673,674,675]	Currently, natural gas supplies the production of electricity, reducing carbon dioxide loads from electricity use. However, carbon dioxide emissions from waste have increased. Ammonia is the main gas released from the use of natural gas for industrial processes.[676,677]	There has been a decrease in health and well-being due to noise, air, water and food pollution. An estimated 14% of the population might be exposed to higher risk of cancer due to high concentrations of toxic hydrocarbons in coastal sediments and seafood, resulting from the combined emissions of industries, vehicles and slash-and-burn farming.[678]

	Biodiversity	Water	Food	Climate	Health
Climate change	The country has experienced declines in species populations and ecosystems' integrity and health. Tobago coral reef health is affected by massive bleaching events, high prevalence of coral disease, and algae and sponge blooms.[679,680]	Increasing droughts and alteration of local hydrological patterns have been identified, representing another pressure on the already limited water resources from land use changes and pollution[681]	The trends of increasing air temperatures, more frequent dry spells in the wet season and increasing floods all affect agriculture. There has been greater use of water and chemicals in agriculture, and more frequent harvest losses by farmers[682]	The country has experienced major changes in rainfall and drought patterns, as well as increasing air temperatures and increases in ocean acidity and temperature.[683,684]	There is a higher risk of heat accumulation and heat-related impacts, as well as the exacerbation of mental health problems for socially vulnerable people, e.g. smallholder farmers in Trinidad.[685,686]
Invasive species	The pet industry contributes to the introduction of exotic species.[687] Invasive species like lionfish are affecting coral reefs. The European honeybee has displaced native bees.[688,689]	No evidence found	There have been increasing incidences of diseases affecting crops and livestock as well as predation by exotic species, e.g. the citrus blackfly, citrus leaf miner and giant African snail.[690]	No evidence found	There is an increasing risk of biotic disease outbreaks and wildlife-human conflicts that harm both human and animal health.[691]

2. Mangrove roots anchored in the mud: relationships between the indirect and direct drivers of change in biodiversity and nature (expanding key message 2)

Table XXII: Relationships between the indirect and direct drivers of change in biodiversity and nature in Trinidad and Tobago

Demographic and Sociocultural Factors	Economic and Technological Factors	Institutions and Governance	Conflicts and Epidemics
The expansion of urban infrastructure driven by increasing migration from rural areas is causing significant land use change. Between 2000 and 2020, the total built-up area expanded at a higher rate than in other larger Caribbean islands, on average, and even faster than the country's human population growth rate.[692,693]	The country's economy heavily depends on the oil, natural gas and petrochemical sectors' exports, which represented 76% of total exports in 2023 and are a major source of sea and land use change, pollution and climate change drivers.[694,695] The economy, hence, is highly vulnerable to global energy markets and is a regionally high GHG emitter, triggering an ongoing diversification process led by the National Development Strategy Vision 2030. Although its HDI is higher than the global average, income inequality and disparities are still high in relation to its Caribbean neighbours, especially between urban and rural areas. These disparities interlink with and exacerbate socioenvironmental vulnerabilities.[696,697,698]	The Environmental Management Authority and the National Council for Sustainable Development coordinate the implementation of the National Environmental Policy. The Environmental Management Authority is the primary regulatory body. The Ministry of Planning, Economic Affairs and Development functions as the National Focal Point for the Convention on Biological Diversity.[699,700] The country has a comprehensive body of national policies and laws and regional agreements targeting all the direct drivers of biodiversity loss and nature's decline. This body aligns with 19 of the 23 targets under the post-2020 Global Biodiversity Framework.[701]	Gang violence, drug trafficking, an increasing influx of migrants and violent reactions to these from authorities exacerbate the existing social tensions and inequalities in the country, disrupting environmental governance and conservation efforts at national and regional levels and challenging regional peace and security.[702,703]
Urban life in Trinidad and Tobago has a high per capita ecological footprint compared to that of its regional neighbours, due in part to fossil fuel reliance, imported goods consumption and consumerism.[704] Around 85% of the food consumption is from imports (above the 60–80% regional range), contributing to natural ecosystem conversion for industrial development, in detriment of local biodiversity-friendly food systems.[705,706]	Progress is ongoing in the research, scaling up and innovation of cleaner technologies and GHG reduction methods. Natural gas is currently the only fuel source for electricity generation, reducing carbon dioxide emissions.[707,708,709 710,]	Key challenges include intersectoral coordination deficiencies, misalignment between extractive industries and environmental sustainability, insufficient mechanisms for local-level implementation, incomplete integration of social equity and justice considerations in the national environmental framework, and insufficient coverage of emerging diseases and pollutants.[711]	Vector-borne and zoonotic disease risk is a concern given the country´s biodiversity and proximity to South American disease reservoirs, climate change effects, the overexploitation of wildlife and land use changes.[712] The COVID-19 pandemic also affected resource use patterns and environmental pressures.[713] Related curfews and lockdowns restricted access to natural areas, resulting in benefits such as ecosystem recovery but also causing spikes in illegal activities such as poaching and squatting in protected areas.[714]

