GLOBAL CENTRE ON BIODIVERSITY FOR CLIMATE

Annual Evidence Review

GCBC Annual Evidence Review 2023

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Foreword

Department for Environment Food & Rural Affairs

Successfully addressing the interlinked challenges of biodiversity loss, climate change and poverty alleviation requires targeted place-specific evidence. The launch of the Global Centre on Biodiversity for Climate (GCBC) in 2022 marked a significant step in the United Kingdom's delivery of such evidence. It was a timely development because the urgency for this evidence has never been greater; extreme events and other shocks from the climate system are increasing, as is the speed of biodiversity loss, with negative impacts from both on communities around the world. Evidence that provides understanding of how biodiversity can be better harnessed to create greater resilience to climate change offers significant opportunities to alleviate poverty globally.

Since its inaugural year, GCBC has run activities and events that continue to shape and consolidate the programme's place in a substantial research landscape. The Fund Management Lead (DAI Global) and Strategic Science Lead (RBG, Kew) delivered a first competitive research grant round in 2023 which saw 14 new projects join the GCBC portfolio. Another highlight has been the GCBC research symposium, held in March 2024, which brought together all GCBC projects to discuss their research and share the positive outcomes many of them are already having on the local communities and environments they are working with.

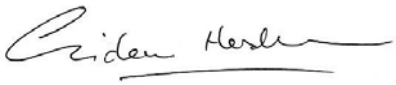
Central to the GCBC is the recognition that, to achieve outcomes that protect biodiversity, improve climate outcomes, and protect vulnerable communities, a commitment to evidence must inform decision making, policy and investment. It is just as important that this evidence is built on equitable collaborations, particularly in the face of continuing change and uncertainty in local contexts. To this end, the GCBC has prioritised collaborations led from the Global South and has created space for the transfer of knowledge between experts from around the world.

As we look towards 2025 and beyond, the GCBC will continue to identify opportunities to deliver high-quality evidence on the sustainable use of biodiversity for climate and livelihoods. It will champion scalable, replicable solutions, and provide a platform for local experts around the world to connect, collaborate and together construct a future that is sustainable, equitable and resilient to climate change.

This second GCBC evidence report presents key research insights from the current cohort of funded projects, details the progress of the GCBC programme towards its goals, and highlights the direction for future evidence delivery.

Professor Gideon Henderson

Chief Scientific Advisor, Department for Environment, Food and Rural Affairs



Executive summary

About the GCBC

Climate change, biodiversity loss and poverty are three of the most pressing global challenges to be addressed. The three challenges are fundamentally linked. Climate change, driven by human activity, is negatively affecting people and nature[1]. Biodiversity loss, which also results from human activity, is increasing; this exacerbates climate risk by reducing the resilience of natural and managed ecosystems[2]. While those living in poverty are often the most vulnerable and the least able to respond to the impacts of climate change (exposure to climate related hazards, impact on economic activities) and biodiversity loss (degraded landscapes and soil, increased food insecurity)[3].

Each of the three challenges connect to global agreements which set out goals to limit their impact - UNFCCC Paris Agreement on Climate Change[4], the UN Sustainable Development Goals (SDGs)[5], and the Kunming-Montreal Global Biodiversity agreement[6]. However, the risk of not meeting the goals for one challenge produces an inherent flow of risk in the other two[7]. Given these interdependencies, the goals cannot be addressed in silos, and the need for co-ordinated, effective, global action based on the best knowledge and evidence is more important than ever.

In light of this, the UK Government announced the Global Centre on Biodiversity for Climate (GCBC) at the 26th UN Climate Change Conference ("COP26") in 2021. This meets commitments under the International Development Act[8] and the International Climate Finance (ICF)[9] to support Official Development Assistance (ODA) eligible countries by building the resilience of people living in poverty and communities to the current and future effects of climate change while protecting, restoring and sustainably managing biodiversity.

On the ground, the GCBC looks to address these challenges through a portfolio of ODA funded research and development projects across priority geographic regions: Latin America and the Caribbean, South East Asia and the Pacific and Sub-Saharan Africa (including Small Island Developing States), and themes. In particular, the GCBC is bringing together world-leading research organisations and local experts to share knowledge and understanding on the sustainable use of biodiversity for climate resilience and poverty alleviation.

The GCBC is funded through 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).

GCBC 2023 in numbers

The first competitive research grant competition awarded 14 new projects funding, taking the total number of GCBC actively funded projects during the reporting period to 22 and the overall number of funded projects to 30

GCBC projects leveraged ***£10,333,231 in public finance*** *and* ***£492,118 in private finance***

31 new case studies *were produced demonstrating transformative change to address the nexus of climate resilience, biodiversity loss and improved livelihoods.*

150 new knowledge products *(models, frameworks, research products) were produced to support operational implementation of sustainable biodiversity activities*

93 new research partnerships *formed*

10,596 people *participating in GCBC led research activities*

75 new policy-relevant evidence products *produced*

Key progress towards the GCBC's goals

Highlights throughout the year include:

*Development and publication of the **GCBC Research Strategy** which outlines the ambition and vision for the GCBC programme with **six strategic science priorities and ten delivery principles** (Annex 1)*

*The **first research grant competition was launched** in 2023, with 14 projects funded*

*The **GCBC website launched in November 2023** with monthly newsletters planned to a GCBC stakeholder community with 645 organisations across 95 countries*

*The **second research grant competition launch** followed in early 2024, with successful projects expected to be on board before the end of 2024*

***A Research Symposium was hosted at RBG, Kew in March 2024** with GCBC funded projects taking the opportunity to share insight into their research and outcomes*

GCBC research insights 2023

While 2023 was a busy year for the GCBC programme, with the launch of the first competitive grant round and design of the second competition, seven ongoing research projects continued their work towards improving the knowledge base around the issues of sustainably using biodiversity to improve climate resilience and livelihoods. They faced challenges, but also made real progress towards improving our understanding in this complex area, providing many useful insights.

Innovative Seaweed Aquaculture

The Innovative Seaweed Aquaculture project set out to collect wild populations of eucheumatoid seaweeds (tropical red seaweeds), in Malaysia, for potential domestication at a research farm. The El Niño phenomenon provided an additional, yet extremely pertinent, challenge to their research goals this year. During El Niño, conditions at the research farm, including high temperatures (up to 38°C), slow water currents (less than 0.1 ms-1), and a lack of rainfall, led to the increased susceptibility of the eucheumatoid seaweeds to pests and ice-ice disease, and consequently a large number of seaweeds over this period were lost. However, this challenge also provided the team with an opportunity to observe the seaweeds that survived during the El Niño; providing potential new temperature-resilient cultivars, some of which grew very well and were successfully propagated. These results, while unplanned, will help to support the sustainability of the eucheumatoid seedstock for the industry amid the effects of a worsening climate.

Bio+Mine

The Bio+Mine project team published their methodological approach for developing a site-specific system for addressing issues associated with legacy mines, which is underpinned by the local community's knowledge and practices, empowering them to be active participants in key decisions (Alonzo et al., 2023). The aim is for this approach to serve as a model for wider implementation in other legacy mines around the world.

Environment Pollution

In their investigation into the effects of microplastics and organic pollutants on riverine fish the Environment Pollution project team developed a novel artificial fish assay approach, designed to determine chemical leaching and absorption into a local species of fish gut. This work provides a stepping stone to better understand the consequences of chemical uptake in a real-world context for both fish species and entire fish populations.

Nature Transition Support Programme

The NTSP project have produced several scoping reports that summarise the dynamics between ecosystems and the economy, as well as a baseline indication of what this shows in the context of four countries Colombia, Ghana, Ecuador and Vietnam. Each of the draft reports is being shared with the respective Government for feedback and to help understand the potential opportunities and limits that future research can explore at this intersection.

OneFood

The OneFood project team developed a functional model that evaluates the economic impact of hazard-associated yield losses across multiple food sectors. Hazard identification and mitigation is critical in order to support climate-resilient, safer, healthier, and more sustainable food supplies. The impact of a hazard is often felt across multiple food sectors, yet it is often investigated for its impact on single food sectors. The model is being finalised, but it is anticipated that such information will prove incredibly valuable to producers, researchers, and policymakers for identifying actions they can take to minimise hazards so that they can increase food yield both within their own sector and feeding across into other, linked, food sectors.

Nature-based Solutions

Evaluating the extinction risk of wild species is a crucial step in effective conservation planning, particularly through the assessment of species for the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. In 2022, more than 350 endemic plant species in Ethiopia lacked red list assessments. Through practical training and support the project has equipped 5 early career scientists with skills and experience to continue risk assessment efforts. Three scientists, among the first from Sub-Saharan countries, completed the IUCN Red List Trainers' Training course, creating in-country capacity to train others. This has led to extinction risk assessments being completed for all 467 Ethiopian endemic plant species, one of the largest country endemic floras to be comprehensively assessed to date. The newly trained Ethiopian scientists led on the authorship of 50 IUCN Red List assessments and provided co-authorship for more than 150 assessments drafted by the project team.

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Introduction

Background

The GCBC is a research grant programme that 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 improve climate resilience and alleviate poverty. 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 intends to support delivery of international (UN Sustainable Development Goal[1], Kunming-Montreal Global Biodiversity Framework[2] and the Paris Climate Agreement[3]) and national commitments (International Development Act[4] and International Climate Finance[5]) and help countries achieve a nature-positive future.

In 2022, a select group of projects was funded that established the GCBC's research portfolio, delivered by Defra. Fifteen projects investigating a wide range of research areas including deep sea biodiscovery, legacy mine management and hazard mapping in the global food system laid the foundation for the GCBC's vision of developing innovative, scalable, evidence-backed approaches to conserving and sustainably managing biodiversity.

In 2023, with the GCBC Fund Management team (DAI Global) and the Strategic Science Lead (The Royal Botanic Gardens, Kew) in place, the first competitive grant round was launched. Fourteen projects were funded in this initial competitive round. Each project will provide evidence to support our understanding on the role of biodiversity in agriculture and natural resources management for climate resilience and improved livelihoods. As the GCBC research community and international network continues to become established (2024 will see a second portfolio of projects funded), activities including sharing new and innovative research, hosting collaborative, insightful events and supporting diverse and equitable partnerships between the Global South and North will remain programme priorities.

About this Evidence Report

This report details the achievements and progress on the GCBC programme in its second year of implementation, following its initial development phase (Phase 1 April 2022- March 2023 delivered by Defra). It summarises the research activities and evidence generated between April 2023 – March 2024, inclusive of both Research Grant Competition 1 and Phase 1 research projects.

Strategic approach

The strategic direction of the GCBC programme is guided by the Research Strategy and the updated GCBC Theory of Change (ToC), both published in early 2024. Together, the Research Strategy and the ToC outline and 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 competitions 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 Indigenous Peoples and Local Communities (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.

