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Climate Adaptation and Its Measurement

CHALLENGES AND OPPORTUNITIES

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LIST OF ACRONYMS

AMAT	Adaptation Monitoring and Assessment Tool
ATLAS	Adaptation Thought Leadership and Assessment
CIFs	Climate Investment Funds
COP	Conference of the Parties
CVCA	Climate Vulnerability and Capacity Analysis
EbA	Ecosystem-based Adaptation
FAO	Food and Agriculture Organization
GADRRRES	Global Alliance for Disaster Risk Reduction and Resilience in the Education Sector
GCF	Green Climate Fund
GEF	Global Environment Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
KPI	Key Performance Indicator
LDCF	Least Developed Countries Fund
M&E	Monitoring and Evaluation
NDC	Nationally Determined Contributions
NAP	National Adaptation Plan
OECD	Organization for Cooperation and Development
PMERL	Participatory Monitoring, Evaluation, Reflection and Learning
RBM	Results Based Management
SCCF	Special Climate Change Fund
TAMD	Tracking Adaptation and Measuring Development
UKCIP	United Kingdom Climate Impacts Programme
UNDP	United Nations Development Program
UNEP DTU	United Nations Environment Program Danish Technical University partnership
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNITAR	United Nations Institute for Training and Research
USGS	United States Geological Survey
WRI	World Resources Institute

EXECUTIVE SUMMARY

Key Messages

- There is a growing need to track progress on adaptation[1] for policy and programming at multiple levels.
- Adaptation defies typical measurement: it is a context-specific, ongoing process rather than an endpoint, which means it requires an approach that can evolve over time and often involves value judgments about the decisions to be made.
- It is not enough to pursue adaptation in isolation; instead, all aspects of development programming need to be modified to consider climate risk so that it is also an adaptation to climate change.

Adaptation Tracking: A Challenging Imperative

The need to adapt to climate change is undisputed, as evidenced by the increasing commitments being made to adaptation. At the international level, for example, the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) set a global goal for adaptation, and the global stocktake process aims to assess progress towards this goal. Similarly, at the national level, many countries are making their own commitments, often in addition to their UNFCCC obligations, which they are required to track. And the increasing volume of adaptation finance being managed through multilateral and bilateral donors makes it imperative to track whether these funds are achieving their intended goals.

Despite the recognized need, there are significant challenges that make it very difficult to track, monitor, and evaluate adaptation. There is no "one size fits all" approach; instead, what adaptation looks like varies depending on the context and scale. Because climate change is evolving and will continue to evolve, adaptation is also not a one-time action or endpoint, but rather a process (or an adaptation pathway) that requires adaptive management as new information comes to light. The future trajectory of climate change also makes it difficult to judge when adaptation has been successful, as the consequences of today's actions often become apparent only after climate conditions have changed. Adaptation also involves value judgments that reflect risk tolerance and trade-offs. Taken together, these factors mean that adaptation defies typical metrics.

A Multitude of Frameworks and Approaches to Tracking Adaptation

Despite these challenges, different institutions and organizations have advanced their own approaches to measuring adaptation. After many years of methodological deliberations, including under the Nairobi Work Programme on adaptation, the first global stocktake recently concluded its multi-year process at COP28 in Dubai, based on submissions from Parties. Within the realm of adaptation finance mechanisms, the Least Developed Countries Fund (LDCF), the Special Climate Change Fund (SCCF), the Adaptation Fund, and the Climate Investment Funds (CIFs) require funded projects aimed at adaptation to utilize specific results frameworks and indicators for reporting their progress. In addition, various bilateral donors and non-governmental organizations (NGOs) have attempted to develop indicators and frameworks for use at the national and sub-national levels (including in relation to resilience measurement, which is closely related, as [climate] resilience is often framed as an outcome of climate adaptation). As is typical of cross-scalar aggregation, there is a trade-off between more generic indicators that can be used at large scales (e.g., international or regional) and the context-specific indicators that are more appropriate at higher resolutions.

1 This report will refer to climate adaptation simply as "adaptation"

Adapting Development to Climate Change

One of the biggest sticking points has been defining the relationship between adaptation and development. The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as "the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities". The goals of adaptation and development are thus complementary. However, development alone is not necessarily adaptation (although it can contribute to it). Rather, adaptation is development that takes climate risk into account. To avoid the risks of non-adaptive or maladaptive development, it is crucial to outline an adaptation rationale that shows how particular actions will lead to an intended outcome and how that outcome will lead to reduced risk in the face of climate change. For this reason, it is not enough to support adaptation activities through a climate change program alone; rather, all development programming needs to be modified to consider climate risk so that it is also an adaptation to climate change.

