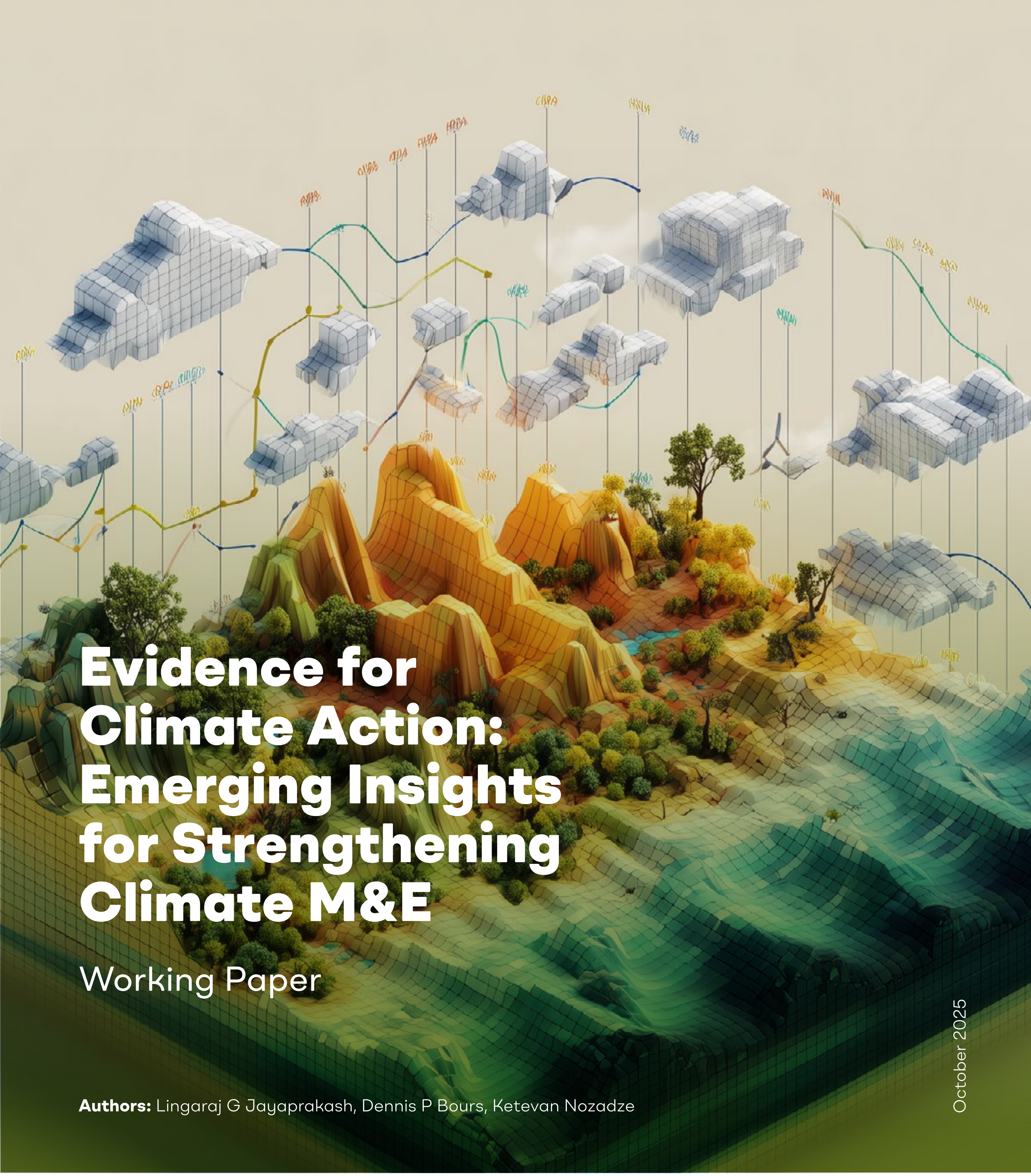

Evidence for Climate Action: Emerging Insights for Strengthening Climate M&E

Working Paper

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global evaluation initiative

Contents

Abbreviations

AFOLU	Agriculture, Forestry and Other Land Use
BIOFIN	Biodiversity Finance Initiative
BURs	Biennial Update Reports
CBD	Convention on Biological Diversity
CIF	Climate Investment Funds
CLEAR	Center for Learning on Evaluation and Results
ETF	Enhanced Transparency Framework
GCF	Green Climate Fund
GEF	Global Environment Facility
GEI	Global Evaluation Initiative
GHG	Greenhouse Gas
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
L&D	Loss and Damage
MESA	Monitoring and Evaluation Systems Analysis
MRV	Monitoring, Reporting, and Verification
NBSAPs	National Biodiversity Strategies and Action Plans
NC	National Communications
NDCs	Nationally Determined Contributions
SDGs	Sustainable Development Goals
TAMD	Tracking Adaptation and Measuring Development
TCLP	Transformational Change Learning Partnership
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
UNGA	United Nations General Assembly
WIM	Warsaw International Mechanism for Loss and Damage

Preface

As the world grapples with climate change, robust national monitoring and evaluation (M&E) systems have become essential. These systems go beyond reporting; they are critical for informed decision-making, ensuring national strategies align with global commitments and deliver real outcomes. However, significant knowledge gaps remain in designing and strengthening M&E systems that can address the complexities of climate and nature sustainability.

This paper examines the pivotal role of national climate M&E systems in promoting integrated approaches that link climate adaptation, mitigation, and biodiversity conservation, reflecting the growing understanding of the interconnectedness of human and natural systems.

Developed at the request of the Global Evaluation Initiative's (GEI) Network, this paper responds to partner countries' demand for clearer guidance on integrating climate- and nature-related results into national M&E systems. Led by Ketevan Nozadze, with authors Lingaraj Jayaprakash and Dennis Bours, the GEI climate team prepared this paper to bridge knowledge gaps and highlight good practices.

The paper is part of GEI's broader effort to support countries in strengthening climate- and nature-informed M&E systems that enhance reporting, learning and adaptive management, and reinforce evidence-based policy making. As a working knowledge product, it will be shared across the GEI Network to foster dialogue and promote integration of climate and nature considerations into M&E practices.

The paper is divided into six chapters, starting with an overview of international M&E requirements and concluding with recommendations to strengthen national systems. These recommendations focus on integration into national frameworks, improving enabling environments, enhancing organizational capacities, and building individual skills.

A Glossary is included to clarify key terms such as adaptation, mitigation, biodiversity conservation, transformational change, and M&E.

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Executive Summary

Effective country M&E systems are essential for aligning national policies with global commitments, including the Sustainable Development Goals (SDGs), the Paris Agreement, the Sendai Framework, and the Kunming-Montreal Global Biodiversity Framework. In the face of escalating pressures to curb greenhouse gas emissions, enhance climate resilience, and protect ecosystems, countries require reliable data and transparent processes to gauge whether their strategies are delivering tangible benefits. National M&E systems are important to meet reporting mandates and inform evidence-based policy making, helping decision-makers identify barriers to success, prioritize resource allocation, and adopt innovative practices.

M&E systems provide decision-makers with actionable insights that improve the relevance and effectiveness of climate strategies at both national and subnational levels. By systematically tracking implementation, robust M&E systems enable real-time course correction, allowing policy makers to identify maladaptive projects early and reallocate resources where interventions are underperforming. Increasingly, credible and transparent M&E data are a prerequisite for accessing climate finance, ensuring that national proposals meet stringent standards of accountability and effectiveness. Moreover, integrated M&E frameworks enhance policy coherence by linking national climate plans (e.g., NDCs, NAPs) with broader development priorities including poverty alleviation, food security, and equity targets.

Designing effective climate M&E requires integrating data across mitigation, adaptation, disaster risk reduction, and biodiversity efforts while ensuring alignment with national development systems. A balanced combination of quantitative and qualitative indicators, such as GHG inventories, ecosystem health metrics, and community vulnerability assessments, helps capture both visible outcomes like emissions reductions and less tangible impacts such as improved governance and social cohesion. However, limited integration with national planning and budgeting often leaves climate indicators disconnected from decision-making processes, leading to underutilized data and missed opportunities to align climate goals with socioeconomic investments. Cross-ministerial collaboration and participatory approaches are essential to avoid siloed focus on reporting and enhance the use of data and evidence for national decision-making.

Strengthening climate M&E hinges on greater policy coherence, targeted investments, and inclusive governance practices that promote transparency and learning. First, embedding climate indicators into national development plans and codifying M&E mandates in legal frameworks can reduce fragmentation and ensure sustained political commitment. Second, establishing cross-ministerial committees and standardized data protocols fosters institutional coordination, while capacity-building initiatives—such as South-South cooperation, technical assistance, and professional training; equip practitioners to handle evolving data and reporting requirements. Third, integrating novel cost-effective technologies, such as centralized data portals or open-source geospatial analytics, can boost efficiency and accuracy, particularly in settings with limited resources.

Advancing the effectiveness of climate M&E systems requires a deliberate reorientation from a narrow emphasis on technical reporting and compliance toward enhancing their utility for learning, strategic reflection, and adaptive management. A functional climate M&E system must be more than a data repository for transparency and accountability. It should actively support decision-makers in adjusting strategies, reallocating resources, and improving outcomes in response to changing climate risks and evolving evidence. This requires embedding learning processes into the design and implementation of M&E frameworks, ensuring that findings are not only collected but regularly analyzed, discussed, and applied. By prioritizing use over form, countries can transform M&E systems into tools that drive continuous improvement, support innovation, and inform climate-resilient development pathways. This shift calls for clear feedback loops, capacity building across institutions, and a culture that values evidence-based adaptation as a core component of climate governance.

Participatory monitoring and evaluation (M&E) approaches that engage local governments, Indigenous peoples, and community-based organizations help reveal ground-level realities, lending greater legitimacy and effectiveness to climate action. Incorporating equity-focused indicators, which track gender, income, and cultural dimensions, can offer deeper insight into how climate strategies shape social outcomes. In turn, such information ensures that policies protect vulnerable populations and minimize unintended consequences. Iterative and adaptive management models reinforce these efforts by introducing signposts and thresholds that prompt regular reassessment. Through this continual feedback, policymakers can respond proactively as climate risks evolve. The result is a more integrated, evidence-based M&E system capable of steering countries toward their climate objectives while advancing co-benefits for ecosystems, communities, and future generations.

1. Introduction

Chapter 1 explains why strong national M&E systems are key to meeting global commitments like the Paris Agreement, the Sendai Framework, Agenda 2030, and the Global Biodiversity Framework. But it's not just about international reporting—good M&E also helps countries improve their own policy planning. By tracking progress and learning what works, M&E promotes transparency, accountability, and smarter decision-making. This allows governments to design better policies, use resources more effectively, and scale up successful programs.

The chapter also highlights how human and natural systems are deeply connected, which makes managing climate and nature challenges even more complex. Strengthening M&E systems helps countries tackle these challenges, ensuring they stay on track with both global goals and national priorities, even as the world continues to change in unpredictable ways.

1.1 Background to This Paper

Climate change and the degradation of natural systems are interlinked global crises that require coordinated, multidimensional, and long-term action based on evidence and M&E data. Over recent decades, rising greenhouse gas emissions have driven unprecedented shifts in temperature and precipitation patterns, amplified the frequency and severity of extreme weather events, and accelerated the loss of natural capital that underpins food security, clean water availability, cultural values, and economic prosperity (IPCC, 2022; IPBES, 2019). At the same time, human reliance on these natural systems for essential ecosystem functions—such as carbon sequestration, flood regulation, and soil fertility—underscores the urgency of designing policies that simultaneously reduce emissions, enhance resilience, and maintain or restore the integrity of landscapes and ecosystems.

Numerous international commitments—including the Sustainable Development Goals (SDGs), the Paris Agreement, under the United Nations Framework Convention on Climate Change (UNFCCC), the Sendai Framework for Disaster Risk Reduction, and frameworks promoting nature-based solutions, such as the Kunming-Montreal Global Biodiversity Framework—emphasize the need for integrated strategies. These recognize the mutual dependencies of human and natural systems, aiming to foster sustainable development, biodiversity conservation, and long-term human well-being (UNFCCC, 2015; UNISDR, 2015; UNDRR, 2022; UNDP, 2024).

The intertwined challenges of climate change, ecosystem degradation, and human development demand integrated policy responses and adequate M&E frameworks that reflect the complexity of socio-ecological systems. Effective responses must recognize that policy interventions rarely operate in isolation. Mitigation actions targeting emissions from energy, industry, and transportation may influence land-use patterns or the availability of natural resources. Similarly, adaptation measures designed to strengthen infrastructure resilience may inadvertently affect ecosystem health and community livelihoods. Nature-based solutions—such as restoring wetlands, forests, and mangroves—hold promise for tackling multiple priorities simultaneously, delivering improved water quality, enhanced carbon storage, and reduced disaster risk (UNEP FI, 2023; IISD, 2024a).

