SUPPORTING THE EXPANSION OF THE RESTORATION BAROMETER

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MANAGER:
Suxin Yan

DEPUTY MANAGER:
Amy Calitz

TEAM MEMBERS:

Morgan Booher	Tessa Owens
Stephen Hart	Liza Roberts
Kerri Hoolihan	Tanishka Sachidanand
Matthew Landin	Leanna Tang
Max Lulavy	Aliya Tuzhilin
Aidan McKean	Kate Wister
Laura Millar	Chandana Yelkur

Design and layout by Aidan McKean and Leanna Tang.

REFERENCE:
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DISCLAIMER

In partial fulfilment of the requirements for Columbia University's Master of Public Administration degree in Environmental Science and Policy, students analyse pressing sustainability issues for public sector or non-profit sector clients and recommend policy solutions. This document was produced in collaboration with IUCN to support the global program "Supporting the Expansion of the Restoration Barometer."

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EXECUTIVE SUMMARY

Global ecosystem restoration must be scaled up in order to meet the compounding challenges of land degradation, biodiversity loss and the climate crisis. The Restoration Barometer, initially launched in 2016 as the Bonn Challenge Barometer by the International Union for Conservation of Nature (IUCN), is a tool used by governments to identify, assess and track the progress of restoration commitments. As adoption of the Barometer grows, the need for additional tools to aid countries in developing and implementing restoration policies in line with their goals has also grown.

This report assists IUCN and governments in designing and monitoring progress towards these goals. Firstly, the policy assessment tool aids the initial stages of restoration policy design and streamlines policy assessments. It highlights the core components of a well-designed policy, such as the governing body charged with implementation, restoration monitoring systems and stakeholder involvement. Countries can use this set of questions to review a restoration policy for the core elements of a robust policy. The case study of Bangladesh highlights restoration progress and identifies gaps in policy implementation by reviewing submitted data. Finally, the carbon impact tools database is a repository of available tools for measuring the net carbon impacts of ecosystem restoration interventions. Countries can use the database to identify tools to measure the climate impact of their restoration activities across eight core ecosystems (see Figure 1).

By using the policy and climate tools developed, countries are able to better design and monitor restoration efforts and IUCN will have more instruments available to facilitate conversations with these countries. Identified gaps in climate measurement will asist scientists in expanding ecosystem restoration research. Finally, improved climate measurement will aid low-income countries receiving funding from international donors who rely on accurate monitoring and reporting.

INTRODUCTION

Rapid ecological degradation across the planet has been clearly documented: over 75 percent of Earth's land has been disrupted and transformed by humankind (IPBES, 2018). Human activities have caused habitat destruction, pollution, overharvesting and climate change, triggering the sixth mass extinction (Pievani, 2014). This loss of biodiversity damages the environment's ability to provide ecosystem services like clean air, food, water and public health that are essential to human survival (IPBES, 2018). Additionally, ecological degradation and climate change are mutually reinforcing. Degradation releases greenhouse gases into the atmosphere and reduces carbon sequestration potential, while climate change exacerbates degradation through increased drought, flooding and erosion, among other phenomena (IPCC, 2019b). Thus, global ecosystem restoration must be expanded to rebuild resilient ecosystems and meet the compounding challenges of land degradation, biodiversity loss and the climate crisis.

IUCN is a membership Union composed of over 1,400 governmental and non-governmental organisations with the mission to "influence, encourage and assist societies throughout the world to conserve nature and to ensure that any use of natural resources is equitable and ecologically sustainable" (IUCN, n.d.a.). IUCN works on fifteen themes related to conservation, environmental and ecological issues, and is one of the implementing partners in the ongoing United Nations' Decade on Ecosystem Restoration (IUCN, n.d.b.). IUCN's two flagship restoration monitoring tools are the Red List of Ecosystems and the Bonn Challenge Restoration Barometer, both hugely impactful in the pursuit of ecological restoration through nature-based solutions.

The Bonn Challenge, launched in 2011 by the Government of Germany and IUCN, is a global goal to restore 150 million hectares of degraded and deforested landscapes by 2020, and 350 million hectares by 2030 (InfoFLR, n.d.). The Bonn Challenge uses a forest landscape restoration approach to restore ecological integrity and improve human well-being through multifunctional landscapes.

In 2017, international pledges to the Bonn Challenge surpassed the 150 million hectare milestone set by IUCN (IUCN, n.d.c.).

The need for a public-facing restoration monitoring tool became apparent as the Bonn Challenge expanded. The Restoration Barometer fulfils this need. The Barometer launched in 2016 as a "universally applicable, systematic framework for identifying, assessing and tracking action on global restoration commitments" in forests (InfoFLR, n.d.). It is now expanding to track progress on restoration targets across eight terrestrial ecosystems, recording the size of the area being restored, the environmental and economic benefits of restoration and the enabling policies and financial structures that result in successful restoration efforts (IUCN, forthcoming). The Restoration Barometer measures four action and four impact indicators across eight ecosystems (ibid.). The indicators provide a comprehensive understanding of a country's restoration progress. They are designed to be flexible and inclusive so that the Barometer can be used even with incomplete data. The Barometer offers national and sub-national governments the opportunity to streamline reporting on their restoration commitments, and can help track progress toward global goals (ibid.). Application of the Barometer is ongoing in twelve countries, with data publicly available for six: Brazil, El Salvador, Madagascar, Mexico, Rwanda and the United States (Progress Report, 2018).

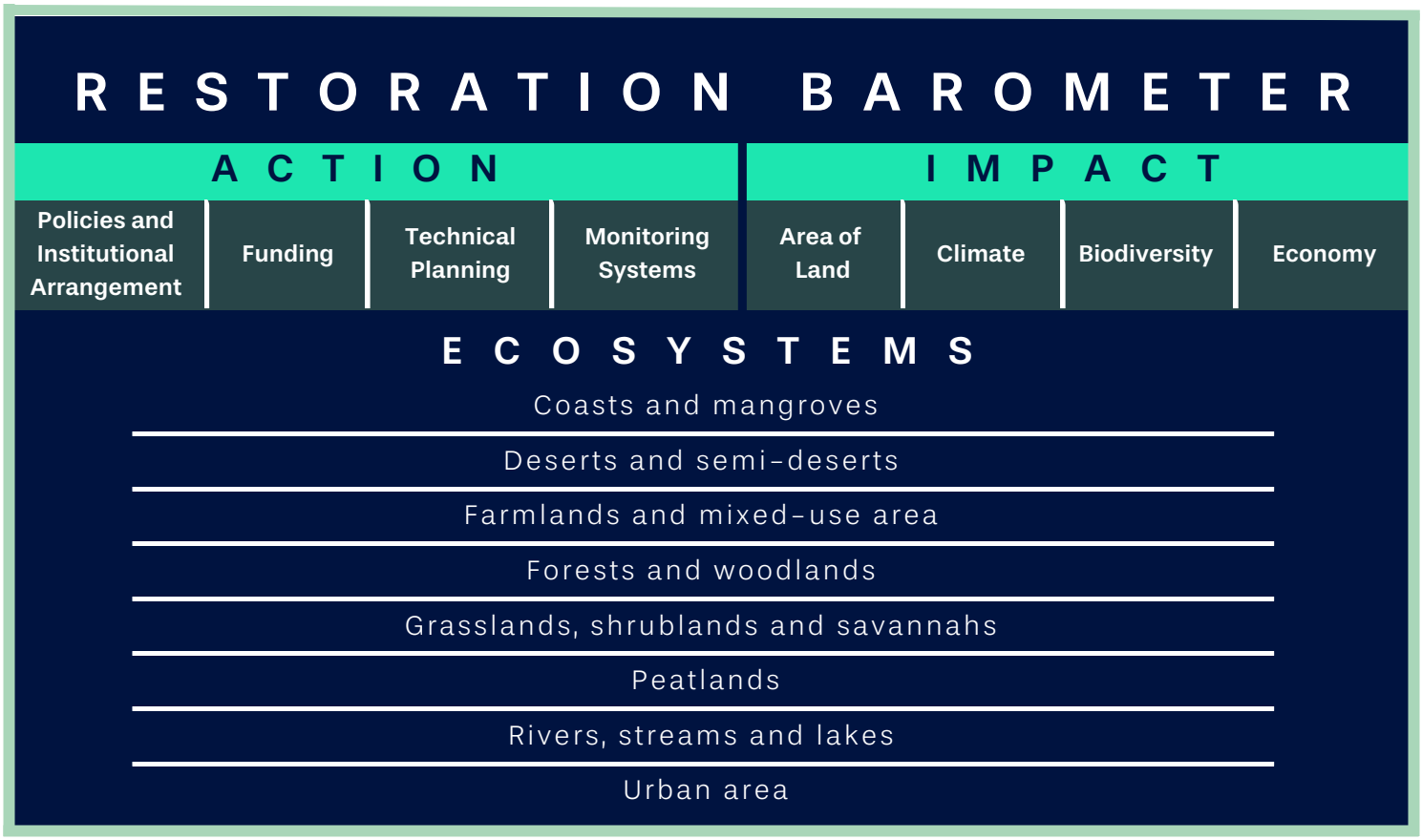


Figure 1: The Restoration Barometer tracks metrics in four action indicators and four impact indicators across the eight IUCN ecosystem types in order to measure restoration progress in each country (IUCN, forthcoming).

