GLOBAL CENTRE ON BIODIVERSITY FOR CLIMATE

Research Strategy

Global Centre on Biodiversity for Climate

February 2024

Department for Environment Food & Rural Affairs

Royal Botanic Gardens Kew

DAI

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Foreword

The Global Centre on Biodiversity for Climate (GCBC) is an Official Development Assistance (ODA) programme that funds research into natural solutions to climate change, biodiversity loss and poverty.

By working in partnership with scientists, academics and research institutions in the Global South, the programme seeks to develop scalable approaches to the conservation and sustainable use of biodiversity that delivers climate resilience and improves livelihoods.

The GCBC is funded by the UK's Department for Environment, Food and Rural Affairs (Defra) and managed in partnership with DAI Global (Fund Management Lead) and the Royal Botanic Gardens Kew (Strategic Science Lead).

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"As the strategic scientific lead of the GCBC, we at the Royal Botanic Gardens, Kew, believe there could not be a more timely or societally relevant nexus: to focus on the intersection of benefits to climate, nature, and poverty alleviation, through the combination of science, nature and practical knowledge. By supporting a portfolio of 'high risk, high gain' innovative projects, alongside those with less novelty but higher likelihood of success, GCBC is set to make a tangible and distinctive contribution in the UK's research and Overseas Development Aid funding landscapes.

PROF. ALEXANDRE ANTONELLI
Director of Science, *Royal Botanic Gardens, Kew*

It is our hope and conviction that GCBC-funded research will help the world move closer to achieving the ambitious goals set by the Paris Accord, the Kunming-Montreal Global Biodiversity Framework and the United Nations Sustainable Development Goals and to answering the urgent call for action set out in the Intergovernmental Panel on Climate Change's 6th Report."

PROF. GIDEON HENDERSON
Chief Scientific Adviser, *Defra*

Department for Environment Food & Rural Affairs
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Introduction – The Challenge

A headline outcome from the Kunming-Montreal Global Biodiversity Framework[1] launched by the Convention on Biological Diversity (CBD) in December 2022 was the agreement to protect at least 30% of all terrestrial, inland water, coastal and marine ecosystems; and ensure that at least 30% of areas of which are degraded in these same ecosystems are under effective restoration by 2030 to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity. This represents a near-doubling of conserved land surface from 17 to 30% in 8 years and is a hugely ambitious target in a short timeframe.

Tackling the Interlinked Challenges: Climate, Biodiversity and Livelihoods

Failure to address the climate and biodiversity crises will have dire consequences for our planet and ultimately its human population. People, especially those in marginalised communities in Development Assistance Committee (DAC) listed Official Development Assistance (ODA) eligible countries, are already experiencing the impact of climate change on a frequent basis and this is forecast to worsen unless urgent and transformative action is taken. Consequences include famine and malnutrition, poor health, increased mortality, displacement and migration, failed economies (markets and value chains) and social conflict.

Relationships between biodiversity, climate (change) and livelihoods (people) are multi-directional and each of their links can be positive or negative, as illustrated in **Figure 1**. Some of these links have been studied more intensively than others due to the greater availability of data; but for others, evidence gaps still exist. For example, the effect of climate on the geographic ranges of different species has been examined under a wide range of scenarios using occurrence data and distribution modelling under predicted climate change conditions. Yet there is often a lack of scientific evidence to inform strategies that support local community management of natural resources. Additionally, science often fails to engage with the systemic drivers (root causes) of biodiversity loss, climate change and poverty, such as the role of economic growth as a driver of nature loss. An urgent need exists to identify solution-orientated approaches focusing on the less obvious but more powerful leverage points (interventions for leveraging change) with greater potential for transformational change. This will involve understanding the political economy with systems thinking and using natural, social and economic research.

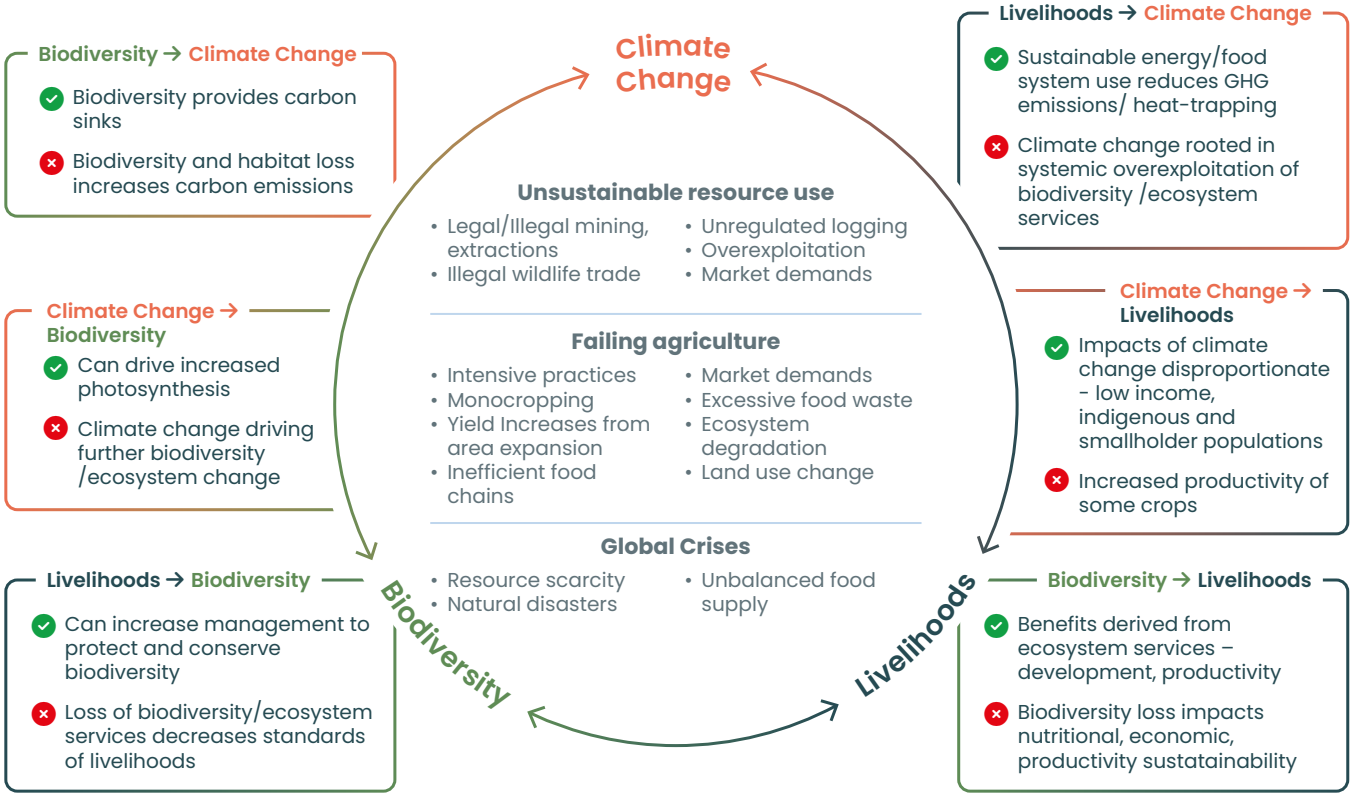

Figure 1: Examples of positive (+) and negative (–) multi-directional links between Climate Change, Biodiversity and Livelihoods and the global pressures and their drivers that are impacting on all three pillars

International Policy and Ambition

The three focal areas of climate change, biodiversity and poverty alleviation have been prominent in international environmental policy agreements for three decades; from the Rio de Janeiro Earth Summit in 1992, focused on biodiversity and climate change; the Convention on Biological Diversity (CBD) in 1993 aimed at the conservation and sustainable use of biodiversity; and the United Nations Framework Convention on Climate Change (UNFCCC) in 1994 to combat climate change by limiting average global temperature increases. The United Nations Millennium Declaration in 2000[2], highlighted the need to create an environment conducive to development and the elimination of poverty. The Millennium Development Goals were replaced by the Sustainable Development Goals (SDGs) in 2015. The Kyoto Protocol, binding developed country parties to emission reduction targets, was reinforced by the Paris Agreement to keep global temperature rise this century well below 2°C above pre-industrial levels.

The Millennium Ecosystem Assessment[3] mainstreamed the concept of ecosystem services (ES), capturing the linkages between biodiversity and human well-being, emphasising approaches from natural sciences and economics. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), conceptual framework (2015)[4] placed Nature's Benefits/Contributions to People (NCP) at its heart. The IPBES Global Assessment identified the role of economic growth as a key driver of nature loss, with 1 million species of plants and animals at risk of extinction (2019)[5]. The IPBES Value Assessment (2022) developed by experts in social science, economics and humanities provides four general perspectives in which people conceive and value nature: living from, living with, living in and living as nature[6]. In 2022, the Kunming–Montreal Global Biodiversity Framework succeeded the Aichi Biodiversity Targets.

Despite these unprecedented efforts by the international community, successes have been limited and the key issues of climate change, biodiversity loss and poverty are more prominent than ever before, remaining key preoccupations for world leaders.

UK Government's Call for Action: Global Centre on Biodiversity for Climate

The UK Government's International Development Act[7], the 2030 Strategic Framework for International Climate and Nature Action[8] and the International Climate Finance ICF Strategy[9] together set out an ambitious framework for delivering on the UK's climate, biodiversity and poverty goals. Within this context of major threats to humanity and the natural world on the one hand, and a real sense of opportunity and potential for positive impact on the other hand, the UK Government announced the Global Centre on Biodiversity for Climate (GCBC) through the Department for Environment, Food and Rural Affairs at the 26th UN Climate Change Conference ("COP26")[10].

Innovative policies and practices will be needed to consider the interconnectedness of climate, biodiversity and livelihoods as well as with policy for food, health, energy, water, land use and oceans etc. Achieving much closer coordination with these wider areas is a major challenge for policy makers, which not only requires the right evidence, guidance and tool kits to help with informed decision making, but also taking a systems approach.

This Research Strategy sets out the vision through the theory of change and ambition for a systems approach (**Section 2**) for the GCBC programme to ensure new scientific evidence, knowledge and partnerships developed support the poor directly or indirectly, with improved livelihoods and resilience to climate change, while sustainably managing and using biodiversity.

In highlighting the systems approach, the strategy also identifies some of the relevant pressures (**Section 3**), solutions (**Section 4**) and enablers (**Section 5**); and then shows how filling the evidence gaps across these can help with system transformation (**Section 6**), both at the local (project level); and the multi-spatial level (country, region, global). How the programme will deliver is then described with detail on the governance, activities, delivery principles and the proposed approach to synthesis of evidence, monitoring and evaluation (**Section 7**). Case studies from GCBC funded projects are then included (**Section 8**) to illustrate the six strategic science priorities with examples of innovative projects which can help identify interventions for transformative change.

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Vision and Ambition

The GCBC aims to support countries eligible for ODA funds to shape decision-making and develop policies that better value, protect, restore and sustainably manage biodiversity in ways that tackle climate change and poverty.

Vision: Theory of Change

Unlocking the potential of nature to support climate resilience and improve livelihoods through practice and governance

By working in partnership with scientists, research institutions and practitioners in the Global South and North, the GCBC seeks to develop innovative and scalable approaches to the conservation and sustainable use of biodiversity that deliver climate resilience and improve livelihoods. The GCBC will support delivery of the UN Sustainable Development Goals, the Convention on Biological Diversity (CBD)'s Kumming-Montreal Global Biodiversity Framework (KMGBF) and Paris Agreement, and help countries achieve a nature-positive future.

The GCBC Theory of Change (ToC) (**Table 1**) describes how the programme intends to bring about the changes required to deliver ***informed, effective and inclusive climate resilient interventions and investments to improve livelihoods and reduce poverty through the conservation and sustainable use of biodiversity***. This will have an impact on ecosystem resilience to climate change, halting and reversing biodiversity loss and contributing to poverty alleviation.

The ToC is designed to address the GCBC problem statement: there is a lack of: a) evidence on how the conservation and sustainable use of biodiversity contributes to inclusive climate resilient development and poverty reduction; and b) processes, resource and coordination mechanisms to use this evidence to bring about the transformational change needed.

By conducting programme activities such as running regular research funding calls on priority evidence needs; synthesising evidence; and improving research partnerships and capacity, the GCBC will:

- Provide an opportunity for inter- and trans-disciplinary research, directly addressing barriers to change, and breaking down natural, environmental and social research silos.
- Incorporate strong engagement from the local stakeholders, including culturally diverse IPLCs and seek to identify good practice which can be scaled up and replicated elsewhere; as well as supporting new and innovative approaches with novel data and uptake promotion of research outputs.
- Meet both short and longer term needs, focusing on ensuring strategic, policy-relevant results and a global network of knowledge exchange and learning.