National M&E systems are an important mechanism to measure and learn about the multifaceted outcomes of development policies based on indicators and methodologies that capture the full complexity of socio-ecological interactions, bridging gaps between environmental science, social sciences, economics, and governance studies (Cohen-Shacham et al., 2019; Reid et al., 2019). However, in many contexts, M&E systems remain weak, fragmented, and underutilized, limiting their potential to inform national policies and track progress toward global commitments.

1.2 Problems to be Addressed

Effective governance depends on the ability of countries and stakeholders to track progress, evaluate outcomes, and adapt policies over time. Robust national M&E systems are therefore central to achieving these goals. Yet many still struggle to meet the demands of multiple, interconnected goals. These include mitigation, adaptation, disaster risk reduction, resource management, and equitable development. Maintaining methodological consistency and credibility across such diverse objectives remains a major challenge. When M&E systems operate in isolation, coordination weakens and opportunities for joint learning are lost. Integrated M&E systems that link climate and nature dimensions can help bridge these gaps. They reveal how policies interact across sectors and scales, providing valuable insights for more strategic and evidence-based decision-making.

The landscape of international agreements and financing mechanisms places additional demands on national M&E systems, making coherence and integration even more critical. Under the Paris Agreement, countries must communicate their efforts to reduce emissions, strengthen resilience, and mobilize finance through regularly updated reports, transparency frameworks, and global stocktakes designed to track collective progress (UNFCCC, 2015). Simultaneously, other frameworks like the Warsaw International Mechanism for Loss and Damage and the Sendai Framework for Disaster Risk Reduction require distinct but complementary reporting on issues ranging from extreme event impacts to capacity-building efforts (UNFCCC, 2013; UNISDR, 2015; UNDRR, 2022). Meeting these overlapping obligations can overwhelm limited institutional bandwidth and produce data that are not easily comparable across contexts.

In addition to meeting reporting obligations, robust M&E frameworks are instrumental in enabling countries to access and justify climate finance. Donors, investors, and international climate funds often require evidence of performance, transparency, and accountability before committing resources. Countries that can present clear, verifiable indicators showing emission reductions, enhanced resilience in vulnerable communities, or improved functioning of natural systems are better positioned to attract and retain financial support (Bours et al., 2014; IPCC, 2022 and 2023). Effective M&E not only secures funding but also helps allocate resources more strategically, ensuring that limited financial means flow toward interventions with proven impact and potential for scalability. By strengthening confidence among investors and partners, M&E frameworks ultimately help countries move from isolated pilot projects toward systemic, transformative actions that deliver sustained socio-ecological benefits.

At its core, M&E is not merely about compliance and accountability; it is equally a catalyst for learning, innovation, and continuous improvement. The use of national M&E systems for learning and adaptive climate management is often undermined. Inadequate M&E impairs the capacity to learn from experience, limiting the potential for adaptive management and the scaling up of effective practices (Bours et al., 2014; Leiter, 2015; Price-Kelly et al., 2015). By embedding iterative learning into policy cycles, M&E frameworks can transform governance models into adaptive systems. This approach enables strategies to evolve in response to emerging insights, technological advancements, and shifting environmental conditions. For instance, periodic evaluations tied to evolving climate scenarios can help decision-makers identify successful interventions and avoid maladaptive practices, fostering resilience in the face of uncertainty. Such adaptive governance is crucial in a rapidly changing socio-ecological system, where static policies are unlikely to remain effective over time.

Overcoming fragmentation and capacity gaps in national M&E systems requires active collaboration among stakeholders, including governments, civil society, and private sector actors. Each group plays a pivotal role—governments in setting policies and standards, civil society in representing local stakeholders, providing local knowledge and oversight, and the private sector in mobilizing resources and innovation. By aligning these contributions, M&E frameworks can yield high-quality, comparable, and policy-relevant information, enabling decision-makers to target interventions effectively, align finance with strategic priorities, and enhance transparency and accountability in international climate and nature governance.

1.3 Scope of This Paper

This paper will deliberately use the single term "climate M&E" to refer to national monitoring and evaluation systems that must be established to fulfil the Paris Agreement obligations and to manage closely linked issues such as ecosystem change, disaster risk, socioeconomic development, land degradation, and climate finance.

The scope of this paper is to identify key challenges and opportunities for climate M&E systems through a comprehensive desk review. This paper addresses climate M&E across the full spectrum of inter-linked domains: (i) mitigation: cutting greenhouse gas emissions and enhancing removals across energy, industry, land, and oceans; (ii) adaptation: reducing vulnerability and building resilience of people, ecosystems, and economies to current and anticipated climatic shifts; (iii) loss and damage: addressing the unavoidable residual impacts of climate change through risk management, finance, and recovery support; and (iv) enabling conditions; the finance, technology, capacity building, policy coherence, and equitable governance that make sustained mitigation and adaptation possible.

Effective climate M&E must therefore track not only emission trajectories but also adaptation outcomes, the distributive effects of climate impacts and support flows. By doing so, it provides decision-makers with an integrated evidence base to steer these four domains in a coherent and mutually reinforcing manner.

1.4 Aims and Objectives

The aim of this paper is to provide comprehensive knowledge about climate M&E systems and explore two questions:

1. **What are the main gaps and emerging opportunities in existing climate M&E systems?**
2. **What capacities are required for countries to enhance climate M&E systems ?**

1.5 Who Should Read This Paper

The findings and recommendations will inform GEI's country programs on strengthening national M&E systems. It is expected that the paper will have a broader value and provide information and knowledge on climate M&E systems for a wider audience of policy makers, development practitioners, international organizations, researchers, and other stakeholders involved in climate governance and the M&E sector.

2. M&E Requirements under International Commitments

This chapter provides an overview of M&E requirements embedded in key international agreements that address global challenges. It traces the evolution of M&E has evolved from a focus on tracking greenhouse gas emissions to encompass to a broader agenda that includes adaptation planning, ecosystem integrity, disaster risk reduction, and the social dimensions of environmental governance. The chapter highlights the importance of robust M&E systems in ensuring transparency, accountability, and effective implementation of commitments under the Paris Agreement on climate change, the 2030 Agenda for Sustainable Development, the Kunming-Montreal Global Biodiversity Framework, and the Sendai Framework for Disaster Risk Reduction. It also emphasizes the crucial role of equity and inclusion in these frameworks, with particular attention to the needs of vulnerable populations.

The chapter details the specific reporting mechanisms and requirements under each framework, including Nationally Determined Contributions (NDCs), Biennial Transparency Reports (BTRs), National Biodiversity Strategies and Action Plans (NBSAPs), and disaster loss reporting. It explains how these mechanisms aim to track progress toward global targets, promote mutual learning, and facilitate continuous improvement. The chapter also examines how these environmental agendas intersect with the broader Sustainable Development Goals (SDGs), emphasizing the need to align social equity metrics with environmental indicators to achieve holistic and equitable outcomes.

Finally, the chapter acknowledges the importance of specific thematic areas within M&E, such as carbon pricing and market-based mechanisms, and the use of specialized tools for biodiversity monitoring, like the World Database on Protected Areas (WDPA) and the International Union for Conservation of Nature (IUCN) Red List. It underscores the interconnectedness of these international frameworks and the need for integrated M&E approaches to address complex global challenges effectively.

M&E have emerged as cornerstone elements in the effective implementation of international commitments addressing climate action, biodiversity conservation, disaster risk reduction, and sustainable development. Initially focused on tracking greenhouse gas (GHG) emissions, M&E frameworks have progressively expanded to include adaptation planning, ecosystem integrity, resource mobilization, and the social dimensions of climate and nature governance. This evolution reflects the growing complexity of climate and nature governance and the need for M&E systems that track outcomes across environmental, economic, and social dimensions. M&E requirements are there to ensure methodological rigor, transparency, and alignment with international frameworks, while at the same time incorporating equity and inclusiveness considerations.

The 2015 Paris Agreement, under the United Nations Framework Convention on Climate Change (UNFCCC), illustrates this transformation by adopting a bottom-up model through NDCs, empowering countries to define their climate priorities and actions within a global framework (UNFCCC, 2015). Consequently, M&E must incorporate indicators of equitable outcomes, such as improved access to climate-resilient infrastructure, financial support, and technology transfer, and utilize disaggregated data to assess the inclusivity and effectiveness of these interventions. This makes it essential for M&E systems to capture not only emissions reductions but also the differential impacts of climate actions on vulnerable populations. Adaptation reporting under the Agreement often prioritizes vulnerable populations, particularly Least Developed Countries (LDCs) and Small Island Developing States (SIDS), recognizing their heightened exposure to climate impacts.

Central to the Agreement is the Enhanced Transparency Framework (ETF), which mandates regular reporting on mitigation actions, adaptation measures, and support provided and received. Initially, developed countries submitted Biennial Reports (BRs), while developing countries prepared Biennial Update Reports (BURs) to detail GHG inventories, mitigation efforts, and financial or technological assistance. From 2024 onward, however, BTRs will replace both BRs and BURs, creating a unified reporting system that fosters comparability, enhances accountability, and integrates adaptation on equal footing with mitigation (Qi & Beauchamp, 2023a and 2023b).

Within the Paris Agreement's broader M&E architecture, adaptation reporting has gained considerable prominence. Encouraged through NDCs, National Adaptation Plans (NAPs), and the ETF, adaptation reporting helps capture climate risks, vulnerabilities, and resilience-building measures over time (Dale et al., 2020a and 2020b; Huang & Perez, 2018). Although not mandatory, NAPs allow countries to articulate medium- and long-term adaptation priorities and strategies. Adaptation components within NDCs, meanwhile, offer optional but incentivized avenues for countries to present adaptation actions, link them to mitigation co-benefits, and outline support needs. These reporting mechanisms are designed to support equitable adaptation efforts by emphasizing the needs of marginalized and vulnerable populations. With the introduction of BTRs, adaptation reporting becomes more structured and integrated, requiring Parties to provide information on adaptation measures, their effectiveness, and progress toward NAPs and adaptation-related NDC commitments. This ensures a clear connection between national plans and on-the-ground implementation, while the flexibility provisions support LDCs and SIDS in tailoring reporting to their capacities.

The ETF's comprehensive approach to adaptation and mitigation reporting is reinforced by a two-step review process designed to enhance accountability and mutual learning. First, the Technical Expert Review (TER) evaluates completeness, accuracy, and consistency of the reported data—ranging from GHG inventories to adaptation progress—offering recommendations for improvement. Second, the Facilitative Multilateral Consideration of Progress provides a collaborative platform for Parties to discuss results, address queries, and exchange experiences, promoting transparency, credibility, and iterative refinement.

Shifting focus to biodiversity, the Kunming-Montreal Global Biodiversity Framework (GBF) and its Monitoring Framework establish a comprehensive system for tracking progress toward global biodiversity targets, including conserving at least 30 percent of terrestrial, freshwater, and marine ecosystems by 2030 (the "30x30 target") (CBD, 2022a and 2022b; EAS, 2024). Parties articulate national biodiversity priorities, strategies, and resource needs through National Biodiversity Strategies and Action Plans (NBSAPs), aligning domestic policies with global targets. While reporting through NBSAPs is encouraged for all Parties, capacity-building measures and flexibility provisions support developing nations, particularly LDCs and SIDS, in adapting their reporting processes. Target 22 of the Kunming-Montreal GBF recognizes the importance of Indigenous peoples and local communities in biodiversity conservation. M&E systems under the GBF must measure progress toward ambitious targets, such as the 30x30 goal, while ensuring that efforts are participatory and inclusive. Indicators should track progress on biodiversity outcomes, resource mobilization, and benefit-sharing, ensuring alignment with broader conservation goals. Under the GBF's Monitoring Framework, countries use headline, component, and complementary indicators to measure a range of biodiversity outcomes, from protected area coverage and threatened species status to ecosystem restoration and resource mobilization. Beginning in 2024, standardized indicators and regular National Reports will form the primary basis for assessing progress, enabling consistency and comparability across Parties.

Beyond climate and biodiversity commitments, the Sendai Framework for Disaster Risk Reduction (SFDRR) integrates ecosystem considerations into its M&E architecture. Global targets and indicators require countries to quantify disaster losses, evaluate reductions in vulnerability, and track improvements in preparedness and governance (UNISDR, 2015). By emphasizing healthy ecosystems as natural buffers against disaster, the SFDRR aligns closely with climate adaptation and biodiversity conservation goals, even encouraging Parties to incorporate environmental indicators into their risk assessments. M&E under the SFDRR focuses on measuring disaster losses, preparedness improvements, and ecosystem-based resilience. Key indicators assess progress toward Disaster Risk Reduction (DRR) targets, including access to early warning systems, reduced vulnerability, and improved governance capacity. Where relevant, M&E can include metrics to ensure that DRR measures benefit at-risk populations and address vulnerabilities equitably.