This report supports IUCN's ongoing work to expand the Barometer and aid countries with restoration activities. Firstly, to address challenges in policy design and support governments in evaluating their progress on the policy action indicator, a policy tool was developed to assess completeness of restoration policies. The tool expands upon the questions included in the Restoration Barometer to aid countries in developing effective restoration policies. Second, to aid IUCN in assisting the government of Bangladesh with their restoration efforts, an analysis of the actions taken by the Bangladeshi government was conducted. This analysis was then used to develop policy recommendations to facilitate further restoration. Finally, to aid countries in having access to reliable and relevant climate impact measurement tools, a database of open-source tools that measures carbon sequestration across the eight Barometer ecosystems was developed. The database can assist governments in reporting on the climate impact indicator and measuring the net carbon impacts of their restoration activities.

ACTION INDICATOR: POLICY

To assist the Restoration Barometer in tracking and analysing restoration policies, a policy assessment tool was developed. The tool is designed to guide restoration managers in reporting and assessing restoration policy features and completeness. It can also be used to aid countries with policy creation by ensuring they consider key criteria during the design stage. Country representatives will fill in details of their country's current restoration policies and IUCN can review the results to engage the representatives and provide feedback. To simulate this process as well as evaluate the tool, the team researched and assessed restoration policies in the Bonn Challenge pilot countries: Brazil, El Salvador, Madagascar, Mexico, Rwanda and the United States of America. Policy documents from these countries were primarily found through the Barometer website, government websites, the Food and Agriculture Organization (FAO) and ECOLEX. The evaluation results informed assessments of each country's overall policy regime.

The tool is formatted as an open-source spreadsheet with 32 questions designed to aid governments in evaluating a policy's objectives, completeness and context. This tool also provides guiding questions for assessing policy regimes as a whole. The criteria for assessment are based on reports pertaining to restoration policy design published by IUCN and the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES), among others (IPBES, 2019; Slobodian et al., 2020; see Appendix A). Various publications informed the drop-down selections created to provide standardised terminology for responding to the assessment questions (Bengtsson et al., 2010; IPBES, 2019; IUCN, 2021; Jacob et al., 2019; OECD, 2009).

The policy assessment tool begins with eight questions to establish context for each policy under analysis. Respondents first identify the title of the policy, its primary restoration goals, the types of ecosystems it targets and, if applicable, the primary Forest-Landscape Restoration (FLR) activity it utilises. Respondents are then asked to input the year the policy was enacted, what legal body it was enacted by, the governmental office responsible for overseeing the policy and the policy's budget for restoration.

Evaluation Criteria

Target Setting	Does the policy set clear goals or quantitative targets at the national and landscape levels?
Restoration Interventions	Does the policy outline clear plans for restoration intervention activities, such as FLR?
Stakeholder Involvement	Does the policy have mechanisms to involve stakeholders in its implementation?
Land Rights	Does the policy address existing land rights?
Policy Enforcement	Does the policy contain any provisions for non-compliance?
Governance and Institutional Arrangements	Are there clear institutional arrangements for the implementation of the policy?
Rights-Based Instruments and Norms	Does the policy promote equity of outcomes? Does the policy incorporate cultural and indigenous practices?
Knowledge and Capacities	Does the policy provide for training, knowledge-transfer and continued follow-up?
Monitoring and Evaluation	Is there a monitoring framework to measure progress against a recorded baseline?
Policy Tools and Instruments	Does the policy utilise implementation tools or instruments (see Appendix B)?

Figure 2: The policy assessment tool offers a system to assess whether a restoration policy encompasses the evaluation criteria in the left hand column by answering the questions in the right hand column.

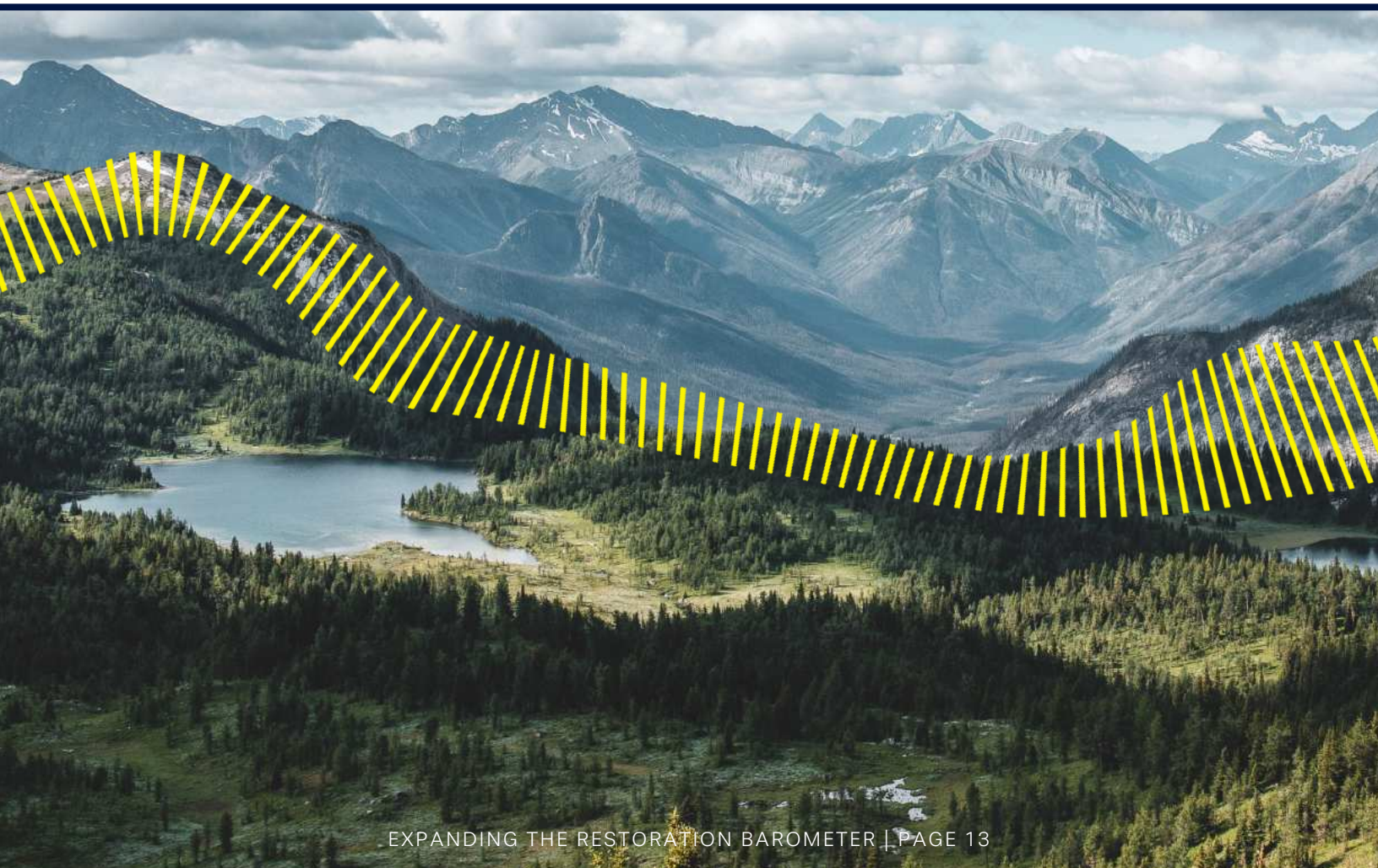
With this context established, there are ten criteria included in the tool to develop a policy's objectives and key components as well as to shed light on any existing gaps within the policy regime. Each question is first phrased to elicit a "yes" or "no" response with three options: "yes, the criteria is mentioned"; "yes, the criteria is mentioned and details are provided"; or "no, the criteria is not mentioned." For each criteria found in a given policy, respondents are asked to elaborate on how the policy incorporates that component (see Appendix B).

After completing this ten-step analysis, respondents are asked to identify if the policy has been included in the country's Nationally Determined Contribution (NDC) to the Paris Agreement targets and describe any prominent obstacles to implementation. Identifying a policy's relationship to the country's NDC is helpful in promoting coherence across a policy regime. Goals listed in an NDC without supportive policies to realise them indicate a potential gap in the policy regime and may act as an opportunity for improvement in the future design of restoration policy.

Key obstacles for governments include lack of financing structures, insufficient enforcement capabilities, public resistance or cultural mismatch. This supplementary information adds additional context to the assessment of a nation's restoration policy regime, which is helpful when moving beyond evaluating completeness.

When all relevant policies have been evaluated, the completed assessment can be used to identify common trends or oversights in the overall policy regime. For example, the assessment may reveal that forest ecosystems tend to be the main target for restoration through sustainable forest management activities, or that national plans often do not set clear numerical targets or establish detailed monitoring and evaluation systems. IUCN can use both the individual policy breakdowns and the overall assessment to provide countries with policy recommendations at all levels.