Using a systems approach to all the activities and initiatives, the GCBC programme anticipates delivering the following outputs:

1. New (or consolidation of existing) innovative and transformative research, evidence, and scalable solutions on the conservation and sustainable use of biodiversity for climate resilient inclusive development and poverty reduction;
2. New or strengthened diverse and equitable inter- and trans-disciplinary research networks and partnerships;
3. Research is actively disseminated to policymakers, investors, practitioners and communities through audience-appropriate knowledge products and channels.

With such outputs delivered, and with further assumptions, the GCBC intends to deliver three long term outcomes:

1. System transformation through local community natural resource management is informed and enabled by the demonstration of the interconnectedness of biodiversity, climate and livelihoods;
2. Evidence uptake leads to widespread implementation of policies, practices and investment strategies that deliver inclusive climate resilient poverty reduction through conservation and sustainable use of biodiversity;
3. Research partners have stronger capacity, capability and networks to identify, fund, implement and disseminate research.

GCBC Theory of Change

Activities

Run themed research grant competitions to develop portfolios of inter-disciplinary research projects, with a strong poverty reduction focus.

Support implementation of research projects with a focus on science, learning (including from local / indigenous communities) and impact.

Monitor, evaluate and learn from projects and themes to increase understanding of evidence gaps and priorities on linkages between biodiversity, climate, and poverty reduction

Synthesise a new and widely accessible, high quality evidence base across themes and geographies.

Broaden access to evidence and knowledge developed across the programme through different communication channels / events, including for new, diverse and hard to reach audiences.

Develop a diverse and inclusive international network to share information and build capacity of research, policy and practice supporting the sustainable use of biodiversity for climate and livelihoods.

Outputs

New (or consolidation of existing) innovative and transformative **research, evidence and scalable solutions** on the conservation and sustainable use of biodiversity for climate resilient inclusive development and poverty reduction.

New or strengthened **diverse and equitable inter- and trans-disciplinary research networks** and partnerships.

Research is actively disseminated to policymakers, investors, practitioners and communities through audience-appropriate knowledge products and channels.

Outcomes

System transformation through local community natural resource management is informed and enabled by the demonstration of the interconnectedness of biodiversity climate and livelihoods.

Evidence uptake leads to widespread **implementation of policies, practices and investment strategies** that deliver inclusive climate resilient poverty reduction through conservation and sustainable use of biodiversity.

Research partners have **stronger capacity, capability, and networks** to identify, fund, implement and disseminate research (with or without GCBC funding).

Impact

Informed, effective, and inclusive climate resilient interventions and investments improve livelihoods and reduce poverty through the conservation and sustainable use of biodiversity.

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This Theory of Change is designed to address the GCBC problem statement.

There is limited evidence on and understanding of how the conservation and sustainable use of biodiversity contributes to inclusive climate resilient development and poverty reduction. There are also limited processes, agency and coordination mechanisms to use this evidence to bring about the transformational change needed.

Assumptions

- Relevant organisations and researchers in regions are willing to: form networks and partnerships; and apply for GCBC funding
- Policymakers, investors, practitioners, and communities are willing and able to; use an improved evidence base on the sustainable use of biodiversity; and change their approaches based on new research and evidence
- External funding opportunities for biodiversity research continue to exist
- Identified approaches to conservation and sustainable use of biodiversity can provide income opportunities that are sufficient to replace business as usual
- Uptake of evidence (including interventions and investments) adopts a systems approach and follows GCBC delivery principles, notably gender equality and social inclusion (GESI).

The Global Centre on Biodiversity for Climate is an international research and development programme that funds research into natural solutions to climate change and poverty. It was announced at UNFCCC COP26 with £40m of UK Official Development Assisstance funding. The GCBC's three targeted regions are Latin America and the Caribbean; sub-Saharan Africa; and South-East Asia and the Pacific (including Small Island Developing States).

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Ambition – Systems Approach

Our economies, livelihoods and well-being all depend on our most precious asset: nature. Using science and knowledge to understand how nature benefits people and society in all kinds of ways can support better decision-making for climate resilience, sustainable management of biodiversity and poverty alleviation.

The GCBC programme uses systems thinking to make sense of the complex interactions between climate, nature and people as one system; and a theory of transformative change using evidence (at an individual project level and synthesised at a programme level) from the funded projects.

A system is a group of interrelated parts (or elements) that interact with characteristic behaviours (a function or purpose) – systems are greater than the sum of their parts. Systems can be simple (e.g. an irrigation channel) with a few parts and interconnections which are easy to define, or complex (e.g. a tropical rain forest) with many parts and interconnections which are difficult to define, and therefore with an overall behaviour that is hard to predict and influence. A system can be made up of many other sub-systems, for example a tropical forest is made up of plants, animals, fungi, soil, etc. all of which can be thought of as individual systems.

Systems thinking can be used as a framework to problem-solving in the research agenda, by understanding the root causes and drivers of system behaviour, as well as the connections and feedback loops within a system which are often difficult to navigate. Importantly, systems thinking can enable identification of actions to catalyse incremental change (enablers) and where action can be taken within a system to create transformative change (leverage points). In the context of the nexus of climate, biodiversity and livelihoods, using interventions as leverage points that reconnect people to nature, restructure institutions and rethink how knowledge is created and used are more likely to achieve solution-orientated approaches for sustainable outcomes. This will involve addressing the evidence gaps across the interacting biophysical, social, economic, legal, political and ethical dimensions. To date, the global approach to governance of climate, biodiversity and human development issues has been one of increasing ambition and goals, along with a move toward pledge-and-review processes. However, as global crises prevail and, in many cases, intensify, there is an increasing recognition of the need for a more transformative systematic approach, along with incremental changes.

A major thread across all GCBC initiatives is the need to support inter- and trans-disciplinary research, the establishment of diverse, collaborative and equitable partnerships, and the creation of new ways of working to develop solutions, that can be upscaled or transferable across regions, countries and context. The GCBC will provide robust new data, evidence and knowledge of what works, where, why and for whom which can be scaled and replicated in countries and regions to achieve long-term lasting change. This will help empower governance (community, local and national) to improve climate resilience and the livelihoods of the poor, by sustainably managing biodiversity (**Figure 2**).

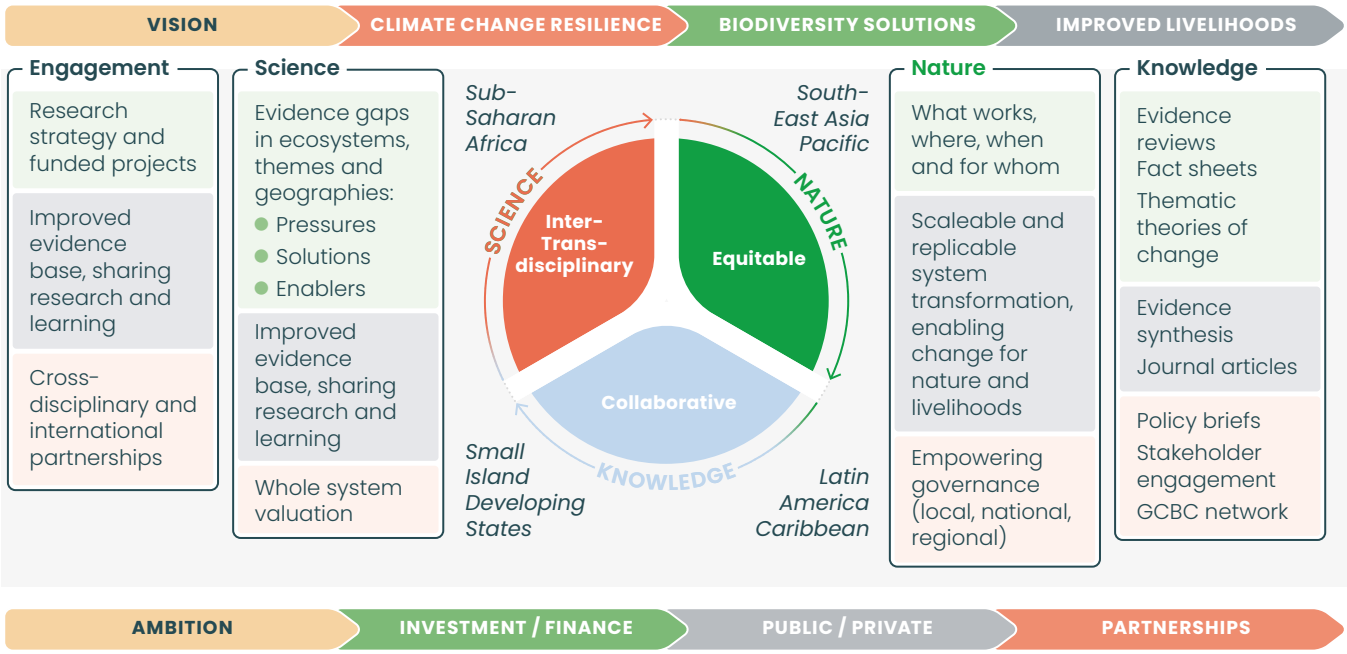

Figure 2: Integration of science, nature and knowledge in GCBC programme system transformation

The GCBC programme will address the evidence gaps for:

- Discovery and quantification of the drivers, creating both indirect and direct **pressures**, that will affect biodiversity and nature globally, and more specifically in the different **geographies of focus** for the GCBC (Latin America and Caribbean (LATAC), Sub-Saharan Africa, South East Asia Pacific and Small Island Developing States (SIDS));
- Development and deployment of **solutions** that are proven to make a difference, using evidence acquired through science, nature and knowledge combined; and
- **Enablers of change** (both incremental and systemic) contributing to the implementation of evidence-based policy and decision-making, by policy-makers, investors and practitioners, to strengthen the science-policy-practice interface and adoption of solutions.

The new evidence, data and knowledge across pressures/drivers, solutions and enablers for the different themes of grant competitions will support the adoption of **systems approaches** in tackling the nexus of climate, biodiversity and livelihoods. By understanding and managing the complex interactions between science, society and the multiple interacting systems through temporal and spatial scales; it will be possible to recommend solution – orientated approaches for **transformative change** across different sectors and regions (**Figure 3**).

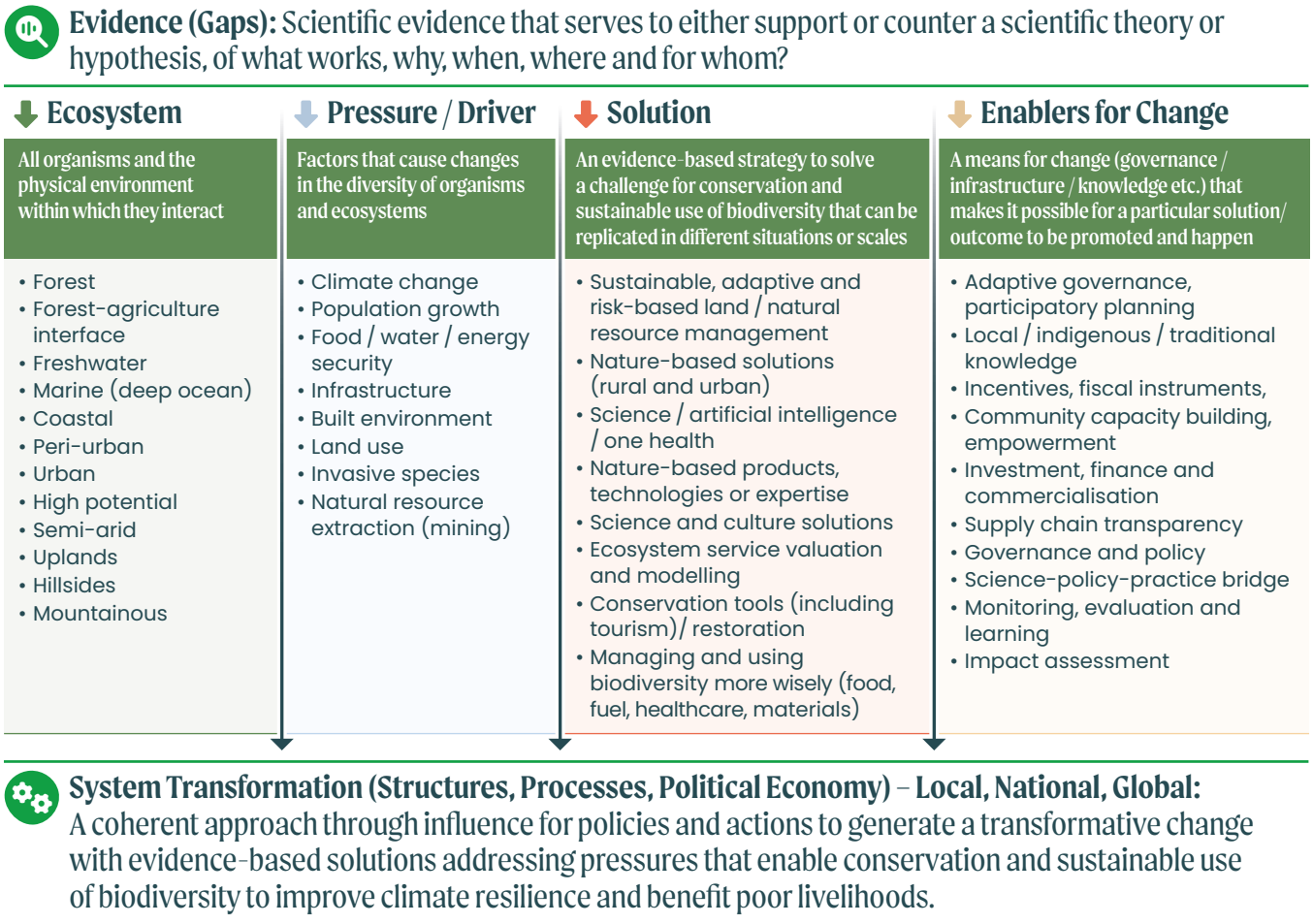

Figure 3: Relevant themes for GCBC

Each research grant competition will have a target theme selected to ensure coherence of funded projects, so that aggregation of results and learning is possible across the focus regions (Sub-Saharan Africa, Latin America and Caribbean (LATAC), South East Asia and Pacific, Small Island Developing States (SIDS)), in specific ecosystems as appropriate.