Design Principles for Robust Adaptation

Because it is imperative to define what adaptation looks like before it can be measured, this report proposes several principles that should underpin the selection of a particular adaptation practice or activity, which in turn must reflect the climate risk and context in question. These principles aim to ensure that initiatives:

- focus on vulnerability reduction, including by identifying and addressing the multiple facets of vulnerability;
- are participatory/beneficiary-informed, to ensure that they are driven by and directly responsive to the needs of the people they are intended to benefit;
- are robust to current and future climate risks (hazard-specific);
- are equitable and contribute to social inclusion and equality;
- are themselves adaptable as new information becomes available and circumstances evolve, consistent with an adaptation pathways approach or the application of adaptive learning; and
- consider multiple scales and the embeddedness of the project scale within a broader scale to minimize potential negative off-site impacts.

Recognizing that it is not enough to support adaptation interventions through a climate change program alone, but rather that all development programming needs to be modified to consider climate risk so that it is also an adaptation to climate change, this report provides some illustrations of how this might look in different sectors, including education and natural resource management. In particular, it highlights the need for programming in these sectors to consider climate risk in achieving objectives. At the same time, it is often possible to modify these activities slightly to achieve the original sector objectives while also supporting adaptation to climate change.

1. INTRODUCTION

The need to adapt to climate change is undisputed. In recent decades, adaptation has been integrated into national and international policy frameworks, programming, and practice. However, the very nature of adaptation makes it difficult to track, monitor, or evaluate. This difficulty is largely due to the variability of adaptation approaches in different contexts, shaped by different climate futures and existing vulnerabilities.

This report aims to summarize the current state of knowledge on adaptation measurement and provide practical guidance on what adaptation measurement might look like in different sectors. It is intended for USAID senior management who want an overview of the state of the art, as well as technical advisors involved in programming who need to know what adaptation looks like in their sectors and how to measure it.

The report is organized as follows. Section 2 provides an overview of the origins and rationale for measuring adaptation, including why it is important but also what makes it challenging, before summarizing attempts by various parties to date. Section 3 outlines the current state of adaptation, while Section 4 turns to adaptation principles, building on the latest knowledge about what characterizes sound adaptation practice and outlining a set of principles that should be considered when designing adaptation projects and programs. Section 5 illustrates how these principles could be applied to education and natural resource management, and Section 6 provides a conclusion.

2. MEASURING ADAPTATION: EMERGENCE, CHALLENGES, AND CURRENT APPROACHES

2.1 Emergence of the Need to Measure Adaptation

The need to adapt to climate change is becoming increasingly urgent, as evidenced by the IPCC's Sixth Assessment Report, which showed that there is a short and rapidly narrowing window of opportunity to address climate change.[2] The imperative to measure adaptation stems primarily from two distinct but related drivers. On the one hand, the Paris Agreement to the United Nations Framework Convention on Climate Change set an adaptation target for the first time. The global goal on adaptation set out in Article 7 has the aim of "enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal" (i.e., to limit the global average temperature increase to 2°C, with a view to limiting it to 1.5°C). The global stocktake proposed under Article 14 is intended to recognize the efforts of developing country Parties, enhance the implementation of adaptation action, review the adequacy and effectiveness of adaptation, and review the overall progress made in achieving the global goal. Thus, Parties to the UNFCCC now have a mandate to measure adaptation, which is to be done through adaptation communications (see Annex A for more details on the global stocktake and Box 1 for the findings of the first global stocktake).

2 (IPCC, 2022)

While the initial impetus may have come from the international policy arena, there are other entry points for measuring adaptation.

- An increasing number of countries have their own climate change strategies and plans—complementary to and in addition to their obligations as Parties to the UNFCCC—and there is therefore a growing interest in measuring adaptation to track progress against these national commitments.
- There is also an increasing number of adaptation projects under implementation—both in relation to national and international policy commitments and reflecting the resulting increase in adaptation finance flows.
- As a result, there is a growing interest in tracking the success of adaptation projects against stated objectives and their progress towards adaptation goals.

All international sources of climate finance have results frameworks that include adaptation indicators against which all funded programs must report (see Annex B), and donors and philanthropic organizations typically require monitoring and evaluation (M&E) of adaptation in the same way they would for sector-based programming. However, this is often complicated by the nature of adaptation, as described below.

The first global stocktake of the Paris Agreement under the UNFCCC

The first global stocktake, mandated under Article 14 of the Paris Agreement, recently concluded at COP28 in Dubai. A multi-year process, the global stocktake began with Parties and other entities gathering relevant information for their submissions (2021–2023), which were then synthesized and published in September 20233 as input to COP28 decisions on the response. They are intended to inform increasing levels of ambition in the next round of nationally determined contributions due within the next two years.

Key findings on adaptation from the global stocktake show that progress to date is insufficient and that a step change is needed to meet the commitments of the Paris Agreement, i.e., that "increased adaptation action and enhanced efforts to avert, minimize and address loss and damage are urgently needed." While adaptation efforts are being tracked, they tend to be fragmented and poorly coordinated. The synthesis report also highlighted the importance of transparent and comprehensive reporting, which is key to measuring adaptation to ensure that all progress is captured and that adaptation is integrated into decision-making processes.