This risk-informed perspective complements the Paris Agreement and the GBF by illustrating how climate adaptation, biodiversity conservation, and disaster resilience are mutually reinforcing objectives. M&E systems under the SFDRR are designed to measure disaster losses, preparedness improvements, and ecosystem-based resilience. Effective indicators should assess progress toward disaster risk reduction targets, such as access to early warning systems, reductions in disaster vulnerability, and improvements in governance capacity. Where relevant, M&E systems can include metrics to ensure that DRR measures benefit at-risk populations and address vulnerabilities equitably.

The SDGs add an overarching dimension of integration, linking climate, biodiversity, and disaster risk reduction efforts with a broader agenda of social and economic development. Goals such as 1 (No Poverty), 5 (Gender Equality), and 10 (Reduced Inequalities) emphasize inclusivity and equity, which are critical enablers of adaptive capacity and resilience. For M&E, this means integrating social equity metrics with environmental indicators to track the intersectionality of outcomes. Indicators should measure whether climate actions reduce poverty, improve health outcomes, or enhance gender equity. For instance, tracking the percentage of women-led projects in renewable energy or monitoring poverty reduction rates in regions receiving climate adaptation support can directly link equity goals to climate action progress. Although the SDGs are not exclusively focused on climate or biodiversity, they encourage countries to consider M&E indicators that track progress on issues such as poverty reduction, health, and resource availability which are critical enablers of country's adaptive capacities (ICSU, 2017; Lucks et al., 2016; Schwandt et al., 2018). Table 1 below provides a concise summary of the key international frameworks discussed above, highlighting their primary focus areas and associated reporting requirements.

Table 1. Summary Table of Key Frameworks

Framework	Focus areas	Reporting requirements
Paris Agreement	Mitigation, adaptation, loss and damage, transparency,	Biennial transparency reports, Nationally Determined Contributions (NDCs)
Kunming-Montreal GBF	Biodiversity, ecosystem restoration	National Biodiversity Strategies and Action Plans (NBSAPs)
Sendai Framework (SFDRR)	Disaster risk reduction, ecosystem health	Disaster loss reporting, governance assessments
2030 Agenda	Social, environmental, and economic development	Voluntary National Reviews (VNRs)

The Voluntary National Review (VNR) mechanism is the 2030 Agenda's principal peer-learning and accountability vehicle, bringing every UN Member State to the High-Level Political Forum (HLPF) to present a self-assessment of SDG progress. The VNRs are state-led, non-binding progress reports that combine a qualitative narrative covering policy alignment, "leave-no-one-behind" measures and lessons learned with quantitative evidence drawn from the official SDG indicator framework. The UN Department of Economic and Social Affairs (DESA) provides Voluntary Common Reporting Guidelines and a detailed Handbook that set out recommended sections (context and methodology, goal-by-goal assessment, means of implementation, next steps) and call for broad, multistakeholder consultation at every stage of preparation. The approach has gained near universal traction: more than 375 VNRs have already been submitted or scheduled, meaning almost every country has reported at least once and many are into their second or third cycle, thereby generating an unprecedented, publicly available dataset on national SDG strategies, financing flows and statistical capacities. The key elements of VNR are outlined in Table 2.

Table 2. Key Elements of VNR

Key elements	Common practice in low-income and lower-middle-income countries	Illustrative country cases
Institutional set-up	High-level steering committee and National Statistics Office; small SDG secretariat coordinates ministries, donors, CSOs.	Uganda embedded its SDG Secretariat in the Office of the Prime Minister and created a National Standard Indicator Framework binding all agencies to one metric list (Uganda, 2018).
Indicator coverage and gaps	LDCs report on ~40 % of indicators; Tier I/II are prioritized, Tier III handled through proxies or narrative.	Rwanda 2023 VNR supplies data for 143 indicators (62 %) but flags wide disaggregation gaps (Republic of Rwanda, 2023).
Data sources and methods	Census, DHS/MICS and administrative records remain the backbone; rapid uptake of geospatial/remote-sensing to back-fill land-use and poverty; validated citizen-generated data (CGD) where surveys are too costly.	Kenya applies its Statistical Quality Assurance Framework to vet CGD before publication on the KNBS SDG portal (Kenya National Bureau of Statistics, n.d.). Government of Malawi (2020) VNR used multistakeholder technical groups to mine new administrative sources under acute time pressure.
Publication platforms	> 40 countries run Open SDG/ SDMX portals that auto-generate charts and machine-readable metadata, cutting layout costs.	Kenya and Uganda feed their live dashboards directly into VNR annex tables (Open SDG, n.d.) (Uganda, 2018).
Financing and external support	Core statistical budgets remain thin; UNSD-FCDO "Get-Everyone-in-the-Picture", PARIS21 and the Global Partnership for Sustainable Development Data fund portals, surveys and staff secondments; statistics still receive < 0.4 % of total ODA.	PARIS21 (2023) documents two-thirds of low income countries lacking predictable funds for even Tier I series. The developing-country SDG investment gap is estimated to be about ≈ US$ 4 trillion annually (Data 4 SDGs, n.d.).
Quality assurance and innovation	Regional peer reviews and United Nations Department of Economic and Social Affairs (UNDESA) data clinics vet metadata; donor pilots explore AI-assisted record linkage and satellite administrative fusion.	World Bank's 2022 Remote-sensing Guide showcases nighttime lights and other free earth observation products now used by several VNR teams (World Bank, 2022).

The UNDESA Handbook for the Preparation of VNRs frames each review as a peer-learning document that pairs a qualitative narrative with the official SDG indicator set. However, on average, low-income countries can report on only about two-fifths of the 231 global indicators, with gender-specific metrics showing the largest gaps. Governments therefore rely on a combination of prioritization, proxy data, and innovation to sustain the VNR reporting process.

Beyond the overarching frameworks, M&E also address specific thematic areas. Carbon pricing and market-based mechanisms, initially established under earlier climate regimes such as the Kyoto Protocol, emphasize the importance of accurate monitoring, reporting, and verification (MRV) systems for quantifying and verifying emissions reductions and ensuring accountability (Haites, 2014). Although they are evolving into new market mechanisms under the Paris Agreement, these established methodologies continue to shape current reporting standards and data quality expectations. Similarly, biodiversity-focused M&E frameworks likewise inform the management effectiveness of protected areas and the conservation of species. Tools like the World Database on Protected Areas (WDPA) and the Management Effectiveness Tracking Tool help countries assess how well protected areas are managed, while the IUCN Red List provides standardized criteria for evaluating the conservation status of species (Stolton et al., 2021). For a more comprehensive list of frameworks and tools available for climate M&E, see Annex 1.

3. Existing Climate M&E Systems and Practices

Chapter 3 examines existing M&E systems and practices across key environmental domains, including climate mitigation, adaptation, loss and damage, biodiversity, and transformational change. Climate mitigation M&E relies on GHG inventories and project-level monitoring, guided by IPCC methodologies. While standardization and data quality have progressed, challenges remain in data accuracy, comparability, and attributing emissions reductions to specific policies. Adaptation M&E, which aims to assess the effectiveness of efforts to reduce vulnerability and build resilience, is often hindered by the complexity and context-specific nature of adaptation outcomes, as well as by resource constraints in developing countries.

M&E for Loss and Damage (L&D) is still in its early stages and facing difficulties in distinguishing climate-induced losses from other factors and quantifying intangible losses. The importance of Locally Led Adaptation (LLA) in addressing L&D is highlighted, emphasizing the need for metrics that track both the quantity and quality of funding directed to local communities. Biodiversity M&E utilizes indicators such as species population trends and protected area coverage, but challenges persist in capturing functional diversity and addressing data gaps, particularly in developing countries.

Finally, M&E for transformational change and just transitions aim to assess systemic shifts in governance and societal norms but faces difficulties in defining and measuring these complex processes.

A key cross-cutting issue is the capacity gap between developed and developing countries. Developing countries often face resource limitations, data fragmentation, and limited institutional mandates, hindering robust M&E. Common challenges include methodological inconsistencies, a lack of integration of qualitative and equity-focused indicators, and limited institutional capacity. Overcoming these hurdles calls for increased support, flexible reporting mechanisms, and enhanced knowledge sharing.

Examples of existing national and subnational climate M&E systems are provided in Annex 2, whereas Annex 3 provides an overview of best practices.

3.1 M&E in Climate Mitigation

Measurement, reporting, and verification (MRV) is a core component of climate mitigation M&E systems, providing a structured approach to quantifying greenhouse gas (GHG) emissions and tracking the impacts of mitigation actions. MRV frameworks enable countries to assess progress toward mitigation targets, fulfill international reporting obligations such as those under the Paris Agreement, and verify results with civil society to build trust with stakeholders. As part of a broader M&E system, MRV provides the technical backbone for evidence-based planning, resource mobilization, and policy refinement in climate mitigation.

M&E systems for mitigation traditionally rely on two key components: nationally reported GHG inventories and project-level monitoring. Standardized methodologies, like the Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC, 2006; WRI, 2014), guide data collection and reporting. Best practices emphasize internationally recognized protocols, ensuring comparability through common reporting formats. These practices also encourage iterative improvements in data quality (Niederberger & Kimble, 2011; UNFCCC, 2015; IPCC, 2019; Lam, 2021).

National inventories provide comprehensive accounts of a country's emissions and removals, serving as a baseline for measuring progress. Project-level M&E integrates tools like remote sensing, modeling, and on-site measurements to quantify emissions reductions from specific interventions (Haites, 2014).

However, significant challenges persist, particularly regarding data accuracy and comparability (WRI, 2014; IPCC, 2022). Complexities in land-use accounting, differing national capacities, and difficulties in attributing emissions reductions to specific policies persist (Romero-Lankao et al., 2018). Developed countries often have more sophisticated data infrastructures and advanced tools like Geographic Information Systems and remote sensing (EEA, 2020). In contrast, developing countries face resource constraints and capacity gaps. Additionally, limited integration of M&E findings into policy making further hinders the effectiveness of mitigation strategies (Khan & Akhtar, 2015; Ssekamatte, 2018). Box 1 outlines nine critical factors identified by Sarr (2018) that provide a structured pathway for countries to build robust and transparent MRV systems, with a tenth point added by the authors of this paper on equity and participation.

Box 1: Critical factors for building transparent MRV systems as outlined by Sarr (2018)

- **Political leadership:** Strong leadership at the highest political levels ensures that climate change remains a national priority, with adequate resources and support for MRV implementation. High-level commitment facilitates resource mobilization, inter-agency coordination, and sustained focus on emissions reduction.
- **Alignment with national development plans (NDPs):** Integrating NDCs into existing national planning frameworks fosters coherence and sustainable, low-carbon development. Unified plans that align NDCs with national development goals help mainstream climate action into broader economic and social policies.
- **Progressive sectoral approach:** A phased, sector-by-sector approach allows countries to focus on specific areas, particularly those with higher emissions reduction potential, such as energy or transportation. By starting with sectors where data are easy to collect—the "low-hanging fruit"—countries can build capacity gradually and roll out MRV systems incrementally.
- **Ownership by state structures:** Institutional ownership within relevant government agencies or departments is critical for ensuring accountability and long-term sustainability. Anchoring each component of the MRV system in local institutions enhances transparency, strengthens institutional memory, and reinforces commitment to achieving climate targets.
- **International principles and guidelines:** Adopting internationally recognized guidelines, such as the IPCC's GHG inventory protocols, ensures that data collection and reporting are reliable and comparable across countries. Standardization supports transparency and credibility within global reporting frameworks.
- **Simplification and integration through technology:** Streamlining MRV processes with institutionalized structures and IT platforms simplifies data collection, analysis, and reporting. An integrated platform can improve efficiency and reduce duplicative efforts, allowing cross-sectoral data accessibility and consistency.
- **Performance indicators and continuous improvement:** Establishing key performance indicators (KPIs) and regularly auditing the MRV system ensures that it evolves in response to new information and lessons learned. Continuous monitoring supports adaptive management.
- **Effective fund management:** Centralizing climate-related financing through a national climate fund and applying robust accountability measures—such as independent audits—helps ensure that resources are managed transparently and efficiently. A well-functioning fund management system is essential for attracting and sustaining access to international climate finance.
- **Preventing GHG emission losses:** Ensuring that GHG reductions from NDC projects are credited to the country of origin prevents double counting, particularly when developed countries purchase Certified Emission Reductions from developing countries. Safeguarding these credits is essential for maintaining accountability within global carbon markets.
- **Equity and participation:** Ensure MRV systems are inclusive by engaging diverse stakeholders, including marginalized communities, civil society, and the private sector. Participatory approaches can enhance transparency and legitimacy.