Programme initiatives will connect project partners across themes and geographies, to help strengthen research outputs, share learning and develop new partnerships for the future to achieve the GCBC ambition for 2030 (**Figure 4**). Wherever applicable, research should also help improve or refine policy and legislation.

What will the GCBC Research Strategy achieve by 2030?

1 New scientific evidence, knowledge and partnerships

From the GCBC's research programme can benefit climate resilience for the poor with improved livelihoods and long-term impact for biodiversity by:

- helping the poor directly, or through institutions supplying services to the poor, employers of the poor and relevant policymakers; and
- within target and non-target countries by sharing information and evidence across the international research and development system.

2 The GCBC programme makes a difference for target stakeholders comprising:

- **Scientists and researchers** participating in the GCBC collaborate sharing knowledge and best practice to help deliver the evidence disseminated by the GCBC International Network;
- **Indigenous peoples and local communities** IPLCs (e.g. hunters, gatherers, herders and fishers) have access from sustainable use of biodiversity to improved livelihoods, which are more resilient to climate;
- **Farmers and land-owners** are informed, can access and afford appropriate sustainable farming and land management practices that protect, restore and manage biodiversity wisely;
- **Third sector** (charities, social enterprises, voluntary groups) use their networks, help poor communities improve their livelihoods and resilience to climate change while protecting nature;
- **Local and regional bodies** support action to help businesses, including primary producers and consumers work together in addressing the challenges;
- **National governments** have the evidence and guidance needed to inform policies, direct innovation, set clear strategic goals and address market failures (through regulation where appropriate);
- **Financial institutions and investors** are more engaged with the agenda and less risk adverse in securing investment for climate and nature with support reaching IPLCs;
- **Businesses** are more aware of their dependencies on and impact on biodiversity and develop strategies to move towards a nature-positive future, with benefits to their operations; and
- **Consumers** find out more about the initiatives to protect, restore and manage biodiversity and use their influence and spending power to support those initiatives.

3 The GCBC Research Strategy will have an impact on:

- **Coherence between GCBC activities and country / regional priorities** working with stakeholders and partners in country to develop priority research themes within specific geographic areas to promote more effective and appropriate linkages with improved exchange of information.
- **High quality, new or strengthened inter- and trans- disciplinary research networks and partnerships** formed through the GCBC International Network to address evidence gaps with robust science, monitoring and efficacy assessment and/or develop tools / frameworks for the sustainable conservation and management of biodiversity.
- **Improved design and relevance of project proposals** through clear data requirements for monitoring data collection implemented by funded projects; and best practice guidelines on specific themes for project leaders e.g. data analysis, indigenous knowledge, Access Benefit Sharing etc.
- **Robust new evidence and knowledge** for short and longer-term needs, by demonstrating the interrelation of climate, biodiversity and people (what works, where, why and for whom), ***enabling better climate resilient policies, programmes and practices with positive impacts for biodiversity and poverty alleviation.***
- **Stakeholder take up of GCBC research outputs** through targeted communications (International Network, website, social media, project portal, events, seminars, training webinars) promoting GCBC outputs (yearly evidence synthesis products / toolkits / frameworks / guidance for policy-makers / evidence gap and researchable constraint analysis / state of the science thematic factsheets etc.).
- **Informing the work of policy developers and development practitioners globally** to help narrow the gap between the current and required investment for biodiversity solutions to realise the programme's potential in relation to climate change and socio-economic development in ODA eligible countries.

Figure 4: GCBC research strategy ambition for 2030

Pressures

Human activity, such as greenhouse gas emissions and habitat destruction, is pushing our planet's natural and biophysical systems over their limits. Up to a certain point, many of these systems are resilient, acting to balance human impacts – for instance, forests and oceans are absorbing more carbon dioxide as atmospheric levels increase. However, as human activity continues to force change upon natural systems, there is the risk of triggering potentially irreversible 'tipping points', such as the loss of sea ice, melting permafrost, or rainforest ecosystems experiencing a 'regime shift' and transforming to savannah vegetation.

Biodiversity encompasses the full variety of life on Earth and its importance to humanity cannot be overstated, providing key ecosystem services including, for example, food security, the provision of clean water and the regulation of the climate (**Figure 5**). Yet biodiversity is declining globally, faster than at any other time in human history, with more than 1 million species of animals and plants (39% of all plant species) estimated to be threatened with extinction due to human activity. While changes in land and sea use are considered to have been the main drivers of biodiversity loss in the last 50 years, other factors considered to be of major importance in relation to current and future loss include climate change, the unsustainable exploitation of species, pollution, invasive species and new diseases (**Figure 6**).

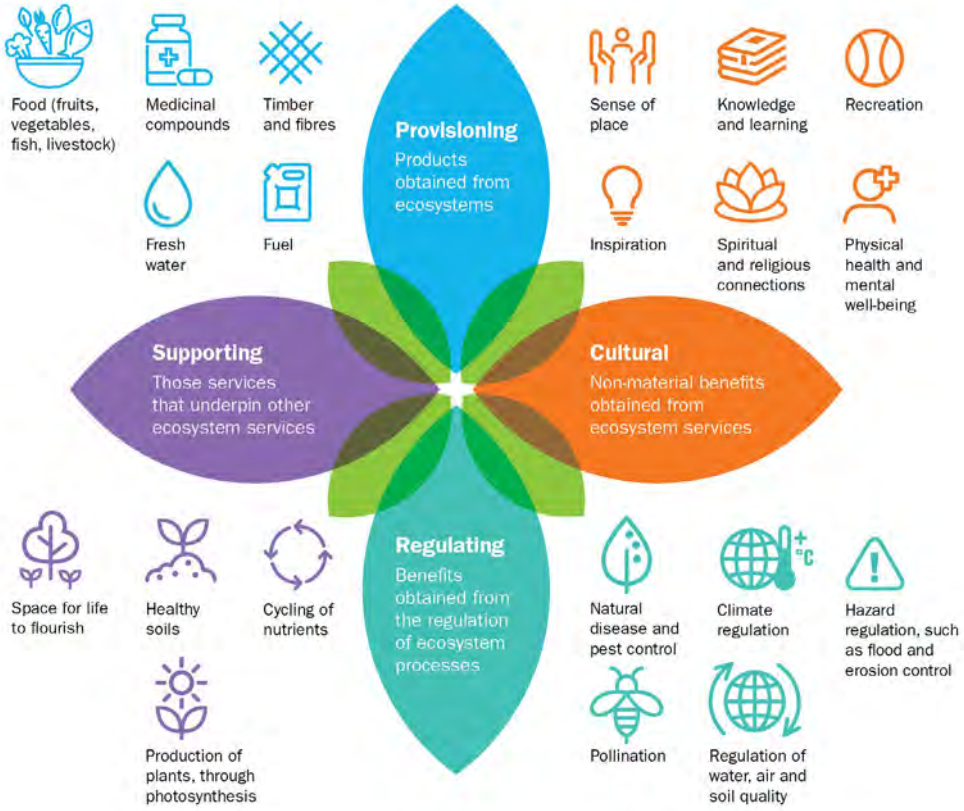

Figure 5: How earth's ecosystems support all of our lives - when healthy and functioning well, earth's ecosystems provide provisioning, cultural, regulating and supporting services[11]

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The Dasgupta Review of the economics of biodiversity[12] identifies many factors that threaten the ecological sustainability of our economies. The main concern is the rapid conversion and degradation of natural habitats, such as forests, wetlands and grasslands. The principal threats are from agriculture, forestry, infrastructure, human settlements and other economic activities. Critically where current subsidies and economic pressures mean that conversion of natural areas to agriculture, forestry and other land uses is less costly than sustainable management or protection, there is a need to explore alternative economic or political approaches.

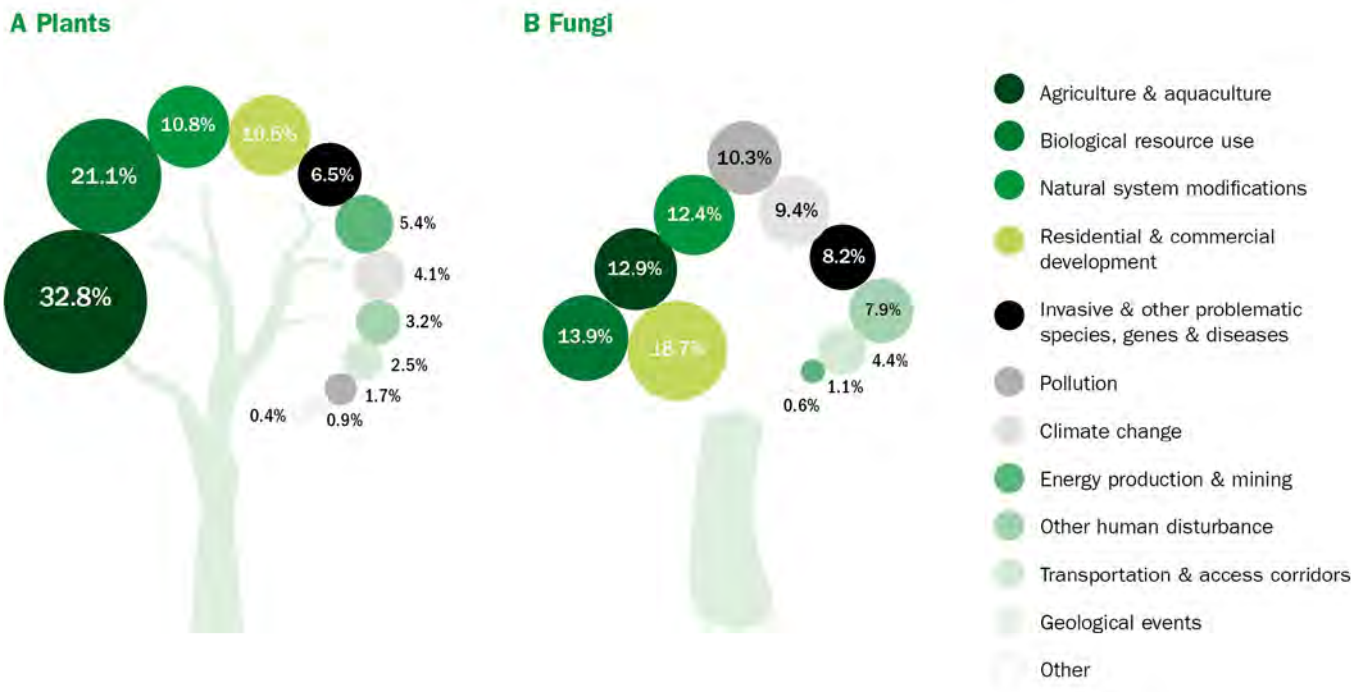

Figure 6: Why species are at risk - the major threats to plants (a) and fungi (b) that have been assessed for the IUCN red list of threatened species[13]

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Pressures and their Drivers in Different Geographies

Vulnerability to climatic hazards is higher in locations with poverty, governance challenges, limited access to basic services and resources, violent conflict and high levels of climate-sensitive livelihoods (e.g. smallholder farmers, pastoralists, fishing communities). At different spatial levels, vulnerability is exacerbated by inequity and marginalisation linked to gender, ethnicity, low income or combinations thereof, especially for many Indigenous Peoples and Local Communities (IPLCs)[14].