Box 1: The first global stocktake of the Paris Agreement under the UNFCCC

3 (UNFCCC, 2023)

2.2 Why adaptation measurement is challenging

ADAPTATION IS CONTEXT-SPECIFIC

While the IPCC has provided a theoretical definition of adaptation (Box 2), its practical application is highly context-specific. There are many possible adaptations (e.g., Table 1), but the most appropriate strategy must be chosen to reflect the nature of climate risk, which is determined by the interplay of hazard, exposure, and vulnerability, which vary across sectors and locations. For example, adaptation strategies for agriculture under increasingly dry conditions are very different from those for agriculture under increasingly wet conditions. Similarly, a city's approach to adapting to rising temperatures will differ from its approach to adapting to an increase in other extreme weather events, such as heavy rainfall. And the methods used by a rural farmer to adapt to flooding are different from those used by an urban area to adapt to flooding.

IPCC definition of adaptation

"In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects."[4]

Box 2: Definition of adaptation

Put another way, what may be considered an adaptation intervention in one place may be inappropriate or maladaptive in another context. For example, irrigation may be an appropriate adaptation where the sustainability of future water availability has been determined—but not where such an assessment has not been made (and there are many recent examples of installed micro-irrigation systems that have failed because they were planned on the basis of past, rather than future, water availability). As a result, it is not possible to provide a universal list of adaptation options that will work in all contexts.

The consequence of the context-specificity of adaptation is that there are no universal metrics for measuring it, unlike other development areas where the Sustainable Development Goals and the Human Development Report provide standardized indicators for poverty or socio-economic outcomes. The challenge is that knowing what to measure depends on what adaptation looks like in a particular context. While this may be relatively easy to address at the individual project level, it is particularly challenging when data needs to be synthesized and aggregated across contexts and scales. This is typically required by donors and climate finance funds to cover their portfolios. It is also required for the global goal on adaptation, where national efforts need to be aggregated.

4 (Möller et al., 2022)

Table 1: Examples of adaptation interventions across sectors[5]

SECTOR	OPTIONS FOR ADAPTATION INTERVENTIONS
Agriculture/food	Shifting planting dates and changing crop varieties, soil improvement and water management for livestock and crops, aquaculture, restoring coastal and hydrological processes, introducing heat- and drought-adapted genotypes into high-risk populations, increasing the size and connectivity of habitat patches, agroecological farming, agroforestry and managed relocations of high-risk species
Ecosystems	Adjusting conservation actions and site objectives to reflect changing species distributions and habitat characteristics, reducing non-climatic stressors to increase ecosystem resilience, restoring natural ecological communities and processes, protecting, restoring or creating large areas of natural and semi-natural habitats, intensive management for vulnerable species, increasing habitat connectivity (for terrestrial, freshwater, and ocean ecosystems), conservation of microrefugia, assisted reintroduction, translocation, and migration of species (for terrestrial and ocean ecosystems)
Health	Environmentally sustainable and resilient technologies and infrastructure, health information systems (including integrated risk monitoring and early warning and response systems, vulnerability, capacity, and adaptation assessments, health and climate research), service delivery (including climate-smart health programs, management of environmental determinants of health, disaster risk reduction), collaboration with other sectors, agencies, and civil society, leadership and governance and coherent policies and strategies, strengthening health delivery and system resilience
Urban	Gray/physical infrastructure: dikes, seawalls, water storage, slope revetments, air conditioning, passive cooling, upgrading of transport, energy, water, and sanitation infrastructure, information and communication technologies, urban design, and building regulations Nature-based solutions: urban agriculture, street trees, green roofs, parks and open spaces, community gardens, rain gardens, bioswales, retention ponds, riverbanks, floodplains, and watershed restoration Planning and social policy: land-use planning, social safety nets, emergency and disaster risk management, health services, climate education, heritage conservation

ADAPTATION IS A PROCESS, NOT AN ENDPOINT

The IPCC definition above emphasizes that adaptation is a process, not an outcome. This differs from standard development practice, for example, in that it recognizes that the path of future climate change is uncertain and depends, at least in part, on future emissions trajectories and the success (or otherwise) of the UNFCCC mitigation architecture. As a result, planning for adaptation as a singular and one-off action is unlikely to be sufficient in the context of shifting baselines. In particular, there has been a move towards the conceptualization of adaptation pathways. Adaptation pathways represent sequences of actions that can be implemented incrementally depending on future conditions and can be alternative routes to a defined future or broad directions of change that lead to different and more climate-resilient outcomes.[6] Recognizing adaptation as a process or pathway complicates measurement because there are moving targets.