3.2 M&E in Adaptation

Adaptation M&E systems assess the effectiveness of interventions designed to reduce vulnerability and build resilience to climate impacts (UNDP, 2010; GIZ, 2013; OECD, 2015). Good practices emphasize participatory approaches, theory of change methodologies, and the use of both qualitative and quantitative indicators to capture context-specific and long-term outcomes (Huang & Perez, 2018; Reid et al., 2019). Alignment of indicators across local, national, and global scales enables data aggregation for national and international reporting (Adaptation Fund, 2022; Chen & Uitto, 2014). However, adaptation M&E faces challenges due to the inherent complexity, context-dependence, and long time horizons of adaptation outcomes.

Many adaptation metrics struggle to capture intangible or indirect benefits and to distinguish climate-induced changes from other stressors (Dale et al., 2020a and 2020b; Leiter, 2015). Developing countries often have limited resources for systematic monitoring, restricted access to advanced technologies, and fragmented data sources. While some nations integrate adaptation M&E into national planning, many still lack operational systems for continuous M&E (Leiter, 2021).

Addressing these gaps requires capacity building, methodological harmonization, and greater efforts to incorporate local knowledge and vulnerable group perspectives, ensuring equitable and contextually relevant adaptation measures (Bours, et al., 2015; Ford et al., 2015).

3.3 M&E in Loss and Damage

Loss and Damage M&E focuses on assessing climate-related impacts that exceed the adaptive capacity of communities and ecosystems, including both economic (e.g., infrastructure damage) and non-economic losses (e.g., cultural heritage or biodiversity) (UNFCCC, 2012; Huq et al., 2013; ILO, 2018). While the Warsaw International Mechanism (WIM) under the UNFCCC has placed L&D on the global agenda, operationalizing M&E in this area is still in its early stages (Roberts & Pelling, 2018).

Methodological challenges include distinguishing climate-induced losses from other social, economic, or environmental factors, and quantifying intangible or culturally sensitive losses. The literature recommends developing new indicators and methodologies that move beyond economic metrics, employing participatory assessments and scenario-based approaches to capture the full range of L&D (Mechler & Schinko, 2016; Mechler et al., 2018).

Enhanced data collection on slow-onset events, the integration of local and Indigenous knowledge systems, and the development of improved data-sharing platforms are essential. Aligning L&D M&E with adaptation and disaster risk reduction frameworks can foster coherence and ensure that responses are informed by robust evidence as indicated in the Box 2 below.

Box 2: Locally-led adaptation as a strategy for addressing Loss and Damage

Locally-led adaptation (LLA) is an approach that empowers local actors to lead adaptation efforts by drawing on their knowledge and capacities to address climate challenges effectively. It places communities most affected by climate change at the forefront of designing and implementing adaptation initiatives. By recognizing that local actors possess unique insights into the context-specific climate risks and needs, LLA supports the development of more effective, tailored solutions. Crucially, this approach prioritizes the transfer of decision-making power and adaptation finance to the community level, ensuring that interventions align with local capacities and aspirations.

Coger et al. (2021) propose key metrics for governments to track and report LLA finance, thereby enhancing accountability and verifying that resources reach the most vulnerable. These include:

- **Quantity Metrics:** Gauge the total volume of finance directed to local levels, offering policy makers a clear measure of overall support.
- **Quality Metrics:** Evaluate the extent to which funding mechanisms empower local decision-making, provide flexibility, and encourage adaptive responses, especially important in dynamic or rapidly changing environments.

Governments can use tools like Climate Budget Tagging (CBT) and Public Expenditure Reviews (PER) to monitor these metrics. For example, CBT allows governments to track climate-related expenditures, ensuring funds are allocated efficiently and reach intended beneficiaries, while PER assesses the effectiveness of public spending in achieving adaptation goals. Embedding them within broader National Adaptation Plans (NAPs) further ensures that LLA finance aligns with national Loss and Damage (L&D) priorities, enabling communities to address immediate climate risks while enhancing long-term resilience.

By centering on local needs, knowledge, and leadership, LLA-driven M&E provides a more nuanced assessment of climate impacts and adaptation progress. Unlike traditional M&E frameworks, these systems emphasize participatory approaches, capturing qualitative insights alongside quantitative data to reflect local realities more accurately. As L&D emerges as an increasingly urgent concern, LLA plays a critical role in channeling resources to frontline communities and enabling meaningful local ownership of adaptation strategies. By emphasizing both the quantity and quality of funding, this M&E approach enhances accountability and ensures that adaptation efforts effectively address L&D in vulnerable regions—thereby strengthening overall community resilience.

3.4 M&E in Biodiversity and Ecosystems

Biodiversity M&E relies on frameworks established under the Convention on Biological Diversity (CBD) and assessments by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019; CBD, 2010, 2022a and 2022b). Internationally recognized indicators—such as species population trends, protected area coverage, and habitat quality—help track progress toward biodiversity targets, including the Kunming-Montreal Global Biodiversity Framework's 30x30 conservation goal (CBD, 2022a; EAS, 2024). Integrated approaches leverage remote sensing, ecological modeling, and citizen science to enhance data quality and coverage (Stolton et al., 2021). For example, Brazil's use of satellite monitoring to track deforestation has improved transparency and informed policy decisions. Nonetheless, significant challenges remain. Many indicators fail to capture functional diversity, ecosystem services, and socioeconomic benefits of biodiversity conservation (IPBES, 2019), which are essential for demonstrating the broader value of biodiversity interventions to society. Data gaps and capacity constraints, particularly in developing countries, limit the regular and high-quality reporting needed for informed decision-making. Strengthening national monitoring systems, improving the alignment of biodiversity indicators with climate and development goals, and bolstering technical assistance are critical steps toward more effective biodiversity M&E (Reid et al., 2019).

3.5 M&E for Transformational Change and Just Transitions

Transformational change M&E aims to assess systemic shifts in governance, societal norms, and economic structures that underpin long-term resilience and sustainability (O'Brien et al., 2012; GIZ, 2013). Unlike incremental improvements, transformational change involves deep structural alterations in development pathways. Best practices combine qualitative and quantitative indicators, longitudinal studies, and scenario analysis to capture these complex processes (Pelling, 2011; Levine et al., 2021). However, defining and measuring transformational change remains challenging due to the abstract nature of systemic shifts and the extended timelines required to observe meaningful results. Similar difficulties arise in M&E for just transitions, which must track social equity, labor market impacts, community engagement, and the distribution of benefits and burdens (Newell & Mulvaney, 2013; Rosemberg, 2010).

Developing standardized methodologies and co-creating indicators with affected stakeholders—such as labor unions, local governments, and community organizations—can enhance the credibility and relevance of these M&E systems (Swilling et al., 2018). For example, South Africa's Renewable Energy Independent Power Producer Procurement Program integrates social equity metrics to track employment creation and community benefits, demonstrating how transformational change can be systematically monitored.

3.6 Cross-Cutting Issues

While developed countries often possess sophisticated infrastructures for data collection and analysis, developing countries face significant capacity constraints in implementing robust M&E systems (Khan & Akhtar, 2015; Ssekamatte, 2018). Resource limitations, data fragmentation, and limited institutional mandates impede comprehensive monitoring of mitigation, adaptation, and biodiversity outcomes. Even where frameworks like NAPs exist, few developing countries have advanced from initial commitment to operational M&E and systematic evaluation (Leiter, 2021). Addressing these challenges requires increased financial and technical support, flexible reporting frameworks (as provided under the ETF), and stronger knowledge-sharing networks, such as the NDC Partnership, to ensure M&E data inform national planning and policy making. Additionally, leveraging technology, such as remote sensing or AI-powered data analytics, can help bridge data gaps and improve the scalability of M&E systems, particularly in resource-constrained settings.

Several cross-cutting gaps span mitigation, adaptation, L&D, biodiversity, and transformational change M&E systems. Persistent methodological inconsistencies, insufficient integration of qualitative and equity-focused indicators, and limited institutional capacities emerge as common hurdles (Huang & Perez, 2018; Newell & Mulvaney, 2013). Annex 2 presents examples of climate M&E good practices from a range of socio-ecological contexts.

4. Key Gaps and Opportunities

Chapter 4 explores the multifaceted challenges and opportunities in developing effective climate and environmental M&E systems. It highlights critical gaps, including conceptual ambiguities, methodological fragmentation, and weak integration into national systems. These challenges are compounded by the inherent complexity and uncertainty of climate interventions, capacity constraints, and the need for inclusive, participatory approaches.

The chapter begins by addressing conceptual and definitional gaps, emphasizing how inconsistent interpretations of terms like "adaptation" and "resilience" hinder global standardization and the comparability of M&E frameworks. It then examines key methodological challenges, including how to balance global standardization with local relevance and how to design metrics for intangible or long-term outcomes, such as improvements in governance. The lack of integration between climate M&E and national M&E systems is identified as a major obstacle to coherence, while embracing complexity through systems thinking is proposed as a mechanism to address the dynamic, interconnected nature of socio-ecological systems.

Stakeholder participation is highlighted as essential for legitimacy and inclusivity, with tools like citizen science and community-based monitoring providing practical pathways for engagement. The chapter concludes by examining capacity constraints and resource limitations, identifying the need for targeted investments, simplified frameworks, and international cooperation to overcome institutional and financial challenges.

In addition to identifying key gaps, this chapter also outlines emerging opportunities—understood as current trends and conditions that create favorable momentum for change. These include growing international alignment on climate and development reporting, advances in digital monitoring tools, and increased stakeholder demand for integrated, transparent, and participatory systems. By synthesizing these interconnected themes, chapter 4 provides a roadmap for addressing key barriers while advancing innovative, integrated, and adaptive approaches to climate and environmental M&E systems.

4.1 Conceptualization and Definition Gaps

One root cause of fragmentation and complexity in climate M&E systems lies in the conceptual and definitional uncertainties surrounding fundamental terms and objectives (Noltze et al., 2021; UNDP, 2022). While mitigation M&E benefits from relatively well-established MRV frameworks and IPCC guidelines for GHG inventories (IPCC, 2006), other domains—such as adaptation, L&D, and just transitions—lack standardized definitions. For example, while "adaptation" might focus on infrastructure resilience in one context, it could emphasize social equity or natural ecosystem recovery in another, complicating global efforts at standardization. Terms like "adaptation," "vulnerability," "Loss and Damage," "just transitions," and "resilience" remain contested and context-dependent (STAP GEF, 2017). Stakeholders often understand these concepts differently, making it difficult to reach consensus on what constitutes "successful adaptation" or "transformational change." Such conceptual ambiguity impedes the development of clear M&E objectives and hampers comparability across regions and projects (Prabhakar, 2014).

Without a common language and agreed-upon metrics, measuring and comparing progress, scaling up successful interventions, and ensuring that adaptation or just transition efforts meet their intended goals become problematic. This lack of alignment also undermines efforts to link local or national-level progress with international frameworks, further limiting opportunities for mutual accountability and shared learning. This definitional fluidity also blurs the line between planned interventions and unplanned, external social or natural processes that contribute to climate action, further complicating the design of effective M&E frameworks (UNDP, 2022).

4.2 Methodological Challenges and Fragmentation of M&E Frameworks

A core challenge centers on reconciling the desire for coherence and comparability with the need for contextual relevance. International frameworks, such as the Enhanced Transparency Framework (ETF) under the Paris Agreement, emphasize standardized indicators and methodologies to facilitate aggregation, global stocktakes, and mutual accountability (UNFCCC, 2018 and 2022; IPCC, 2022).

While uniform metrics enable cross-country comparisons and bolster transparency, they may overlook local nuances (Schoenefeld et al., 2018). For instance, while globally accepted metrics like carbon sequestration rates can effectively track mitigation outcomes, they may fail to account for co-benefits such as improved soil health or increased agricultural productivity that are critical to adaptation and livelihood priorities in many developing regions. Variations in ecological conditions, socioeconomic vulnerabilities, and governance arrangements mean that standardized indicators can fail to capture what truly matters in diverse settings (Eriksen & Kelly, 2007; Spearman & McGray, 2011; NAP Global Network, 2020).

Further complicating this tension between global uniformity and local specificity is the evolving, context-dependent nature of climate risks, which defy static or universal measurement models (Dilling & Lemos, 2011; Ford et al., 2015; Leiter, 2015). As such, designing M&E frameworks that align with internationally recognized standards yet remain adaptable to unique national and subnational realities remains a key methodological challenge.