Key considerations for pressures in the GCBC focus regions are given in some detail below:

1 Sub-Saharan Africa

More than 62 percent of Africa's rural population rely on the continent's diverse biodiversity for their food, water, energy, health and secure livelihood needs[15]. This biodiversity provides a variety of genetic capital, beneficial not just to the people living there but to the world. The decline in biodiversity, from activities including land use change, over-harvesting and poaching, alongside indirect drivers such as rapid population growth and urbanisation, is increasing the region's vulnerability to climate related risks, and reducing the benefits available and required for sustainable livelihoods.

2 Latin America and the Caribbean

The region hosts around 50% of the world's biodiversity[16] and has a high reliance on natural resources and ecosystems services for supporting livelihoods and economic activities[17]. This, along with high levels of poverty and inequality, highlights the region's increased vulnerability to the impacts of climate change with the effects being felt both directly (exposure to climate related hazards) and indirectly (through impacts on associated economic activities)[17]. There have been steps to address these different challenges, such as meeting the 2020 Aichi targets to protect its biodiversity and landscapes, however there is still immense pressure being exerted on the region's biodiversity through human activities. In particular, the transformation of natural landscapes to human-dominated landscapes[18], including key challenges around illegal activities such as deforestation.

3 South-East Asia and the Pacific

High rates of economic growth coupled with similarly high rates of urbanisation and resource use to meet the needs of a wealthier population are putting immense pressure on ecosystems and biodiversity in the South-East Asia and Pacific region[19]. Land use change is an important driver of biodiversity loss, with around 30% of the land area in this region used for agriculture. Much of the recent expansion has involved the logging of highly diverse, primary forests, home to many unique wild mammals and birds, to make way for large scale monocultures of oil palm and rubber[19]. Coastal areas in the region are also experiencing biodiversity loss due to activities such as overfishing, pollution and land run-off, which is exacerbated by climate induced changes such as sea level rise and ocean warming[19]. Many habitats (coral reefs, mangroves, seagrass beds)[20,21] are under threat, as are the benefits (coastal protection, food and economic security, genetic diversity)[22] they provide to local communities.

4 Small Island Developing States (SIDS)[23]

As a heterogeneous group of geographically wide-ranging islands, SIDs share a unique set of developmental and environmental challenges, from geographic remoteness to a higher vulnerability from climate change and natural disasters; with a more limited ability to respond[24]. SIDS collectively, hold 14% of the world's coastlines, but less than 1% of the global land area[24]; and control ~30% of global oceans and seas, with some large economic exclusion zones. There is a high reliance on natural resources to support local livelihoods and economies, through agriculture, tourism and fisheries[25]. Many SIDs are looking to development of the "blue" economy for increased economic development[24]. The primary drivers of biodiversity loss across SIDS include invasive species, land and sea use change, over exploitation, coastal damage and hazards[25]. In view of this, there is a pressing need for robust policy and regulatory agreements that reflect the diversity across the SIDS, to ensure biodiversity, economic and social benefits[26].

Solutions

There are already many known solutions to the challenges facing the planet and humanity. For example: renewables, energy efficiency, ecosystem restoration, food system reform and more. Solutions are available that can be quickly implemented to build resilience to climate change for local communities. However, these solutions have not been put into practice at a meaningful scale and speed[27].

The need to base policy on sound evidence and the need for robust indicators to underpin this evidence is becoming increasingly recognised by policy-makers[28]. Three powerful tools can help find the evidence for the solutions: **science**, which through rigorous and transparent methods can test specific hypotheses about what works and what doesn't, model potential outcomes, and develop innovations with potential for transformative change; **nature**, which has inspired humans throughout evolutionary history, creating a great variety of life forms, adaptations and solutions that still hold untapped potential in this time of crisis; and **knowledge**, acquired by indigenous and traditional communities, scientists and development practitioners which can be combined with advances in science and nature to help find equitable solutions to the challenges facing local communities.

Science

High quality, new operationally relevant research evidence (what works, where, why and for whom) around the conservation and sustainable management of biodiversity, including application of decision tools/ methodology frameworks, is needed to provide timely, cost-effective, workable, impactful interventions; and effective governance and monitoring at the local, national and global scales. Innovation and transdisciplinary approaches with strong local stakeholder engagement are also needed to help drive solution-orientated approaches directly addressing the barriers to change and seek good practice for scaling up and replicating elsewhere.

Genetic tools and techniques are a way to introduce genetic diversity from wild species into modern crops or livestock for food, fibre or other uses with the benefit of improved traits (e.g. taste, nutrition, disease/pest resistance) and resilience /adaptation to climate change (e.g. drought, salt, heat tolerance); and also support diversification of farming systems using wild species with useful characteristics (**Figure 7**).

Robust scientific data is essential for developing evidence-led approaches that provide replicable and scalable solutions. This includes collecting the right data at the right scale, aided by appropriate and fast-developing technologies such as sensors, satellite imaging and robotics. Data accessibility is a key aspect; and there is a growing global effort to make scientific data open access[29] (e.g. creative commons, Global Biodiversity Information Facility, United Nations Biodiversity Lab, National Aeronautics and Space Administration Earth Observation Data). While there are good examples of the benefits of sharing open data available (e.g. during the COVID-19 pandemic, teams across the world sequencing the virus genome shared this data, enabling vaccines to be developed at pace[30]), there are still challenges around sharing data (for example, linked to ownership rights, and the potential for data misuse or breach of confidentiality).

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Crop Biodiversity for Climate Resilience and Livelihoods

Genetic tools have bought time in the race to feed a rapidly growing population. Since thale cress (*Arabidopsis thaliana*) was first sequenced, the genes that underpin useful traits are better understood. Early farmers selectively bred from plants with favoured traits, giving rise to landraces suited to local conditions. Later, commercial breeding of cultivars resulted in uniform crops with little genetic diversity. Today, plant breeders investigate crop wild relatives and landraces with useful properties, harnessing their genes to make modern crops more resilient to climate change for different uses[31]. Modern biotechnological tools can also help genotype and characterise wild species accessions in botanical and crop gene banks to support crop diversification[32,33]. This will contribute to alternative regenerative farming systems with economic benefits for growers (improved livelihoods), while providing social (better health and wellbeing) and environmental benefits (helping soil and biodiversity).

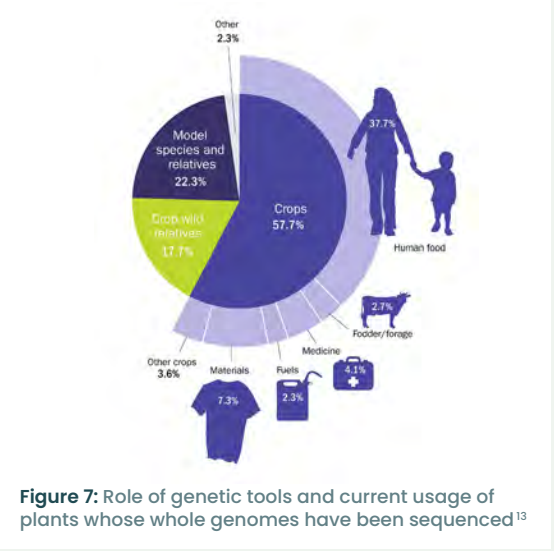

Figure 7: Role of genetic tools and current usage of plants whose whole genomes have been sequenced[13]

One challenge is ensuring the equity of benefits (Access and Benefit Sharing - ABS) from the data collected, as it is often those with the existing resources and capabilities that reap the benefits. In response to this, instruments have been developed to address these imbalances e.g. the Nagoya Protocol which plays an important role in setting out the legal ABS framework for genetic resources and traditional knowledge associated with those resources[34]. Yet, other biodiversity data still suffers from a lack of clarity on whether it is included or not in these instruments, and therefore is currently not subject to such legal frameworks and protection[35]. A second challenge exists around how the vast amounts of data being collected now (including metrics that allow success to be measured, particularly for biodiversity data) are rapidly evaluated and how this data can be integrated with modelling disciplines to better predict and decide on solution pathways[36].

Nature

Nature-based Solutions (NbS) are solutions or actions to "protect, sustainably manage and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefits"[37]. The concept of NbS recognises that natural systems can provide multiple, simultaneous, often cascading benefits, including a regulated climate, protected biodiversity and sustainable development. NbS and natural habitats are a crucial element for climate resilience[38], with potential to provide up to one third of climate mitigation towards global targets by draw-down and storage of carbon from the atmosphere. Investment by companies and governments around the world into natural climate solutions such as tree planting or peatland restoration is rapidly growing[39]. However, although NbS are increasingly proposed for carbon offsets towards protection and restoration of healthy ecosystems, more evidence is needed on the efficacy and robustness of NbS for climate mitigation under current projected climate scenarios, including research on verification, monitoring, reporting and carbon trading.

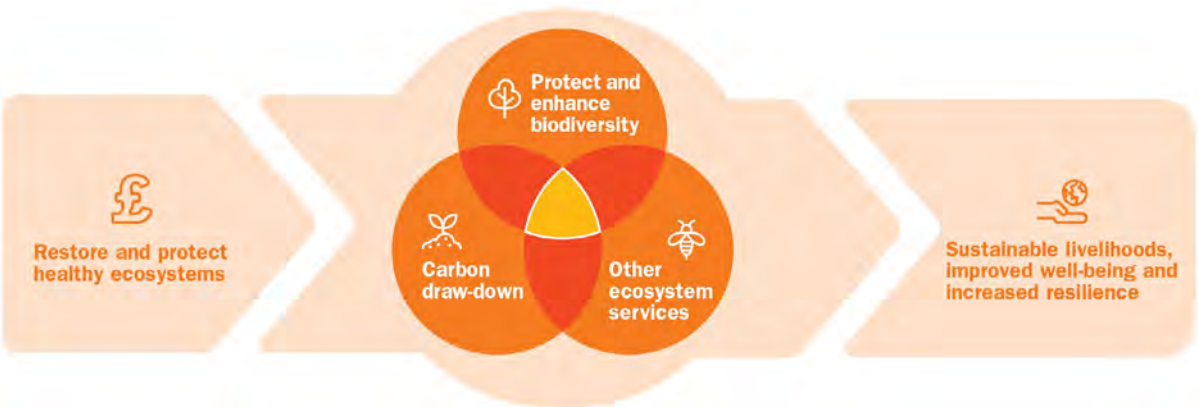

Figure 8: Nature-based solutions

As biodiversity decreases, the global population continues to grow to a predicted population of 9.7 billion by 2050, with an increasing demand for natural resources to provide food, clothing, transport, infrastructure, and housing. It is crucial to create a consumption system within the planetary boundaries to address climate change, biodiversity loss and to ensure a sustainable future for the poor. Wild plants, algae and fungi provide food, nutritional diversity and income for an estimated one in five people around the world, in particular women, children, landless farmers and others in vulnerable situations [40]. However, overexploitation remains a major threat to many wild species. Neglected and Underutilised Species (NUS) have a potential to be used more wisely to improve food security and meet many other resource demands (e.g. fuel, materials and health), while also helping to protect and conserve traditional knowledge and biodiversity [41]. Examples include the following:

Health

Nature represents a largely untapped medicine cabinet but 723 plant species used medicinally are threatened with extinction. Estimates suggest that 70% to 80% of the people in low-income countries use raw medicinal plants to meet their primary health care needs [32], in part due to the limited accessibility, availability and affordability of modern medicines. Sustained demands for health products are continuously created due to economic development, the rapidly aging world population and resistance to drugs such as many antibiotics. The impact of climate changes on the abundance of these medicinal species is poorly documented.
Over the last few years, the interest in plants and fungi has increased not only for their medicinal uses in over-the-counter products but also as functional foods and in cosmetics. Trading of herbal medicines generates economic opportunities for vulnerable groups living in peri-urban, rural and marginalised areas.

Materials

Globally, logging produces over 5,000 different products and generates a gross added value of more than 600 billion dollars per year. Approximately 7,400 species of trees are used all over the world as a major source of wood and wood products, with 2.4 billion (one-third of the global population) relying on fuelwood for cooking. The GlobalTreeSearch database reports the existence of 60,082 tree species, with nearly half of all tree species (45 percent) belonging to just ten families. Nearly 58% of all tree species occur as single-country endemics [43]. The timber industry exerts pressures on ecosystems along the value chain, with the choice of tree species and their association crucial to preserving forest biodiversity [44]. Furthermore, extraction activities (quarries, mining) result in ecosystem damage and biodiversity loss; and while restoration stands as a solution to reverse this damage, further evidence-based research is needed to support these efforts [45].