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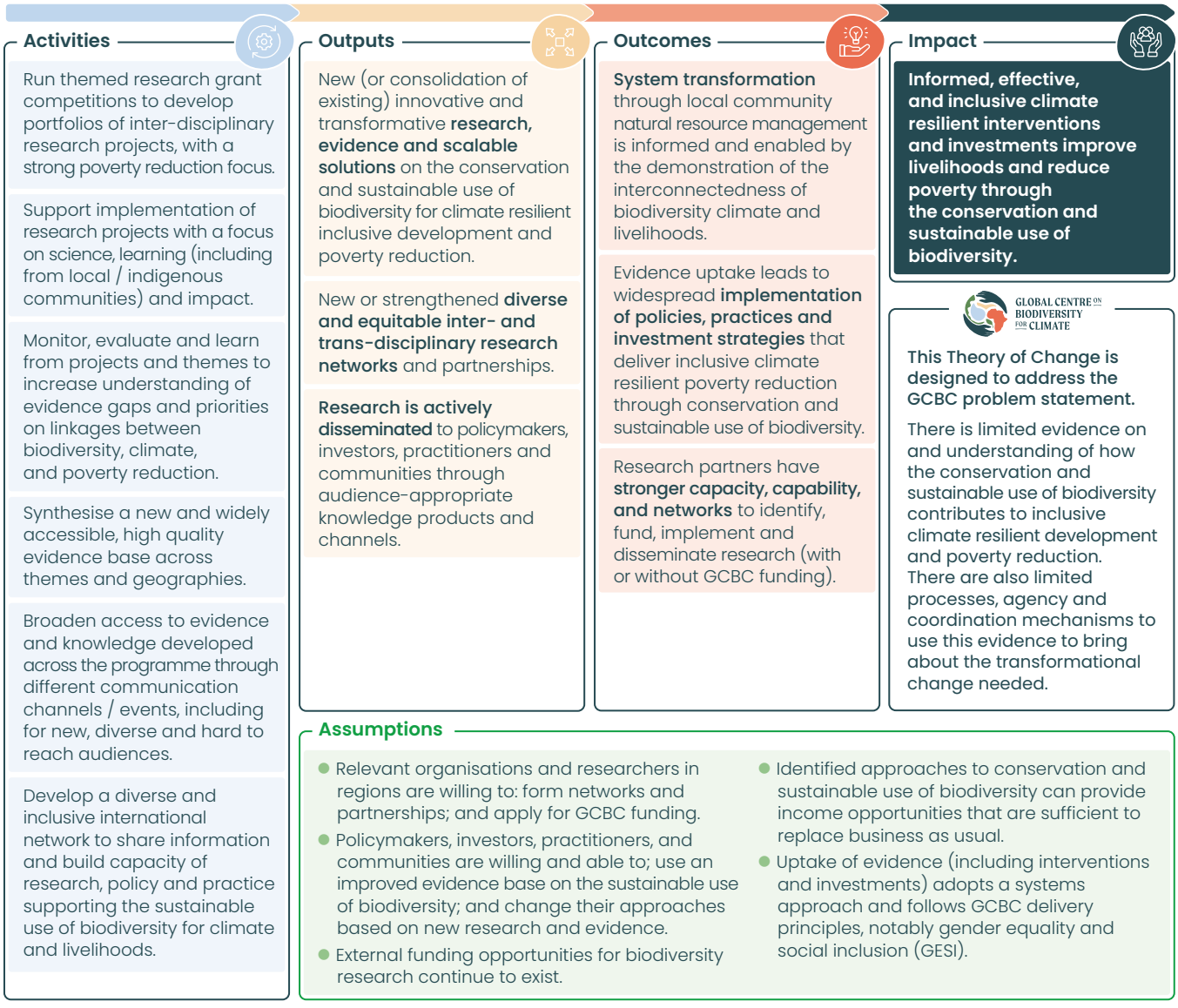

The Global Centre on Biodiversity for Climate is an international research and development programme that funds research into natural solutions to climate change and poverty. It was announced at UNFCCC COP26 with £40m of UK Official Development Assisstance funding. The GCBC's three targeted regions are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

Figure 1: *GCBC Programme Theory of Change*

Thematic evidence priorities

The first GCBC Research Grant Competition, held in 2023, invited applications for research projects that addressed **the role of biodiversity in Agriculture and Natural Resources Management (NRM) for climate resilience and sustainable livelihoods**. Research questions, intended as a guide for grant proposal development, sought to highlight thematic evidence priorities while also providing a broad platform that allowed applicants to address locally identified issues and to develop unique and scalable tools, solutions and innovations.

Evidence priorities were centred around four pillars: building evidence bases, local capacity building, informing policy and decision makers, and increasing investment in biodiversity conservation.

Biodiversity is crucial for the stability of functioning ecosystems and the ecosystem services they provide[6]. Agricultural and natural resource extraction activities are leading drivers of biodiversity loss, through their impact on land and sea use change[7]. Yet, biodiversity and the vital resources it provides are the building blocks for climate resilience and improving livelihoods, but this requires solutions and pathways to ensure a sustainable relationship between us and nature[8]. So how can natural resources be used in ways that protect and preserve their role in the wider ecosystem and support local livelihoods? How can the biodiversity needed to transition to agroecological / regenerative agriculture be supported? What biodiversity conservation and sustainable use techniques already

exist locally and are these appropriate for scaling up or replicating? Addressing these questions requires focused, high-quality research, in conjunction with timely, workable and impactful solutions and innovations, and effective governance and monitoring at the local, national and global scales.

Key project achievements in 2023

The further establishment and consolidation of the GCBC through 2023 saw good progress continue to be made towards the impact and outcomes outlined in the Theory of Change. Despite only being up and running towards the end of this reporting period, RGC1 grant recipients contributed more than expected towards some of this year's outcomes.

£10,333,231 in public finance and £492,118 in private finance was leveraged by GCBC projects in this reporting period to support effective climate resilient development via the conservation and sustainable use of biodiversity.

- Phase 1 projects leveraged £9,600,707 in public finance during the reporting period, of which, 99.5% was leveraged by a single project, DEEPEND.
- Phase 1 projects leveraged £172,93 in private finance during the reporting period, of which 100% was leveraged by the DEEPEND project.
- A total of £732,524 was leveraged in public finance by two RGC1 grantees (the Cherangany Forest Restoration project > 99% and the Harvest Resilience project < 1%).
- Cherangany Forest Restoration was the only RGC1 project to leverage private finance in this reporting period, £319,187.

31 new case studies were produced demonstrating transformative change to address the nexus of climate resilience, biodiversity loss and improved livelihoods.

- Phase 1 projects were solely responsible for the 31 case studies produced this reporting period, with many of their demonstrations outlined in the report.

150 new knowledge products (models, frameworks, research products) were produced to support operational implementation of sustainable biodiversity activities.

- The Phase 1 projects, DEEPEND (46) and Environmental Pollution (54), produced the majority of the knowledge products reported, accounting for 100 products between them.

93 new research partnerships formed or strengthened.

- Phase 1 projects reported a total of 54 new research partnerships formed during the reporting year.
- 39 new research partnerships were formed as RGC1 projects began.

10,596 people participating in GCBC led research activities.

- The Phase 1 project, Environmental Pollution, had 8224 people participating in their research activities for this reporting period.
- RGC1 grantees had 295 people participating in the early stages of their projects.

75 new policy-relevant evidence products were produced.

- The Phase 1 projects, Environmental Pollution (46) and Nature-based Solutions (16), accounted for 62 policy relevant evidence products this year.
- RGC1 projects contributed 4 evidence products.

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Research Grant Competition One (RGC1) Portfolio

Research Grant Competition One (RGC1) Portfolio

The first competitive grant round of the GCBC was conducted in 2023 addressing the research theme - **The role of biodiversity in agriculture and natural resources management (NRM) for climate resilience and sustainable livelihoods**. Fourteen projects received funding and began in the first half of 2024, with project durations up to 36 months. They cover a wide range of research and development areas across 16 countries, from identifying biodiversity positive management practices across the pastures of Madagascar, through to enhancing mangrove conservation with the use of gamification technologies for knowledge sharing among local communities.

As the research portfolio develops, there will be an emphasis on identifying cross-cutting aspects, particularly around the delivery principles of the GCBC (e.g., transdisciplinary ways of working, effective capacity strengthening, replicating and scaling work) that are present. The intention is to synthesise the outcomes and developments around the GCBC delivery principles to improve our understanding of how these work across many different contexts, providing support for future development, and practice and policy guidelines.

Figure 2: *Map of RGC1 project implementation countries*

01 Flourishing Landscapes Programme

Empowering communities to scale biodiversity's benefits across the agricultural-forest matrix

Countries: Ecuador, Ghana, Vietnam

Partners: University of Oxford (UK), Kwame Nkrumah University of Science and Technology (Ghana), Tay Nguyen University (Vietnam), IKIAM Universidad Regional Amazonica (Ecuador), PanNature (Vietnam), WWF Ecuador (Ecuador), Yakum (Ecuador), NatureMetrics (UK), WTW (UK)

Project duration: 36 months

Background

Humanity faces a triple challenge, encompassing climate change, biodiversity loss, and threats to livelihoods[1]. Urgent action is needed to address these interconnected issues holistically, including reducing emissions, halting deforestation, restoring nature, and promoting social justice. Tropical agricultural landscapes at forest frontiers face a particularly acute version of this challenge due to expanding commodity production and resulting deforestation, which contributes significantly to greenhouse gas emissions and biodiversity loss[2]. Moreover, smallholder producers, who are already vulnerable due to historical power imbalances, are now grappling with the impacts of climate change[3]. Therefore, it is essential to adopt a comprehensive approach that safeguards both the health of ecosystems and the livelihoods and wellbeing of those who depend on them.

Addressing the problem

The Flourishing Landscapes Programme (FLP) addresses the triple challenge of livelihoods, climate change, and biodiversity loss at tropical forest frontiers. It will develop novel landscape-scale transdisciplinary research, via a new network of scientists and practitioners, to investigate strategies to both biodiversity and the climate resilience of smallholder farmers. By investigating agroforestry and community-led reforestation as nature-based solutions (NbS), the FLP addresses key knowledge gaps regarding the role of biodiversity in maximising nature's contributions to people (NCPs) in agricultural landscapes. Building on this, via a human-centred design approach applied in Ghana, Ecuador, and VietNam in coffee and cocoa production landscapes, the FLP will co-design, with rural communities, a citizen-led biodiversity monitoring toolkit to empower communities to utilise adaptive management to harness NCPs in their production. To showcase the value of the research data sets and citizen-science approaches, the project will lead a co-design process with farmers, value chain actors and the insurance industry to explore risk sharing mechanisms that incentivise value chain investments in nature.

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02 Multifunctional Agroforestry Ethiopia

Multifunctional agroforestry for enhancing biodiversity, improving livelihoods, and creating resilient landscapes in Ethiopian highlands

Countries: Ethiopia

Partners: International Centre for Research Agroforestry (Ethiopia), Tree Aid (UK), The University of York (UK), Mattu University (Ethiopia), Mekelle University (Ethiopia), Ethiopian Biodiversity Institute (Ethiopia), The Ethiopian Forestry Development (Ethiopia)

Project duration: 35 months

Background

Ethiopia is one of the most biodiverse countries in the world, hosting several biodiversity hotspots including the Eastern Afromontane and the Horn of Africa. It is also home to a variety of traditional agroforestry practices known for promoting and safeguarding local biodiversity. Most agricultural production takes place in the highland areas from 1,500 to 3,200 metres above sea level, where land productivity has traditionally coincided with the densest rural populations. These landscapes are increasingly degraded with severe soil erosion occurring on the steep slopes from continuous cultivation. Scarcity of fuel wood in many rural areas compels farm households to burn manure and crop residues for household energy, thus resulting in further decreased agricultural yields, animal feed and pressure on remaining forests. The incorporation of trees into crop fields and agricultural landscapes have significant social, economic and ecological benefits[1,2]. There is an urgent need to promote portfolios of diverse tree species and management options that meet income, fodder, fruit, fuelwood and soil fertility needs without compromising biodiversity conservation goals. Moreover, as trees are vulnerable to climate variability and change[2], identifying resilient species for climate-resilient development and biodiversity enhancement is essential.

Addressing the problem

The project will generate evidence on how highland systems in Ethiopia could be improved for a more biodiverse future that supports improved livelihoods and poverty reduction. By comparing traditional and modern agroforestry systems in four regions of Ethiopia, the project will implement a suite of knowledge-based multifunctional agroforestry systems on homesteads, farmland areas, and model rural resource centres to promote uptake of multifunctional agroforestry. This will generate scalable tools, approaches, knowledge products and capacity building for thousands of highland farmers. It will also develop a strategy, partnerships, and infrastructure to lay the foundation for further land restoration, biodiversity protection, poverty alleviation, and improved ecosystem resilience.