The goal of this tool is to aid restoration managers in assessing restoration policy features and completeness based on the categories provided. However, it is limited in its applicability and self-reflective nature. The tool is meant to be used by country representatives with a thorough understanding of their country's restoration policy landscape. Thus the pilot country assessments may be incomplete due to the team's limited knowledge of each pilot country's political and environmental context. Additionally, this tool is primarily self-reflective and does not allow for comparison across different countries or policies.



Pilot Country Assessment: Madagascar

Madagascar has a number of recent policies and strategic plans that aim to both protect and restore the country's natural resources (see Appendix C). The strategic and action plans, in particular, provide comprehensive goals to achieve improved management of Madagascar's natural resources and often achieve all ten of the key policy criteria. Although some policies were quite broad in terms of the types of landscapes and ecosystems referenced, the policies largely focused on forest reforestation efforts. Therefore, Madagascar could benefit from additional policies that aim to restore other key ecosystems within the country. Additional specificity around the budget allocated to each restoration policy could also improve implementation and compliance. Many of the policies reviewed have a strong focus on the importance of communities contributing to restoration efforts. Mention of stakeholder engagement was consequently consistent across all policies referenced. Additionally, many policies established governance and educational frameworks to provide communities with the power and knowledge to aid in improved natural resources management and restoration. To fully understand the effectiveness of these policies, it will be key to better understand how these policies are applied at the local level, and how each community interprets the goals outlined in the strategic plans to meet their needs.

CASE STUDY: BANGLADESH

A case study was conducted on Bangladesh, researching and reviewing data relevant to the Barometer. Data gathered through public research and submitted by IUCN Bangladesh was inputted into spreadsheets specific to ecosystem types with current or planned restoration within the country (see Appendix D). Using the data and spreadsheet results, the target country's performance was analysed on the four action indicators.

Action Indicator 1:
Policies and Institutions

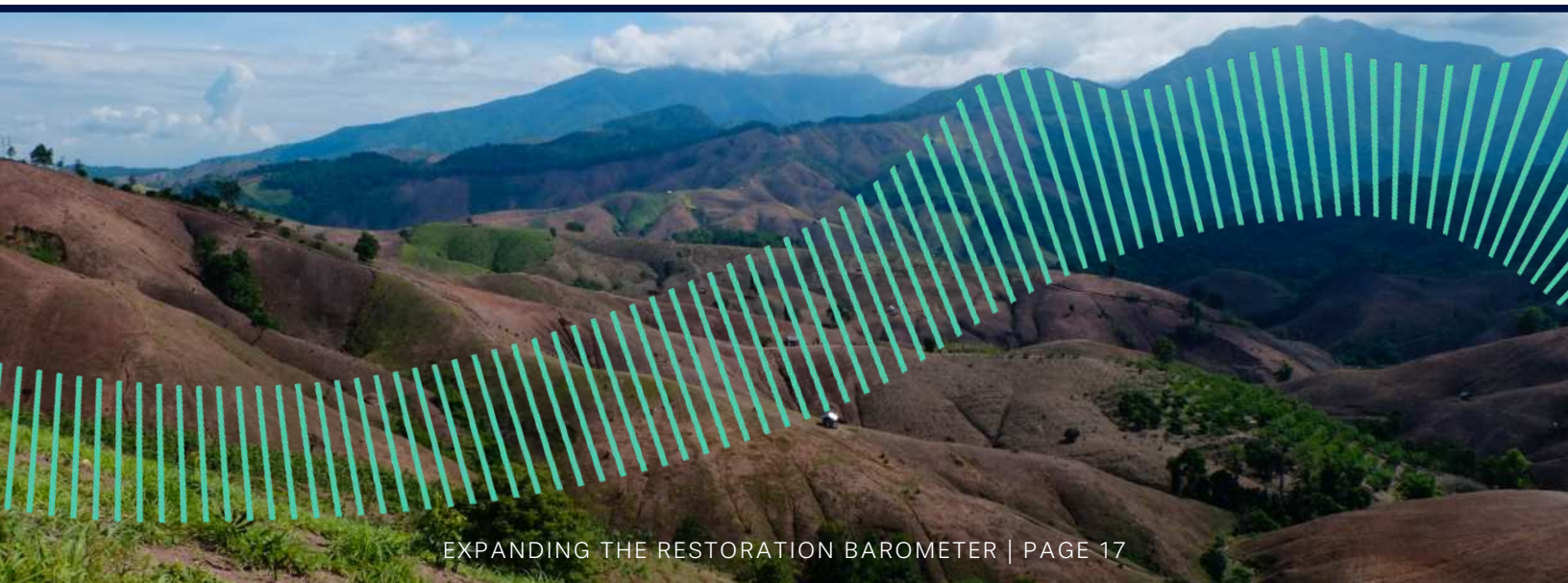
Policies indicate how committed a government is to its restoration promises, by tracking relevant policies and institutional arrangements that support restoration. The Barometer looks at current policies that have already been enacted to track a government's progress in creating enabling conditions for restoration through its ending year. The Barometer also looks into the number of hectares for restoration under a policy, the budget allocation, and the implementing institution.

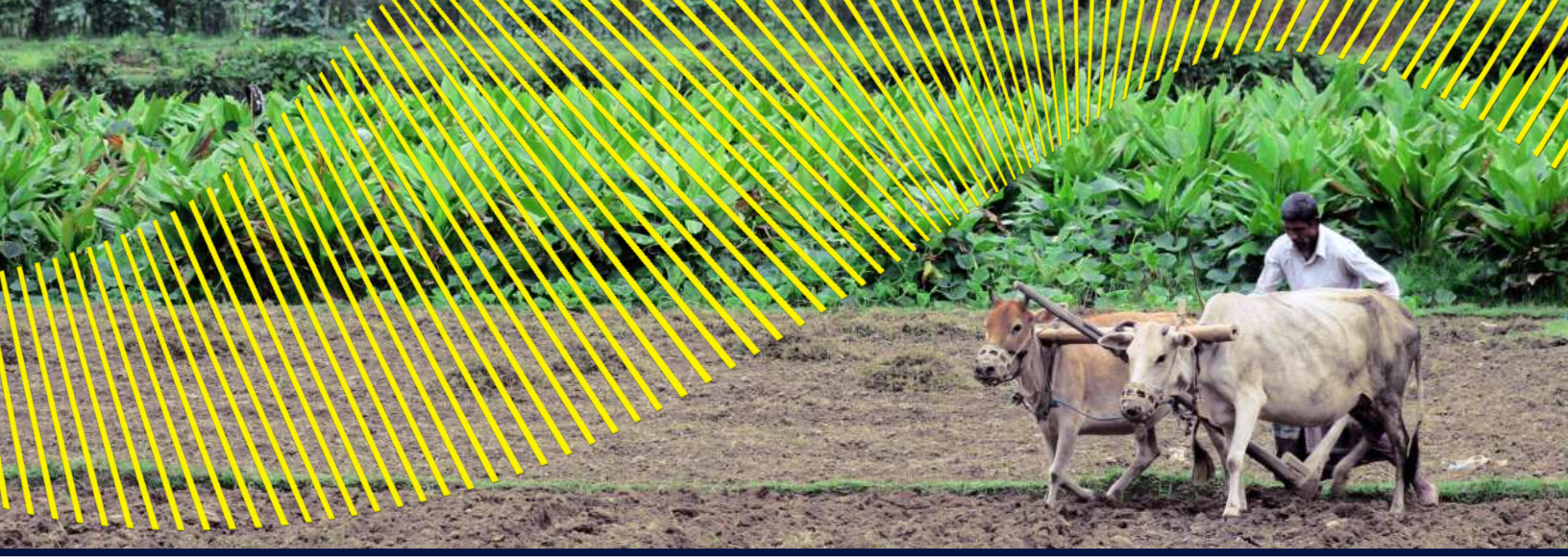
Bangladesh has a long history of recognizing the societal benefits of ecosystem conservation, but the means of conservation and targeted benefits have changed over time. In laws derived from British colonial rule, management practices focused on the protection of natural resources that could be harvested from an ecosystem – namely forests – for the purposes of benefiting colonial businesses and trade (Biswas & Chouhury, 2007). This was an approach that excluded those with centuries- to millennia-long ancestral and cultural ties to the land. As late as 1989, updates to Bangladesh's forest policies maintained these traditional exclusionary approaches, including harsh punishment for trespassing and non-permitted harvesting (ibid.). In the 1990s, however, policies and laws began expressly acknowledging the wider value of ecosystem services, such as fostering climate change resilience and mitigation (MoEF, 2016). These considerations became central to forestry and conservation laws and policies by the 2000s (ibid.). Additionally, this period saw a shift from exclusionary practices to increasing local community involvement

in management efforts, with social forestry becoming a focus of Bangladesh's forest policy in 2000 (Biswas & Chouhury, 2007).