Energy

Only 6 crop species yield 80% of global industrial biofuel, but some of the methods to produce green energy are harming the environment, while some plant and fungi species can be used to generate energy [13]. A promising model for the future is for communities to produce renewable energy to meet their needs using species of local origin that match to appropriate technologies. Countries with a high proportion of fuel species, such as many African countries, often suffer the most from energy poverty.

Food

Approximately 7,039 edible plant species (but only 417 are considered food crops), 7,500 species of wild fish and aquatic invertebrates, 1,700 species of wild terrestrial invertebrates and 7,500 species of wild amphibians, reptiles, birds and mammals are used all over the world as a food source. The current lack of diversity of domesticated crops and animals limits local and global adaptive capability to climate change. Almost 50% of calories consumed globally originate from just three crop species (wheat, rice and maize). Protein sources are equally limited in diversity, being provided by very few crop, animal and fish species. The various reports of the IPCC suggest that one of the main routes for adaptation to climate change is the utilisation of biodiversity (wild genetic resources) and agrobiodiversity (wild and cultivated genetic resources), i.e. a wide variety of cultivated species, cultivation ecosystems and agricultural practices [13].


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Knowledge

There are approximately 476 million Indigenous Peoples worldwide, in over 90 countries[45]. Indigenous Peoples and Local Communities (IPLCs) (including Afro-Descendants and First Nation communities) make up only 6% of the global population, but conserve over 80% of biodiversity worldwide[46]. The identities, cultures, spirituality and ways of life for IPLCs are inextricably linked to biodiversity. IPLCs community-based conservation and local governance practices are proven to be effective in preventing habitat loss, and often even more effective than traditional conservation methods[47]. Indigenous Peoples' traditional knowledge informs practical approaches to ensure the balance of the environment in which they live may continue to provide essential services – such as water, fertile soil, food, shelter and medicines. Women in particular, who provide at least half of the agricultural workforce globally, transmit ancestral and indigenous knowledge, languages and views on local context[48].

Changes to farming and wider land management are fundamental to achieving a net zero economy and stabilising global temperatures[49]. Farmers manage some of the largest stores of carbon on Earth (above and below ground), a situation which offers a unique potential to mitigate climate change. Traditional techniques, some millennia old, for growing food, controlling wildfires and conserving endangered species could help arrest the dramatic decline of the natural world[48,50]. Local knowledge is important in terms of understanding methods and approaches which work in the local context and have an impact. Opportunities exist to combine this knowledge with nature and science to provide solutions contributing to new and more sustainable practices:

Natural Resources Management

is an approach that strives to achieve a balance between the collective need for resources (air, water, land, soil, plants, animals and micro-organisms) and the complex needs of the environment. Natural resources are an essential part of reducing threats from drought, erosion, flooding, tsunamis or storm surges; but are threatened by increasing population, climate variability and poor management. New approaches are needed to leverage the value of biodiversity and manage it in an integrated manner alongside other societal needs[51], providing resilience to climate and weather shocks.

Sustainable Agriculture

can be multi-functional addressing the complexity of the interface of agriculture (aquaculture, arable, horticulture and livestock) with the interactions between social, environmental and economic factors; and the problems underlying climate change resilience, biodiversity conservation and improved livelihoods for the poor. This involves using local knowledge, ideas, strategies, techniques and practices spanning many disciplines, for example in regenerative agriculture (a conservation and rehabilitation approach to farming) to restore soil and ecosystem health including integration of livestock and conservation (zero-till) agriculture, as well as intensified and enriched agroforestry[52].

Urban and Peri-Urban Agriculture

Rapid urban growth and the simultaneous conversion of fertile agricultural land into built-up urban areas, are emerging as key challenges for urban food security and sustainability[53]. By 2050, about two-thirds of the world's population will live in cities, and most future urban growth (about 90%) will occur in the Global South[54]. In this context, urban and peri-urban agriculture plays a multi-functional role as a food supplier, livelihood strategy and employment opportunity. Whether creating new opportunities, or marginalisation of farmers, the growth and extension of urban communities into rural areas is connected to intensification and commercialization processes, resulting in new farming practices[55].

Building with nature

applies natural processes, to help prevent coastal erosion and flooding to benefit both nature and people, in any water-related infrastructure challenge, whether in rural, urban or port areas; sandy or muddy coasts; lakes, estuaries or rivers. Giving rivers more space and restoring natural riverbanks or stimulating vegetation growth, can help break the force of incoming waves. Mangroves and coral reefs are vital in reducing wave energy, storm surges and mitigating sea level rise, as well as more life-threatening ocean risks such as tsunamis[59]. There is evidence that mangroves saved lives in Indonesia during the 2004 tsunami by reducing tsunami wave height[60].

Improving Land Use

Large-scale operations such as mining, cattle ranching and hydro-electric projects are increasingly claiming sizeable tracts of land across the tropics, especially when it is unclear who owns this land[56]. In Brazil's Atlantic Forest, these activities have displaced local communities, including Indigenous Peoples, from lands to which they have a claim. Evidence suggests IPLCs with secure rights to their land are the best defenders of the natural environment and can both improve livelihoods and conserve forests.

Reforestation

of forests recently lost, could protect biodiversity and help fight global climate change by removing more carbon dioxide from the atmosphere. Forest restoration, when implemented appropriately, using the 'ten golden rules for reforestation', helps restore habitats and ecosystems, create jobs and income and is an effective nature-based solution to climate change[57]. While 61 countries have, together, pledged to restore 170 million hectares of degraded forest lands under the Bonn Challenge, progress to date is slow[58].

Nature-based tourism

including wildlife watching, supports mental and physical well-being, raises awareness and facilitates connections to nature, in addition to bringing local benefits such as direct income generation to local communities. Wildlife watching generates substantial revenue, contributing US$120 billion in 2018 to global gross domestic product (five times the estimated value of the illegal wild species trade) and sustaining 21.8 million jobs[61].

Greening Cities

A key challenge in cities is the integration of the social demands for green spaces with the maintenance of key ecosystem structures and processes as well as the biodiversity of the green spaces[62]. Cities are often harsh environments for plants, insects and animals because of disturbance, pollution, drought, radiation, heat and microclimatic extremes[63].

Marine Protection

through Marine Protected Areas has increased in recent years, to sustainably manage and protect marine ecosystems by recovering rare, threatened and important habitats and species from damage caused by human activities. As trade-offs between biodiversity conservation and fisheries management, along with diverging objectives and expectations of various stakeholders, become evident; strategies are needed to synergize the conservation and exploitation of marine ecosystems and resources[64].

Enablers for Change

Despite the call for more evidence-informed decision making to drive change for good, there are many contributing factors for the lack of implementation. The most common barriers limiting the use of evidence for incremental change associated with day-to-day decision-making processes of practitioners, organisations, and local or national governments are organisational structures, management processes and resource constraints. Attention to the different enablers for both incremental change, as well as systemic change, is a key part of strengthening the science-policy-practice interface [65].

Grantees and applicants may wish to consider the following enablers in a systems approach, when developing their research project theories of change and implementation plans:

Adaptive governance

An approach to reduce uncertainty by improving the knowledge base for decision making; which can benefit from systematic and flexible decision-making tools and methods such as participatory multicriteria methods for evaluation of options [66].

Community capacity building

Focuses on enabling all members of the community, including the poorest and the most disadvantaged, to develop skills and competencies so they can take greater control of their own lives. This contributes to communities becoming more cohesive, more resilient and better placed to confront economic and social challenges [67]. Meaningful and effective community capacity building can be stimulated and fostered by national and local governments, and by the capacity which communities have already developed, so that empowerment becomes increasingly embedded within them.

Fiscal instruments

Usually include a new policy, law or economic / social programme designed to influence government bodies, business, non-governmental organisations or local people to conserve or manage biodiversity in a sustainable manner. A commonly used incentive is the control of market prices for different products through the application of selective taxes and subsidies [68].

Supply chain transparency

for businesses ensures an awareness of product status throughout the supply chain with data-driven information for both internal and external stakeholders. This can meet regulatory requirements, optimise operations, guarantee quality of outputs and ensure sustainability of processes [69].

Investment and Finance

Most businesses depend on biodiversity, either directly, indirectly as ecosystem services, or through their supply chains. A business with a negative impact on biodiversity, risks losing essential resources and services. As a result, the private sector needs to demonstrate strong and improved performance on biodiversity to ensure their future financial position and performance [70]. Biodiversity impact assessments for business need a robust concept of biodiversity and to generate results or insights that can be actioned within a decision-making framework.

Commercialisation

Commercialisation of products derived from wildlife resources has potential to generate wealth, reduce poverty, improve human well-being and raise awareness of the value of biodiversity, incentivising its conservation. Nature-based enterprises are diverse in operation but with more support can bring new foods, medicines and materials to market providing more protection for biodiversity, resilience to climate change, while simultaneously generating spin-off benefits to help poor communities [71].

Science-policy-practice bridge

Bridging the communication divide that often exists between research, policy and practice is needed to prevent loss of knowledge from a lack of understanding. Appropriate evidence and analysis is needed to understand the constraints and solutions for the interlinked challenges of climate change, poverty, food security and biodiversity. The solutions identified by the evidence then need to be translated for use in policy frameworks, or to support policy, investment and management decisions, so the solutions can be scaled up into practice [72]. Evidence based solutions will help global donors with the business case for better-directed investments (subsidies, taxes, incentives etc.) to avoid unintended outcomes.

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System Transformation

Barriers to systemic transformative change include failure to challenge the incumbent political-economy, and a lack of understanding of where the leverage points in a system exist and who is best placed to act on them.

Systems-level approaches are needed to address the complex interlinked societal challenges facing policymakers today, including transformation across technological, economic and social systems [73,74]. For example, biodiversity cannot be separated from the challenges of climate change, natural hazards, food security, urbanization, poverty alleviation and global health, nor the dynamics introduced by political economy, governance, power and vested interests. Such challenges will require resilient and effective responses that are sustainable for all parts of the system and work for both people and ecosystems.

Encouraging a transformative change from current trends in management of biodiversity to more sustainable approaches will require a more collaborative approach to implementation of priority governance interventions targeting specific leverage points. Depending on the specific context, levers may be applied by a range of actors such as intergovernmental and non-governmental organisations, governments and the private sector; and it is important to understand the power dynamics within a system to identify which leverage points would be a priority (**Figure 9**) [75]. Transformative interventions are likely to be integrative, informed, inclusive and adaptive [76].

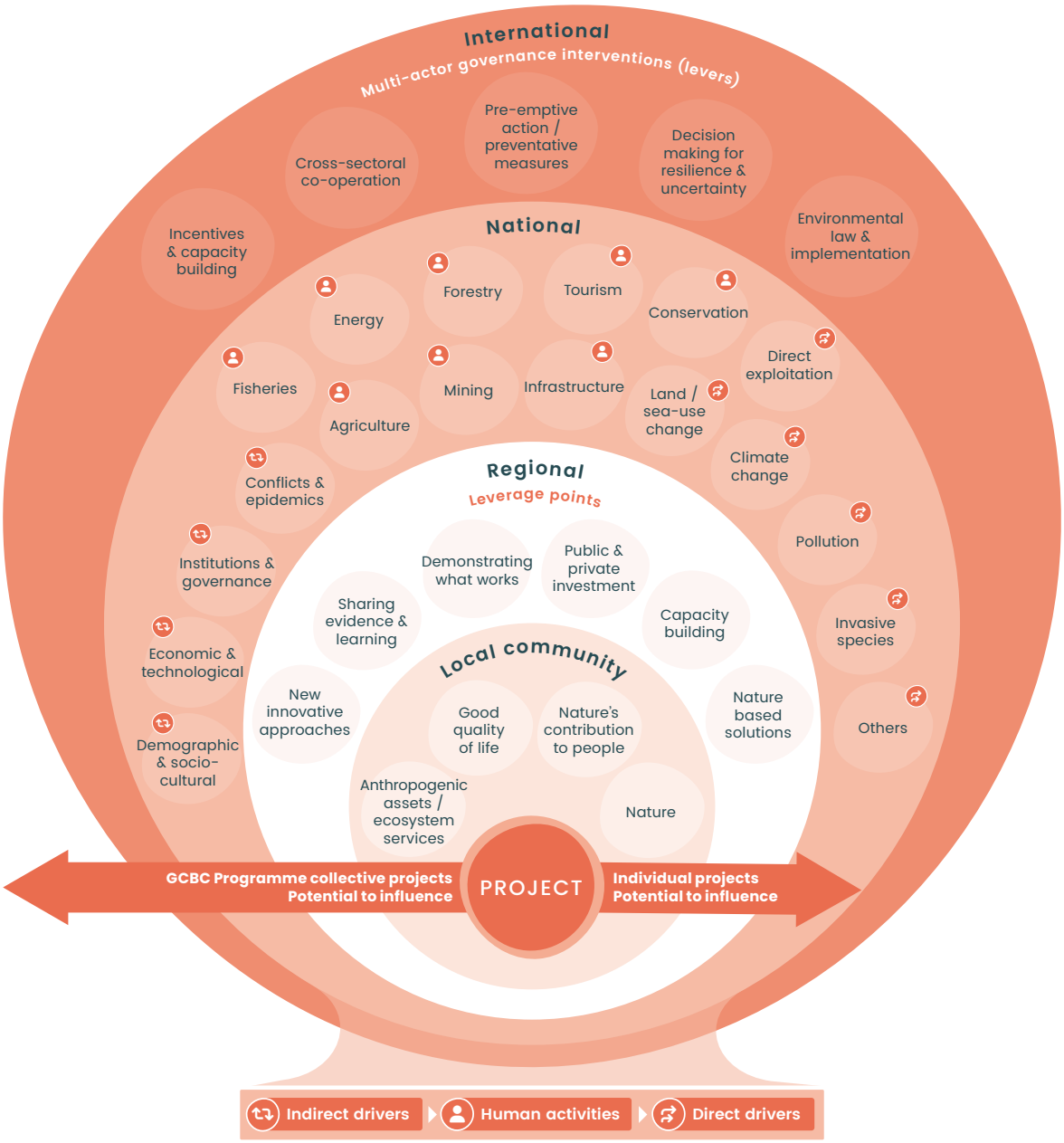

Figure 9: GCBC potential for transformative change in global sustainability pathways