Scattered trees on farm and agroforestry practices in Tigray

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Agroforestry landscape

03 Green Legacy Initiative

Deploying diversity as a strategic asset for scaling of Ethiopia's Green Legacy Initiative for climate change resilience and livelihoods

Countries: Ethiopia

Partners: Alliance of Bioversity International and International Centre for Tropical Agriculture (Italy & Colombia), World Vegetable Centre, The Centre for International Forestry Research, Ethio-wetland and Natural Resource Association (Ethiopia), The Ministry of Agriculture (Ethiopia), Ethiopia Forestry Development, Ethiopian Biodiversity Institute, Debre Berhan University (Ethiopia)

Project duration: 36 months

Background

Ethiopia is among those countries suffering the most from climate change effects including economic, social as well as political perspectives. Recurrent, long-lasting drought and unpredicted flash floods in recent years are climate change-related stresses affecting Ethiopia at large. The green growth economy strategies designed as the Green Legacy Initiative (GLI) is an important step towards adaptation to climate change through greening the landscape that ultimately results in the reduction of carbon emissions, increases biodiversity, creates jobs, ensures ecosystem health and functioning which results in the sustainability of crop and livestock production, and improves food and nutrition security. The initiative encompasses agroforestry, forest sector development, greening and renewal of urban areas, and integrated water and soil resources management with a long-term plan of reducing climate change impact and reversing environmental degradations.

Addressing the challenge

This project will focus on generating evidence-based information to ensure the economic, social equity, ecosystem and resilience benefits derived from GLI before its full scaling within Ethiopia and outside. This project is aimed at building on existing undertakings on survival rate and species composition of seedlings planted by GLI during the first and second phases of GLI at the national level. Capitalizing on existing information, this project will provide evidence-based information on diversity deployment of the system, its economic values, perception of the general community on the potential of GLI for ecosystem services and resilience to climate change.

The project will help to draw lessons for recommendations that can be used by policymakers to re-design GLI practices and impacts, if any. Using a modern state–of–the–art approach, the project will assess the types of plant diversity planted by GLI and its species- site matching, diversity for functional uses (food and diet, restoration, pollination, water percolation, medicinal value), and ecological functions (soil properties, carbon storage, habitat improvement etc.) as well as climate adaptation functions.

04 Nature Nurture

Upscaling smallholder resilience through improved research and networking for agrobiodiverse food, fuel, fibre and pharma supply chains

Countries: Indonesia, Tanzania, Philippines

Partners: International Institute for Environment and Development (UK), MWIWAARUSHA (Tanzania), The Non-Timber Forest Products – Exchange Programme (Philippines, Indonesia)

Project duration: 35 months

Background

Strong market forces are driving homogeneity in global food, fuel, fibre and pharma supply chains in search of product uniformity and scale efficiencies. Along with reducing biodiversity, this approach exacerbates inequality and poverty where smallholder farmers' livelihoods are disadvantaged and excluded in increasingly monopolised commercial supply chains[1]. Yet, diverse agroforestry systems still thrive in parts of the world, including the Labian-Leboyan Watershed in West Kalimantan Indonesia, the Ikalahan Indigenous community in the northeast of the Philippines, and Tanzania's Karatu and Monduli districts. Despite these examples, more practical research is required to understand how these inclusive, resilient systems are maintained in terms of social and ecological organisation and how they nurture nature, climate and livelihoods benefits. This knowledge can then be used to upscale inclusive, resilient agrobiodiverse system models and to identify leverage points.

Addressing the challenge

Working closely with smallholder farmers in Indonesia, the Philippines and Tanzania, the project will tackle agrobiodiversity loss, enhancing global production systems for improved livelihoods and climate resilience. Using the latest research co-production methodologies, it will improve evidence on how to upscale inclusive, resilient, agrobiodiverse production systems globally. It will build locally based, internationally linked research networks that enhance continuous long-term learning and capacity support around best practices with smallholder producers, fostering multidisciplinary partnerships that effectively advocate for better policies, leverage public and private investments, and drive transformation in how we produce food, fuel, fibre, and medicines that are good for nature, climate and livelihoods.

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05 Harvesting Resilience

Harnessing Andean Crop Diversity to Weather Climate Change

Countries: Peru, Ecuador

Partners: International Potato Centre CIP (Peru), Grupo Yanapai (Peru), ANDES (Peru), EkoRural (Ecuador), Instituto Nacional de Investigaciones Agropecuarias (Ecuador)

Project duration: 36 months

Background

The Andean region is characterised by its rich agricultural biodiversity and traditional farming practices. However, the impact of climate change such as unpredictable weather patterns, increased episodes of drought, and the accelerated spread of crop pests and diseases to higher altitudes are directly impacting the productivity and resilience of Andean farming systems[1]. Andean farmers already cultivate multiple potato varieties in the same field to mitigate risk, however only a small proportion of these varieties are drought tolerant. In the face of increasingly frequent and intense drought events, and increased pest and disease outbreaks farmers strive to adapt their variety portfolio towards more drought tolerance and pest resilience. In addition to the impacts of climate change on crop diversity in farmers' fields, a lack of market incentives also exacerbates the issue. This decreases the attractiveness of smallholder farming, fosters migration and agricultural abandonment, thereby undermining the sustainability of cropping systems[2].

Addressing the challenge

This project aims to strengthen the resilience of Andean agriculture by leveraging both traditional potato and mashua varieties and gene bank resources. Through an integrated and interdisciplinary approach, climate adaptation will be promoted and food security improved. Applied methods will involve participatory evaluations, nutritional analyses, market appraisals, genotyping, and restoration of lost biodiversity. Transformational change will be achieved through the integration of research, knowledge sharing, innovation, and enhanced market access. The project will employ a comprehensive communication strategy to share key findings and foster policy engagement. It will also create lasting benefits by endorsing diversity conservation, catalysing transformational change, and applying advanced agricultural technologies.

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06 HABITAT

Harnessing Pasture Biodiversity and Productivity

Countries: Kenya

Partners: Bangor University (UK), International Livestock Research Institute (Kenya & Ethiopia), University of Eldoret (Kenya), University of Manchester (UK), National Museum of Kenya (Kenya)

Project duration: 36 months

Background

The highlands of Kenya comprise some of the most biodiverse regions of the world. However, these regions are under significant threat to land degradation as a result of human-induced climate change, land-use change, and the unsustainable use of the natural resources. Smallholder extensive dairy farms that rely on pastures to feed their cattle play an especially important role in these ecosystems. While these vulnerable farmers rely inextricably on the ecosystem services of the natural resources, often their management practices contribute significantly to their degradation. As identified by local stakeholders, while some research exists dedicated to understanding pasture management practices in these systems and greenhouse gas emissions, little is known about the trade-offs and synergies with biodiversity, and productivity.

Addressing the challenge

By adopting a multidisciplinary approach, the project will explore existing pasture management practices, identifying ones that lead to enhanced biodiversity indicators and improved productivity, thereby decreasing GHG emission intensities, tackling poverty and enhancing climate resilience. Project partners will work with the farmers in their communities to stimulate farmer to farmer dissemination and scaling of improved practices. This will be facilitated by analyses of the potential bottlenecks and opportunities for different farming household types to use improved pasture management practices. More nuanced recommendations for stakeholders and policy makers resulting from these processes will further enable the scaling of these practices to similar contexts in the African region.

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07 Grassland Management

Optimised spatial resource management of Madagascar's open grassy ecosystems supporting livelihoods, climate and biodiversity in a global biodiversity hotspot

Countries: Madagascar

Partners: Royal Botanic Gardens, Kew (UK), Kew Madagascar Conservation Centre (Madagascar & UK), Missouri Botanical Gardens (USA), Laboratoire des RadioIsotopes (Madagascar), Royal Botanic Gardens Edinburgh (UK)

Project duration: 36 months

Background

Open grassy ecosystems cover an estimated 38 million hectares, 65% of Madagascar's land area[1]. Far from being the product of historical deforestation, recent research shows that Malagasy grasslands are ancient and biodiverse[2,3]. The misunderstanding of Malagasy grassy ecosystems as barren landscapes of no biodiversity, carbon or livelihood value has directly led to: i) reforestation on inappropriate landscapes unlikely to be successful or sustainable, ii) forest restoration failing to sequester carbon due to soil disturbance, tree mortality and erosion, and iii) old growth grasslands overlooked as valuable ecosystems leading to negative biodiversity outcomes by causing unintended harm and negatively impacting communities dependent upon them. Addressing this evidence gap in understanding and characterising the value of Madagascar's grassland is critical to refocusing reforestation initiatives on suitable locations, thereby enhancing their effectiveness, and aligning them more closely with the goals of biodiversity conservation, livelihood sustenance, and climate change mitigation.

Addressing the challenge

Employing data-driven strategies, this project will transform perceptions of Madagascar's extensive and overlooked grasslands from low-value landscapes to biodiversity rich ecological assets that can support human livelihoods and carbon sequestration. This will enable sustainable reforestation by identifying optimal locations that enrich ecosystems and safeguard local livelihoods. The project vision is to redefine the intersection of reforestation and grassland preservation, fostering an understanding of these ecosystems' critical role, promoting local prosperity, and strengthening Madagascar's resilience to climate change.

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08 Ecosystem Services for Key Biodiversity Area Management

Informing site management and protection strategies for Key Biodiversity Areas (KBAs) in Ecuador through analysis of ecosystem service delivery under climate change

Countries: Ecuador

Partners: Birdlife International (UK), The UN Environment Programme World Conservation Monitoring Centre (UK), Durham University (UK), Fundación Jocotoco (Ecuador)

Project duration: 36 months

Background

Expanding and improving protected areas has a critical role to play in biodiversity conservation as well as sustainable natural resources management because conserving intact ecosystems is generally less costly than restoring degraded habitats. However, the current system of perverse subsidies and narrowly framed economic decisions means that the full value of natural areas is underestimated, leading to conversion to agriculture, forestry or other land uses rather than preserving natural habitats. This situation happens largely because ecosystem services (i.e., the benefits that nature provides to people) and their valuation are not currently integrated into economic decision-making, including considerations of when and where to protect natural habitats and how to manage them. An assessment of the total value of the full range of ecosystem services in a landscape would also benefit ecosystem restoration efforts, for instance to inform decisions relating to efforts to reforest (or rewet) marginal areas where agricultural productivity is low.

Addressing the challenge

This project aims to inform site management and protection strategies for Key Biodiversity Areas (KBAs) in Ecuador by generating robust knowledge on the ecosystem services delivered by these sites and their beneficiaries, as well as their exposure and resilience under climate change.

This new evidence of the impacts on livelihoods of climate change and different management or protection options, and the resulting recommendations, will directly support more effective implementation of the Global Biodiversity Framework '30×30 target', and lead to better-informed decision-making for nature and people.

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09 Cherangany Forest Restoration

Understanding Cherangany forest links to human wellbeing

Countries: Kenya

Partners: Nature Kenya, National Museums of Kenya, Kenya Forestry Research Institute, Kenyatta University, the Kenya Forest Service and Indigenous Peoples and Local Communities

Project duration: 35 months

Background

The Cherangany Hills are located within the Rift Valley region, within the Elgeyo Marakwet, West Pokot and Trans-Nzoia Counties. The hills cover an expansive area measuring about 95,600 ha and span an altitudinal range of 2,000–3,365m above sea level. This forest is part of the afro montane global biodiversity hotspot and a Key Biodiversity Area critical for water, climate mitigation and flood regulation among other forest ecosystem services. The forest is threatened by several anthropogenic pressures as a result of rapid population growth and the increasing incidence of poverty, which has triggered encroachment into the forests for settlements, farming, timber, charcoal, firewood and grazing. The area also has witnessed conflicts between downstream and upstream communities over the dwindling water resources because of watershed degradation by upstream communities. Understanding the levers for linking forests and biodiversity with human wellbeing and climate resilience in Cherangany forests will provide the foundation for future sustainable natural resource management.