Bangladesh's approach to conservation has thus evolved over the past few decades, from the colonial era's exclusionary approach to a strong push for local community involvement, and finally into the current approach of co-management (Ullah et al., 2022). Co-management provides local communities with government compensation for their contributions to conservation and restoration in forests and other ecosystems, while also channelling the direct economic gains from these managed lands to the local communities in an effort to foster a deeper personal investment in the ecosystem. Certain case studies of co-management have proven successful, with increased local economic opportunity and community engagement in conservation (Hajjar et al., 2021). Other examples have shown less success, however, with deforestation continuing at high rates in protected areas (Ullah et al., 2022). The discrepancy in outcomes indicates the need for certain conditions to exist for co-management practices to find success and realise conservation and restoration goals. Namely, research has found that property rights, and the community's ability to exercise those rights, are crucial to creating community ownership over outcomes and successful implementation of co-management (ibid.). These conditions will be a vital consideration as the practice becomes more standard for conservation and restoration efforts.

Despite acknowledgement by the national government of the economic, resiliency and climate-related importance of conserving and restoring critical ecosystems in Bangladesh, funding and coordination remain significant barriers to scaling up these efforts commensurate with the country's goals. Economic development remains the national government's primary goal and often takes financial precedence due to limited resources. Additionally, different ecosystems fall under the jurisdiction of different governmental agencies and the ability to act within those ecosystems is subsequently hampered by difficulties coordinating across agencies. This challenge of coordination makes tying economic development goals to the economic benefits of conservation and restoration more difficult. Furthermore, because many of the restoration projects throughout Bangladesh occur on a local level, their results may not be communicated to higher levels of government. This strains efficiency and coordination, and further hampers restoration efforts.





Action Indicator 2: Funding for Restoration

To track actual expenditure on restoration, the Barometer includes five components to help IUCN staff consolidate information to easily upload to the Restoration Barometer portal. First the Barometer looks at each project's funding type: domestic public expenditures, private investment, international donor support or domestic philanthropic and non–profit organisations. The Barometer then looks at the project's funding amount, tier levels of confidence in accuracy, data references and current percentage of funds spent on restoration.

Bangladesh has received international funding for projects focused on development, economic growth and health and sanitation since the 1970s (Banglapedia, 2021; USAID, 2022). In the years following the 2004 Indian Ocean earthquake and tsunami, the government of Bangladesh has been focused on coastal restoration and climate resilience in order to mitigate and adapt to rising sea level and potential future natural disasters. Prominent international financial institutions such as the World Bank and the Asian Development Bank have funded development projects with a focus on ecosystem restoration in the last 10 years (BWDB, 2022; World Bank Group, 2021). International governments such as the United States, Denmark, Sweden, United Kingdom, Germany and Switzerland have also aided the country in meeting its climate resiliency and NDC targets by establishing funds and trusts. These include the Bangladesh Climate Change Resilience Fund, Bangladesh Tropical Forest Conservation Fund, Climate Resilient Infrastructure Mainstreaming and the Bangladesh Climate Change Trust Fund (Tashman, 2016). Due to the policies within international financial institutions, reports on fund disbursement and restoration progress for initiatives funded by international financial institutions are publically available. However, tracking progress for restoration projects funded domestically or by local NGOs is more difficult.

Action Indicator 3: Technical Planning

Effective planning is critical for identifying where, how and why restoration efforts will take place and assessing potential benefits.

This indicator captures the restoration planning approaches used to define the interventions and target the degraded areas. Ecosystems are often unique to their locations and multiple factors must be taken into account when planning a restoration project, such as restoration approach, restoration area, scale, ecosystem type and impacted endangered species. Documenting these details provides countries with a clear technical understanding of previously successful restoration projects, which can then inform and improve future restoration plans.

The Bangladesh government's broad support of restoration initiatives has led to the completion of many restoration projects in the past few decades. Historically, most of these projects were focused on forest restoration, with restoration activities consisting primarily of planting more trees (Biswas & Choudhury, 2007). This focus on forests, however, has meant that other ecosystems – such as coastal mangroves and urban areas – were ignored at the same time that damaging pollutants accumulated, leading to their degradation (ibid.).

Additionally, reforestation practices disregarded the effect that establishing reserves and protected areas would have on the local communities that live off the land and rely on resources provided by these ecosystems. In recent years, there has been a pivot to both diversify targeted ecosystems and to include community participation and stewardship in restored areas, with the goal of improving the nation's resilience to climate change while supporting local communities (Islam et al., 2018; Rahman et al., 2017). The Bangladesh government has begun to diversify its restoration initiatives to include other previously ignored ecosystems like rivers, coastlines and mangroves. This can be observed in Hilsa sanctuaries in southern Bangladesh. The Department of Coastal and Marine Fisheries established these sanctuaries within the Meghna–Padma Rivers and other associated tributaries in order to protect the Hilsa fishery for local fishing communities, interviewing farmers to ensure that the sanctuary was successfully protecting the fishery while providing income for the fishermen (Islam et al., 2018). However, ecosystems such as urban areas and peatlands continue to be neglected (Uddin & Mohiuddin, 2019).

Action Indicator 4: Monitoring Systems

Monitoring systems track a country's progress toward its restoration goals and create an iterative learning process that allows decision-makers to understand the impacts of their work and make informed decisions. The Barometer consolidates monitoring systems in a country by looking into managing institutions, geographic scale, type of monitoring system and alignment with monitoring and reporting systems such as Sustainable Development Goals (SDGs) and NDCs.

Bangladesh's decades-long partnership with the international NGO system to address conservation and climate resilience has led to a number of monitoring and evaluation partnerships to track its progress on ecosystem restoration. Projects like the Bangladesh Forest Inventory, which is implemented by the Government of Bangladesh with technical support from the Food and Agriculture Organisation of the United Nations, demonstrate bilateral collaboration to establish a monitoring and evaluation framework that is owned and operated by the national government (MoEF, 2020). Additionally, some monitoring programmes, such as the Sundarbans Environmental and Livelihoods Security (SEALS) programme, have been developed exclusively by the Government of Bangladesh with international financing assistance (Rogers et al., 2009). One component of SEALS is a grant programme for innovations in sustainable restoration that includes a clear monitoring and evaluation protocol for awardees that looks at progress toward restoration goals.

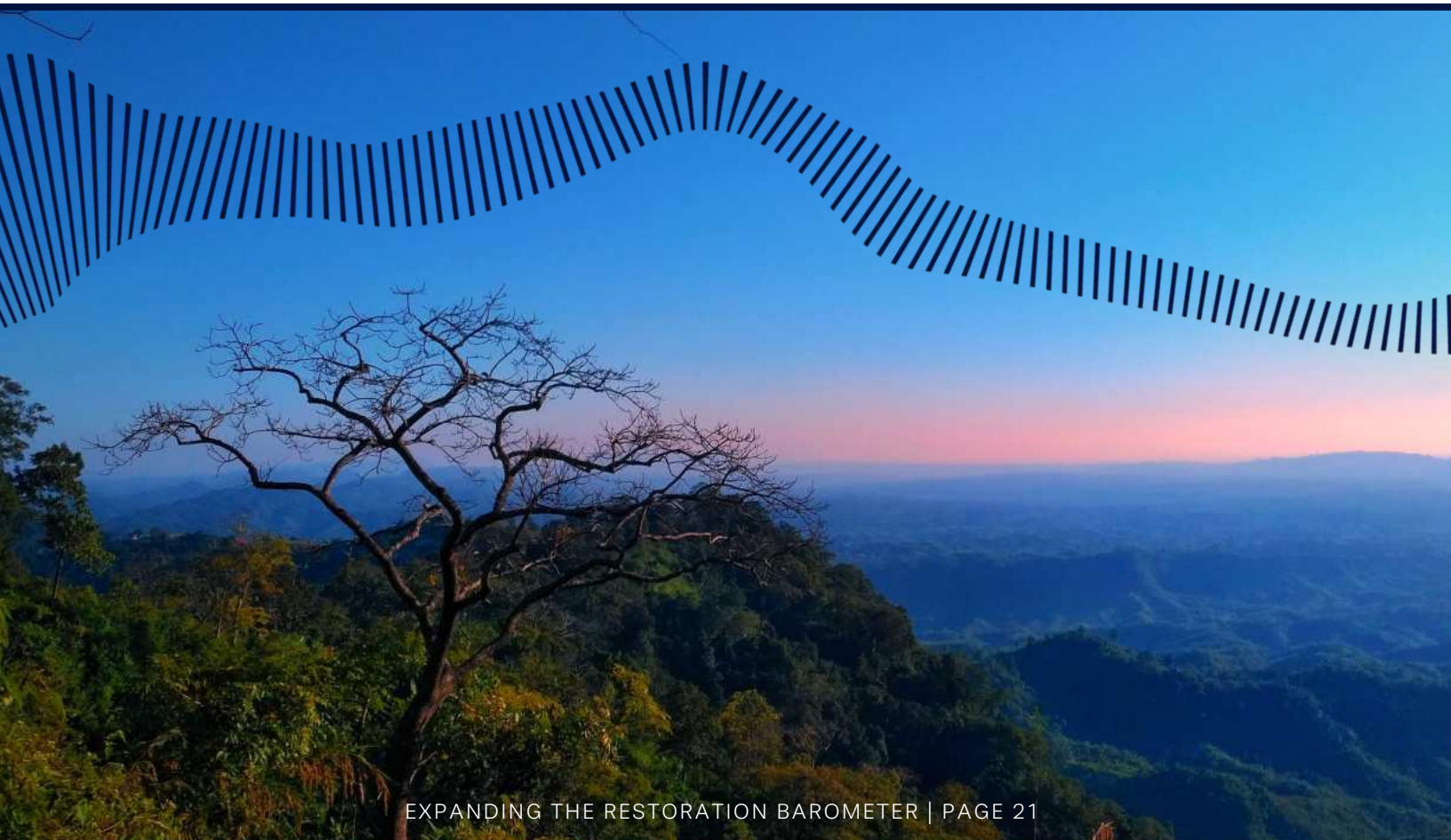
Another common approach to restoration monitoring within Bangladesh is for international NGOs and donor agencies to establish and implement a programme with support from the government. Some examples of this are Mangroves for the Future, a multinational monitoring programme, and IUCN's impact monitoring of wetland biodiversity of 13 water bodies in Pabna and Natore (IUCN, 2015; IUCN, 2016). One drawback, however, is the consistency of publicly available information. Progress toward SDGs is reported in annual reports published by the government's Ministry of Planning (GED, 2020), but public facing databases are not regularly updated (BBS, 2020).