The implication of adaptation as a process is that it is difficult to apply typical monitoring and evaluation systems, which are typically set up to achieve a predefined end goal rather than a moving target. Adaptation as a process means that effective measurement requires adaptive management and adaptive learning, through touchpoints that allow goals to be revisited and results frameworks to be updated. However, this can be burdensome and does not always fit well with the portfolio approaches of donors and other funders.

5 (Pörtner et al., 2022)
6 (Werners, et al., 2021)

ADAPTATION AS A FUTURE STATE

Related to the notion of adaptation as a process, in many cases the success of adaptation is only visible when a hazard occurs and exposure to that climate hazard does not result in negative outcomes. For example, urban planners can relocate and reinforce water and sewer pipes to better withstand the risk of flooding. However, it is only when a flood occurs that it is possible to determine whether this adaptation has been successful. The future success of the adaptation is further complicated by the fact that it may result in an avoided loss, as opposed to an immediate positive gain. Avoided losses are notoriously difficult to assess because there is no baseline against which to compare what would have happened if the adaptation had not been put in place. Thus, the future nature of adaptation makes it difficult to measure.

Many attempts at adaptation actually build adaptive capacity, or "the ability of systems, institutions, and individuals to adjust to potential damage, to take advantage of opportunities, or to respond to consequences".[7] Adaptive capacity can be built in the present and activated in the future, in the event of exposure to climate hazards, to bring about adaptation. Adaptive capacity is thus a latent state, whereas adaptation can be seen as a tangible outcome. Measuring adaptive capacity is easier than measuring adaptation as a future state, but care must be taken to ensure the adequacy of adaptive capacity actions.

DEFINING ADAPTATION CAN BE NORMATIVE

Recognizing the process-based nature of adaptation and the fact that its success is only visible (and therefore measurable) as a future state, recent conceptualizations have also considered that there is not just one adaptation option, but rather an adaptation space in which different adaptations can emerge but have similar effectiveness. This adaptation space is bounded by both hard and soft limits (Figure 1).[8] Hard limits include ecosystem boundaries—for example, the multi-year drought in East Africa in the early 2020s has exposed hard limits to adaptation in the biophysical environment and raised questions about the appropriateness and feasibility of some livelihood options under future climate conditions. Under the UNFCCC, discussions on loss and damage have emerged in recognition of these hard limits—such that loss and damage compensation is available where adaptation is no longer an option.[9]

Soft limits and constraints, on the other hand, reflect human systems and are therefore more variable over time. For example, a soft limit to adaptation may exist because an institution does not have the human capital capacity or policy framework to support adaptation activities; however, if these human capital and policy framework constraints are addressed, the soft limit will change and lead to an expansion of the adaptation space. Often these soft limits are also defined by the limit of acceptable risk, which reflects perceptions and experiences. For example, a place that has been exposed to tropical cyclones may have a higher degree of acceptance of tropical cyclone risk than an area that has never experienced tropical cyclones but will be exposed as a result of a changing climate. The implication of this adaptation space is that unless the specific adaptation goal within the space is identified and agreed upon in advance, it is difficult to measure the range of options within the space. And even if the adaptation goal is identified and agreed upon, it is subject to the aforementioned challenge that success can only be seen at a future point in time.

7 (MA, 2005)
8 (Dow, et al., 2013).
9 (Mechler et al., 2020)

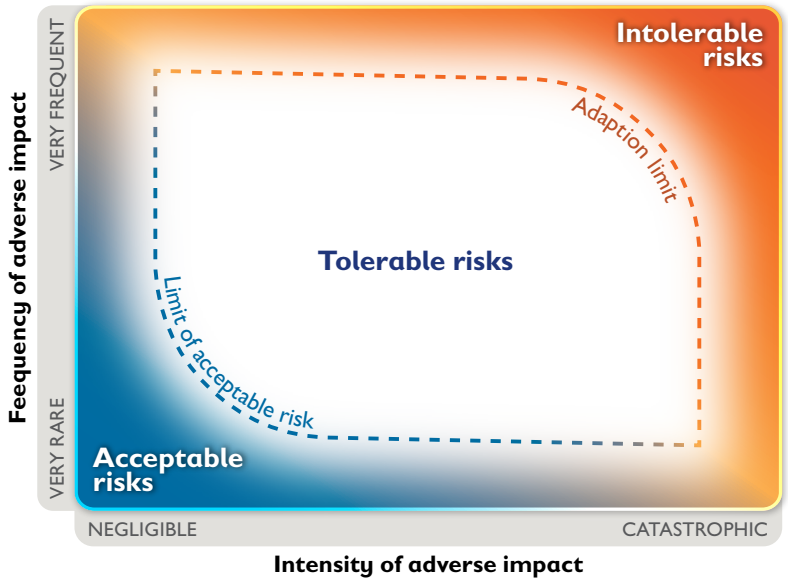

Figure 1: Conceptual model of the determinants of acceptable, tolerable, and intolerable risks and their implications for limits to adaptation[10]