One Health Approach

Figure 10: One Health Approach

One Health Approach looks at the complexity of the relationships between the health of people, animals (livestock and wildlife), plants, fungi and the environment (ecosystem) to develop mutually beneficial interventions. A better appreciation of the links between climate change, biodiversity, health and disease can enhance the understanding of how health-focused measures affect biodiversity, conservation measures affect health, and climate mitigation measures impact on biodiversity and health. This integrated multi-disciplinary perspective is essential to manage biodiversity and ecosystems to meet the demands of rapid urbanisation, climate resilience, and reduce the burden of disease. In addition, it can identify the socio-economic drivers by which the links are influenced; and in so doing, determine the appropriate interventions and policies[77].

The GCBC programme will apply a systems approach throughout implementation for all projects, initiatives and guidance notes developed. Important characteristics of a systems approach include attention to productivity, profitability, efficiency, stability, sustainability, equity, flexibility, adaptability and resilience. The One Health approach is an example of a systematic approach / framework that can be used (**Figure 10**).

Connected resilience is not just about enhanced risk assessments and precautions, but being prepared for, to cope and to recover quickly from national crises. This means projects should look at the big picture and all the ways in which a society is connected and interdependent, with an appreciation of how business, environment, society (nationally and internationally) all need to work together. In this context, it is important to keep in mind all five 'capitals' not just the financial case as follows[78]:

- **Natural environment** (as the basis of all life);
- **Human capital** (skills and aptitudes);
- **Social capital** (institutions and communities);
- **Physical capital** (everything from infrastructure to cities to manufactured goods); and
- **Financial capital** (the means of transfer between the other four capitals).


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Assessment of sustainable livelihood strategies of rural communities provides real practical value in resource conservation as rural communities are mainly responsible for the degradation of these resources. A livelihood is sustainable when it can cope with and recover from stresses and shocks[79], while not undermining the natural resource base. The Sustainable Livelihoods Approach (**Figure 11**) considers the five 'capitals' above as 'Livelihood Assets' and provides an approach to enable local people and communities to bring in their knowledge and perception into the decision-making processes.

Livelihood support measures can either be direct to encourage the use and management of specific biological resources or ecosystems increasing their value and sustainability for local income and subsistence; or indirect through rural development activities, with support to social infrastructure and employment generation, that improve, diversify and make livelihoods more secure, providing choice and affordability, to curtail economic activities that degrade biodiversity[68]. Community benefit-sharing is a widely used incentive for biodiversity conservation using the revenues generated by protected areas to finance development activities in adjacent rural areas[68].

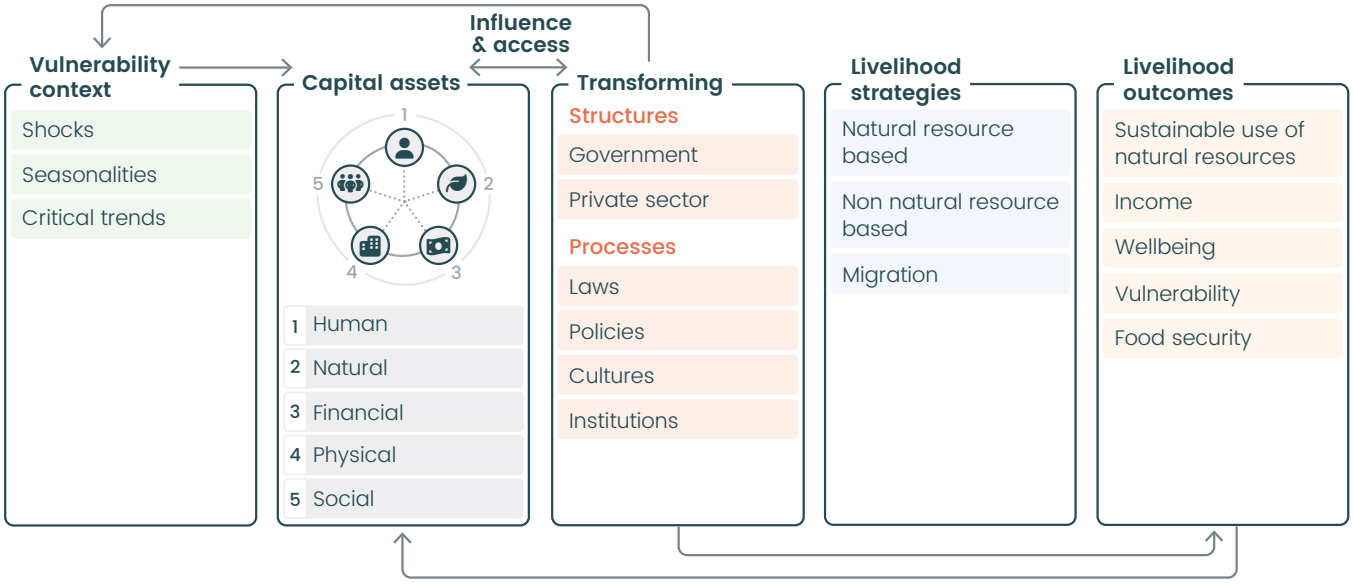

Figure 11: System transformation and sustainable livelihoods[80]

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Programme Delivery

Governance

The GCBC Hub, is comprised of DAI Global as the Fund Management Lead (FML) and the Royal Botanic Gardens, Kew (RBG Kew) as the Strategic Science Lead (SSL) (**Figure 12**). An Evidence Advisory Group (EAG), appointed by Defra will provide independent advice and scrutiny on the design, scope and outputs of the GCBC. The GCBC will be delivered through a hub and spoke model. The 'hub' will commission the research spokes, bringing together world-leading developing and developed country experts to deliver high impact research, data and evidence.

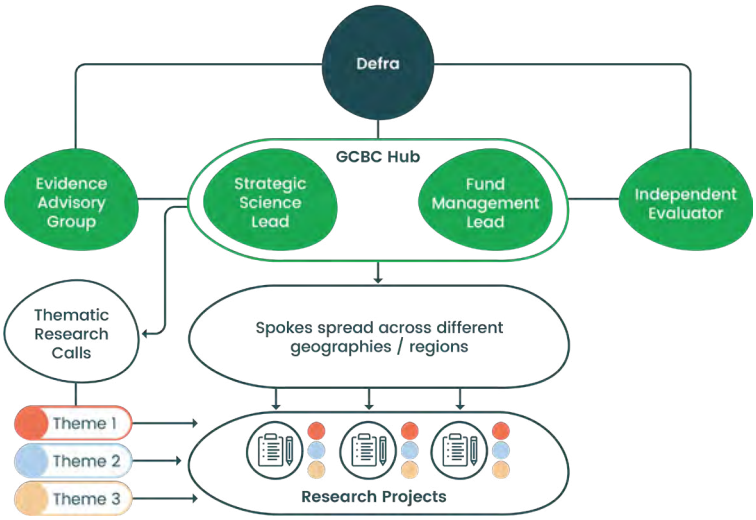


Figure 12: GCBC programme structure

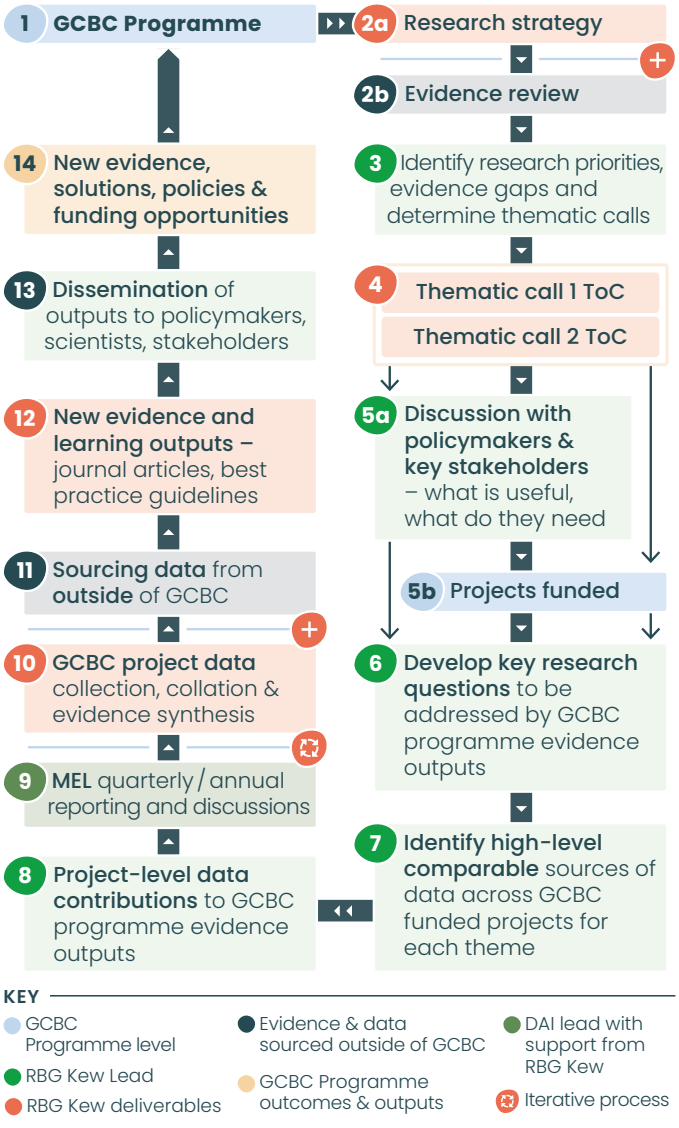


Figure 13: GCBC evidence synthesis process

Evidence Synthesis

SSL will be responsible for the strategic science direction of the GCBC, identifying themes and priorities to inform grant calls, gather insights, data and learning from funded projects (**Figure 13**) and other sources to inform future research and guidance to stakeholders (researchers, policy makers, practitioners, business etc.).

SSL will support the implementation of the Research Strategy and development of a high-quality evidence base, sharing research and learning opportunities widely, and contributing to the technical and practitioner literature.

Activities (what we do)

The GCBC will focus on three areas of engagement (activities) with key actions for each activity (**Table 2**).