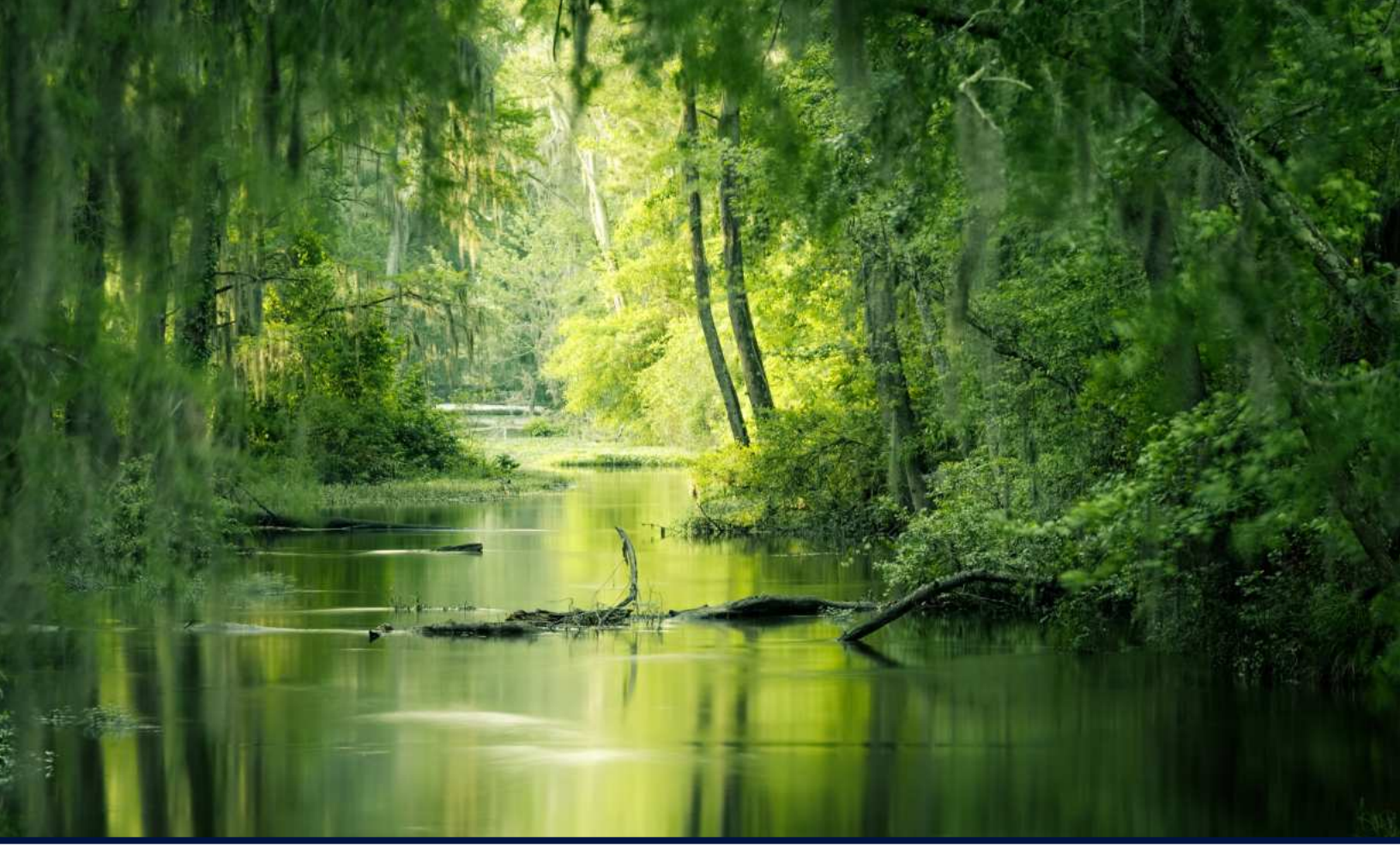
Policy Recommendations

Three recommendations to improve the coordination of current policies and resources and facilitate further restoration in Bangladesh have been developed. The recommendations focus on a "ridge-to-reef" approach to restoration, which addresses the interactions between upland and coastal and marine ecosystems. These interactions include protecting coasts from sedimentation by restoring degraded uplands, and protecting uplands from storm surges and flooding by restoring shoreline and reef ecosystems. This approach aims to make restoration efforts more efficient by targeting areas with benefits beyond the restored ecosystem itself.

Recommendation 1: Encouraging co-management practices by local governments on municipal lands.

Particular attention should be given to the interaction between rapid urbanisation and the preservation of current Protected Areas and Ecologically Critical Areas, as well as the expansion of managed lands to meet conservation and restoration targets. Local governments should adopt a model of co-management for ecologically valuable municipal lands to engage and economically benefit local and indigenous communities. This should occur in coordination with local governance bodies so that regional and national conservation policies are adapted to reflect local conditions and priorities (Sharma, 2011).



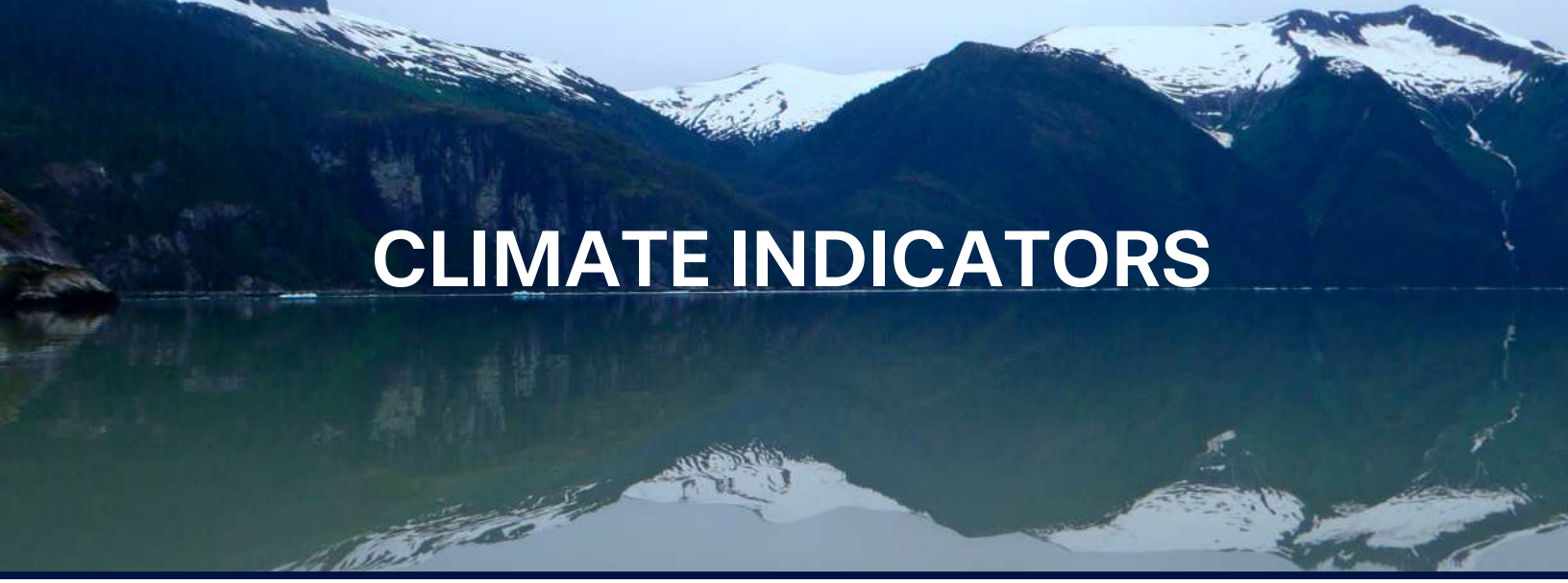


Recommendation 2: Tying financing for economic development to reporting requirements for restoration and conservation.