Addressing the challenge

The project aims to promote positive long-term impacts for biodiversity, poverty alleviation and ecosystem resilience to climate change in the Cherangany forest landscape by understanding how natural forest resources can be used and managed sustainably and identifying the levers for linking forests, biodiversity and human wellbeing in this landscape. The project targets research and development of solutions which will be applied by national and county governments, local communities and conservation agencies and actors to protect and sustainably use biological diversity for climate adaptation and mitigation, as well as supporting and improving livelihoods through climate smart agriculture and natural resources management. Evidence generated will include an ecosystem services assessment and a restoration opportunity assessment and mapping (ROAM) of the Cherangany forest landscape; these will then inform the Cherangany Forest Restoration business case for future funding, Ecosystem Based Adaptation Strategy and action plan, and multiple Participatory Forest Management Plans implemented by community forest associations.

Cherangany Forest landscape

Cherangany Forest landscape

10 Gran Tescual Reservation Climate Plan

Countries: Colombia

Partners: The Corporation for Research and Social and Economic Action (Colombia), Indigenous Reservation of the Gran Tescual community

Project duration: 23 months

Background

Colombia stands out as a globally acclaimed biodiverse and megadiverse nation, owing to its strategic geographical location, diverse topography, varying climates, and a plethora of ecosystems. Among Colombia's rich ecosystems are tropical forests, mangroves, wetlands, dry forests, coral reefs, and páramo systems, each supporting an extraordinary variety of species. These ecosystems play a critical role in regulating the climate, purifying water, protecting against floods, and conserving soil.

The Gran Tescual Indigenous Reserve of the Pastos people is a vast and sacred territory known as "ATUCZARA" (where the heart of the water is located). This area includes the ancestral settlements of Chapal, Puerres, Canchala, Tescual, and Alpichaque, forming part of the extensive territory of the Nudo de Los Pastos, which stretches from the Andean region to the eastern Amazonian slopes. Recognized as a leader in environmental protection and climate action in the Nariño region, the Gran Tescual Indigenous Reserve spans 36,175 hectares, consisting of 10,174 formalized hectares and 26,000 hectares of ancestral possession, and is home to 857 indigenous Pastos families.

Eighty percent of these lands are designated for environmental protection and are divided into two distinct areas:

Globe One: This area includes the Zonquer Páramo Zone, known for its abundant frailejón coverage and diverse páramo flora and fauna. Unfortunately, it faces significant threats from the expansion of grazing lands and the deforestation of native plants. The most pressing danger is climate change, which reduces water retention and leads to longer and more intense rainy seasons.

Globe Two: Located in the upper Amazonian foothills, this region is rich in Amazonian foothill ecosystems. It is traversed by the Trans-Andean oil pipeline, which is often targeted for illegal oil extraction, causing severe issues such as oil spills and disturbances in the watersheds.

Addressing the challenge

Over the next two years, this project will focus on the Colombian Pan-Amazonian region, a strategic area in the fight against climate change. Led by indigenous women with an intersectional and feminist approach, this initiative seeks to improve the living conditions of the indigenous Pastos people residing in the reserve. The project employs a holistic strategy that integrates biodiversity conservation research with indigenous knowledge to safeguard their biocultural heritage. Additionally, it advocates for climate action by considering ethnic and gender dimensions at local, regional, and continental levels. The primary goal is to protect ecosystems, enhance the well-being of indigenous communities, and positively impact biodiversity conservation, poverty alleviation, and the climate resilience of natural systems.

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11 Adaptive Fisheries Governance

Building adaptive fisheries governance capacity

Countries: Uganda, Malawi

Partners: University of Birmingham (UK), Institute for Poverty, Land and Agrarian Studies (South Africa), Lilongwe University of Agriculture and Natural Resources (Malawi), National Fisheries Resources Research Institute (Uganda)

Project duration: 36 months

Background

Freshwater fisheries face multiple climate change impacts, associated with rising global temperature, altering rainfall patterns and changing human behaviour[1]. Inland small-scale fisheries already face a plethora of challenges, associated with overexploitation, pollution and lack of policy recognition and investment[2]. They are also associated with high levels of poverty, resulting from marginalisation, stigma, and rural and dispersed locations, leading to limited investment and being served by poor infrastructure[3,4]. However, small-scale fisheries remain critical in low-income countries, due to accessibility for income and employment, and contribution to nutrition, food security and export revenue[5]. Whilst there is urgent need to build climate resilience within fisheries management in a fair and effective way, governance systems of small-scale fisheries are not as effective as they need to be, due to insufficient funding and capacity, and lack of alternative livelihood options contributing to unsustainable fishing pressure. Limited incorporation of climate adaptation objectives and tools in fisheries governance, and the need to bring climate resilience together with ecosystem-based management, mean that pathways to more adaptive and effective governance are urgently needed.

Addressing the challenge

To address these challenges, this project will identify how inclusive and sustainable adaptive capacity can be developed in inland fisheries governance of Malawi and Uganda. Including both countries in the project will generate greater evidence on how to build inclusive and sustainable adaptive fisheries governance, enable knowledge exchange between the countries and facilitate dissemination of findings across sub-Saharan Africa. The research takes a transdisciplinary co-production approach, working closely with the departments of fisheries, NGOs, and local communities in all activities, and facilitate South-South learning. The project includes an assessment of adaptive governance capacity at national, district and community levels, studies on information generation and changing fishing practices, and learning from action research involving pilot biodiversity protection interventions and network meetings.

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Boats on Lake Chilwa

12 Following the Water (Madagascar)

Following the Water: Participatory research to understand drivers and nature-based solutions to wetland degradation in Madagascar

Countries: Madagascar

Partners: The Wildfowl & Wetlands Trust (UK & Madagascar), Mavoa (Madagascar)

Project duration: 36 months

Background

Madagascar is one of the world's greatest biodiversity hotspots, with very high levels of endemism.[1] It is also one of the most threatened with an extremely high historic loss of natural habitats. This combination of high biodiversity value and high threat lies within one of the world's poorest countries, with extremely high rates of poverty, food insecurity and lack of access to clean water, with exceptionally high exposure to climate risks.[2] Conservation effort has historically been focussed on forest habitats and species. The country's wetlands, on the other hand, support extraordinarily high levels of endemism and numerous globally threatened species[3,4,] and are critical to the livelihoods of a large proportion of the human population. Yet are poorly represented in the Protected Area network and generally under-represented in conservation initiatives.[5,6]

Addressing the challenge

This project focuses on the theme of 'water' using interdisciplinary and participatory research to understand drivers and solutions to wetland degradation in Madagascar. It will trace flows of water (considering quality and quantity) through the social, ecological, and biophysical elements of selected river catchments and sub-catchments, building a holistic understanding of these complex systems. Then, the project will work with communities to co-design interventions to address some of the drivers of wetland degradation and poverty, including from climate change.

Field site visit

The project builds on years of relationship-building with wetland communities and partners and will create innovative evidence-based solutions that are stress-tested in real world situations, thus ensuring they are cost-effective and sustainable solutions for biodiversity and livelihoods in the face of a changing climate. While the solutions tested under the project may vary between catchments, the approach developed to co-design and pilot them will also be transferable, allowing locally appropriate solutions to be devised for other locations, or at different scales.

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13 ENHANCES

Enhancing coastal protection, biodiversity and ecosystem services through better knowledge and engagement in mangrove rehabilitation in Suriname and Guyana

Countries: Suriname & Guyana

Partners: University of Durham (UK), Herriot-Watt University (UK), Edinburgh University (UK), Anton de Kom University of Suriname (Suriname)

Project duration: 36 months

Background

Occupying tropical and sub-tropical latitudes, mangroves provide a multitude of ecosystem services to coastal communities, including contributing US$ 3,000-80,000 ha-1yr-1 to the economy[1], protecting water quality by removing nutrients and pollutants and providing nursery habitat and refuge for commercial aquatic species and other biodiversity. They are also amongst the most carbon-rich ecosystems in the tropics[2,3], storing up to five times as much organic carbon as tropical forests particularly in their soil[4]. Despite mangroves rendering multiple ecosystem services, several challenges exist around their implementation for coastal protection, including 1) knowledge of individual mangrove species and 2) how these are impacted by and recover from environmental and climatic stresses at the local scale. Given the necessarily local nature of effective coastal protection, better scientific evidence, shared knowledge and consensus with local communities is needed to inform and promote best practices and action locally.

Addressing the challenge

Coastal protection through mangrove conservation involves understanding where species of mangrove are located and their site-specific failure thresholds, and stakeholder's consensus on benefits and strategies of implementation. The project will work with partners in Suriname and Guyana to (i) operationalise novel in-situ and remote-sensing technologies to map and quantify the health, status and distribution of mangrove species at the local and regional scales, whilst (ii) monitoring changes and thresholds to generate new understanding, and (iii) use this to generate consensus on local coastal protection strategies and methods using a gamification platform co-developed with local stakeholders for knowledge-sharing and equitable debate.

Coastal field site

Project members on a field visit

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14 Global Seaweed - SUPERSTAR

Supporting livelihoods by protecting, enhancing, and restoring biodiversity by securing the future of the seaweed aquaculture industry in developing countries

Countries: Malaysia & Indonesia

Partners: The Scottish Association for Marine Science (UK), Natural History Museum (UK), University of Malaya (Malaysia)

Project duration: 36 months

Background

Seaweeds are vital for marine ecosystem functioning. The habitats that they form are some of the most productive ecosystems on the planet, supporting an immense biodiversity of marine organisms, providing a wide variety of ecosystem services and, as major carbon sinks, playing a critical role in mitigating climate change[1]. In particular, seaweeds support significantly enhanced biodiversity, with 38% greater species richness in seaweed forests compared to deforested areas[2]. They also play an important role in mitigating impacts of climate change through carbon and nitrogen capture[3] and supporting the livelihoods of over 6M farmers and their families in rural coastal communities in over 56 countries worldwide[4]. Yet, wild seaweed communities are predicted to lose up to 71% of their current distribution by 2100, either through overharvesting or climate-driven impacts, such as pollution, invasive species or pest and disease outbreaks[5]. Despite their significant ecological and economic importance, wild seaweeds receive minimal or no protection through policies or legislation globally[5].

Addressing the challenge

The Global Seaweed - SUPERSTAR project will directly address the acute problem of lack of protection and overharvesting of wild seaweeds. The operationally and policy-relevant project outputs will be used by the seaweed industry, Indigenous Peoples and Local Communities (IPLCs) and local, regional, and global policymakers, with the aim of ensuring increased protection, enhanced climate resilience and the sustainable management of wild and cultivated stocks and their associated habitats. This will increase biodiversity, protect livelihoods, and safeguard the future of this vital seaweed industry for developing countries in south-east Asia and globally.

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A seaweed farmer in Sabah, NE Borneo, Malaysia

GCBC projects in action 2023

GCBC projects in action 2023

Eight ongoing projects from the initial development phase of the GCBC programme (Phase 1), continued their research through 2023. An additional project, Pineapple Waste to Biochar, was also funded in 2023. Phase 1 projects have developed tools and solutions and have identified pathways leading to positive changes in the use of biodiversity to improve climate resilience and livelihoods, both at a local project scale and beyond.

Figure 3: *Map of ongoing projects 2023*

01 Bio+Mine

Case study: Sto. Niño Mesocosm Experiment

Countries: Philippines

Partners: Natural History Museum (UK), Imperial College London (UK), De La Salle University (Philippines), Mindanao State University - Iligan Institute of Technology (Philippines), University of New South Wales (Australia)

Background

The Sto. Niño legacy mine is located in Sto. Niño, Brgy. Ambassador, Municipality of Tublay, Benguet, Philippines. Mining operations were carried out from 1972 to 1981 and were completely abandoned in 1982. The Sto. Niño Mine had two porphyry copper types of ore bodies, the Southwest ore body and Ulman ore body. The Southwest ore body was mainly mined by an open pit and copper ores were floated to produce copper concentrates. The area is currently occupied by residents who engage in vegetable and flower farming as their primary livelihood. Given its past exposure to anthropogenic activities, the soil and plant species in the area may have become contaminated due to the accumulation of heavy metals and metalloids. To address this issue, during the first year of the Bio+Mine project, the Ecological team assessed the accumulation of different elements in the soil and plants, and identified common hyperaccumulator plants (capable of growing in soil with high concentrations of metals), that could be used for further research. In the second year of the project, the team isolated bacterial species identified in the area to assess their potential for bioaugmentation and constructed a mesocosm setup to evaluate the interactions between the hyperaccumulator plants, bacterial species, and the soil for rehabilitation purposes. The entire project aims to devise a long-term strategy for the reconstruction of Sto. Niño mine, leading to a full-scale system of interventions for the succeeding years.