Methodological fragmentation is a critical barrier to effective climate M&E. Initially designed for simpler, more predictable contexts, traditional M&E approaches assume linear cause-and-effect relationships that are ill-suited to the complexity, uncertainty, and long-term horizons of climate change interventions (Williams, 2016; Ericsson, 2014; Lam et al., 2021). Mitigation M&E, though relatively standardized, still faces challenges in accurately attributing outcomes, dealing with baselines, and ensuring data quality and cost-effectiveness (CPI, 2019; Vine & Sathaye, 1997). Adaptation, L&D, and just transitions pose even greater methodological hurdles. Their intangible outcomes, such as strengthened governance or improved social cohesion, often defy standard evaluation techniques and require long-term observation. Establishing baselines, measuring non-events (e.g., the absence of floods due to adaptation), and attributing observed changes to specific interventions rather than broader socioeconomic trends is difficult (Bours et al., 2013; Leiter & Pringle, 2018; Lam et al., 2021). For example, adaptation success might manifest over decades, exceeding typical project cycles, or appear indirectly as improved governance and social cohesion rather than easily quantifiable outputs (Hallegatte et al., 2016).

The absence of standard indicators is not just an added difficulty, but rather a reflection of the conceptual and methodological complexity involved in defining and measuring adaptation success. Without agreed-upon metrics for adaptation, L&D, or just transitions, practitioners rely on ad hoc, context-dependent indicators, reducing comparability, scalability, and learning opportunities (Leagnavar et al., 2015; Leiter et al., 2019).

Innovative approaches, such as participatory monitoring or scenario-based methodologies, could help capture nuanced, process-oriented dimensions like community empowerment or enhanced governance. While standardization can simplify reporting, overly rigid indicators risk overlooking nuanced, process-oriented dimensions like enhanced governance or community empowerment. Thus, M&E methodologies must strike a balance between rigor and practicality, accommodating complexity and uncertainty while remaining implementable, especially in resource-constrained settings.

Another formidable challenge arises from the proliferation of overlapping reporting demands. Countries often grapple with requirements from the Paris Agreement's Enhanced Transparency Framework (ETF), Convention on Biological Diversity (CBD), climate finance institutions, the Sendai Framework for Disaster Risk Reduction, and the SDGs, among others. Each initiative employs its own indicators, timelines, and reporting protocols, creating a patchwork that can overwhelm already burdened national M&E systems (NAP Global Network, 2019; OECD, 2020; UNFCCC, 2023a). In many cases, reporting fatigue results, diverting attention from meaningful analysis and organizational learning toward repetitive data reconciliation and form-filling exercises. Streamlining reporting requirements across frameworks, as piloted by the NDC Partnership, could help reduce duplicative efforts and improve resource efficiency. At the same time, concerns around transparency and open access—such as restrictive data-sharing policies, paywalls, and insufficient metadata—undermine independent verification and scrutiny, weakening both accountability and public trust (Gupta & Mason, 2014; IPCC, 2018; OECD, 2019).

4.3 Aligning Climate M&E with National M&E Systems

Another significant obstacle is the weak integration of climate M&E systems into existing national M&E frameworks. National M&E systems, often managed by finance or planning ministries, track progress on development initiatives such as poverty reduction and health improvements. However, climate M&E frequently operates in silos—housed within environmental or sectoral ministries—leading to fragmentation, inefficiencies, and missed opportunities for policy coherence (Khan & Akhtar, 2015; Ssekamatte, 2018).

Institutional fragmentation, weak data-sharing mechanisms, and limited collaboration between governmental and non-governmental entities create parallel reporting streams that seldom intersect (IISD, 2024b). This disconnect is further exacerbated by varying indicator sets, timeframes, and methodologies that hinder data aggregation and comparative analysis. Developing countries, often facing capacity and resource constraints, struggle to manage multiple reporting requirements arising from different international agreements and climate finance mechanisms (Haites, 2014).

While countries cannot modify the fixed reporting cycles of international conventions, there have been growing efforts—such as those by the GEF and GCF—to promote greater alignment and coherence in reporting requirements across climate and biodiversity agendas, helping countries streamline data collection and reduce duplication in national M&E systems. facilitate the use of M&E findings for strategic decision-making (IIED, 2017; Pringle, 2021).Multilateral development banks (MDBs) support the integration of climate- and nature-related M&E into country systems by promoting harmonized methodologies, aligning results measurement with national priorities, and investing in institutional capacity. Through the Common Approach to Measuring Climate Results, MDBs encourage countries to embed climate indicators into their national M&E frameworks, enabling better tracking of progress toward climate goals and international commitments such as the Paris Agreement. Similarly, the MDB Common Principles for Tracking Nature-Positive Finance aim to help countries monitor biodiversity and ecosystem-related outcomes by fostering the development of country-owned data systems and indicators. MDBs provide technical assistance, digital tools, and knowledge-sharing platforms to strengthen countries' institutional and technical capacities for both climate and nature-related reporting (Joint MDB Report, 2023; World Bank, 2021; MDB Nature-Positive Principles, 2023). These efforts enhance the credibility, transparency, and utility of results data while empowering countries to lead evidence-based climate and biodiversity policy and investment planning.

4.4 Embracing Complexity, Systems Thinking, and Uncertainty

Conventional M&E frameworks are often ill-equipped to capture the complexity and uncertainty that characterize climate action. Climate interventions operate in dynamic, interconnected socio-ecological systems, influenced by feedback loops, threshold effects, and emerging risks (O'Brien et al., 2012; Pelling, 2011). While climate projections provide increasing certainty at the global level, significant cascading uncertainties arise as these are translated into national and local contexts—due to variability in exposure, local socioeconomic conditions, institutional responses, and political decision-making—complicating the design of effective and adaptive M&E systems.

As interventions scale up from single projects to comprehensive national frameworks, linear logic models and simplistic indicators become inadequate. Systems thinking addresses these limitations by encouraging practitioners to view interventions as part of broader networks of relationships at local, national, and global levels (Noltze et al., 2021). Systems thinking also supports forward-looking evaluations that assess the potential efficacy of interventions under different future climate scenarios, anticipating maladaptation risks and identifying transformative opportunities. For instance, adaptive monitoring systems can detect early warning signs of maladaptation, such as unintended socioeconomic impacts on vulnerable communities, allowing for timely course corrections.

By integrating qualitative and quantitative data, M&E can uncover the underlying processes of change—such as enhanced governance structures, social learning, and empowerment—that enable lasting climate resilience (Leiter & Oliver, 2016). The Netherlands' Delta Programme, detailed in Box 3, exemplifies how these principles can be operationalized to balance near-term flexibility with long-term planning.

Box 3: Adaptive management in climate M&E – The Delta Programme in the Netherlands

The Netherlands' Delta Programme showcases how adaptive management can be integrated into climate M&E by leveraging robust early warning systems. A central component of this nationwide initiative—tasked with protecting against flooding and ensuring water security—is the Dynamic Adaptive Policy Pathways (DAPP) approach, which combines near-term, low-regret actions with long-term strategies that flexibly adapt to new data, signals, and potential tipping points (Haasnoot et al., 2018). Under the DAPP framework, the Delta Programme identifies "signposts," or critical indicators (e.g., sea-level rise, precipitation patterns, river discharge), and sets thresholds that, once reached, trigger policy adjustments. These signposts provide advanced warning of evolving conditions, enabling decision-makers to enact new measures or modify existing approaches. By tying these indicators to actionable thresholds, the Programme ensures timely, data-driven responses to climate risks.

Key elements for effective adaptive management

- **Measurable and reliable signposts:** Indicators must be scientifically credible and institutionally recognized, improving stakeholder confidence and response quality.
- **Timely monitoring and early warnings:** Frequent data updates and routine assessments allow for proactive planning and rapid policy shifts when thresholds are exceeded.
- **Institutional integration:** Embedding the monitoring system within existing governance structures streamlines decision-making, ensuring that observed changes lead to concrete actions.
- **Stakeholder engagement:** Collaborative design and review of monitoring frameworks foster trust, ensuring that signposts align with real-world needs and reflect local expertise.

By integrating the monitoring system with adaptive management principles, the Delta Programme demonstrates how governments can remain responsive to climate uncertainties. This blend of near-term flexibility and long-term planning, built on regular data assessments and well-defined thresholds, offers important directions for other countries to emulate.

Additional insights: While the Delta Programme represents a large-scale, resource-intensive initiative, its core principles—such as the use of actionable thresholds and stakeholder-driven monitoring—can be adapted to smaller-scale or resource-constrained contexts. For instance, community-based flood management in Bangladesh employs similar approaches by using locally defined indicators and participatory monitoring to inform adaptive responses to climate risks.

4.5 Wider Participation: Civil Society, Communities, and Stakeholders

Fostering inclusive, participatory M&E practices is widely acknowledged as essential for capturing diverse perspectives, ensuring cultural relevance, and building legitimacy (Huq et al., 2013; Reid et al., 2019). Civil society organizations, local communities, and marginalized groups offer invaluable local knowledge, help identify meaningful indicators and highlight unintended consequences or "maladaptive" outcomes that top-down approaches might overlook. For example, Indigenous-led conservation monitoring in Canada has demonstrated how local expertise can improve biodiversity outcomes while empowering communities.

The multifaceted nature of social justice inherent in just transitions, for instance, demands that M&E frameworks engage with those directly affected to understand how climate interventions redistribute risks, benefits, and opportunities (Newell & Mulvaney, 2013; Rosemberg, 2010). Achieving meaningful participation is challenging, and tailored capacity-building programs are often needed to ensure that local stakeholders can interpret data and influence decision-making. Political sensitivities, language barriers, and resource constraints further complicate these processes (Levine et al., 2021; Swilling et al., 2018). Strategies such as co-designing decision-making processes, offering financial or technical support, and providing translation services can help overcome these barriers.

Investing in participatory approaches to M&E can yield long-term gains in legitimacy, contextual accuracy, and the identification of locally appropriate indicators. Tools such as citizen science, community-based monitoring, and stakeholder workshops can facilitate knowledge exchange, promote ownership, and strengthen the adaptive capacity of M&E frameworks. Aligning these approaches with global commitments like the Paris Agreement and the SDGs ensures their broader applicability and integration into international climate governance. Community-based monitoring helps fill critical data gaps, particularly for adaptation, biodiversity, and Loss and Damage, by capturing localized impacts often missed by national systems.

While full integration into global MRV frameworks may not be feasible, initiatives like the UNFCCC's Local Communities and Indigenous Peoples Platform (LCIPP), the IPCC's recognition of Indigenous knowledge, and the CBD's Global Biodiversity Framework support the inclusion of Community based monitoring efforts in national reporting. These precedents highlight growing international openness to locally grounded data, reinforcing the case for connecting CBM with formal M&E systems to enhance equity, relevance, and responsiveness. CBM is particularly important and well supported in under resourced countries.

4.6 Capacity Constraints and Resource Limitations

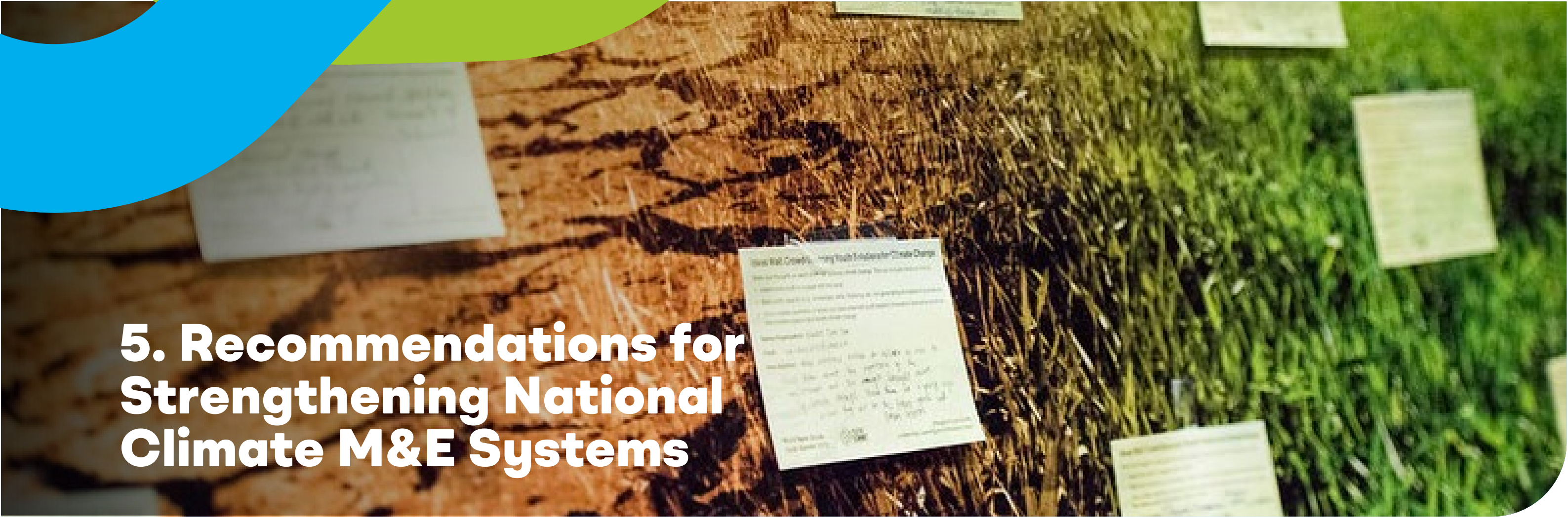
Capacity constraints remain a formidable challenge, particularly in developing countries where technical expertise, financial resources, and institutional support are limited (Dinshaw, 2018). Effective M&E requires stable funding, skilled personnel, and continuous access to quality data and measurement tools. However, the cost of robust MRV systems, the difficulty in establishing credible baselines, and the complexity of measuring indirect and long-term outcomes all place strain on institutional capacities.