The national funding for economic development goals in the 8th Five-Year and Delta Plans should be tied to reporting on preservation goals within high-growth regions, as a means of incentivising restoration and conservation at local and regional levels. A local restoration green fund should be established and made accessible through reporting of successful restoration and management projects at the local level. Additionally, a national green fund for projects that have publicly available progress data and involve collaboration between ministries and national organisations should be created.

Recommendation 3: Training local communities on evaluation and streamlining reporting mechanisms.

To increase compliance with reporting at all levels, local development agencies should be trained in monitoring and evaluation of management and restoration projects. Management of, and accessibility to, a central reporting database should also be improved. Increased ease of reporting, combined with stronger coordination across local, regional and national levels, will allow restoration data to be efficiently aggregated for better reporting on Bangladesh's NDC progress. In turn, better reporting can help unlock further international funding for the nation's restoration and conservation efforts.



CLIMATE INDICATORS

There is significant capacity for restoration across many ecosystems that will play an important role in global restoration efforts. With the Restoration Barometer now expanding to include the additional ecosystems of deserts, grasslands, freshwater bodies, coastal regions, mangroves, urban areas and farmlands, it is necessary to identify tools that can measure carbon sequestration and storage capacity for ecosystems after the application of restoration interventions beyond forests. Varying landscapes have different capacities to store carbon and require different restoration approaches with specific systems for measuring carbon impacts. While there is no "one size fits all" approach for carbon measurement across ecosystems, there is considerable overlap in some ecosystems.

Open-source tools for each of the eight ecosystem types as defined by IUCN have been identified. These tools span different levels of complexity and granularity of measurement to calculate the net impact of greenhouse gas emissions and sequestration linked to various restoration interventions. The tools researched were selected based on their availability, level of peer review and applicability across ecosystems. An in-depth literature review focusing on select tools for each ecosystem illuminated some patterns and challenges found across the various ecosystems, such as the lack of availability of tools and the complexity of carbon measurements in some ecosystems. The tools assessed in the literature review are detailed in Appendix E.

Additional measurement tools for each ecosystem were added to create a database that governments can use to assess carbon storage and sequestration capabilities across various ecosystems. The tools included in the database differ in their methodologies, the complexity of calculations, data requirements, user knowledge and ease of use, providing a variety of options depending on countries' resources and needs. This database is a repository of existing tools and methods as of April 2022 that will be vital to measuring carbon impacts of restoration and expanding the Restoration Barometer. Moreover, it provides governments with a list of tools to use in their national greenhouse gas inventories and quantify the impacts of their restoration projects.

Carbon Impact Tools Database

Figure 3: Many tools can be used to calculate carbon emissions or sequestration across multiple ecosystems, particularly those with similar biophysical characteristics.

Some tools are specific to particular ecosystems, using special models that account for the unique characteristics of the ecosystems. There are, however, many tools that can be used to calculate carbon emissions or sequestration across multiple ecosystems. These tools are especially prevalent for ecosystems that have similar characteristics, such as forests, farmlands and grasslands. These tools highlight the benefit of including overlapping ecosystems in the measuring systems. If a country is likely to be performing restoration on both forests and farmlands, it may be more efficient to use one tool.

One trend that was identified is based on the prevalence of tools for certain ecosystems, like forests and farmlands, and not for others, like peatlands or deserts. This clearly displays that historical restoration priorities have placed greater emphasis on certain ecosystems and thus developed a greater mechanism for measurement and evaluation in these ecosystems. Ecosystems that have not been the target of extensive restoration campaigns similarly lack tools for measurement of carbon impacts, as they have not been necessary.

Additionally, despite some ecosystems having extensive measurement tools, others are limited. Ecosystems with fewer widely used tools available included peatlands, freshwater bodies (rivers, lakes and streams) and deserts. While there are not many large, highly developed tools available for these ecosystems, there are tools that are currently under development or have been recently released that can be applied to some of these ecosystems. The lack of widely developed tools available for some ecosystems highlights a gap in the current technology available and showcases the need for new tools to be developed that can better assess carbon sequestration across these ecosystems. As restoration projects diversify to include vulnerable ecosystems like coasts, mangroves and freshwater bodies, governments or other stakeholders should develop corresponding tools for these ecosystems.

CONCLUSION

IUCN's Restoration Barometer is an essential tool in aiding countries achieve the global restoration target of 350 million hectares by 2030 (InfoFLR, n.d.). The need for all countries to embed ecosystem restoration in government priorities is prevalent – the Barometer facilitates exactly that. This report provides three solutions to problems currently faced by both IUCN and governments. Firstly, the development of a policy assessment tool aids countries in developing restoration policies as well as IUCN in assessing the completeness of existing country policies. This streamlined process helps to centralise the repository of policies, allowing for an overview of a country's progress to be made. Secondly, an analysis of actions taken by the Bangladeshi government provides IUCN with an overview of the progress the country has made. This enables IUCN to progress with governmental conversations and provides general insight into approaches to restoration in developing countries. Finally, the climate indicator database provides a single repository of carbon sequestration tools. These open-source, IPCC-compliant tools will enable governments to reliably measure the impact of their restoration work.

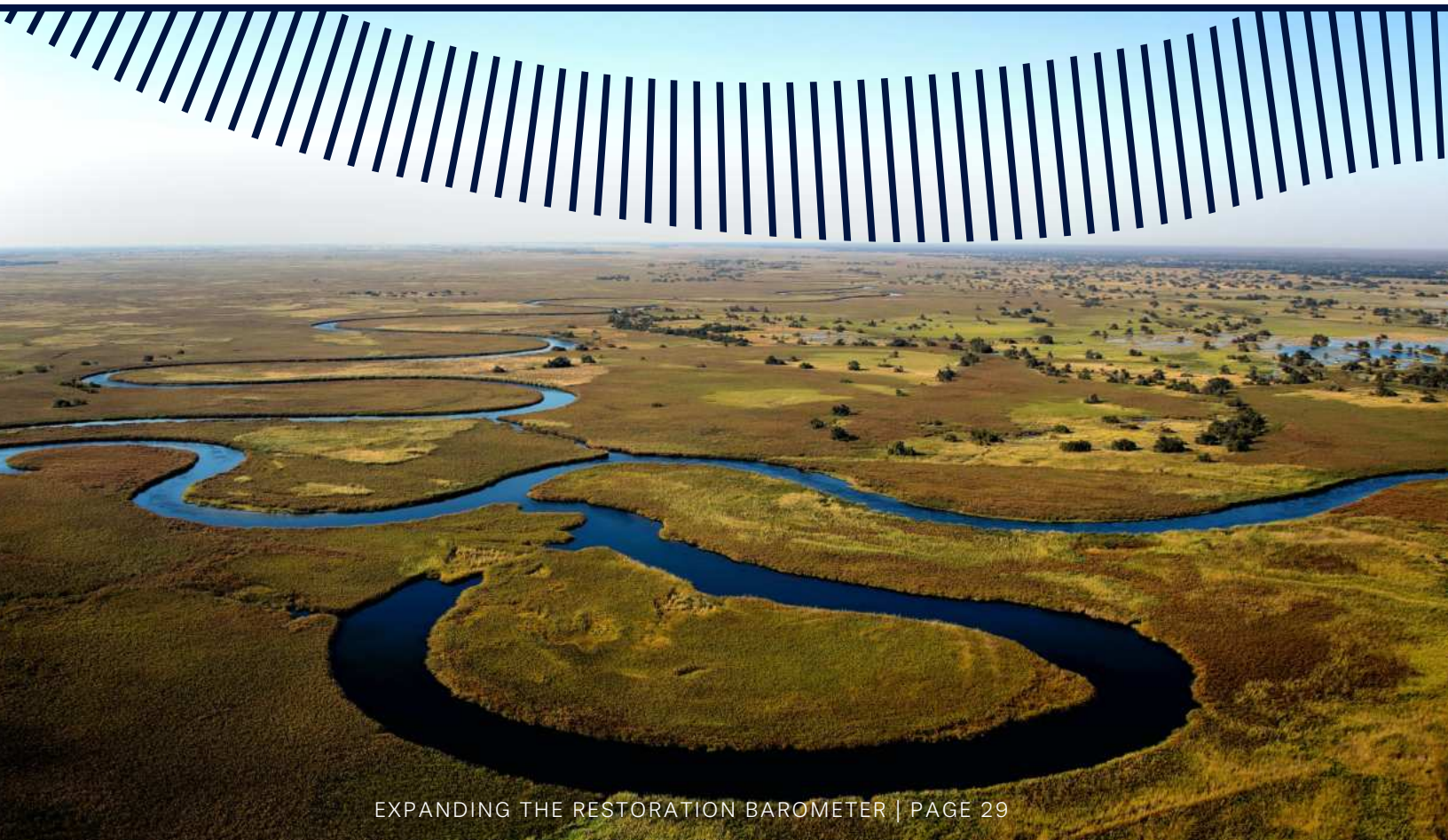
Beyond the benefit to IUCN, this work addresses environmental justice in two ways: it assists low-income countries with open-source climate measurement tools and increases funding potential for restoration projects. Many developing countries rely on external aid, through international NGOs and financial institutions, to fund restoration and wildlife conservation. A challenge for iNGOs is the lack of measurable impact, which is an important component to the international donors who ultimately fund these projects. By using a scientific, internationally-accredited measurement tool, such as those defined in our climate indicator database, reliable measurement can be communicated to donors. This ultimately increases countries' long-term access to funding for restoration.