3. The tides around the mangrove roots and mud: bright spots lighting the path towards TC and nexus approaches (expanding key message 3)

Table XXIII: Bright spots lighting the path towards TC and nexus approaches in Trinidad and Tobago

Priority pathways	Projects/initiatives/ organizations	National policies	Regional projects/ policies
Integrated land-use planning	- BES-Net TT - BIOREACH - Tobago Reforestation and Watershed Rehabilitation - BIOREACH: Biodiversity Conservation and Agroecological Land Restoration in Productive Landscapes of Trinidad and Tobago		- CARICOM beekeeping policy in progress
Economic diversification to reduce reliance on fossil fuels	- BIOREACH - Tobago Reforestation and Watershed Rehabilitation	- Blue Economy policy in progress	- The Caribbean Blue Tourism Initiative - CARICOM beekeeping policy in progress - Caribbean Biodiversity Fund
Strengthening environmental governance	- EnviroRightsTTEnviroRightsTT: Building civil society capacity to access information, participate in policymaking and access justice in environmental matters in Trinidad and Tobago - Tech4coastalresilience: Integrating digital technologies and participatory tools to support coastal community resilience in Trinidad and Tobago - Caribbean National Resources Institute (CANARI)	- Blue Economy policy in progress	- The Ocean Coordination Mechanism - CARICOM beekeeping policy in progress - Advancing the ecosystem approach to fisheries for resilient Caribbean coastal communities and livelihoods
Incorporation of social and environmental justice, pluralism, health and well-being in environmental planning	- EnviroRightsTTEnviroRightsTT: Building civil society capacity to access information, participate in policymaking and access justice in environmental matters in Trinidad and Tobago - TT National Outlook on Indigenous and Local Knowledge of Biodiversity - CANARI		- Advancing the ecosystem approach to fisheries for resilient Caribbean coastal communities and livelihoods