2.3 Current Approaches to Adaptation Measurement

The challenge of defining adaptation means that many monitoring and evaluation systems tend to prioritize process over outcomes and impacts, because reporting on what you do is less methodologically problematic than reporting on outputs or how well interventions contribute to climate resilience. This compromises adequacy and effectiveness because it is possible to follow a process well without that process necessarily leading to adaptation. There is a strong emphasis on sound principles for delivering adaptation (e.g., through finance), institutional safeguards, and fiduciary requirements. As a result, many means of measuring adaptation relate to whether or not there are plans or policies in place, or how much money is allocated for adaptation, rather than how effectively they are implemented or whether they lead to the desired adaptation changes. There is even a focus on whether resources are effectively used for their intended purpose, but less emphasis on what that purpose should be, and on its downstream adequacy and effectiveness. Outcomes and impacts are even more challenging, as the conceptual challenges of adaptation often make it difficult to define what they should look like. While desired adaptation outcomes may include things like "reduced vulnerability to climate change" or "improved resilience," it is difficult to define what this looks like in practice (Box 4 provides a comparison of the similarities and differences between measuring adaptation and measuring resilience). This means that many adaptation M&E systems are forced to focus on indicators such as "adaptation projects taking place"—without a critical analysis of whether or not these projects are actually leading to adaptation.

10 (Dow, et al., 2013)

A variety of examples of systems for measuring adaptation have been proposed by development organizations,[11,12,13] international climate finance and donors,[14,15,16] and national governments as part of their commitments to track progress against national policies.[17,18] More details on some of these approaches are provided in Annex B.

International climate finance approaches to measuring adaptation by the Green Climate Fund, Adaptation Fund, the Least Developed Countries Fund, the Special Climate Change Fund, and the Climate Investment Funds tend to cover similar areas of focus. These relate to reducing the vulnerability of people, livelihoods, assets, and the natural environment, and strengthening institutional capacity to respond to climate change, for example through policy. Each typically has several indicators related to each of these objectives (intended outcomes), and all require disaggregation by gender. The indicators are deliberately kept very general to make them applicable to a wide range of very different projects, and the intention is that projects will be able to report against them while having their own context-specific monitoring and evaluation frameworks. Reflecting the challenges mentioned above, the focus tends to be on the number of people reached or the number of natural assets protected, with less attention paid to whether this is the most appropriate or optimal adaptation (see Annex B for more information on the indicators).

Some development partners have developed and tested frameworks and tools that are intended to be widely applicable. One that has undergone extensive testing is Tracking Adaptation and Monitoring Development (TAMD), developed by the International Institute for Environment and Development (IIED).[19] TAMD is a twin-track approach that allows for a top-down assessment of climate risk management approaches (Track 1) with a bottom-up assessment of the success of adaptation interventions in leading to effective development and how development interventions can strengthen communities' capacity to adapt to climate change (Track 2), thus attempting to address both ends of the development/adaptation continuum (Figure 2). The approach aims to be replicable and cost-effective, and a key criterion for shortlisting indicators is measurability and ease of data access, as well as ensuring linkage to national development indicators. Scorecard approaches are used to allow for qualitative assessment of change where appropriate. They have been used in a number of countries, including Ethiopia,[20] Uganda,[21] Cambodia,[22] Kenya, Mozambique, Nepal, and Pakistan. Box 3 illustrates the use of TAMD in Mozambique. TAMD is arguably better for smaller-scale interventions because, while the approach is comparable, the lack of need for international comparisons avoids the challenge of scale-dependent indicators and the tension between program and project levels that exists in most international adaptation finance. It is therefore better suited to tracking progress over time at the project level.

11 (GIZ, 2012)
12 (CARE, 2012)
13 (IIED, 2011)
14 (CIF, 2012)
15 (Global Environment Facility, 2014)
16 (Green Climate Fund, 2021)
17 (Department for Environmental Affairs, 2017)
18 (Republic of Kenya, 2018)
19 (Brooks et al., 2011)
20 (Awraris et al., 2014)
21 (Kajumba et al., 2020)
22 (Rai et al., 2015)