The second critical area the carbon impact tools database addresses is identifying the gap in knowledge for core ecosystems. Deserts, mangroves and

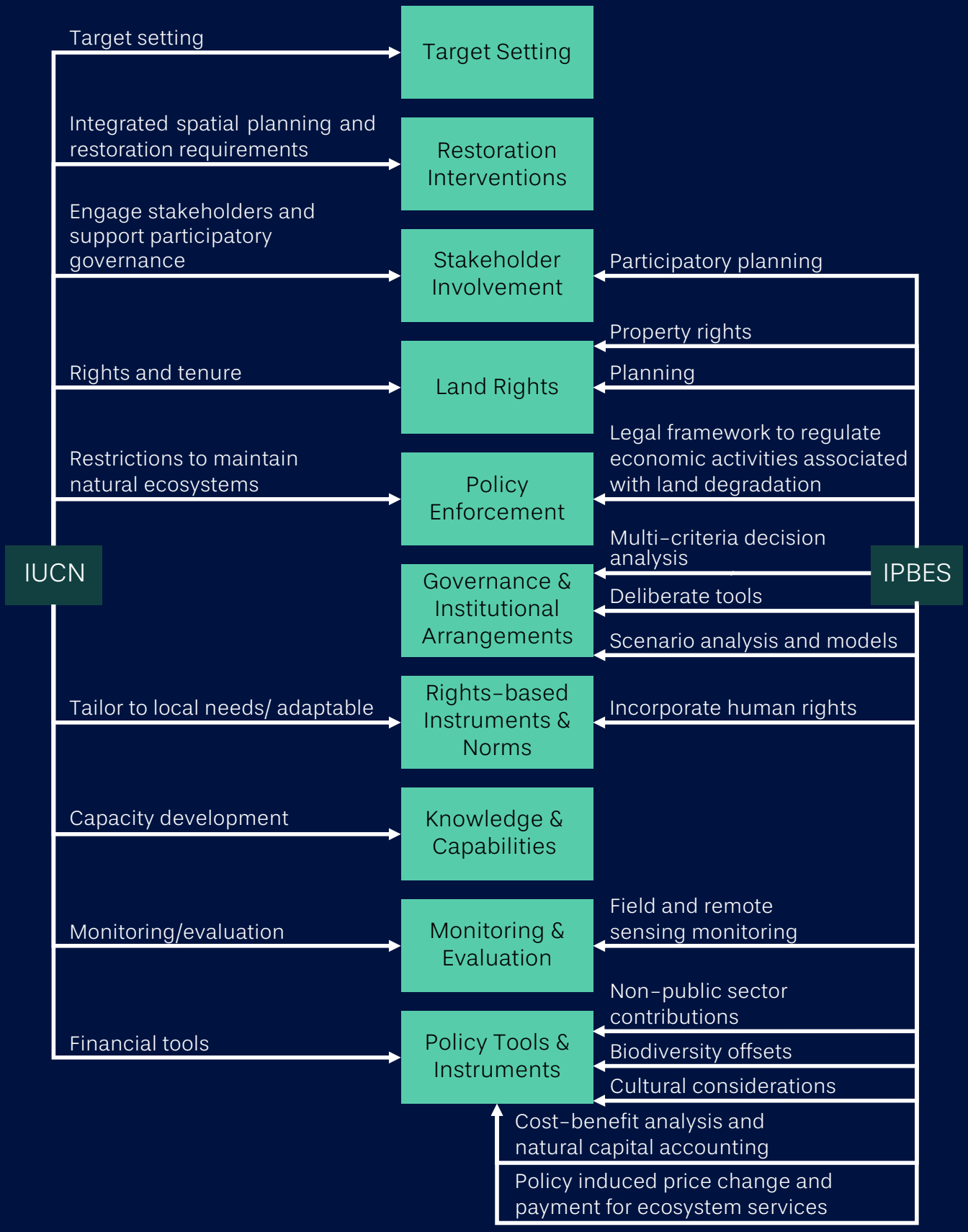
peatlands have significantly fewer measurement tools available compared to forests, farmlands and rivers. This dearth of tools may reveal priorities of the Global North, which are particularly focused on the agricultural sector. The relatively neglected ecosystems have greater significance for the Global South; thus, increasing attention on these ecosystems can help support those underfunded countries currently engaged in restoration work. By highlighting the need for work in these ecosystems, scientists and NGOs can shift their focus to supporting these critical ecosystems and help decrease the burden currently placed on developing governments with limited resources.

For example, Bangladesh is especially susceptible to flooding, rising sea levels and other climate change impacts. The restoration and protection of coastal mangroves will play a critical role in saving lives, protecting endangered species, preserving community land and preventing climate migration for millions of people. Our work can help illuminate best practices for design components that utilise co–management to restore mangroves and embed restoration in national priorities. Finally, by drawing attention to the gaps in carbon sequestration measurement tools, the scientific community can focus on researching peatlands and mangroves to benefit Bangladesh and many other emerging economies.

The scale and relevance of this report will aid countries and IUCN in achieving the necessary ecosystem restoration needed to adapt to climate change and protect diverse species' survival. This report provides guidance for NGOs, such as IUCN, and governments on their next steps for restoration, facilitated by the identification of knowledge gaps in core ecosystems.



Appendix A: CRITERIA DEVELOPMENT



Appendix B: EVALUATION CRITERIA

1. **Target setting**
   a. Does the policy set clear goals or quantitative targets at the national and landscape levels?
   b. Describe the goals or targets.

2. **Restoration Interventions**
   a. Does the policy outline clear plans for restoration intervention activities, such as FLR?
   b. Describe the restoration interventions specified in the policy.

3. **Stakeholder Involvement**
   a. Does the policy have mechanisms to involve stakeholders in its implementation?
   b. Describe the mechanisms and stakeholders.

4. **Land Rights**
   a. Does the policy address existing land rights?
   b. Describe the policy's approach to land rights.

5. **Policy Enforcement**
   a. Does the policy contain any provisions for non-compliance?
   b. Describe the enforcement mechanisms.

6. **Governance and Institutional Arrangements**
   a. Are there clear institutional arrangements for the implementation of the policy?
   b. Describe the arrangements.

7. **Rights-Based Instruments and Norms**
   a. Does the policy promote equity of outcomes? Does the policy incorporate cultural and indigenous practices?
   b. Describe how the policy promotes equity.

8. **Knowledge and Capacities**
   a. Does the policy provide for training, knowledge-transfer and continued follow-up?
   b. Describe how the policy promotes the transfer of knowledge.

9. **Monitoring and Evaluation**
   a. Is there a monitoring framework to measure progress against a recorded baseline?
   b. How are the impacts of the policy monitored and evaluated? What are the relevant indicators and units?

10. **Policy Tools and Instruments**
    a. Does the policy utilise implementation tools or instruments?
    b. Select applicable: Economic and Financial Policy Tools and Instruments
       - Market-based Incentives
       - Monetary Penalties
       - Technical Assistance and Supplies
       - Biodiversity Offsets
       - Ecosystem Valuation
       - Other
    c. Select applicable: Social and Cultural Policy Tools and Instruments
       - Participatory Approach
       - Cultural Considerations on Land-use Management
       - Certification
       - Corporate Social Responsibility
       - Other

Appendix C: MADAGASCAR POLICIES

1. Setting the Conditions for the Implementation of Contractual Management of State Forests – 2001–112 (Ministere des Eaux et des Forêts, 2001).
2. National Policy to Combat Climate Change (Ministère de l'Environnement et des Forêts, 2008).
3. Establishing a National Commission for Integrated Management of Mangroves – 2015–629 (Ministre de l'Environnement, de l'Ecologie, de la Mer et des Forêts & Ministère des Ressources Halieutiques et de la Pêche, 2015).
4. Malagasy Environment Charter – 2015–003 (Assemblée Nationale du Madagascar, 2015a).
5. Revision of the Management Code of Protected Areas – 2015–005 (Assemblée Nationale du Madagascar, 2015b).
6. Environmental Programme for Sustainable Development – 2015–1308 (Ministère de l'Environnement, de l'Ecologie, et des Forêts, 2016).
7. National Biodiversity Strategy and Action Plans – 2016–128 (Ministre de l'Environnement, de l'Ecologie, de la Mer et des Forêts, 2016; Rabarison et al., 2016).
8. Malagasy Forestry Policy – 2017–376 (Ministère de l'Environnement, de l'Ecologie, et des Forêts, 2017a).
9. Establishing, organising and operating the Interministerial Committee for the Environment – 2017–1106 (Ministère de l'Environnement, de l'Ecologie et des Forêts, 2017b).
10. National Strategy on Forest Landscape Restoration and Green Infrastructures in Madagascar (Ministère de l'Environnement, de l'Ecologie, et des Forêts, 2017c).
11. National Strategy of Environmental Information and Communication for Sustainable Development in Madagascar (Ministère de l'Environnement et des Forêts, 2019).