Positive impacts

The assessment of heavy metal accumulation in plants and soils at the Sto. Niño legacy mine provides baseline information for the local and scientific communities regarding the hyperaccumulation activity of plants in the area. This information is crucial for the restoration and rehabilitation of the legacy mine. Plants identified with hyperaccumulation potential were subsequently used in a mesocosm experiment to further investigate their hyperaccumulation capabilities in a controlled environment. Mesocosm experiments offer the advantage of simulating natural environments while maintaining control over specific variables such as pH, temperature, and humidity. This controlled setting aids in isolating these variables to understand their effects on the environment better. Additionally, mesocosm experiments provide realistic conditions that allow for more accurate exploitation of results to natural ecosystems. By assessing heavy metals in soils and plants and conducting mesocosm experiments, the local community gains a valuable method for rehabilitating the Sto. Niño legacy mine. Utilizing locally found hyperaccumulator plants and propagating more of these plants can significantly contribute to the mine's rehabilitation and support a long-term strategy for its reconstruction.

Challenges

A challenge the project had to overcome was accurately replicating the natural environment within the mesocosm, including humidity, temperature, and sunlight, while controlling variables such as the plants' water intake. Initiating the project during the typhoon season further complicated this task, introducing risks such as potential landslides and screenhouse damage due to severe weather conditions. Additionally, there were concerns about the plants' viability over the 120-day period in pots. Ensuring the plants acclimatized and thrived during the early stages was crucial. Fortunately, our mesocosm setup remained stable and functional until the experiment's conclusion. Despite these challenges, the overall mesocosm experiment proceeded successfully.

Replicability and pointers for successful implementation

The mesocosm methodologies, while based on established research practices, required site specific modifications; because of these site-specific considerations, effective implementation can be ensured through collaboration with local communities and agencies. Building flexibility into the project timeline is a good idea to accommodate unforeseen delays, such as those caused by weather or administrative processes. Collaboration with local experts and organizations is essential, as their knowledge and resources can be critical in addressing site-specific challenges. As is conducting a thorough risk assessment before starting the experiment, allowing the identification of potential risks (e.g., natural disasters, logistical issues) and the development of mitigation strategies. Another pointer is to implement regular review points throughout the experiment to assess progress and make necessary adjustments. This could include periodic team meetings and interim data analysis.

The ecological team scopes the site for rock samples

02 OneFood

Case study: The One Food Community of Practice

Countries: South Africa

Partners: Centre for Environment Fisheries & Aquaculture Science (UK), Animal & Plant Health Agency (UK), Department of Science and Innovation (South Africa), Council for Scientific and Industrial Research (South Africa), Human Sciences Research Council (South Africa), National Agricultural Marketing Council (South Africa), Agricultural Research Council (South Africa), Department of Forestry, Fisheries and the Environment (South Africa), FCDO SIN regional office, FAO

Background

The One Food project is developing a risk analysis tool to promote cross-food system approaches to hazard identification and mitigation in support of climate-resilient, safer, healthier, and more sustainable food. Such an initiative requires food system transformation, which can only be enabled through trans-disciplinary effort. The project has developed a Community of Practice (CoP) to foster trans-disciplinary conversation and learning. The CoP is hosted on an online platform to host workshops, garner viewpoints, disseminate project outputs and share food systems knowledge.

Positive impacts

Membership of the CoP has grown month-on-month since initiation in October 2022 (year 2 saw a 99% increase in members, at 215 as of March 2024), with jumps in membership around workshops and communication opportunities (e.g. publication of videos from partners). The members hail from 12 countries (a 140% increase on year 1), illustrating that the concept is spreading beyond the initial partnership in South Africa.

Challenges

The project has not experienced any particular challenges associated with the CoP itself, other than the general challenge of keeping people engaged in a modern information-rich, multi-website world. There have been dips in engagement when there are gaps in content uploaded to the platform; to counter this the project team have tried to spread content across the year and provide a mix of spoken and written content. Hosting hybrid events on the platform can be challenging, particularly if attendees have limited internet connection. This has been combatted by working with professional workshop facilitators and recording some segments in advance if necessary.

Replicability and pointers for successful implementation

The Community of Practice is intended to be location-independent and, while the One Food project is currently focused on South Africa, the concepts are global and members hail from around the world. Communities of Practice are an effective way to foster trans-disciplinarity engagement and work well for bringing together groups of people with shared interests but diverse knowledge. When using CoP to look at complex challenges, it is useful to start with a smaller group of core partners and then build the community; trust and comfort builds as people begin to better understand each other's viewpoints and mindsets.

03 Environmental Pollution

Case study: Development and application of a mathematical model for assessing water quality of the Msunduzi River: accommodating for the effects of climate change and wastewater flow.

Countries: Vietnam, South Africa

Partners: Vietnam project: The Global Alliance on Health and Pollution (Switzerland), Ho Chi Minh City University of Natural Resources (Vietnam), Environment Together, Department of Natural Resources and Environment of An Giang Province (Vietnam), Institute of Agricultural Environment (Vietnam)

South Africa project: Joint Nature Conservation Council (UK), Institute of Natural Resources (South Africa), Durban University of Technology (South Africa), University of Kwazulu-Natal (South Africa), Rhodes University (South Africa)

Background

There has been a recent decline in the quality of treated wastewater entering rivers and streams in South Africa with the impacts of increased rainfall and flooding from climate change set to exacerbate the problem. It is important for water managers to understand how pollutants are transported and degraded in the river system; to understand the impacts on the people and biodiversity that depend on this resource. Therefore, modelling that predicts river water quality is crucial. Numerous water quality models have been used by researchers; however, several studies have discussed their limitations and the need to develop new models. This project aims to develop and apply an improved new model that considers the uncertainties associated with climate change, incorporating this model into a user-friendly tool. The knowledge acquired from this tool will allow water managers to make more sustainable decisions that improve the river water quality for use by people and biodiversity.

Challenges

A challenge has been the development of microsensors that can be deployed in the field for continuous monitoring. Options were investigated in the UK, as well as South Africa which were not viable due to the cost of the equipment. As a result, the components have been procured individually and UKZN (The University of KwaZulu-Natal) are fabricating the microsensors themselves. UKZN have also procured an Aquatroll which will be used for collecting data during site visits. The microsensors will be calibrated using the Aquatroll.

Positive impacts

A stakeholder workshop was held in October 2023, which was well attended by government. Raising awareness of the project and water quality issues across South Africa at this level is a positive step towards maximising the impact of the project.

It is anticipated that the modelling tool being developed will be used by water managers to improve decision making and allow for more sustainable decisions which benefit Msunduzi river water quality. To measure this impact the project can collect feedback from decision makers on whether they are using the tool, how easy it is to use and if it has contributed to their decision making. The next best step would be to follow the impact of these decisions on water quality and if they lead to benefits for people and biodiversity relying on the Msunduzi.

Replicability and pointers for successful implementation

This project is based on the Msunduzi river however, the type of model that will be developed can be applied to other rivers in South Africa. For adapting the model to different rivers, this will likely require sampling to validate and fine tune the model for that particular system.

04 Innovative Seaweed Aquaculture

Case study: Development of the temperature-resilient culture strains of eucheumatoid red seaweeds

Countries: Malaysia

Partners: Natural History Museum (UK), Scottish Association for Marine Science (UK), University of Malaya (Malaysia), Jabatan Perikanan Sabah Fisheries Department (Malaysia)

Background

Seaweeds form some of the most productive marine systems. They support an immense diversity of species and provide a range of ecosystem services including nurseries for fish and coastal protection. Seaweed cultivation offers the potential for a nature-based, carbon neutral and climate resilient solution to restore seaweed communities globally. Upscaling seaweed production offers a new, powerful approach to enhance community resilience, re-build natural seaweed communities, increase biodiversity and enhance ecosystem services, such as carbon sequestration. It can also provide a socially acceptable means of restoring the local environment of a community whilst maintaining sustainable livelihoods.

Nevertheless, the industry is undergoing challenges with increases in pests and diseases due to the impact of accelerating climate change, loss of genetic diversity and biosecurity issues. Introduced cultivars present the risk of bringing pathogens, parasites and non-native species, with escapees potentially competing or hybridizing with wild species/strains. This is leading to dramatic declines in yield, notably in the major Southeast Asia seaweed producing countries, with catastrophic socio-economic impacts on communities reliant on seaweed production. For example, seaweed production in Malaysia has declined by 45% between 2012 and 2020. To address these challenges, there is an urgent need for new temperature resilient cultivars, derived from indigenous wild stocks, to be brought into cultivation to enhance the climate resilience of cultured stocks.

In collaboration with the seaweed farming communities in Malaysia, this project sets out to collect wild population of seaweeds for potential domestication at a research farm. The seaweeds have been cultured at the farm using the basket and cage net methods to protect the wild-collected seaweeds from seaweed grazers especially turtles and rabbit fish. Both net methods used in the study area indeed have better growth and survival of the seaweeds, however, climate change affected the seaweed growth. Malaysia has been experiencing El Niño since April 2023, and this phenomenon is predicted to come to an end in July 2024. The temperature increases and lack of rainfall affected the seaweed industry as ice-ice disease and pest occurrence increased in frequency and severity. During this period, the farmers employed under the project were tasked to monitor the condition of the seaweeds besides collecting data of the seawater environmental parameters and seaweed biomass growth. The data recorded will be used for a paper on the effect of El Niño on the seaweed farming.

Positive impacts

The result of this project will lead to the development of potential temperature-resilient cultivars, derived from indigenous wild stocks, to be brought into cultivation to enhance the climate resilience of cultured stocks. Some of the seaweeds that survived during the El Niño and grew very well are potential new temperature-resilient cultivars and have been successfully propagated. This is needed to ensure the sustainability of the eucheumatoids (tropical red seaweeds) seedstock for the industry amid the worsening climate change.

Challenges

The major challenge during the project was the El Niño phenomenon. The highest temperature recorded at the research farm was up to 38°C. The slow water current (less than 0.1 ms-1) and lack of rainfall in addition to the high temperature led to the increased susceptibility of the eucheumatoid seaweeds to pests and ice-ice disease, and consequently quite a number of seaweeds were lost during the project.

Replicability and pointers for successful implementation

The outcome of this project is to have the new temperature-resilient cultivars used by the local farmers. A number of the wild seaweeds not only survived the El Niño but were successfully propagated and shared with some of the local farmers.

05 Nature Transition Support Programme

Countries: Colombia, Ecuador, Indonesia, Ghana

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

Background

Acknowledging nature's contribution to people is key for developing a more resilient, sustainable, inclusive and just economy. The Nature Transitions Support Programme (NTSP) is an applied research project that aims to provide support, in the form of research, to enhance the evidence base that decision-makers in partner countries can draw upon when developing policies to deliver its sustainable development ambitions. The overall aim of the NTSP is to explore current and alternative development pathways and the potential to protect and restore nature while enhancing outcomes for people and promoting economic prosperity. To do so, the NTSP has the capacity to delve deeply into the dynamics between nature and prosperity, advancing models at the nexus of biodiversity and sustainable development and tailoring efforts to specific priorities expressed by policy makers in-country. After establishing a baseline for economic transformation, the NTSP will explore various scenarios that enhance prosperity while conserving natural capital, highlight the trade-offs among the different options, and measure outcomes across different dimensions of economic progress beyond Gross Domestic Product (GDP).

Positive impacts

The NTSP conducted a co-creation phase in Colombia and Ecuador from December 2022 to March 2023. During this phase, the NTSP conducted an in-person workshop, followed by periodic discussion to convene key priorities for sustainable development. These priorities were then used for defining the research agenda of the programme.