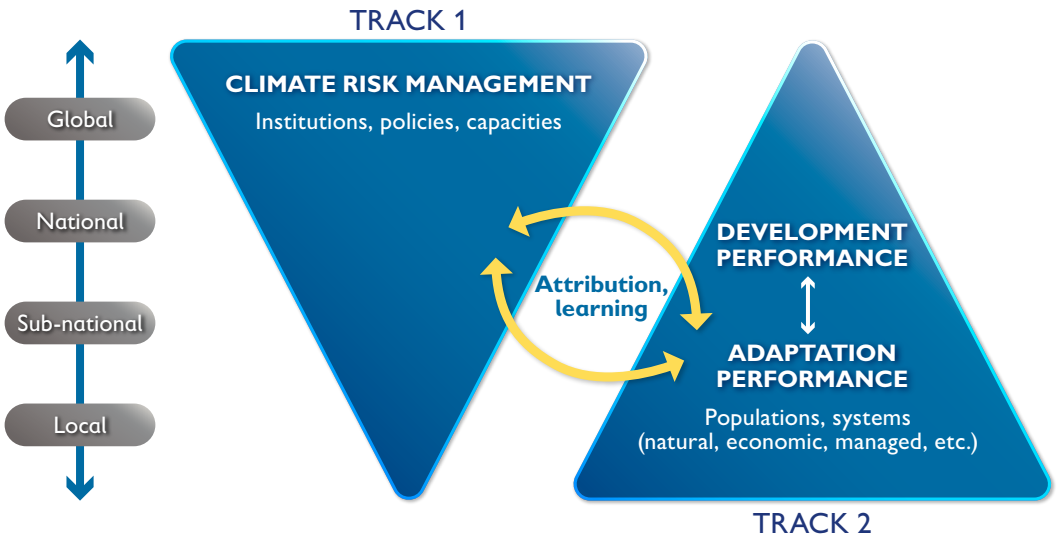

Figure 2: "Twin-track" framework for tracking adaptation and monitoring development[23]

The TAMD approach in Mozambique

In Mozambique, the TAMD approach was used to address the need for a national adaptation monitoring and evaluation system in line with the National Strategy for Adaptation and Mitigation of Climate Change 2015–2025. For Track 1 of TAMD, seven impact indicators and 42 outcome indicators were developed, closely linked to the impact and outcome indicators initially proposed by the government and under consultation to inform the monitoring and evaluation framework. At the local level, TAMD has been used to develop local adaptation plans informed by a participatory climate vulnerability and capacity analysis (CVCA), theories of change, and institutional scorecards. The CVCA provides a baseline against which progress can be tracked, while the theory of change ensures that outcome indicators are rooted in local adaptation priorities and desired future circumstances. Different scale-appropriate scorecards are used at the national and district levels, assessing criteria such as integration of climate change into national planning, coordination mechanisms for climate change interventions, integration of climate information and planning under uncertainty, and awareness and coordination.[24]

Box 3: The TAMD approach in Mozambique

While (some of) the internationally oriented approaches and TAMD try to make room for qualitative assessments through Track 2 and scorecards, some frameworks and tools focus more on the grassroots level. At the local level, there is usually more scope to take into account the local context and local aspirations for the future, but this requires primary data collection, which can be burdensome. CARE's Participatory Monitoring, Evaluation, Reflection and Learning (PMERL) for Community-Based Adaptation aims to assess change in a participatory way along several dimensions, including a local adaptive capacity framework that includes the asset base, institutions and entitlements, knowledge and information, innovation, and flexible forward-looking decision-making and governance (Table 2).[25] The process involves mapping key stakeholders and their interests, and deciding what to monitor. This allows for scale-specificity and a reflection of the goals and priorities of the people being monitored—similar to Track 2 of the TAMD framework. Reflection and learning are also an important part of the process, providing opportunities to change indicators, etc. if ultimately appropriate (see Annex B for more on methods).

23 (Brooks et al., 2011)
24 (Artur et al., 2014)
25 (CARE, 2014)

Table 2: Local adaptive capacity framework used in PMERL[26]

Characteristic	Feature that reflects a high adaptive capacity
Asset base	Availability of key assets that allow the system to respond to evolving circumstances
Institutions and entitlements	Existence of an appropriate and evolving institutional environment that allows fair access and entitlement to key assets and capitals
Knowledge and information	The system has the ability to collect, analyse and disseminate knowledge and information in support of adaptation activities
Innovation	The system creates an enabling environment to foster innovation, experimentation and the ability to explore niche solutions in order to take advantage to of new opportunities
Flexible forward-looking decision-making and governance	The system is able to anticipate, incorporate and respond to changes with regard to its governance structures and future planning

On the similarities and differences between measuring resilience and adaptation

Resilience and adaptation are two concepts often used by development partners. Both are intuitively "good things" to promote, but both are difficult to define and therefore difficult to measure. While adaptation is defined as the process of adjusting to potential and actual changes in climate, resilience is typically defined as the capacity to anticipate, absorb, and recover from system stresses (including climate shocks). In both cases, what adaptation or resilience looks like varies from context to context, and goals need to be defined through theories of change in order to select appropriate indicators to measure progress.