Simplifying M&E frameworks can reduce complexity, but overly simplistic approaches may sacrifice rigor and fail to capture the nuanced, context-specific outcomes of climate interventions (Dekens, 2021). Tackling capacity constraints necessitates targeted investments in training, technology, and institutional reforms. International cooperation, knowledge-sharing networks, and technical assistance can help countries develop standardized baselines (Masvaure & Fish, 2022). For example, initiatives like the NDC Partnership have facilitated resource mobilization and technical support tailored to national contexts. Enhancing coordination across ministries and agencies, investing in data management systems, and incentivizing long-term planning over short-term donor-driven projects can gradually build the stable infrastructures needed for sustainable climate M&E (Beauchamp et al., 2024; Noltze et al., 2021).

Another set of challenges arises from practical and resource-related constraints. The cost of robust data collection—encompassing everything from maintaining meteorological networks to conducting longitudinal vulnerability assessments—places a substantial financial and technical burden on many low-income countries with constrained capacities (World Bank, 2013 and 2014; Giupponi & Myšiak, 2013). Limited baseline data and sparse time series information impede both the detection of trends and the attribution of observed outcomes to specific interventions, diminishing the credibility and usefulness of M&E results (FAO, 2017; Lamhauge et al., 2013; Leiter & Pringle, 2018). This reporting burden not only overwhelms practitioners but also undermines the perceived value of M&E processes, leading to reduced stakeholder engagement and a loss of trust in the system.

Moreover, inconsistent data formats and standards can create what practitioners often refer to as "indicator fatigue," as they struggle to reconcile slightly varying metrics that ostensibly measure similar phenomena (GEF IEO, 2018; WRI, 2016). Governance challenges, including political instability and competing national priorities, often divert resources and attention from strengthening M&E systems, further exacerbating capacity gaps.

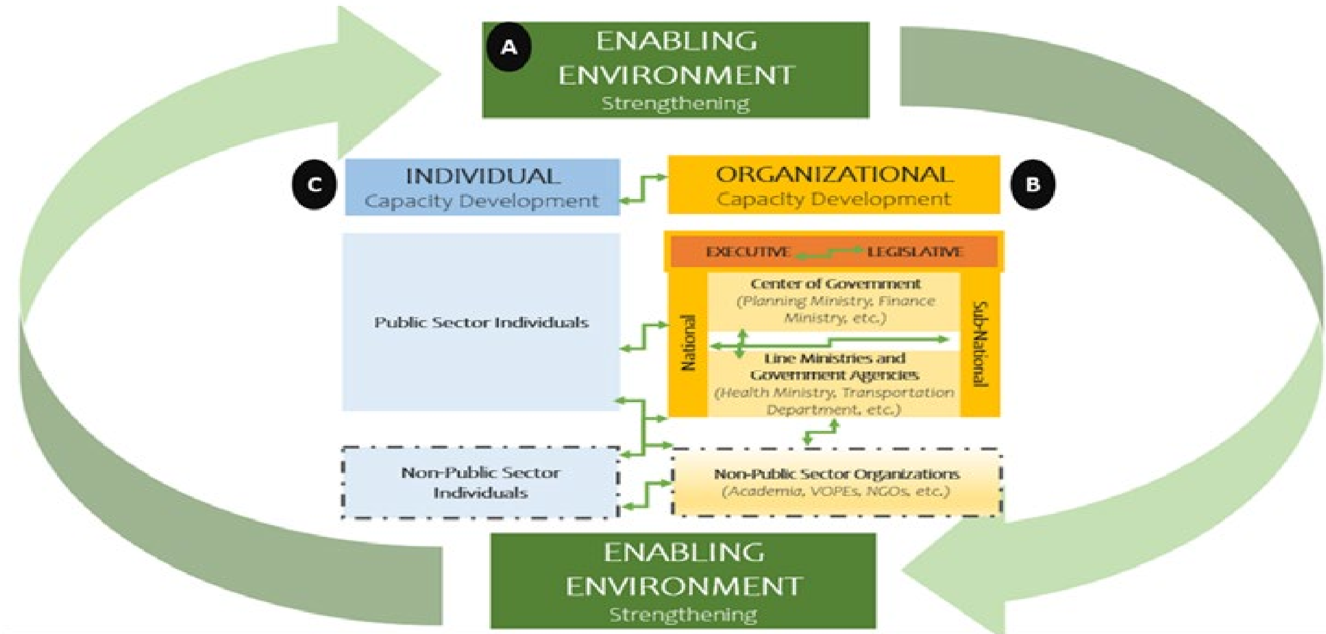
While this paper identifies gaps in national climate and nature M&E systems, it recognizes that these challenges often reflect the legacy of externally imposed reporting frameworks and underinvestment in country-led capacities—not a lack of commitment or capability. Strengthening M&E systems must therefore build on local innovation, align with national priorities, and shift from compliance-driven models toward collaborative, context-responsive learning frameworks.



5. Recommendations for Strengthening National Climate M&E Systems

To guide the development of robust climate M&E systems, this section organizes recommendations across three levels: (A) the enabling environment, (B) organizational capacity development, and (C) individual capacity development. Per Graph 1, the enabling environment refers to foundational legal, policy, and awareness-related conditions that influence climate and environmental M&E. Organizational capacity refers to the ability of government and non-government actors to strengthen their institutional capabilities and adopt adaptive, innovative practices in climate M&E. Lastly, individual capacity refers to the need to strengthen personal knowledge, skills, and competencies to enable effective leadership and participation in climate and environmental M&E.

Graph 1. GEI's M&E capacity building strategy at enabling, organization and individual levels



The proposed recommendations are structured by levels of capacity and development, with each stage including actions classified as **Quick wins**, **Low-hanging fruits**, and **Long-term projects**. Quick wins represent low-effort, low-impact actions that can be implemented immediately to address foundational gaps. Low-hanging fruits offer high-impact solutions that are achievable with moderate effort, leveraging existing capacities and systems. Long-term projects involve high-effort, high-impact initiatives that require sustained investment but offer transformative benefits for M&E systems. This structured approach enables decision-makers to prioritize actions based on available resources and strategic goals.

5.1 Enabling Environment

These actions establish the groundwork for effective climate and environmental M&E systems and are essential for building a robust foundation.

Quick wins:

- **Demonstrate political support and ownership:** Demonstrating political support and ownership can be considered a quick win when there is existing high-level commitment to climate action, or when decision-makers are already engaged and willing to champion M&E improvements. If senior leaders are receptive, visible actions—such as launching a cross-ministerial task force or issuing a public statement on the importance of climate M&E—can be accomplished rapidly, without significant financial or administrative barriers. These actions signal accountability and help build early momentum for broader, long-term reforms.

Low-hanging fruit:

- **Integrate climate M&E into NDPs:** Align climate commitments, such as Nationally Determined Contributions (NDCs), with existing national development frameworks to embed M&E into mainstream planning (Sarr, 2018). This integration prevents siloing and ensures that climate data informs broader socioeconomic and environmental policies.
- **Adopt international standards where appropriate**: Incorporate IPCC inventory guidelines and UNFCCC reporting formats to ensure harmonization, maintain transparency, and align with global frameworks. These standards provide a foundation for robust and credible M&E systems while facilitating international comparability (Sarr, 2018).
- **Co-define key climate and environmental M&E concepts with stakeholders:** Involve national and regional experts, policy makers, civil society organizations, and marginalized groups in defining what "successful adaptation" or "just transitions" M&E mean in the local context (Noltze et al., 2021; UNDP, 2022). This participatory process helps build understanding, align metrics with on-the-ground realities and builds ownership.

Long-term projects:

- **Codify climate and environmental M&E requirements in legal and policy frameworks:** Some countries have advanced with integrating M&E mandates in legal acts and policies but often fail to ensure that M&E covers climate and environmental impacts. Countries can institutionalize periodic evaluations and public disclosure requirements in legal frameworks, ensuring that M&E persists beyond individual projects or political administrations (Sarr, 2018).
- **Set performance indicators and regular evaluations:** Define key performance indicators (KPIs) to monitor the climate and environmental M&E system development itself (e.g., under the Enhanced Transparency Framework). Periodically evaluating these systems ensures continuous improvement and adaptation to changing conditions. Adaptive management approaches enable M&E systems to remain relevant and learning-oriented over time (Brown, Shaker, & Das, 2016).
- **Reflexive frameworks for multilevel governance:** Countries like Germany and Norway illustrate that "learning by doing" and incorporating flexible, iterative metrics across governance levels foster adaptive learning and continuous improvement, and can provide a more nuanced, comprehensive understanding of adaptation progress (Hammill et al., 2014; Amundsen et al., 2010).
- **Feedback mechanisms and public access to evaluations:** Establish public forums, policy dialogues, or other channels to allow stakeholders to learn about the data and evaluations. These mechanisms strengthen transparency and responsiveness, enhancing institutional credibility (Noltze et al., 2021).

5.2 Organization Capacity Building

These actions focus on strengthening climate and environmental M&E organizational systems, enabling adaptability, and addressing complex, forward-looking challenges.

Quick wins:

- **Understand organizational and system gaps and identify priorities:** rapid organizational diagnostics can help identify gaps and priorities for strengthening national climate and environmental M&E systems.

Low-hanging fruit:

- **Formalize data-sharing protocols and inter-ministerial committees:** Establish mechanisms for data exchange, standardize reporting formats, and create cross-sectoral committees to break down institutional silos. Aligning climate indicators with poverty reduction or health strategies fosters mutual reinforcement and coherence (Pringle, 2021). See Box 4 for Ethiopia's experience as an example.

Box 4: Ethiopia's experience in evolving a national climate M&E system

Ethiopia has made notable progress in integrating climate resilience into its national development agenda through the Climate-Resilient Green Economy (CRGE) initiative, which aims to achieve middle-income status without increasing carbon emissions. Supported by the United Kingdom's Department for International Development, Ethiopia has used targeted funding—the Strategic Climate Institutions Programme and the Climate High-Level Investment Programme—to enhance institutional capacity for adaptation and mitigation under the CRGE. Three core M&E tools, each addressing distinct facets of institutional performance, underpin Ethiopia's approach:

- **Organizational capacity assessment matrix:** Evaluates government capacity in planning, monitoring, communication, and program delivery for CRGE goals, employing a 1–4 scoring system that combines self-assessment with documented evidence.
- **Mainstreaming capacity assessment matrix:** Measures how effectively ministries integrate climate considerations into national and regional development plans, using a simpler 0–2 scale tied to concrete proof (e.g., climate strategies, trained staff).
- **Decision-making capacity assessment matrix:** Focuses on the CRGE facility's effectiveness in managing climate finance, ensuring technical quality, and maintaining safeguards, also using a 0–2 scoring system.

This participatory approach has strengthened Ethiopia's ability to identify institutional gaps and align capacity-building efforts with CRGE objectives. The straightforward design of each tool not only facilitates adoption across diverse sectors but also prompts dialogue on essential elements of the process. Over time, these tools have evolved beyond external evaluation mechanisms, becoming part of broader institutional reform and planning processes, guiding discussions on resource mobilization, financial oversight, and climate mainstreaming capacities at both ministerial and subnational levels.

Challenges and lessons learned: Data collection requires skilled enumerators to mitigate the risks of inflated self-assessments, as officials may be reluctant to reveal capacity gaps. The focus on specific institutional capacities can inadvertently overlook broader governance or political factors that influence institutional reform. Nonetheless, the iterative assessment process has helped highlight coordination gaps between ministries, prompting efforts to improve the alignment of climate policy and planning. Ethiopia's experience demonstrates how well-targeted M&E frameworks can operationalize climate goals by fostering ongoing institutional development and adaptive governance.

Develop integrated data portals: Create centralized platforms for collecting, managing, and sharing data across sectors and scales, improving accessibility and reducing transaction costs. Technology integration simplifies MRV processes, increasing reliability and comparability (Sarr, 2018; Haites, 2014).