To understand how the NTSP impacted on national economic and development policies, an analysis was conducted using the NTSP framework which focused on the dependencies of Colombia's Gross Domestic Product (GDP) on nature. The results indicated that at least 48% of the GDP is generated by industries with a moderate to very high dependence on nature.

The analysis highlighted sectors that are more dependent on nature. In this context, the Ministry of Finance and Public Credit published the outcomes of the analysis in Colombia's Medium-Term Fiscal Framework, which outlines Colombia's fiscal and macroeconomic strategy. This document acknowledges the importance of nature for the country's wellbeing and recognizes that action needs to be taken within the economic and fiscal spheres. Additionally, it has acknowledged that increasing the understanding of the links between the economy and nature and the associated risks are key for achieving their National Development Plan "Colombia: Potencia Mundial de la Vida".

Challenges

Two main challenges were experienced by the NTSP. The first was related to political changes. In November 2023, Ecuador experienced an unusual change of political administration. This resulted in a complete change in the focal points and government personnel that the NTSP was working with. Consequently, the country engagement and associated work, which required government feedback, was delayed. To mitigate a longer delay, the NTSP continued working with the National Institute of Biodiversity (INABIO), as they have experience and expertise in the country. The second challenge is associated with administrative processes. The government stakeholders from the countries have expressed several times that the NTSP is not long enough to get involved as they would like, or for creating a long-term impact since it does not align with governmental timelines.

Replicability and pointers for successful implementation

The economic transformation towards a more sustainable, resilient and inclusive economy has been studied and is recognised as being needed in order to conserve biodiversity, tackle climate change and achieve poverty alleviation. The NTSP is one of the first and few efforts globally to implement the above transformational changes at a national level, particularly in countries where both economic development and environmental conservation are very important. The NTSP serves as a blueprint for future efforts, providing valuable insights. This kind of work has transformative potential for economic and environmental integration going forward.

In this context, the NTSP is working on an economic transformation positive for nature and people handbook. The intention for this handbook is to act as an overall guide for transforming economies towards more sustainable, inclusive and resilient ones, with a vision of embedding the economy within nature, that any country can draw upon as guidance. The handbook will show a methodology for economic transformation based on the case studies of implementing the Nature Transitions Support Programme in the four partner countries.

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06 Nature Based Solutions

Realising the potential of plants as nature-based solutions in African biodiversity hotspots: Supporting climate resilient, sustainable development

Case study 1: Establishment of plant nurseries to support community livelihoods and reforestation at TIPAs sites in Guinea

Countries: Ethiopia, Guinea, Sierra Leone

Partners: Royal Botanic Gardens Kew (UK), Addis Ababa University (Ethiopia), Ethiopian Biodiversity Institute, Herbier National du Guinee (Guinea), Guinee Ecologie (Guinea), Institut de Recherche Agronomique du Guinea, Centre Forestier Nzerekore (Guinea), Njala University (Sierra Leone), The Alliance of Bioversity International & CIAT (Italy)

Background

Following the end of project workshop for a previous CEPF-funded project, the local communities near the TIPAs of Mt Béro and Diécké classified forests requested more engagement and awareness training around threatened plants. The success of the project in Guinee Maritime funded by Fondation Franklinia which set up village nurseries near TIPAs enabled this model to be extended to Guinee Forestière. An initial tree nursery was set up at the forestry centre Nzérékoré (CFZ), which would distribute threatened and useful plants collected with the communities for restoration work. Later in the project, four village nurseries were commissioned to have greater impact at a local scale and provide skills and a future income stream.

Positive impacts

The nursery at CFZ produced a total of 2,682 plants having had some issues with pests and disease resulting in the loss of 753 plants. The 2 village nurseries at Mt Bero produced 2,250 plants (150 mortality), the 2 nurseries at Diécké produced 1,145 plants (255 mortality). In total, 7,127 plants of threatened and useful plants were produced (601/6526 respectively). These village nursery plants were shared between the group members of each village and the CFZ plants were split between these villages and 2 further villages, at Mt Bero and Diécké. The villagers and CFZ did a fantastic job at raising these plants and are all very encouraged by their efforts. Many of the groups have gone on to do other work together such as creating market gardens or planting ginger or maize crops. This will bring extra income to the group and create new opportunities.

Challenges

The main challenges remain from getting enough seed of threatened species and propagating them successfully since few of these species have been propagated before. Propagation data has been collected on the techniques used and shared with other NGOs working with villages to grow threatened and useful plants in Guinee Forestiere. The information is also available on the Herbier National de Guinée (HNG) website (www.herbierguinee.org/gcbc.html).

Replicability and pointers for successful implementation

This approach is a replication of activities already taking place as part of another Kew/HNG lead project as mentioned in (a). It is a simple and effective intervention; however, making sure that the communities are onside is essential and that they are involved at all stages is very important. Continued awareness training on why biodiversity and wider environment are important, and the benefits are necessary to ensure successful implementation. Our methodology is being replicated by other NGOs working in the area.

06 Nature-Based Solutions

Case study 2: Coffea stenophylla in Sierra Leone

Countries: Ethiopia, Guinea, Sierra Leone

Partners: Royal Botanic Gardens Kew (UK), Addis Ababa University (Ethiopia), Ethiopian Biodiversity Institute, Herbier National du Guinee (Guinea), Guinee Ecologie (Guinea), Institut de Recherche Agronomique du Guinea, Centre Forestier Nzerekore (Guinea), Njala University (Sierra Leone), The Alliance of Bioversity International & CIAT (Italy)

Background

Coffea stenophylla is a species of wild coffee restricted to Guinea, Sierra Leone and Côte d'Ivoire, and was previously grown commercially as "highland coffee". It has been found to tolerate warmer temperatures than the popular Arabica coffee (Coffea arabica) and is said to boast a superior flavour. This "forgotten" species therefore has the potential to support a resilient coffee industry in the face of global climate change as it could be grown commercially in warmer climates than Arabica, a crop that is documented to be under threat from climate change. However, C. stenophylla is rare in the wild and is assessed on the IUCN Red List as globally Vulnerable because of the loss and degradation of its natural habitat. This case study therefore aimed to locate important wild populations of this species as part of a wider ongoing collaboration between Kew, Njala University and other key stakeholders in Sierra Leone, to assess the feasibility of commercialising C. stenophylla whilst conserving its wild populations.

Previous field trips in phase 1 of the project identified the Kasewe Forest Reserve (FR) as a significant site of conservation value for this species. In phase 2, a population structure and conservation status assessment were carried out at Kasewe FR and Kambui Hills Forest Reserve. Presence / absence was recorded as well as threats to the subpopulations.

Positive impacts

The main positive impact is the identification of two significant subpopulations of this globally threatened coffee species in Sierra Leone at Kasewe FR and Kambui Hills FR, both subpopulations show natural regeneration, but it varies across sites. Fruiting has been observed and can be monitored and studied which will help inform cultivation of this species as a coffee crop. This would, in turn, benefit the local community and promote protection of the remaining forest resources.

Challenges

The main challenges are the threats seen against these subpopulations. In Kasewe FR charcoal production is still a major threat despite earlier efforts to sensitize the local population. In Kambui Hills logging, artisanal gold mining and harvesting of seedlings are major threats. In the section of the forest that sampling was done in the Kambui Hills, communities have been harvesting seedlings from the forest floor to support the establishment of C. stenophylla nursery project that is being undertaken by a private enterprise.

Replicability and pointers for successful implementation

This example is species-specific but the identification of other non-timber forest products with commercial potential offers a means of promoting biodiversity conservation through linking it to community wellbeing. Continued engagement with local communities and raising awareness around the importance of protecting the wild population could benefits the health of C. stenophylla in these forest reserves in the long term.

06 Nature Based Solutions

Case study 3: Payments for agricultural conservation services (PACS) in Ethiopia

Countries: Ethiopia, Guinea, Sierra Leone

Partners: Royal Botanic Gardens Kew (UK), Addis Ababa University (Ethiopia), Ethiopian Biodiversity Institute, Herbier National du Guinee (Guinea), Guinee Ecologie (Guinea), Institut de Recherche Agronomique du Guinea, Centre Forestier Nzerekore (Guinea), Njala University (Sierra Leone), The Alliance of Bioversity International & CIAT (Italy)

Background

Agrobiodiversity is the variety of plants and animals that we use for food and agriculture. Whilst global declines in wild biodiversity are well known, the concurrent declines in agrobiodiversity are less reported. Conserving the spectacular diversity of the plants we use and eat is critical to address global climate and sustainable development goals.

Currently, much agrobiodiversity (and associated indigenous knowledge) is managed and conserved by subsistence farmers, in high biodiversity developing countries. These farmers are providing a ''global good' in maintaining these resources for humanity but receive little rewards for this service. This project aims to develop novel strategies for mitigating the loss of agrobiodiversity in Ethiopia through a 'payments for agrobiodiversity conservation' scheme (PACS). This approach is new, but conceptually similar to 'Payments for Ecosystem Services'. Through the PACS scheme this project will not only reward farmers for conserving agrobiodiversity but will also enhance resilience, food security and support poverty alleviation which will all help to reduce pressure on neighbouring wild biodiversity. This will be achieved through working with local farmers in the buffer zone of Kafa Biosphere Reserve to develop a cost-effective conservation incentive mechanism. It will focus on enset, a relative of the banana, and a staple food for around 20 million Ethiopians.

PACS has been successfully piloted by collaborators in other countries such as with quinoa in Peru and Bolivia, potato and amaranth in Peru, and maize and beans in Guatemala. Working with Bioversity we hope to bring lessons learned from previous PACS interventions to the Ethiopian context.

Positive impacts

Participant quotes:

"We have gained a lot of landraces we have lost for a long time and now we can protect ourselves from hunger and help the community. The landraces we have received are the ones we had lost so now we will take care of them to pass a much more diverse set of enset landraces to the next generation."

"These kinds of projects are very important to secure our food security because we will get landraces that are used for food which we have lost, and we can sell more enset in the market to improve our livelihood."

"Before women were not invited to this kind of project let alone get a reward. We thank this project for respecting us and inviting us to participate."

Challenges

Testing out a new scheme comes with a lot of trial and error to work out the most effective implementation methods. We have relied heavily on input and feedback from project participants throughout the process.

Replicability and pointers for successful implementation

Clear communication around the benefits of the project for participants, how the process will work, and what to expect was incredibly important for this project. Working closely with the farmers throughout the process from initial data collection through to scheme implementation allowed us to build relationships which has been instrumental to the project's success.

3ie Investing in Impact Evaluation

Background

Climate change and biodiversity loss are two of the most pressing and interrelated environmental challenges of our time. The slow pace to meet international commitments to limit global warming to 1.5°C above pre-industrial levels may increase the likelihood of species extinctions and of irreversible damage to marine and coastal ecosystems. Repeated exposure to severe climate shocks and biodiversity loss can negatively affect the livelihoods and adaptation capacities of individuals and communities. Action is urgently needed to address climate change and biodiversity loss as they both represent major threats to human livelihoods and wellbeing.

To inform programming and research decisions around climate change and biodiversity, we conducted an Evidence Gap Map (EGMs), which are thematic collections of the evidence available around specific topics of interest. Based on a systematic search of relevant literature, 3ie EGMs are displayed on an online platform, offering a visual and interactive representation of the evidence. The structure of EGMs is a matrix form based on interventions and outcomes. EGMs are useful to understand where there are clusters of research, as well as the areas where more research is needed; however, they do not analyse the interventions' effectiveness and cost-effectiveness.

An EGM was conducted to compile rigorous research that has evaluated the effects of climate change and biodiversity interventions on environmental and human wellbeing outcomes in low- and middle-income countries (L&MICs). The scope of the EGM was developed with Defra and other key stakeholders in the field and extends across four natural systems and productive activities: i) land and forests; ii) agriculture and livestock; iii) aquaculture and fisheries; and iv) coasts and oceans. Intervention instruments covered by the EGM include regulatory frameworks and policies that are designed to limit harmful behaviours and promote incentives and innovations that support efforts against climate change and biodiversity loss. Decentralisation interventions were considered that transfer the management and decision-making authority over natural resources from national to local actors, and interventions providing information and knowledge to promote and disseminate climate and biodiversity innovations.