Some organizations prefer an adaptation framework and others a resilience framework, although many use both in different circumstances (e.g., USAID's Climate Strategy focuses on building climate resilience). An example of how both adaptation and resilience are used is international climate finance, such as the Green Climate Fund, the Least Developed Countries Fund, the Special Climate Change Fund, and the Adaptation Fund. For example, the Least Developed Countries Fund and the Special Climate Change Fund prioritize adaptation, but one of the indicators refers to resilience (extent of adoption of climate-resilient technologies/practices). The Adaptation Fund does not mention resilience in its project-level indicators. However, at the fund level, where it reports to the UNFCCC, one of the impacts is defined as "increased resiliency at the community, national, and regional levels to climate variability and change," while there are also outcomes of "increased ecosystem resilience in response to climate change and variability-induced stress" and "improved policies and regulations that promote and enforce resilience measures." At the bilateral level, the UK's International Climate Finance reports on 17 key performance indicators, one of which is the "number of people whose resilience has been improved as a result of International Climate Finance (KPI 4).

The conceptual opacity of adaptation and resilience means that both have faced similar challenges in measurement approaches. These include a focus on process and the establishment of institutions, policies, and plans—all of which are easier to measure than the changes that these processes, policies, and plans are intended to bring about.[27] In both cases, subjective tolerance for risk may influence what counts as successful adaptation and resilience in different contexts, and so there is considerable potential to use qualitative indicators informed by the target beneficiary populations.[28]

Box 4: On the similarities and differences between measuring resilience and adaptation

26 Ibid.
27 (Mehryar et al., 2022)
28 (Jones, 2019)

3. CURRENT STATE OF ADAPTATION

3.1 Defining Adaptation

As shown in Section 2, the lack of clarity about what adaptation is and what it should look like in the future is a major obstacle to its effective measurement. In recent decades, there has been a growing interest in adaptation, both from a theoretical and conceptual perspective and in terms of application. A recent review highlights that over 11,000 papers on adaptation have been published in the last 40 years, with an increase of 28.5% per year.[29] This literature covers the Global South across many sectors, including agriculture, coasts, fisheries, health, and urban and peri-urban, with rural foci being the most common.[30] At the same time, the amount of resources allocated to adaptation through international climate finance and multilateral and bilateral donors has also increased. In 2019–2020, annual climate finance flows reached $653 billion (of which $46 billion was for adaptation), 15% more than in 2017–2018 and were expected to increase further to $850–$940 billion by 2021.[31] This is still orders of magnitude lower than the costs of adaptation, currently estimated at $140–$300 billion by 2030 and $280–$500 billion by 2050.[32] The most recent assessment in the 2023 Adaptation Gap Report shows annual adaptation costs of $387 billion, while finance flows have actually declined, resulting in a current adaptation finance deficit of $194–$366 billion per year.[33]

Annex C provides a summary of an inventory of adaptation measurement resources developed to accompany this report, which provides insights into the evolution of the field, the key players, and the geographic spread of application.

While the number of adaptation interventions being designed and implemented has increased, there is a growing message that these efforts are insufficient. This was recently reiterated in the first global stocktake under the Paris Agreement to the UNFCCC (Box 1). It was also highlighted in the IPCC Sixth Assessment Report.[34] The 2022 Adaptation Gap Report, an annual assessment compiled by UNEP that takes stock of progress in adaptation planning, financing, and implementation, shows that while progress has been made in planning, there remains a significant financing gap and that overall progress on adaptation is "too little, too slow."[35] This inadequacy is exacerbated by concerns that many activities labeled as adaptation are not in fact adaptation. The concern that many adaptation activities are vulnerability assessments and intentions to act, rather than evidence of adaptation itself, was first raised over a decade ago[36] and has been reiterated in assessments of reported adaptation actions in national communications.[37]

Part of the challenge in making progress on adaptation has been the nature of its relationship with development. In 2007, WRI published a development-adaptation continuum that remains relevant today (Figure 3). It shows that adaptation requires both generalized measures to reduce vulnerability and dedicated adaptation measures to respond to climate impacts. The former is closely linked to traditional development activities and aims to cover generalized vulnerability reduction measures that help address the current adaptation deficit and better anticipate risks. At the other end of the spectrum are adaptation measures that explicitly

29 (Nalau & Verrall, 2021)
30 (Vincent & Cundill 2022)
31 (Naran et al., 2022)
32 (UNEP, 2016)
33 (UNEP, (2023)
34 (Pörtner et al., 2022)
35 (UNEP, 2022)
36 (Berrang-Ford, et al., 2011)
37 (Lesnikowski, et al., 2015)

target climate impacts. These actions typically involve hard infrastructure and may include climate-proofing existing or planned infrastructure such as dams, drainage systems, and reservoirs.

This distinction between vulnerability reduction and climate-specific adaptation has implications for the targeting of climate finance. Vulnerability reduction actions are difficult to fund through international climate finance because of the emphasis on the climate rationale or climate additionality of activities to avoid "double dipping" of climate finance with traditional development funds. As a result, there has been a disproportionate focus on the latter. A review of GEF-financed adaptation projects found that many focused on information and communications technology, infrastructure, and early warning systems.[38] In contrast, the way in which vulnerability has been operationalized in Adaptation Fund proposals has been variable.[39] "Level of vulnerability" is cited as a driver for allocation of adaptation finance, but in the absence of objective criteria for what constitutes vulnerability, each proposal is left to provide its own motivation.