Appendix D: ACTION INDICATOR

POLICIES AND INSTITUTIONS	1. Year enacted	
	2. Sunset year	
	3. Specified number of hectares for restoration within the policy	
	4. Budget allocation for restoration within the policy	
	5. Implementing institution (i.e. government ministry or contracted partner)	
FUNDING	1. Funding Types	a. Total domestic public expenditures, b. Total private investment, c. Total international donor support and d. Total domestic philanthropic and non-profit organisations.
	2. Amount of Funding	
	3. Tier levels of confidence in accuracy	a. Tier 1: values offer low confidence in accuracy, derived from rough estimates; b. Tier 2: values offer moderate confidence in accuracy, derived from various sources of public information and models; c. Tier 3: values are associated with high confidence in accuracy, derived from dedicated studies or official documentation and surveys.
	4. Data Sources	
	5. Percentage of funds spent on interventions that benefit critical species or habitats	

TECHNICAL PLANNING	1. Approach	
	2. Description of approach	a. National b. Sub-national/State c. Site Specific
	3. Scale	a. <=10m b. 11-30m c. 31-100m d. 101-500m e. 501m-1km f. More than 1km
	4. Predominant status and condition	a. Protected area b. Local hotspot c. Community forest d. Agricultural land e. Pasture land f. Urban g. Community managed area h. Deforested i. Degraded j. Other Status
	5. Red List Species	a. Yes b. No
	6. Details of threatened species and/or their habitats	
	7. Citations, hyperlinks, reports, websites	
	8. Other relevant information	
MONITORING SYSTEMS	1. Managing institutions	
	2. Geographic scale of application:	a. National, b. Sub-national and state or c. Site specific.
	3. Type of monitoring system:	a. Status of implementation of restoration activities, b. Location of implementation of restoration activities, c. Land cover and changes to land cover, d. Effects on environmental conditions, e. Effects on socio-economic conditions, f. Estimated GHG balance, g. Financial flows or h. Other.
	4. Linkages to national monitoring, reporting and verification systems (such as Nationally Determined Contributions and Sustainable Development Goals).	

Appendix E: ECOSYSTEM TOOLS

Resource	Ecosystem	Description	Alt. Ecosystems	Limitations
1. Full Lands Integration Tool (FLINT)	Forests and Woodlands	FLINT is a modular, open-source software that can be used for measuring, reporting and verification of climate impacts of ecosystem restoration. FLINT is applicable to AFOLU ecosystems and combines models, remote sensing and ground data to measure or forecast greenhouse gas emissions or removals in an ecosystem.	Farmlands and Mixed Use Areas	Local variability may affect results and software training may also be necessary.
2. Global Restoration Monitor	Forests and Woodlands	The Global Restoration Monitor is an online platform that uses ground-level data to show current restoration projects, from the local to national levels. As well as measuring the carbon impacts of local restoration, it analyzes three other indicators: training and adoption in local communities, vegetation and biodiversity of the area, and livelihood security of the local people.	Farmlands and Mixed Use Areas	GRM is not currently widely used, some projects do not provide public data, carbon calculator based on highly localized vegetation that may not be as accurate globally.
3. IPCC Inventory Software	Grasslands, Shrublands and Savannahs	The IPCC Inventory Software is a GHG inventory software designed to implement GHG accounting methodologies in the 2006 IPCC Guidelines for National GHG Inventories.	Forests and Woodlands; Farmland and Mixed Use Areas	There is a need for basic training before running the program. The program can only be run on Windows computers.

Resource	Ecosystem	Description	Alt. Ecosystems	Limitations
4. USGS LandCarbon Visualization Tools	Grasslands, Shrublands and Savannahs	The LandCarbon tool creates three future projections of terrestrial carbon stocks based on baseline data under three climate and three ecosystem models. LandCarbon also provides data visualization tools that allow users to explore carbon fluxes in the areas of interest.	Rivers, Lakes and Streams (Freshwater Wetlands)	Only applicable to grassland data in the US, which is a major limitation in the context of global carbon inventorying. Uncertainties include the assumptions made for structure and parameterization of specific methods & models used in assessment, relations and integrations of those models and methods and input data quality.
5. Avoided Conversion of Grasslands and Shrublands to Crop Production (ACoGS)	Grasslands, Shrublands and Savannahs	This methodology quantifies avoided emissions from prevented conversion of grasslands and shrublands to cropland usages in the US. Some factors included are livestock, fertilizer, and crop production emissions as well as natural grassland and shrubland sequestration potential.	N/A	Limited application in the North American context because most of the land has already been cultivated.
6. Massa-chusetts Division of Ecological Restoration Blue Carbon Calculator	Rivers, Streams, and Lakes (Freshwater Wetlands)	This tool uses changes in land cover, type of wetlands under restoration and the acres that have been restored to calculate tonnes of sequestered. The tool is designed to accommodate continuous refinement as more regionally-specific data become available, which can then improve the accuracy and precision of carbon sequestration estimates.	Coasts and Mangroves	Does not cover the conversion of one wetland type to another.

Resource	Ecosystem	Description	Alt. Ecosystems	Limitations
7. 2019 Refinement and 2013 Wetlands Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories	Rivers, Streams, and Lakes (Freshwater Wetlands)	Guidance on how to construct GHG inventories that quantify carbon flux as a result of changes to wetland ecosystems. The IPCC guidelines have been structured so any country, regardless of experience or resources, can estimate emissions and removals with its national activity data at the simplest level using the provided default emission factors in this methodology.	N/A	Does not cover the conversion of one wetland type to another.
8. Guidebook for estimating carbon emissions from tropical peatlands in Indonesia	Peatlands	The guidebook uses groundwater levels to estimate carbon emissions from peatlands. It provides step-by-step instructions on conducting field assessments, measuring groundwater levels, and mapping and creating a groundwater level prediction model.	N/A	This tool cannot be replicated in northern peatlands, as it is specific to tropical peatlands which have a distinct soil type, extent and depth variability that is different from northern peatlands. CH4, N2O and desorbed organic carbon are not included in the measurement.
9. Global Peatland Initiative Smoke on Water Report	Peatlands	The report provides an assessment of the status of peatlands and their importance in the global carbon cycle. Recently, GPI collaborated with the Government of Indonesia to set up a peatland restoration and preservation database. It will examine the importance of peatlands for national economies.	N/A	The report does not have a standardised metric to evaluate carbon sequestration in peatlands or map peatlands.

Resource	Ecosystem	Description	Alt. Ecosystems	Limitations
10. Global Mangrove Alliance Global Mangrove Watch Tool	Coasts and Mangroves	The Global Mangrove Alliance tool partners with Global Mangrove Watch to measure blue carbon and total organic carbon stored in above-ground biomass.	N/A	Aerial data generation may be hampered by country-specific government regulations which restrict mapping.
11. The Blue Carbon Initiative Manual	Coasts and Mangroves	The Manual demonstrates blue carbon accounting management and support further scientific research into the role of coastal ecosystems in climate change mitigation. The Blue Carbon Initiative Manual has been piloted in Costa Rica to measure carbon stocks and mangrove cover.	N/A	Accuracy of measurements and analysis is another important consideration for accessing the reliability of data since there is little information on training procedures to carry out field data collection.
12. i-Tree Eco	Urban Areas	Software application designed to use data collected in the field from single trees, complete inventories, or randomly located plots throughout a study area along with local hourly air pollution and meteorological data to quantify forest structure, environmental effects, and value to communities.	Forests and Woodlands	Some cities only have a location and limited pollution or precipitation data, which will limit some Eco reports availability for an individual city.
13. IUCN Urban Nature Index	Urban Areas	Tool comprises a set of 30 indicator topics nested across six themes, the UNI is intended to help cities understand their impacts on nature, set science-based targets for improvement, and monitor progress accordingly.	N/A	Dependent upon level of input data available, does not directly measure carbon storage or sequestration.

Resource	Ecosystem	Description	Alt. Ecosystems	Limitations
14. CUFR Tree Carbon Calculator (CTCC)	Urban Areas	Tool provides quantitative data on carbon dioxide sequestration and building heating/cooling energy effects provided by individual trees.	Forests and Woodlands	Data from the tool may not accurately reflect the rate of tree growth, microclimate, or building characteristics for every city or location within a region. Tree size and growth data are derived from trees sampled in one reference city within each of the 16 climate zones, but conditions may vary across these zones. The CTCC is based on an older generation of growth equations.
15. Agriculture and Land Use National GHG Inventory and Mitigation Analysis Software (ALU)	Farmlands and Mixed Use Areas	ALU is an open-source tool based on the IPCC accounting guidelines that uses GIS data and country land use statistics to examine the carbon impacts of certain agricultural land management practices.	N/A	Does not account for uncertainties in GHG modeling, which is important for accurate accounting.
16. Agriculture, Forest and Other Land Use (AFOLU) Carbon Calculator	Farmlands and Mixed Use Areas	The AFOLU Carbon Calculator is a tool that uses IPCC-based accounting methods to measure carbon sequestration and emissions in AFOLU systems after the implementation of new land management practices.	Forests and Woodlands; Peatlands	The estimated value does not include emissions related to land-use change, and can only measure CH and N2O in certain contexts.

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