There was also a focus on market integration interventions that address barriers and market failures in L&MICs that hinder the dissemination of climate mitigation, adaptation, and biodiversity-enhancing technologies and practices. The EGM includes studies that have measured environmental or human wellbeing outcomes, focusing on biodiversity and climate mitigation measures, and on welfare outcomes as potential measures of the adaptative capacities of individuals and communities.

A comprehensive search was conducted for impact evaluations and systematic reviews published since 2000, both academic and grey literature. These studies were screened against our inclusion criteria, and we extracted study and project information from included studies. We also critically appraised the systematic reviews included in the map, based on international best practices for conducting and reporting reviews.

The EGM includes 1,605 studies, most of which were published in the last decade. Clusters of research exist in a few countries such as China, Ethiopia, Brazil, India and Indonesia. Mostly, impact evaluations evaluated the effects of interventions on short-term environmental outcomes and human wellbeing outcomes, especially livelihood outcomes. Many gaps in the evidence remain across contexts (such as Europe and Central Asia and in the Middle East and North Africa), ecosystems (aquaculture and fisheries and coasts and oceans) and specific intervention types.

Positive impacts

In a context of limited resources and an urgency for action in mitigating and adapting from the risks associated with climate change and biodiversity loss, evidence can help prioritise decision-making. 3ie's EGMs are public goods, which means that they can improve accessibility to existing evidence, aiding in prioritising future research and guiding policymakers and practitioners on future programming. The interactive aspect of the map allows users to filter the evidence by features of interest, including region, country, evaluation method, population characteristics, among other options.

One way to measure the uptake of the EGM is monitoring the number of times the online map is accessed, and identifying when and how practitioners, policymakers and academics use this work when designing new projects or commissioning new research.

Challenges

Two challenges were encountered while conducting this EGM. Firstly, the climate-related literature has expanded at fast pace in the last decade, meaning that the number of studies screened against the EGM inclusion criteria was high (with over 120,000 studies screened). To expedite this process, machine learning techniques were used to prioritise and auto-exclude records, relying on a larger team of experienced researchers. The second challenge was to disentangle climate adaptation from human welfare outcomes. While welfare outcomes can support increased adaptation and resilience to climate change and shocks, this is not necessarily the case. At the same time, it is difficult to clearly distinguish between climate adaptation and welfare outcomes. After discussions with partners, outcome groups were relabelled and expanded the outcome categories so the map would be more inclusive.

Replicability and pointers for successful implementation

EGMs are designed to be replicable as they adhere to standard processes and methods. These steps are anticipated and reported in a protocol document. The EGM report provides further details of the implementation process.

07 Piloting Pineapple Plant Waste to Biochar

Countries: Kenya

Partners: Chequered Flag, Mananasi Ltd, SustainEA, Criou Energy

Background

The aim of this project is to assess the feasibility of producing biochar in conjunction with fibre and compost as a waste management strategy for industrial pineapple producers. This waste management strategy diverts pineapple waste that would have been burnt in open fire. Open fire burning bakes the soils, killing the microorganisms vital to soil health as well as collapsing its structure. The project will determine 1) the benefits of the use of biochar enriched compost on soil health, biodiversity, and the environment in general, and 2) the social impact with regard to the employment created and the smallholder engagement. In the longer term, this project will produce a plan to scale the concept to process 100% of the plant waste, this will include carbon credit certification.

Positive Impacts

The project produced 5.6 tonnes of biochar from 141 tonnes of pineapple waste. This biochar was blended with compost, producing 15 tonnes of biochar enriched compost. Two tonnes of biochar enriched compost were applied in pineapple fields, and another 2 tonnes applied on banana fields owned by local smallholder farmers. An additional 1 tonne of biochar (as a standalone product) was also applied on other fields.

Challenges

The project experienced challenges in the quality of the feedstock (used to produce biochar) supplied. The original proposition was based on the collection of dry feedstocks from the Del Monte fields. However, the waste management strategy was changed shortly after the pilot commenced. As a result, only wet feedstock was available, and this required changing the biochar production process. Adaptive management measures were put in place to solve the moisture issue associated with wet waste, which included trialling a number of options through mechanical shredding, dewatering by screw press, sun and green house drying, as well as experimenting with rotary drum dryers. While the original proposition may have proven viable given the forecast volumes, with the requirement of an additional drying process, commercial viability has not yet been proven. This was to some extent attributable to the costs of the additional process but primarily due to the time delays and resultant large drop in through put and productivity.

Replicability and pointers for successful implementation

The fibre from pineapple waste (to which it was attached) has shown good outcomes with a high probability of uptake and expansion. There are learnings from the biochar project that will form the basis of knowledge products and even some positive outcomes (such as the use of biochar as filtration medium for decortication wastewater) which may be incorporated in the larger (fibre) project.

The business case learnings are likely to show the feasibility and the commercial viability in the case only where dry waste can be easily collected. At proposal stage, the target to address 100% of the waste, with the biochar taking a significant portion of this was realistic. The unexpected change in the waste management strategy to use wet feedstock means the production of biochar will not form a significant part of the business case for scaling to 100% of waste.
However the use of decortication pulp as an important component part of effective composting, is likely to be used for 100% of the waste as part of a complete waste management strategy. The plan for scaling of the fibre production is a deliverable to be completed during the course of the next financial year. However, ambitions to bring forward the scaling of the operations will, most likely, see a revision of the timeline for this deliverable (bringing it forward to the current year), and the inclusion of composting to go with fibre extraction as part of a complete circular solution for 100% pineapple plant waste problem.

Innovative Solutions and Lessons Learnt

Evidence based research funded by the GCBC in Phase 1 has demonstrated the potential for GCBC in delivering some practical innovative solutions and lessons learnt. These are illustrated below against the **Six Strategic Science priorities (SSP)** *(Annex 1)* **and the Ten Delivery Principles (DP)** *(Annex 1)* identified in the GCBC Research Strategy.

Strategic Science Priority	Tool/ Solution	Lesson Learning	Project	Location
Demonstrating What Works (SSP1)	Identification of common hyperaccumulator plants locally through controlled environment experiments to assess their interactions with bacterial species, and the soil for rehabilitation purposes; and propagation of these to help rehabilitation of an abandoned mine.	Collaboration with local experts and organisations is essential, as their knowledge and resources can be critical in addressing site-specific challenges. **(DP5 – Traditional / Local Knowledge)** A thorough risk assessment before starting the experiment, allows the identification of potential risks (e.g. natural disasters, logistical issues) and the development of mitigation strategies with regular review points. **(DP3 - Robust Scientific Methods)** Disaster risk management training in basic life support helps to build the capacity of women who play significant roles during disaster response and recovery, increasing their motivation to support their community. **(DP6 – Gender Equity)**	**Bio+Mine**	Philippines
Capacity Building (SSP2)	A lab protocol to 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 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. **(DP3 - Robust Scientific Methods)** Understanding where there is a lack of scientific expertise, early in a project team, can be addressed by bringing in experts for the appropriate training to increase the success of the project. **(DP3 – Robust Scientific Methods)**	**DEEPEND**	Pacific SIDS
Best Practice (SSP3)	A new model for water managers to understand how pollutants are transported and degraded in river systems, while considering uncertainties associated with climate change, has been incorporated into a user-friendly decision tool.	Adaptation of the model to different rivers, will likely require sampling to validate and fine tune the model for that particular system. **(DP4 - Replicability and Scaleability)**	**Environmental Pollution**	Vietnam, South Africa
	New temperature-resilient seaweed cultivars developed, with indigenous seaweed farming communities, to enhance climate resilience of cultured stocks. (Innovative Seaweed Aquaculture).	Seaweed cultivation offers a potential nature-based carbon neutral climate resilient solution to restore seaweed forests globally and improve livelihoods to alleviate poverty. **(DP10 – Needs-driven Solution Orientated)**	**Innovative Seaweed Aquaculture**	Pacific SIDS (Cook Islands)
Informing Policy (SSP4)	A risk analysis tool mapping data 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 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. **(DP4 – Replicability and Scaleability)** Communities of practice are an effective way to foster trans-disciplinary engagement and work well for bringing together groups of people with shared interests but diverse knowledge. **(DP1 – Inter- and Intra-Transdisciplinary Research)**	**One Food**	South Africa

Finance (SSP5)	Adapting the concept of 'payments for ecosystem services' to an agrobiodiversity context, a novel, cost-effective conservation incentive mechanism has been developed, to 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 can be strengthened, reducing rates of destructive exploitation of wild plants. **(DP8 – Equitable Access and Benefit Sharing)** Clear communication around the benefits of a project for participants, how the process will work, and what to expect is incredibly important for a project's success. **(DP9 – Collaborative Partnerships)**	**Nature-Based Solutions in African Biodiversity Hotspots**	Ethiopia
Transformative Change (SSP6)	High value plant biodiversity hotspots have been characterised, and the pathways to develop bioresources within them identified from a diverse library of underutilised species and bioresources – including timber, medicines and valuable chemicals.	Sustainable exploitation of the diverse library of underutilised species and bioresources is an untapped opportunity to alleviate poverty, develop value chains and tackle food insecurity, whilst being underpinned by nature conservation. **(DP10 – Needs-driven Solution Orientated)** Continued engagement with local communities in all stages of a project to ensure they are onside and raising awareness around the importance of protecting wild populations is essential. **(DP7 – Social Inclusion and Empowerment)**	**Nature Based Solutions**	Ethiopia, Guinea and Sierra Leone
	Data sets from sectors most exposed to biodiversity loss as well as sectors that cause depletion of those resources have been 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.	Identified pathways with minimum viable data are needed for an economy that is embedded within nature and sets out a credible strategy for a whole economy transition in partner countries. **(DP2 – Innovative Approaches)**	**Nature Transition Support Programme**	Colombia, Ecuador

Table 1: *Practical innovative solutions and lessons learnt (Phase 1)*

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GCBC Project Outreach and Capacity Building Activities

Local Activities and Impact

Through a wide range of outreach and capacity building activities, GCBC projects have been able to demonstrate local impact often beyond their project goals.

Bio+Mine: Women's Group – Disaster Risk Management Training

The Bio+Mine team, along with the Benguet Provincial Disaster Risk Reduction and Management (DRRM) office, conducted a 3-day Disaster Risk Management Training for Women's Group on 6-8 November 2023. This training built the community readiness and resilience in managing disasters and risks. Twenty-seven women from Sitio Sto. Niño, Tublay participated.

Women play significant roles during disaster response and recovery. During crises, they often take up the roles of main caretakers, community organisers, and providers of vital services. The disaster risk management training builds their capacity to support the community to take appropriate response when disasters and risks occur.

Disaster Risk Management Training workshop participants

Impact on the Community

Through the training, the women have "increased their knowledge and acquired skills in basic life support." The geological risk mapping activity enabled them to "identify areas that are prone to risk and dangers" which they can inform their children and other members of the community to avoid, particularly in times of disasters. The DRRM equipment provided increased their readiness "to effectively respond during crises."

More importantly, the training provided an avenue for women's group "to revive their organisation and increased their motivation to support their community".

Disaster Risk Management Training workshop participants

DEEPEND: Sponge ID Workshop

Marine organisms are a promising resource for useful natural products such as medicines. The potential use of biodiversity - or marine genetic resources (MGR) - has yet to be thoroughly explored in the deep sea. These organisms offer the exciting potential discovery of new gene clusters that direct the formation of enzymes and small molecules. These could have useful biotechnological and pharmaceutical applications, including the discovery of novel antibiotics, coming at a time when society faces an antimicrobial resistance crisis. Marine sponges are known to be important sources of novel natural products, yet the identification of sponge taxa (many of which are new to science) requires specialist taxonomic expertise.