- **Start with simple, measurable indicators:** Focus on a limited set of easily measurable indicators, expanding complexity as capacities improve. Regularly review and adjust indicators to remain relevant under evolving conditions (Leiter & Pringle, 2018; Hallegatte & Engle, 2019).
- **Participatory indicator development:** Involve stakeholders in selecting indicators and defining adaptation success. Co-developing metrics ensures that local priorities, traditional knowledge, and social equity considerations shape M&E frameworks, and capture both intended and unintended consequences (Levine et al., 2021; Swilling et al., 2018). Box 5 highlights how Outcome Harvesting, a participatory M&E approach, can help trace both anticipated and emergent outcomes, providing deeper insights into the impacts of adaptation interventions.
- **Pilot innovative tools**: Test small-scale tools, such as mobile apps or community-based monitoring systems, before scaling up (Hammill et al., 2014; Amundsen et al., 2010).

Box 5: Outcome Harvesting in climate adaptation M&E

Outcome Harvesting is a participatory M&E approach that moves beyond predefined indicators and baseline measures, focusing instead on identifying, formulating, verifying, and interpreting outcomes directly influenced by an intervention (Wilson-Grau & Britt., 2012). This retrospective methodology begins with observed changes in behavior, relationships, policies, or practices, and then traces how an intervention contributed to these shifts. By "harvesting" both intended and unintended results, evaluators gain a more comprehensive view of an intervention's impact, including emergent, context-specific changes often missed by traditional M&E methods.

In climate adaptation, where outcomes may be highly complex and difficult to quantify, Outcome Harvesting can capture nuanced, transformational change. Such transformation may entail reconfiguring energy systems, land use, or institutional frameworks to accelerate sustainable practices and foster equitable climate resilience. By documenting these deep, systemic shifts, Outcome Harvesting enables practitioners to identify barriers, highlight successes, and inform adaptive management. This enhances accountability and learning, aligning with calls for more adaptive, context-driven M&E in climate action.

Outcome Harvesting proves particularly valuable in complex or rapidly evolving contexts where traditional M&E frameworks are inadequate. It captures both intended and unintended results, including nuanced changes in relationships, policies, or practices, that standard indicators may miss. By focusing on emergent and unpredictable outcomes, this method is well suited to programs where clear metrics are difficult to define in advance.

Long-term projects

- **Build data infrastructure and IT platforms:** Invest in geospatial tools, remote sensing technologies, integrated databases, and the necessary capacities to strengthen data collection and improve reporting accuracy.
- **Remote sensing and public databases**: Integrate satellite imagery and publicly available global climate or environmental data into national M&E systems. Partnerships with international agencies or NGOs can provide technical assistance and help interpret satellite or model-derived information, enhancing the accuracy and scope of data collection.
- **Encourage scenario planning and adaptive management:** Regularly update methodologies, embrace scenario analyses, and consider multiple future trajectories. Such forward-looking strategies help prepare for uncertainty and guide strategic climate investments (Fisher et al., 2015; Hallegatte & Engle, 2019).

- **Conduct country-led evaluations:** Encouraging local participation in nationally led evaluations on climate and environmental finance strengthens learning and supports the development of more context-specific, evidence-based policies.
- **Embrace mixed methods and systems thinking:** Combine quantitative metrics with qualitative assessments, scenario analyses, and participatory rural appraisal techniques to capture intangible factors like governance quality, empowerment, and cultural values (Fisher et al., 2015; Dekens, 2021). Forward-looking evaluations can anticipate future climate scenarios and identify risks of maladaptation.
- **Balance standardized and context-specific metrics:** A flexible, multilevel M&E framework that includes both standardized national indicators and localized, context-specific metrics ensures scalability and comparability (Hammill et al., 2014; Amundsen et al., 2010). Germany, for instance, complements national adaptation indicators with subnational evaluations, while Norway's qualitative "learning by doing" approach tailors adaptation strategies to evolving local conditions (Hammill et al., 2014; Amundsen et al., 2010).

5.3 Individual Capacity Enhancement

These recommendations focus on building individual-level capacities for leading, sustaining, and strengthening national climate and environmental M&E systems and practices.

Quick wins:

- **Online training:** Existing online platforms and training programs can serve as a starting point for individual capacity building.

Low-hanging fruits

- **Train practitioners and foster knowledge exchanges:** Build capacity through partnerships with universities, research institutions, and regional climate centers, while facilitating South-South learning initiatives (Leiter, 2021; Khan & Akhtar, 2015). Initiatives such as the NDC Partnership have demonstrated how South-South cooperation can catalyze capacity building, as seen in recent peer learning exchanges in sub-Saharan Africa.
- **Long-term capacity building and technical assistance:** Invest in training national and local practitioners in data collection, analysis, and interpretation. Partner with local experts, universities, research institutes, and regional climate centers to build in-country expertise. South-South exchanges and peer learning networks can play a key role in catalyzing knowledge transfer (Leiter, 2021; Khan & Akhtar, 2015).
- **Community-based monitoring and citizen science:** Employ simple tools (e.g., rain gauges, photo evidence, mobile-based reporting) and train community members to collect data. This approach enriches datasets while building trust and increasing the legitimacy of reported findings (DFFE, 2014 and 2020).

6. Concluding Reflections and Future Directions

This document highlights the critical importance of integrated, inclusive, and adaptive M&E systems that transcend traditional sectoral boundaries. As climate and environmental governance expands beyond mitigation-focused approaches to incorporate adaptation, L&D, biodiversity conservation, and just transitions, M&E frameworks must evolve to reflect these broader and interconnected objectives (IPCC, 2022 and 2023; IPBES, 2019; UNFCCC, 2015; UNISDR, 2015). M&E are not purely technical exercises; they are essential governance tools that inform strategic resource allocation, support learning and innovation, and foster accountability among stakeholders.

A persistent challenge is the ambiguity of fundamental concepts and the lack of standardized indicators, particularly in adaptation, L&D, and transformational change. Addressing these gaps requires indicators and methods that capture both quantitative outcomes (e.g., emissions reductions) and qualitative dimensions (e.g., enhanced governance capacity, community empowerment, and social equity) (Leiter, 2015; Reid et al., 2019). Equally important is recognizing that some forms of climate action—such as improving adaptive capacity or sustaining ecosystem integrity—may not yield immediately quantifiable results. M&E frameworks must be flexible enough to accommodate evolving objectives, contexts, and baselines, thereby remaining relevant over the long-term time horizons in which climate impacts unfold (Brown et al., 2016; Hallegatte & Engle, 2019).

Integrating climate M&E into national development systems emerges as a priority. Embedding M&E into broader planning processes enhances policy coherence, reduces reporting burdens, and ensures relevance to socioeconomic priorities such as poverty alleviation, income, jobs, health improvement, and disaster risk management (Kusek & Rist, 2004; Khan & Akhtar, 2015). Strengthening institutional capacities and providing targeted technical and financial support, especially to developing countries, will address resource constraints and capacity gaps and enable sustainability of M&E systems (Ssekamatte, 2018).

A recurring theme is the value of embracing complexity and uncertainty through systems thinking and participatory approaches. Mixed-method evaluations, scenario analyses, and adaptive management strategies allow M&E frameworks to better reflect the multifaceted nature of climate–nature interactions. Inclusive approaches, such as engaging local communities and marginalized groups in indicator development and data collection, enhance cultural relevance, legitimacy, and responsiveness (Huq et al., 2013; Swilling et al., 2018). For example, Nepal's community-based adaptation programs illustrate how participatory monitoring strengthens both data accuracy and stakeholder trust. Such inclusivity is particularly crucial for just transitions, where the distribution of risks, benefits, and opportunities must be carefully monitored to support equitable and transformative change (Newell & Mulvaney, 2013).

Looking forward, four key research and action priorities emerge for national governments, international climate funds and practitioners working to improve the design and use of climate M&E systems:

- **Conceptual and methodological refinements**: Clarify definitions, refine indicators, and develop methods to track both tangible and intangible outcomes of climate interventions.
- **Innovation and technology**: Continue to experiment with tools such as remote sensing, citizen science, and mobile-based data collection to improve cost-efficiency and context appropriateness.
- **Knowledge sharing and collaboration**: Foster platforms for South-South cooperation and peer-to-peer learning to accelerate best practice diffusion and build capacity in resource-constrained settings (Leiter, 2021; Qi & Beauchamp, 2023a and 2023b).
- **Systems integration**: Align M&E frameworks across climate, biodiversity, and sustainable development agendas to reduce fragmentation, enhance comparability, and support more holistic and transformative climate action.

In conclusion, integrated and inclusive M&E systems are indispensable for achieving long-term climate and developmental goals. By refining conceptual frameworks, addressing capacity needs, engaging diverse stakeholders, and embracing adaptive management, M&E systems can guide strategic decisions, enhance credibility, and foster learning in an increasingly complex global landscape. As the climate and nature agendas evolve, so too must the systems that monitor progress, ensuring that countries and communities are well-equipped to meet the challenges ahead.

7. References

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8. Glossary

The following definitions provide concise explanations of key terms related to climate change adaptation, mitigation, biodiversity action, and M&E, ensuring a shared understanding among all readers and stakeholders.

Climate Change Adaptation: "The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities; in some natural systems, human intervention may facilitate adjustment". (IPCC 2022) It aims to enhance resilience and reduce vulnerability to changing climate conditions.

Climate Change Adaptation M&E: Systematic monitoring, evaluation, and learning "to track progress in implementing adaptation plans, policies, programs and actions and to inform iterative risk management for effective and just adaptation at local-to-global levels." (UNFCCC 2023) M&E of climate change adaptation involves the systematic tracking, assessment, and reporting of efforts to adjust and manage the impacts of climate change. This includes evaluating the effectiveness of adaptation measures, identifying gaps and opportunities for improvement, and informing policy and decision-making to enhance resilience. Key components of climate change adaptation M&E include establishing a clear understanding of the initial conditions before adaptation interventions are implemented, developing specific, measurable indicators to track progress and outcomes of adaptation measures, and systematic collection and analysis of relevant data to assess the performance and impact of adaptation activities. Additionally, transparent reporting and communication of findings to stakeholders are crucial for ensuring accountability and facilitating informed decision-making. Effective M&E also involves utilizing evaluation results to learn from experiences, improve future adaptation strategies, and build adaptive capacity over time. This continuous process ensures that adaptation efforts are successful, sustainable, and responsive to the evolving challenges posed by climate change.

Climate Change Mitigation: Mitigation refers to efforts to reduce or prevent the emission of greenhouse gases (GHGs), aiming to limit global warming and its impacts (UNFCCC n.d.). This includes using renewable energy, enhancing energy efficiency, and adopting sustainable practices across various sectors.

Climate Proofing: A project-level process that integrates mitigation and adaptation considerations into infrastructure development to ensure long-term resilience and alignment with climate-neutrality goals. (European Commission, 2021) It is a process of making systems, structures, policies, and practices more resilient to the impacts of climate change by integrating climate change adaptation and mitigation measures into the development of policies, strategies, and programs. It involves assessing potential vulnerabilities and implementing measures to minimize risks and enhance adaptability. The goal is to ensure that the effects of climate change—such as extreme weather events, rising sea levels, and temperature fluctuations—do not compromise the functionality, sustainability, or safety of these systems.

Climate Reporting: The systematic collection, analysis, and dissemination of data related to climate action and its impacts. This includes tracking greenhouse gas (GHG) emissions, assessing the effectiveness of mitigation and adaptation measures, and evaluating progress toward national and international climate commitments. It ensures transparency and accountability, providing stakeholders with essential information to make informed decisions and to meet obligations under frameworks like the Paris Agreement and the ETF.

National M&E Systems: National M&E systems encompass the national, sectoral, line ministry, and subnational levels, integrating systems, processes, stakeholders, and capacities across all tiers. These systems enable governments to systematically collect, analyze, and use data to assess the performance and impact of policies and programs. In the context of climate action, national M&E systems help track progress on mitigation and adaptation measures, evaluate outcomes, and inform decision-making processes. Strong national M&E systems are essential for effective policy implementation, resource allocation, and reporting on commitments under national development plans, NDCs, SDGs, and other international agreements. By involving diverse stakeholders and building capacities at every level, these systems ensure comprehensive and cohesive monitoring and evaluation.

Enhanced Transparency Framework (ETF): This is a critical component of the Paris Agreement, established to promote transparency, accuracy, and accountability in climate action across all participating countries. The ETF aims to ensure that nations provide clear and consistent reporting on their climate-related actions, including mitigation efforts, adaptation measures, and support received or provided.

Global Stocktake: This is a key component of the Paris Agreement, occurring every five years, aimed at assessing the collective progress of all countries toward achieving the long-term goals of the Agreement. It evaluates overall advancements in mitigation, adaptation, and support (including finance, technology transfer, and capacity-building). The findings from the Global Stocktake are intended to inform and enhance national climate actions and international cooperation, ensuring that global efforts are on track to limit global warming and build resilience to climate impacts.