Activities		Aim	Ambition
1. Fund research projects on climate resilience, biodiversity loss and improved livelihoods.			
1.1	Run themed grant competitions to develop portfolios of inter- disciplinary research projects, with a strong poverty reduction focus.	Funding calls support a coherent portfolio of research projects focused on themes informed by existing priority areas of engagement, emerging opportunities for research and collaboration with GCBC partners.	Projects use a systems approach to solve specific research problems and evidence gaps related to GCBC themes from the nexus of climate, biodiversity and livelihoods, to test, deliver and demonstrate effective solutions.
1.2	Support implementation of research projects with a focus on science, learning and impact.	E-platform provides a core tool for GCBC Hub partners and project leads through inception, implementation and close out phases of projects for all Monitoring, Evaluation and Learning (quarterly and annual) reporting and scientific data.	A strong and consistent focus for each project on science, learning and impact; with its own theory of change to ensure a positive impact over its life cycle makes a difference to stakeholders engaged in the project.
1.3	Monitor, evaluate and learn from projects and themes to increase understanding of evidence gaps and priorities.	Thematic grant calls bring together portfolios of funded research projects to fill the evidence gaps for the specific themes; and outputs are integrated to deliver the evidence base.	Projects contribute science data into specific thematic level scientific outputs; to inform future programme activities and thematic funding calls by incorporating knowledge gains and highlighting existing evidence gaps.
2. Consolidate new and existing evidence, research and learning to inform policy and practice.			
2.1	Synthesise a new and widely accessible, high quality evidence base across themes and geographies.	Data collected from projects and activities inform an annual synthesis report; and enable the programme to develop fact sheets, tool kits, best practice guides etc. to support project partners in project implementation.	Evidence products including case studies, gap analyses, impact evaluations, policy briefs, journal publications etc. support policymakers and practitioners adopt and upscale new approaches for transformative change.
2.2	Broaden access to evidence and knowledge base developed across the programme by various communication channels / events.	Programme learning from new and existing research, case studies, evidence synthesis and products, is promoted by developing communication channels through webinars and learning on the GCBC website.	Regular virtual and in-person learning events (monthly or quarterly) and Annual Symposia help project partners and stakeholders benefit from programme outputs to deliver robust research, evidence and data.
3. Facilitate international partnerships for inter- and trans- disciplinary collaboration.			
3.1	Promote stakeholder engagement to understand interests and opportunities for collaboration, catalysing inter- and trans-disciplinary partnerships.	Stakeholder and organisational mapping provides understanding of existing international networks, and multi-disciplinary work across geographies to explore where value can be added.	Stakeholders (government, international/ community and development practitioners, industry, funders etc.) with an interest in developing and scaling biodiversity solutions engage with projects, programme website, international network and events.
3.2	Develop a diverse and inclusive International Network to share information and build capacity of research, policy and practice.	International Network fosters target engagement with specific sectors, focus on key challenges and priority research areas; and development of research projects and associated evidence for adoption.	Virtual Network Platform and in person regional-based approach through GCBC Hubs helps solve future challenges, maximises contributions and complements skills working together.

Geographic Focus

Countries eligible to receive official development assistance (ODA)[81] in Sub-Saharan Africa, Latin America (including Central America) and the Caribbean, Southeast Asia and the Pacific and Small Island Developing States have been identified as the focus for GCBC funded research.

Delivery Principles (how we work)

In order, to meet the ambition of the programme ToC, the GCBC has set out ten delivery principles (**Figure 14**) adopted in the design and implementation of all projects and activities across the programme to deliver the systems approach needed for transformative change. These delivery principles are set out below and with the six GCBC strategic science priorities: **1)** Demonstrating what works, **2)** Capacity building, **3)** Best practice, **4)** Informing policy, **5)** Finance and **6)** Transformative change) (**Table 3**), provide a framework for considering the evidence base and policy development from all aspects together.

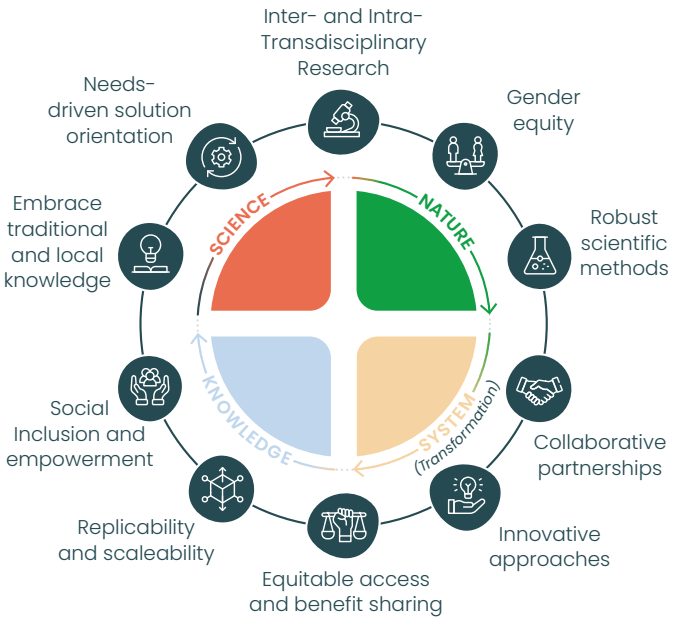


Figure 14: Ten GCBC Delivery Principles

Ten Delivery Principles

	Inter- and Intra-Trans-disciplinary Research	Integrating knowledge from different disciplines and with non-academic stakeholders, respecting social, economic and environmental approaches.
	Innovative approaches	Using a systems approach and new technologies/data to prove what is useful in practice to enhance natural diversity while drawing value in a healthy and sustainable manner.
	Robust scientific methods	Collection and analysis of data to answer the research question with confidence in the analytical decisions to define the outcome and recommendations.
	Replicability and scalability	A clearly defined strategy as to how the solutions demonstrated can be sustainable, scalable and replicable to increase impact at an increased rate.
	Traditional / Local Knowledge	Embrace ancestral and indigenous knowledge, languages and views on local context[43] drawing inspiration from local, indigenous and traditional practices.
	Gender equity	Recognising differential impacts of biodiversity loss and environmental degradation on men and women (across different socio-economic and indigenous groups); and the barriers to their inclusion[82-84].
	Social inclusion and empowerment	Of indigenous and local communities to ensure those less resilient to climate-related shocks are involved and empowered to adopt solutions.
	Equitable Access and Benefit Sharing	Ensuring benefits from the use of the natural resources are shared equally between those using the resources in the local communities and the providers.
	Collaborative partnerships	Including with government ministries and intergovernmental organisations to help take-up of successful interventions nationwide by the relevant Ministries and supporting bodies.
	Needs driven, solution orientated	A realistic understanding of the identified demand, value chains and how the intervention/ solution can be sustained in social, environmental and financial elements.

Monitoring, Evaluation and Learning (demonstrating what works)

The GCBC Hub (Kew and DAI) with Defra will review progress in implementing the Research Strategy on an annual basis, including an assessment of key outcomes and achievements in strengthening links and co-ordination; and aim to complete annual reviews of progress with supporting synthesis of evidence. Progress will be monitored against a series of agreed internal indicators (Key Performance Indicators - KPIs) and external global targets and indicators, which will include alignment with the International Climate Finance (ICF) Indicators (excluding energy KPIs) and the Kunming Montreal Global Biodiversity Framework to ensure the programme is developing in a relevant and useful direction. For example, transformational change (KPI15, 'change that catalyses further change') is one key indicator that GCBC will be monitoring its own progress against utilising the score and qualitative process set out by the ICF. Central to this is positioning the GCBC evidence base and international network as tools that align to the CBD 2030 Goals and Action targets (CBD, 2022) and have the potential to fill gaps in the alignment between current tools and action targets[85].

No.	1	2	3	4	5	6
Global Challenge	Transition to clean technologies and sustainable practices across all sectors.	Build resilience and adapt to climate impacts supporting communities, economies and ecosystems.	Increase protection, conservation and restoration of biodiversity and tackle key drivers of nature loss.	Strengthen international agreements and co-operation to accelerate delivery of climate and nature commitments.	Align global financial flows with a net zero, climate resilient and nature positive future.	Shift trade and investment rules and patterns to support the transition to a net zero, climate resilient and nature positive future.
SYSTEM TRANSFORMATION						
GCBC Science Priorities	**Demonstrating what works** Sustainable management approaches for agriculture, forests, natural resources and land use, integrating climate adaptation/ mitigation and the interface with other sectors.	**Capacity Building** Working with IPLCs, by promoting innovation, coordinated policy action and investment to improve climate resilience and restore/ protect biodiversity.	**Best Practice** Identify, develop and validate new innovative approaches to protect, value and sustainably manage biodiversity for replication and scale across countries and regions.	**Informing Policy** Lead internationally by sharing evidence and learning for innovative policies and practices through collaborative partnerships and networks to inform Governance.	**Finance** Increase public and private investment in more effective climate resilient development through conservation and sustainable management of biodiversity to improve livelihoods.	**Transformative Change** Address indirect and direct drivers as well as socio-economic inequalities to mainstream biodiversity objectives into relevant sectors, from health to agriculture, infrastructure and finance.
Activities	***Fund research projects on climate resilience, biodiversity loss and improved livelihoods*:** • Run themed grant competitions to develop portfolios of inter-disciplinary research projects, with a strong poverty reduction focus. • Support implementation of research projects with a focus on science, learning and impact. • Monitor, evaluate and learn from projects and themes to increase understanding of evidence gaps and priorities.		***Consolidate new and existing evidence, research and learning to inform policy and practice*:** • Synthesise a new and widely accessible, high quality evidence base across themes and geographies. • Broaden access to evidence and knowledge base developed across the programme by various communication channels / events.		***Facilitate international partnerships for inter- and trans- disciplinary collaboration*:** • Promote stakeholder engagement to understand interests and opportunities for collaboration, catalysing inter- and trans- disciplinary partnerships. • Develop a diverse and inclusive International Network to share information and build capacity of research, policy and practice.	
Delivery Principles	*Inter- and Intra- Trans- disciplinary Research*	*Innovative approaches*	*Robust scientific methods*	*Replicability and scalability*	*Traditional /Local Knowledge*	*Gender equity*	*Social inclusion and em- powerment*	*Equitable Access and Benefit Sharing*	*Collaborative partnerships*	*Needs-driven, solution orientated*

Table 3: How GCBC strategic science priorities will address six global challenges from the 2030 strategic framework for international climate and nature action

GCBC Investment, Innovation and Action

Evidence based research will address the six strategic science priorities set out in **Table 3**. These strategic science priorities are detailed here with examples of the interventions which can leverage change that can be addressed by GCBC funded projects (as appropriate to the different themed calls of the grant competitions) and initiatives.

Case studies from GCBC funded projects are given as examples of the practical innovation and actions that can be implemented through the GCBC.

These are drawn from the first fifteen projects funded (£11.5m) under the GCBC (since 2022) operating in 28 countries with over 90 delivery partners. The fifteen projects have led to 128 research partnerships (70 with public organisations, 23 with private sector entities and 35 with third sector) strengthened or formed, and over 3,500 people engaged, either based in the Global South or with strong North-South partnerships, and leveraging over £550k of public and private finance.

1 Demonstrating What Works

Sustainable management approaches for agriculture, forests, natural resources, and land use, integrating climate adaptation/mitigation and the interface with other sectors:

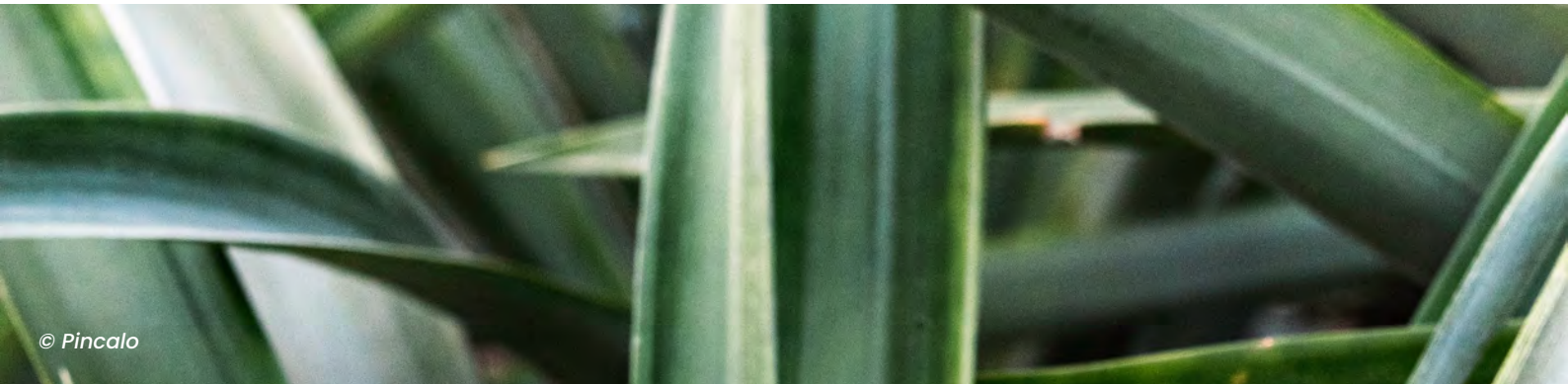
- Develop and facilitate approaches for multi-functional sustainable agriculture (including agro-forestry, aquaculture, crops, horticulture, livestock) for food, fibre, fuel and pharma supply chains.
- Identify natural resource management (NRM) approaches resilient to climate change including protection and/or enhancing ecosystem services, water resource management, natural resource extraction and protecting and/or restoring habitats.
- Develop strategies for minimising ecosystem degradation and rehabilitating degraded ecosystems with an emphasis on community designed programmes.