It was recognised that the DEEPEND team lacked expertise in sponge identification, despite this taxon being of utmost importance in biodiscovery. The workshop provided training for the Discovery Collections Team and improved taxonomic identifications for abyssal sponge taxa currently held in the Discovery Collections at National Oceanography Centre, Southampton, UK.

These materials largely originate from the Porcupine Abyssal Plain Sustained Observatory, Whittard Canyon, Mid Atlantic Ridge and Haig Fras areas in the North Atlantic, as well as selected specimens from the Central Pacific in the Clarion Clipperton Zone, collected during the SMARTEX project.

During the week, there were presentations from the invited experts of the SponBIODIV project on each of the major sponge groups, and hands-on laboratory training in the preparation of sponge spicules for microscopic examination. Over 200 identifications were made during the week and a workshop report is now in preparation detailing the results. A number of publications are also planned to summarise the findings of the workshop. In addition to the incredible science findings, many new connections were made, and a lot of fun was had by the project team learning from their new 'sponger' friends. The microscopic beauty of the sponge spicules was showcased by the project team's resident glass artist, Julie Light, who had plenty of inspiration and even created some glass spicules.

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Innovative Seaweed Aquaculture: growing relationships, knowledge exchange and building capacity

Growing strong relationships, exchanging knowledge and building capacity between partners was always going to be a key part of the success of Innovative seaweed aquaculture, a project that encompassed a nature-based solution for biodiversity restoration and poverty alleviation in the seaweed industry in a time of accelerating global climate change. Working with partners in Malaysia to achieve this goal, on 28th February 2024, the project team led a workshop in Tawau, Sabah: Safeguarding the seaweed industry through biosecurity and seaweed conservation. The workshop was hosted by the Department of Fisheries, Sabah (DoFs) who generously covered the costs of the event.

One of the talks was on the development of cultivars from wild populations which included an overview of the eucheumatoid seaweed industry in Malaysia and the major challenges facing the global industry. Eucheumatoids are red seaweeds (species of Eucheuma and Kappaphycus) that are a source of carrageenan, a valuable polysaccharide for use in the food industry and for other industrial purposes. Particularly striking in the talk was learning about the dramatic decrease in size of individual eucheumatoids. This was graphically illustrated where an image from 50 years showed five men holding one enormous individual contrasted with another image of a harvested eucheumatoid today that was not much bigger than the size of the hand holding it. With the decrease in size there is also a severe decline in the genetic diversity of the crop. However, it was exciting to see what the project was able to achieve where individual seaweeds collected from the wild had been successfully grown in the experimental seaweed farm and showed all the signs of being resilient to climate change.

Another talk on biosecurity for the seaweed industry emphasised the value of biosecurity in controlling the quality of the crop by preventing or minimising the introduction of pests and disease. Presenting evidence from a study from the previous project, GlobalSeaweedSTAR, the effectiveness of introducing biosecurity measures on reducing pests and diseases in the seaweed crop were demonstrated.

The results were striking. With biosecurity measures in place, there was a pest and disease reduction of 60-75% for Kappaphycus malesianus and 29-71% for K. striatus in comparison to the crops without biosecurity measures.

A talk was given on the importance of seaweed conservation to safeguard the survival of the aquaculture industry. This emphasised the need to couple the protection of wild seaweeds and their habitats in the vicinity of seaweed farms and proposed the idea that Marine Protected Areas could potentially provide a framework for developing conservation zones for seaweeds. It also emphasised the need for knowing the identity of the seaweed species that are being grown although this requires considerable taxonomic capacity building in many parts of the world. Approaches to develop an evidence-base for seaweed conservation where there may be no species list or up to date taxonomic information were also discussed, such as focussing on well-known species even when the taxonomy may not be resolved, or ethnophycology *(study of the interrelationships between humans and aquatic autotrophs)* through narratives of the indigenous communities.

There was a session in the workshop on citizen / community science and set the participants the task to think of some ideas for projects that could be undertaken by the local seaweed farming communities. The idea that gained the most enthusiasm was 'Turtle Watch'. Turtle grazing can decimate crops to the point where farmers will not use areas where there are high number of turtles. Monitoring certainly had the potential to be developed into a valuable but fun community science project.

In all, 57 people attended the workshop and the atmosphere was vibrant and engaged. Department of Fisheries participants were from their headquarters, and the following districts: Semporna, Sandakan, Tawau, Kota Belud, Kunak, Lahad Datu. There were also UM researchers and student, four UM employed farmers, and participants from Sabah Parks, the seaweed industry, a researcher from the local University in Sabah and the UK researchers. The atmosphere was vibrant and engaged which was reflected in the unanimous feedback comments we received.

Today's session was incredibly valuable and highly enjoyable. In Malaysia, we are fortunate to have a strong relationship between research, industry and government to ensure a successful and sustained seaweed industry for future decades.

For me, this workshop is very important to every district that own seaweed aquaculture to further improve knowledge on how to preserve seaweed effectively.

Wonderful workshop. A lot of information about seaweed from Department of Fishery Sabah, Prof Phaik, Prof Elizabeth and Prof Juliet. The knowledge sharing is so meaningful for us to look at the whole picture (doing research but at the same time we have to preserve the seaweed for our ecosystems). Climate changes do impact of the seaweed production. Community building among locals is very important so that the transfer knowledge can be spread among local Sabahan.

I am grateful to the organizers of the workshop as the workshop has improved the knowledge of participants. We will apply this knowledge in our daily routine in the field. We anticipate increase in production from our participants' farm with the take-away from this workshop.

This workshop is very interesting and full of information regarding on how to protect the seaweed industrial through biosecurity and seaweed conservation.

Nature-based Solutions: School Awareness Training Programme in Communities bordering TIPAs sites

The GCBC project enabled the hiring of a Guinean project officer to oversee and implement an environmental education programme in the three prefectures (Coyah, Forécariah and Kindia) associated with three TIPA sites in Guinée Maritime. The lack of a dedicated and trained educator was identified as a barrier to implementation of the environmental education activities associated with a previously funded Fondation Franklinia project aimed at conservation of threatened trees at selected TIPA sites.

The 10 schools (8 primary and 2 colleges) are very engaged, and the school eco-clubs have been set up and materials delivered to start the school gardens to help teach more about threatened trees and improving the environment around the schools. Some schools are more advanced than others with students who have identified and collected seed from threatened trees. The project made teaching materials freely available through the HNG website (https://www.herbierguinee.org/gcbc.html) and a new printed version of the teaching booklet has been printed and delivered to roll out to a wider audience. The level of education is lower than some other African countries where Kew works, and the teaching materials had to be significantly modified to be more accessible.

In November 2023, a pilot workshop was held in Kindia with head teachers and deputy heads from 24 schools in the area to increase the outreach from the 4 schools already in the programme. The teachers discussed how to incorporate the messages around protection of the environment and ecosystem services into lesson planning, did exercises with discussion cards and learnt how to use the snakes and ladders game to get children engaged.

The success of the train the trainer's workshop has meant this approach will likely be rolled out across the other areas where the project is engaging with schools in Coya and Forecarich. New funding is now available to roll out the programme in Guinée Forestiere with a tailored booklet for this area printed under the foundation Franklinia grant. The project will continue to monitor and provide support to the teachers checking in via telephone calls and site visits. Messages will be reinforced by giving students hands on practical experience through sowing seed and caring for plants.

Playing snakes and ladders at the teacher workshop

Member of the eco-club at Koba Pastoria 2 primary school, showing his finds

GCBC – 2024 and beyond

GCBC – 2024 and beyond

Moving forward, the GCBC programme will continue to build on the progress made over the past two years in addressing the global challenges around biodiversity, climate and livelihoods. This will include onboarding the successful applicants from the second competitive grant round by the end of 2024, synthesising and consolidating findings and results from across the current portfolio of projects to build the evidence base, announcing further competitive grant rounds that address priority themes, hosting learning events and an annual Research Symposium allowing grantees to meet, share knowledge and build collaborations for the future.

As set out in Table 1, the outcomes from the projects in action 2023, show how the six GCBC strategic science priorities have been addressed. This considers how the projects have demonstrated what works (e.g. the case of common hyperaccumulator plants for mine restoration, building capacity for stakeholders (e.g. the lab protocol to assess deep sea samples), identifying best practice (screening for new temperature resilient seaweeds), informing policy (risk analysis tool mapping data for hazards to the food system), finance / incentives to encourage change (alternative approach to 'payments for ecosystem services' in the context of agrobiodiversity) and through a systems approach aiming for transformative change (identification of pathways to identify and develop bioresources that underpin nature conservation, and the generation of evidence informing a strategy to embed nature in the economy).

In addition, the projects have identified their learnings in addressing all of the ten GCBC delivery principles, giving some useful steers for the projects from RGC1 as they start to be implemented. Notably, the importance of the project's approach towards need-driven solutions, by continued engagement with IPLCs throughout the different stages of the project, and ensuring that the solutions that are developed can be replicated and scaled in other regions taking account of tweaks to ensure a fit with the local context. Gender equity and capacity building is also featured with examples of training initiatives and workshops to support women who play a significant role in disaster response and recovery. Approaches to ensure robust scientific methods, through regular risk assessments, inclusion of the right scientific expertise and local knowledge within the projects are detailed, along with the value this brings to ensure credibility of the evidence gained to address site-specific challenges.

The synthesis of new high quality evidence from GCBC funded projects across themes and geographies will help to inform our understanding of how the conservation and sustainable use of biodiversity contributes to inclusive climate resilient development and poverty reduction. This evidence and knowledge, developed across the programme, will be made accessible to new, diverse and hard to reach audiences through different communication events and channels. This will include through the GCBC international network to share information and build capacity of research, policy and practice.

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Annexes

Annex 1.

To meet the ambition of the GCBC Theory of Change, ten delivery principles (Figure 4) were set out for the programme. These, along with the six science priorities (Figure 5) provide a framework for considering the evidence base, policy development and approaches needed to achieve transformative change.

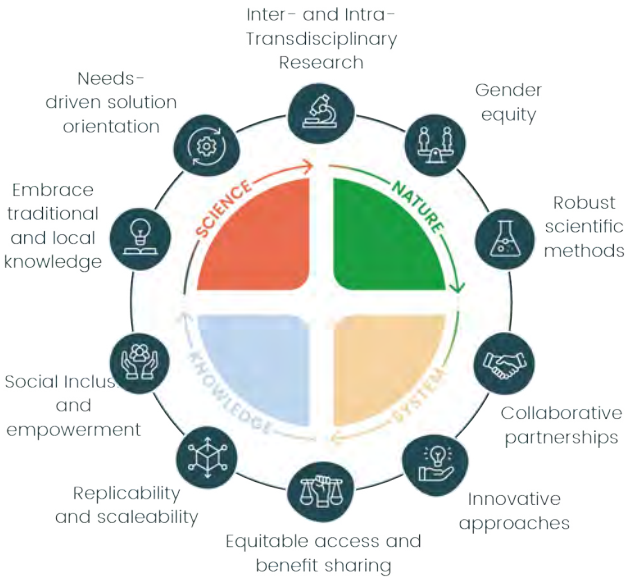

Figure 4: *Ten GCBC delivery principles*

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.

Figure 5: *Six GCBC science priorities*

Annex 2.

***13,336 people** have participated in GCBC led research activities to date*

***30 projects funded** by the GCBC to date*

*GCBC projects have leveraged a cumulative total of **£13,138,251 in public finance and £645,165 in private finance***

***208 research partnerships** have been formed or strengthened through GCBC funded projects*

***219 new knowledge products** (models, frameworks, research products) were produced to support operational implementation of sustainable biodiversity activities*

*A total of **108 policy-relevant evidence products** to date have been produced by GCBC projects*

*A total of **59 case studies** have been produced demonstrating transformative change to address the nexus of climate resilience, biodiversity loss and improved livelihoods*

Figure 6: *Cumulative GCBC Indicator Numbers 2022–2024*

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