Just Transition: A term that refers to the shift toward a sustainable, low-carbon economy in a way that is fair and inclusive, ensuring that the benefits and burdens of the transition are distributed equitably, and no one is left or pushed behind. It emphasizes protecting the livelihoods, rights, and well-being of workers and communities who are affected by the transition, including—but not limited to—those in industries reliant on fossil fuels or other high-emission sectors.

Kunming-Montreal Global Biodiversity Framework (GBF): This framework is a landmark international agreement adopted under the Convention on Biological Diversity (CBD) during the 15th Conference of the Parties (COP15) in 2022. It provides a comprehensive strategy to address biodiversity loss, restore ecosystems, and ensure sustainable use of natural resources by 2030. The framework builds on the Aichi Biodiversity Targets, which ended in 2020, and sets ambitious goals and targets, including the 30x30 target to conserve at least 30 percent of terrestrial, freshwater, and marine ecosystems globally by 2030. It emphasizes protecting critical biodiversity areas, restoring degraded ecosystems, and increasing financial flows to support biodiversity conservation, especially in developing countries.

Loss and Damage (L&D): L&D refers to the adverse effects of climate change that cannot be avoided through mitigation or adaptation efforts. This includes both economic losses, such as property and infrastructure damage, and non-economic losses, like loss of biodiversity, cultural heritage, and human lives. The concept encompasses the irreversible impacts and residual risks resulting from climate-related events, highlighting the need for comprehensive support and compensation mechanisms for affected communities and nations.

M&E framework: A structured plan that outlines indicators, methodologies, data sources, and timelines for monitoring and evaluating progress and outcomes. At the project level, it provides a roadmap detailing what aspects of the project will be monitored and how evaluations will be conducted. At the national level, it establishes indicators and methodologies for assessing the progress of various programs and initiatives in line with broader development goals.

M&E plan: This is a detailed document that specifies the M&E activities, schedules, responsible parties, and resources required. For projects, it guides the implementation of the M&E framework by detailing specific actions, timelines, and responsibilities. At the national level, it outlines the necessary activities, schedules, and responsibilities for M&E across different sectors and programs, ensuring alignment with national policies and strategies.

M&E system: A comprehensive set of procedures, tools, and infrastructure for systematically collecting, analyzing, and reporting data. At the project level, it operationalizes the M&E plan and framework, providing the necessary tools and processes for effective data management and reporting. At the national level, it offers a robust infrastructure to collect, analyze, and report data from various programs and sectors, facilitating informed decision-making, accountability, and policy adjustments on a national scale.

Monitoring, Reporting, and Verification (MRV): MRV of climate change mitigation is a systematic process to track, report, and verify actions aimed at reducing GHG emissions. It ensures transparency, accuracy, and accountability in mitigation efforts by ensuring that emissions data and related activities are measured and disclosed reliably.

The process involves the continuous collection and analysis of data on emissions, emission reductions, and related activities such as energy use and industrial processes (monitoring); the regular documentation and communication of these results to stakeholders including governments, international bodies, and the public (reporting); and the independent review and validation of reported information by third-party entities to confirm its accuracy and credibility (verification). Effective MRV systems are essential for assessing mitigation progress, improving data quality, supporting access to climate finance, informing policy decisions, and ensuring compliance with national and international climate commitments.

Monitoring Framework for the Kunming-Montreal Global Biodiversity Framework: A system established under the Convention on Biological Diversity (CBD). It tracks progress toward achieving the framework's goals and targets, including conserving at least 30 percent of terrestrial, freshwater, and marine ecosystems by 2030 (30x30 target). Adopted at COP15, it provides a structured, indicator-based approach to measure and evaluate global, regional, and national biodiversity actions. The framework uses three tiers of indicators: headline indicators offer high-level metrics such as species extinction risk, ecosystem extent, and biodiversity finance; component indicators provide more detailed insights into drivers and outcomes; and complementary indicators offer context-specific data to support nuanced analysis. It aligns with global frameworks like the Sustainable Development Goals (SDGs) and the Paris Agreement to ensure coherence and reduce duplication in reporting efforts. It acts as a biodiversity-focused counterpart to the Paris Agreement's Enhanced Transparency Framework, reinforcing accountability and collaboration in addressing global environmental challenges.

Nagoya Protocol: A supplementary agreement to the Convention on Biological Diversity (CBD) that promotes the fair and equitable sharing of benefits arising from the utilization of genetic resources. Adopted in 2010, and entered into force in 2014, it establishes a legal framework to ensure that countries providing genetic resources (e.g., plants, animals, or microorganisms) receive a share of the benefits derived from their use, such as in pharmaceuticals, agriculture, or biotechnology. The protocol emphasizes access and benefit-sharing (ABS), requiring users of genetic resources to obtain prior informed consent from provider countries and agree on mutually agreed terms to share benefits, including financial returns, technology transfer, and capacity building. It aims to balance conservation, sustainable use, and the rights of resource-providing countries and Indigenous communities.

Paris Agreement: This is a landmark international treaty adopted at COP21 in Paris in 2015. It aims to combat climate change and accelerate the actions and investments needed for a sustainable, low-carbon, future. Its main goal is to limit global warming to well below 2°C above pre-industrial levels, while pursuing efforts to limit the temperature increase to 1.5°C. The Agreement encompasses commitments from countries to set and achieve nationally determined contributions (NDCs), enhance climate resilience, and provide financial and technical support to developing countries. It also includes mechanisms for transparency, accountability, and periodic review through the ETF and the Global Stocktake process.

Systems-focused M&E: This approach is used to examine the interconnected components of a system to understand how various elements interact and contribute to overall outcomes. It provides comprehensive insights, identifies systemic issues, and supports continuous improvement and adaptive learning by considering the broader context and interactions within the system.

Transformational Change: This involves deep, systemic shifts in structures, practices, values, and mindsets that fundamentally alter how systems operate, aiming for significant and sustainable improvements. This change addresses root causes, going beyond incremental adjustments to create resilient, adaptive, and equitable systems, and supports sustainable, low-carbon or green development by fundamentally altering economic, social, technological, and ecological dimensions. Given the long-term nature of transformational change, longitudinal M&E studies are necessary to capture the full range of outcomes.

Annex 1: Frameworks and Tools for Climate M&E

Framework/tool	Developer	Purpose	Application examples
AdaptME toolkit	UK Climate Impacts Program (UKCIP)	Flexible, question-based approach for designing context-specific M&E systems for adaptation	Used across diverse adaptation programs to focus on maximizing learning and customization
Adaptation monitoring and assessment tool (AMAT)	Global Environment Facility (GEF)	Tracks adaptation progress in large climate finance portfolios, emphasizing standardized indicators for aggregation	Applied in portfolios like LDCF/ SCCF
Tracking adaptation and measuring development (TAMD)	International Institute for Environment and Development (IIED)	Links adaptation interventions to development outcomes, tracking resilience and vulnerability reduction	Adopted by Kenya, Mozambique, Cambodia; integrated with BRACED approach in Ethiopia, Nepal, Senegal
Participatory monitoring, evaluation, reflection, and learning (PMERL)	Various communities and NGOs	Emphasizes local community engagement in adaptation M&E, using participatory methods to capture local insights	Applied in community-based adaptation programs where local input and adaptive management are essential
Results-based management (RBM) framework	GEF	Tracks adaptation progress across GEF adaptation portfolios, including LDCF/SCCF, focusing on results	Used in multicountry adaptation portfolios within GEF's adaptation programs
National emissions registry system (SIRENE)	Brazil	Monitors national GHG inventories to support climate policy decision-making	Operational since 2017 for tracking mitigation and adaptation actions
MRV+ system	Kenya	Tracks GHG inventories, mitigation, and adaptation with a logic model approach (inputs, activities, outputs)	In development since 2012, incorporating a Climate Budget Coding and Tracking Tool
National climate change response M&E system	South Africa	Results-based system integrating mitigation and adaptation within national climate response	Advanced system among developing nations with a full logic model
National forest monitoring system (NFMS)	Ethiopia	Tracks forest cover and carbon stocks using satellite monitoring and forest inventories	Supports MRV for REDD+ and national climate goals
Global protocol for community-scale GHG emission inventories (GPC)	Initiative for Climate Action Transparency (ICAT)	Standardizes subnational emissions data collection and reporting at the community scale	Applied in cities like Pakse and Kaysone Phomvihane, Laos
National adaptation indicator systems	Colombia, Ecuador, Peru, Bolivia	Tracks adaptation measures through national M&E systems, focusing on water security, agriculture, and ecological restoration	Colombia's Lake Tota Basin M&E; Ecuador's Machángara River adaptation; Peru's agriculture adaptation

Annex 2: Examples of National and Subnational Climate M&E Systems

Country/region	System focus	Details
Mexico	National climate change system	SICC tracks emissions, vulnerability, and finance, linked to the national development plan
South Africa	National climate change response policy	M&E for resilience in agriculture, water, and energy sectors; emphasis on public reporting
Rwanda	Green growth and climate resilience strategy (GGCRS)	Integrated M&E tracks emissions, resilience, and clean energy; linked to Vision 2050
Colombia	SISCLIMA	M&E for mitigation and adaptation, coordinating efforts across sectors and agencies
Bangladesh	BCCSAP & community-based monitoring	Focus on resilience for floods and cyclones; community involvement in adaptation M&E
Brazil	Amazon fund	Remote sensing tracks deforestation; community-based adaptation projects in the Amazon
Denmark	Renewable energy M&E	Tracks renewable energy progress in electricity, heating, and transport sectors
California, USA	Climate change scoping plan	Annual inventories and cap-and-trade for emissions tracking across sectors
Spain	Climate change strategy 2013-2020	Dashboard tracks GHG reductions and adaptation; focus on coastal and water management
Queensland, Australia	Queensland climate transition strategy	M&E for emissions reductions, renewable energy, and adaptation in vulnerable areas
São Paulo, Brazil	Municipal climate plan	Tracks urban emissions, air quality, and green infrastructure with alignment to Paris goals

Annex 3: Climate M&E Good Practices

Best practice	Description	Country/region examples
Prioritizing key vulnerable sectors	Focus on sectors most affected by climate change to optimize resource allocation	**Bangladesh**: Targets agriculture and water (BCCSAP) **South Africa**: Prioritizes energy and water sectors within the National Climate Change Response Policy
Simplifying M&E frameworks	Use simplified indicators for scalability and ease of data collection at local levels	**Nepal**: Local Adaptation Plans of Action (LAPAs) with minimal indicators **Rwanda**: Key indicators for land restoration and renewable energy (GGCRS)
Leveraging existing institutional and community capacities	Build on current institutions and community networks for cost-effective M&E	**Kenya**: Uses National Environment Management Authority (NEMA) **Bangladesh**: Community-based monitoring for local data collection on climate impacts
Incremental implementation	Phased implementation allows capacity-building over time	**Ethiopia**: Gradual expansion of CRGE strategy **Mexico**: Focused initially on high-priority sectors and scaled up
Innovative use of technology	Use low-cost tech like mobile apps, remote sensing, and crowdsourcing for data collection	**Brazil**: Satellite monitoring of Amazon deforestation (INPE) **India**: Crowdsourcing climate data in rural areas **Kenya**: Mobile data collection for climate impacts
Institutional strengthening and coordination	Decentralize M&E responsibilities and foster inter-agency collaboration	**Uganda**: Local governments handle climate M&E (national climate change policy) **Indonesia**: Integrated M&E for disaster risk reduction and adaptation
Sustainable financing for M&E	Access blended financing models to ensure long-term M&E sustainability	**Peru**: Uses green climate fund and partnerships **Philippines**: People's survival fund (PSF) for local adaptation projects
Focus on learning and adaptive management	M&E systems incorporate feedback for continuous improvement of climate strategies	**South Africa**: Integrated learning-based M&E system **UK**: Independent monitoring by the Committee on Climate Change (CCC) under the Climate Change Act
Use of low-cost technology for data collection	Deploy mobile apps and community-based systems for real-time data	**Bangladesh**: Mobile-based flood risk monitoring **Kenya**: Community-based mobile apps for climate impact tracking

Best practice	Description	Country/region examples
Partnerships for technical capacity building	Engage with international organizations to enhance technical skills for M&E	**Rwanda & Ethiopia**: training with global framework for climate services **Brazil & Mozambique**: South-South collaboration on forest monitoring
Data sharing and open access platforms	Open-access platforms enable transparent data sharing across sectors	**Costa Rica**: SINAMECC platform consolidates data on emissions, adaptation, and finance **India**: Crowdsourcing platforms for climate data collection
Institutional strengthening through decentralization	Delegate M&E roles to local authorities to tailor climate action to local needs	**Nepal**: Local adaptation plans of action (LAPAs) **Uganda**: District governments manage climate M&E

global
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