Delivering climate resilience through safe and sustainable food systems (OneFood)

The link between food production and nature means that actions on food security impact on the environment and vice versa. Climate change adds further complexity. Hazards drive inefficiencies in food systems. **A risk analysis tool mapping data on hazards has been has been developed to calculate the impact of complex hazards interacting within the whole food system to demonstrate how hazard control creates benefits in terms of yield, profit, trade and biodiversity protection**. The tool will model the country's climate, chemical and pathogen hazards as a holistic entity, to determine: a) key interlinkages across each type of hazard and with the most risks for the food sector and biodiversity; b) optimum benefit from minimising hazards versus maximising yield and climate adaptation; c) impact on export markets and products for domestic use; and d) benefits for other sectors from hazard reduction in one food sector. This identifies the capability and capacity (science, policy) needed to efficiently measure and manage complex hazards which interact with national food systems; and how regional approaches to hazard identification and management could benefit climate – efficient food system resilience at the national level.

UK: One Food (Defra); Animal and Plant Health Agency; Centre for Environment, Fisheries and Aquaculture.

South Africa: Department of Science and Innovation, Council for Scientific and Industrial Research, Human Sciences Research Council, National Agricultural Marketing Council, Agricultural Research Council, Department of Forestry, Fisheries and Environment, FAO. FCDO Science and Innovation Network.



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2 Capacity Building

Working with IPLCs, to promote innovation, coordinated policy action and investment to improve climate resilience, restore/protect biodiversity and improve livelihoods:

- Empower marginalised communities (particularly women) to increase productivity of farming systems to reduce emissions, restore biodiversity and improve livelihoods.
- Develop evidence and toolkits to incorporate biodiversity consideration into climate assessments and adaptation planning (e.g. waste management and water supplies).
- Identify management practices within Urban Green Infrastructure to consider the importance of bio-diversity friendly areas and compensation policies.
- Develop evidence and frameworks for effective mainstreaming of biodiversity-health linkages in policy making for climate resilience through holistic approaches.

TerraViva – Restoring biodiversity, improving carbon-efficiency and building sustainable coffee landscapes

In southern **Colombia**, the coffee-growing community have prevailing monocropping production systems, unsustainable agricultural practices, a history of social armed conflict and a lack of access to markets. By understanding the interactions of the interconnected patchwork of different land uses, ecosystems, land covers and human dimensions (governance structures, communities, socio-economic status) using participatory tools such as appreciative inquiry and the Community Capitals Framework (CCF) (systems research approach, with seven capital assets: natural, human, social, cultural, build, financial and political), a new tool has been developed. **The Common Territorial Agenda (CTA) is a replicable sustainable landscape approach for any productive landscape, to inform decisions by communities of producers to restore biodiversity, improve carbon-efficiency and livelihoods on a farm-by-farm issue.**

Colombia: Sustainable Agriculture Network (SAN); Alliance of Biodiversity International, International Center for Tropical Agriculture (CIAT), Fundacion Natura, Inter-American Institute for Cooperation on Agriculture (IICA).

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3 Best Practice

Identify, develop and validate new innovative approaches to protect, value and sustainably manage biodiversity for replication and scale across countries and regions:

- Increase / improve / build crop diversity (local landraces, wild species, underutilised species, and traditional knowledge).
- Couple economic incentives for sustainable agriculture with strengthening governance of land tenure and land zoning to prevent further loss of forests, wetlands and grasslands.
- Promote and support a coherent set of evidence-based metrics and standards to evaluate and monitor biodiversity across agricultural productivity, resource use and environmental impacts.

DEEPEND: Deep Ocean Resources and Biodiscovery

The green energy transition is Increasing demand for certain natural resources, such as lithium, cobalt and manganese, for use in electric vehicle batteries. With vast reservoirs of minerals present in the deep sea, the biodiversity value (intrinsic and economic) from seabed mining protected marine regions in Areas Beyond National Jurisdiction (ABNU) in the abyssal central tropical Pacific and abyssal north Atlantic is being determined. Baseline data of the variation in chemistry from different organisms and the same organism from different locations and under different stresses will determine how their chemistry has helped organisms survive extreme environments. A lab protocol will allow assessment of deep-sea samples for natural products, specifically for their potential to treat endemic diseases (e.g. diabetes and Neglected Tropical Diseases such as Dengue). Working with new networks and capacity-building in Pacific Small Island Developing States (PSIDS) (Cook Islands, Kiribati), will expand potential collections and collaboration to support identification of sustainable solutions to ocean mineral mining and delivery of key conservation messages based on scientific data.

UK: Natural History Museum, National Oceanography Centre, University of Aberdeen, University of Strathclyde Glasgow, University of Southampton.

Pacific: Cook Islands Seabed Minerals Authority, University of the South Pacific, Pacific Community.

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4 Informing Policy

Lead internationally by sharing evidence and learning for innovative policies and practices through collaborative partnerships and networks to inform Governance:

- Develop, validate and implement innovative technologies to generate new data and decision-support systems that integrate biophysical and socio-economic information that enable learnings to be scaled and replicated elsewhere.
- Utilise biodiversity / ecosystem services databases, to develop novel, innovative approaches to harnessing this data in ways that will benefit biodiversity, climate change and livelihoods (including medicines, health).
- Support improved transparency and access to information to ensure that interventions are effective and efficient, and do not create perverse incentives.

Biodiversity positive mining for the net zero challenge (Bio+ Mine)

The Philippines is a major producer of copper, an essential metal for the energy transition to renewable energy and has the capacity to increase production fivefold. Bio+ Mine has delivered an in-depth audit of the abandoned Sto. Nino site in Benguet for geological, hydrogeological, ecological and social parameters. The project has developed with Local Indigenous People (IP) communities the data cube as a tool to design nature and people positive interventions for the regeneration of the mine site. Innovative technologies used include low-cost drones for remote sensing and monitoring, advanced automated mineral characterisation tools for rapid and thorough analysis of mineralogical materials as well as rapid environmental DNA techniques for sampling water, soils and water materials. Future realistic interventions for a nature positive and sustainable future use of the site by the empowered indigenous communities will be linked to devising ongoing, affordable, monitoring programmes that can assess the success of the interventions. The project will provide an exemplar to be further developed for planning post-mining landscapes elsewhere.

UK: Natural History Museum, Imperial Collect London.

Philippines: De La Salle University, Mindanao State University, Iligan Institute of Technology, University of South Wales, Sydney.

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5 Finance

Increase public and private investment in more effective climate resilient development by conservation and sustainable management of biodiversity to improve livelihoods:

- Identify actions countries can take to improve resilience measures in the shorter term and inform future investments in adaptation of biodiversity conservation.
- Identify how 'payments for ecosystem services' or 'payments for agrobiodiversity conservation' approaches reduce biodiversity or agrobiodiversity loss, whilst delivering co-benefits for climate mitigation and poverty reduction.
- Identify innovative finance modalities to encourage more investment opportunities in natural capital for businesses to address the triple challenge of climate resilience, biodiversity conservation and improved livelihoods.

Nature Transition Support Programme (NTSP)

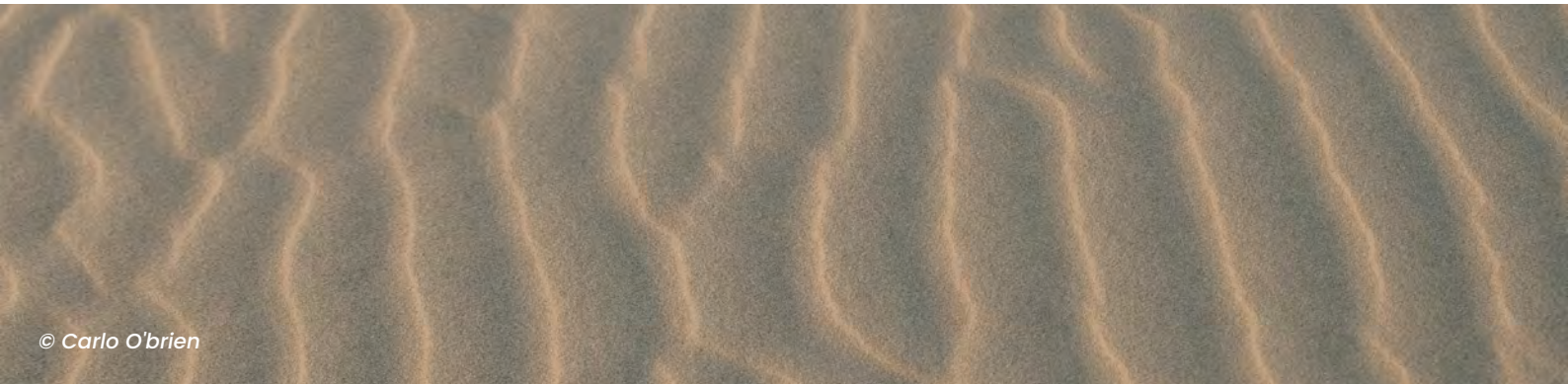
The NTSP aims to identify pathways towards an economy that is embedded within nature and set out a credible strategy for a whole economy transition in partner countries. The project is exploring the minimum viable data needed to effectively map natural capital and monitor changes in condition with pilots in Colombia and Ecuador, to understand a) ecosystem health - whether spatial links can be made between activities that draw down natural capital; and b) economic effects on Gross Domestic Product (GDP) resulting from Business as Usual (BaU) use of natural assets. Sectors most exposed to biodiversity loss as well as sectors that cause depletion of those resources will be prioritised. Data sets developed will be integrated into a **decision framework for land use planning (e.g. agriculture, mining) as part of a strategy to mainstream nature into decision making for Governments** in the two countries.

UK: UN Environment Programme World Conservation Monitoring Centre.
Colombia: Alexander von Humbolt Biological Resources Research Institute.
Ecuador: Instituto Nacional de Biodiversidad (INABIO).
US: United Nations Development Programme, University of Minnesota.

Trialling an incentive mechanism for agrobiodiversity conservation

Communities in Western Ethiopia maintain their farms as hotspots of agrobiodiversity, delivering a 'public good' for global agricultural systems. Yet farms receive few benefits for services provided. When communities become more vulnerable and less resilient, they have little alternative than to exploit wild resources including by habitat conversion and deforestation resulting in a poverty trap. The project is adapting the concept of 'payments for ecosystem services' to an agrobiodiversity context. **A novel, cost-effective conservation incentive mechanism, will reward farmers for maintaining agrobiodiversity and specifically targets the recovery of declining crop species and landraces (e.g. yams, enset)**. By enhancing livelihoods, local farmers' roles as custodians of indigenous forest will be strengthened, reducing rates of destructive exploitation of wild plants.

UK: Royal Botanic Gardens, Kew. Alliance of Bioversity International, CIAT. Ethiopia: The Nature and Biodiversity Conservation Union, Ethiopian Biodiversity Institute, Addis Ababa University.



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6 Transformative Change

Address indirect and direct drivers as well as socio-economic inequalities to mainstream biodiversity objectives into relevant sectors, from health to agriculture, infrastructure and finance:

- Identify nature-based solutions to help address pressures on land and water resources from mismanagement of tourism.
- Target efforts to preserve local flora and fauna biodiversity pool for use in conservation, research and/ or commercial applications.
- Realise the potential from products derived from nature to improve livelihoods in the face of climate change; and raise awareness of the value of biodiversity to incentivise conservation.

Realising the potential of plant bioresources as nature-based solutions in African biodiversity hotspots: supporting climate resilient sustainable development

Sustainable use of the diverse library of underutilised species and bioresources – including timber, medicines and valuable chemicals – is an untapped opportunity to alleviate poverty, develop value chains and tackle food insecurity, whilst being underpinned by nature conservation. **High value plant biodiversity hotspots and the pathways to develop bioresources within them in Ethiopia, Guinea and Sierra Leone are being characterised**. Research includes: a) plant-focused case studies with valuable plant-derived chemicals, crop wild relatives and underutilised crops; b) novel collections; c) field and bioinformatic modelling; and d) understanding bioclimatic and socio-economic drivers of agrobiodiversity hotspots. An ecosystem assessment toolkit will help to understand social and agroeconomic provisioning services that high biodiversity landscapes provide in the surrounding area and their impact on local communities.

UK: Royal Botanic Gardens, Kew. Sierra Leone: Njola University.

EU: Alliance of Biodiversity International. CIAT.

Ethiopia: Addis Ababa University. Ethiopian Biodiversity Institute.

Guinea: Herbier National du Guinee, Guinee Ecologie, Institut de Recherche Agronomique du Guinea, Centre Forestier Nzerekore.

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