Figure XXVI: Exploring potential nexus responses of the BES-Net TT project

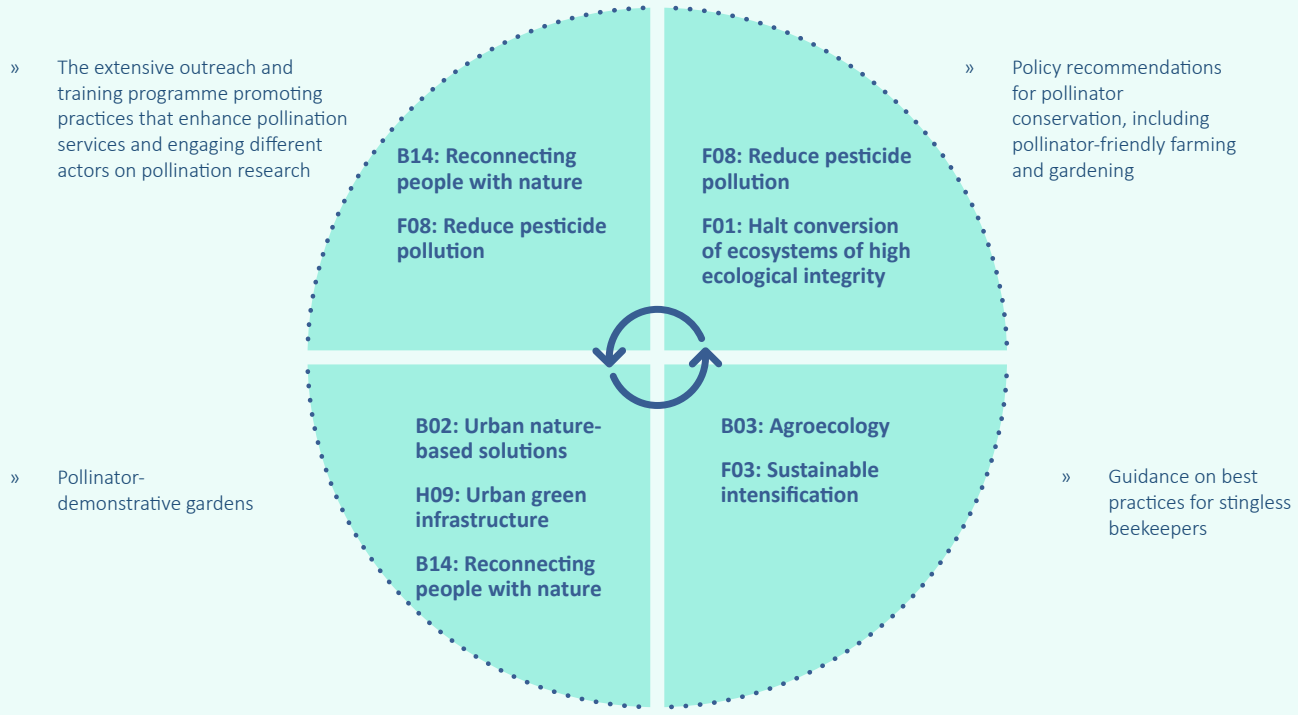

Figure XXVII: Exploring the transformative potential of the BES-Net TT project

What results are desired?	» Enhanced connection among policy, practice and science that sustains the effective conservation and management of pollinators and pollination services in Trinidad and Tobago
What are the project's core values, and how do they align with the principles for TC?	» Promotes a harmonious coexistence between pollinators and people, hence aligning with the TC principle of respectful relationships between people and nature. » Engages different actors in the research activities and the formulation of the policy recommendations towards a harmonic coexistence with pollinators, hence aligning with the TC principle of inclusion and pluralism
What strategies for TC does the project contribute to?	» Conserve and regenerate places of value for nature and people by promoting policies and practices that contribute to the conservation of pollinators and pollination services for ecosystem integrity, food production and people's well-being in Trinidad and Tobago » Drive systemic change in sectors contributing to biodiversity loss and nature's decline by promoting policy and practices in the agricultural and beekeeping sectors that are pollinator friendly » Shift societal views and values to recognize the interconnectedness of people and nature by engaging the public and actors such as beekeepers and farmers with pollinators and pollination services, and facilitating the mainstreaming of pollination knowledge into public educational curricula
How does the project address the underlying causes of biodiversity loss?	» Fostering a deeper understanding of pollination and its critical importance for ecosystem and human well-being, as well as a deeper connection between humans and pollinators, thus partially addressing the underlying problem of disconnection from and domination over nature. » Promoting policy options and economic practices that prioritize pollination and pollinators, thus partially addressing the underlying problem of the prioritization of short-term, individual and material gains

IV. Learning from the mangroves: emerging opportunities to strengthen collaboration, integration and transformative potential

The persistent systemic challenges observed across the Trialogue target countries are the very barriers that reinforce the Caribbean's high vulnerability and obstruct its TC potential toward a sustainable future (see Figure III and Section C of Chapter I). Governance is key to addressing and overcoming these barriers. The mangrove metaphor offers critical insights: resilience emerges from interconnection – between roots, mud, and tides – and so our governance systems must alsobe integrative, inclusive and accountable. Just as mangroves adapt to shifting tides, governance must be flexible, reflexive and adaptive. Could we begin to treat governance like a mangrove – resilient, adaptive and rooted in community? Could we design governance that listens, learns and evolves like the ecosystems we seek to protect? Let us all reflect further on these questions in the Trialogue.

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[44] "Multi-stakeholder, multisectoral, collaborative processes to adaptively co-manage landscapes and seascapes over the long term with an emphasis on connectivity between socioecological systems with synergistic outcomes for environmental, social and economic objectives."

[45] "Recognizing and respecting Indigenous Peoples' food production systems and food requirements, formalizing and securing their land tenure rights to traditional territories and supporting safe, healthy and sovereign Indigenous food systems."

[46] "A range of options for designing urban infrastructure based on the principles of water-sensitive urban design to conserve water, protect biodiversity and mitigate water-related risks such as pollution, flooding and water scarcity."

[47] "Place-based responses that involve participatory planning and integrate health promotion and interventions with landscape, seascape and watershed management approaches to support human health and well-being and enhance nature's contributions to people."

[48] "Restoring mangrove, seagrass and salt marsh ecosystems to conserve and support biodiversity, contribute to climate change mitigation and adaptation and provide benefits to human health and well-being, including securing livelihoods."

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