Over time, the prioritization of climate-specific adaptation over vulnerability reduction has raised questions about the effectiveness of adaptation and why there is still a significant adaptation gap. In recent years, there has been growing criticism of the "technical fixes" that are typical of climate impact-specific adaptation, especially when they come at the expense of addressing the root causes of vulnerability.[40] However, it is important to remember that adaptation will not take place through development as usual—instead, development and vulnerability reduction must take place in the context of a changing climate and the risk it poses.[41] This can only happen if the nature of future climate risk is understood and adaptations are made that lead to development outcomes that remain robust in the face of that risk. Thus, climate-resilient development is adaptation, and climate-resilient development pathways (recognizing the importance of integrating both adaptation and mitigation) are a focus of the most recent IPCC Assessment Report.[42]

More recently, the concept of transformative adaptation has also gained traction. In part, this is a recognition that the incremental nature of adaptation to date is unlikely to be sufficient to reduce the future climate risks to which the world is already committed. Instead, major paradigm shifts are needed. There is some debate about whether adaptation itself can be transformative, or whether a transformation in systems is the adaptation.[43] And in terms of measurement, there is as much uncertainty about what transformation looks like as there is about adaptation, so the question of which metrics to use is not clear.[44] The paradigm shift aspect of transformative adaptation is similar to the concept of climate-resilient development pathways, as it considers both mitigation and adaptation.

38 (Biagini et al., 2014)
39 (Remling & Persson, 2015)
40 (Nightingale et al., (2020)
41 (Schipper et al., 2020)
42 (Schipper et al., 2022)
43 (Few et al., (2017)
44 (Fazey et al., 2018)

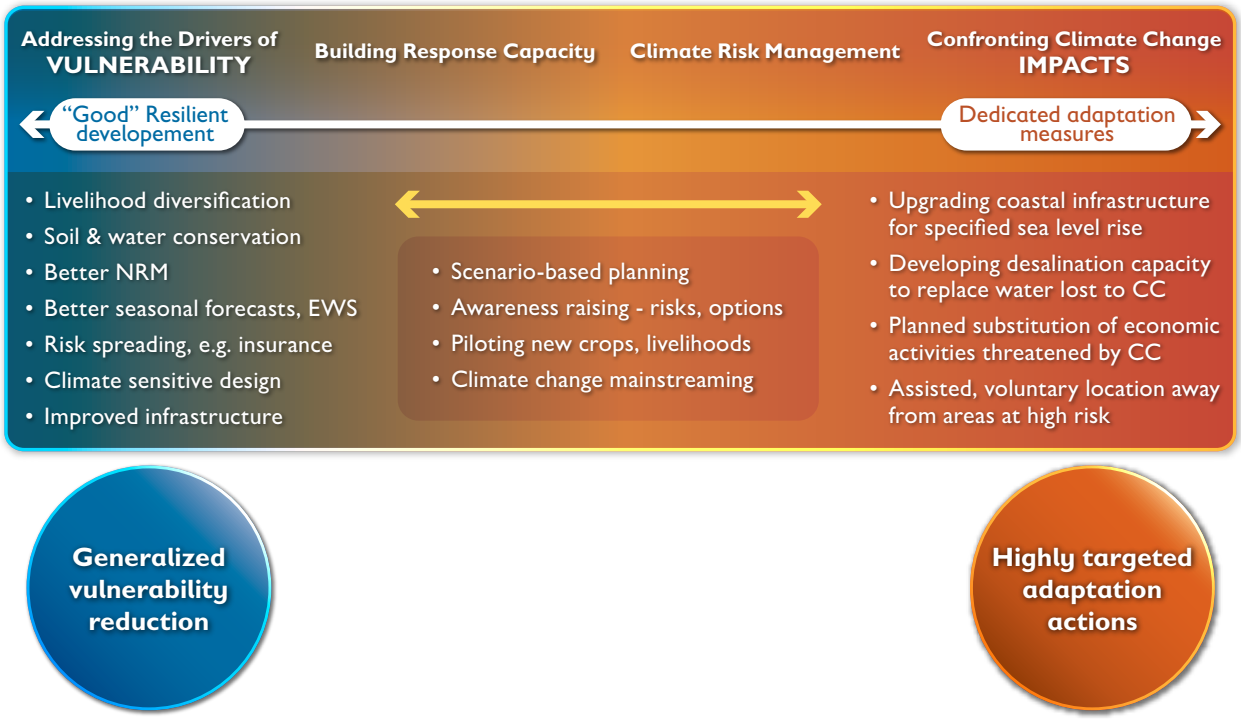

Figure 3: The development-adaptation continuum[45]

3.2 Outlining an Adaptation Rationale

All of this has implications for adaptation measurement, as it reiterates that the intended adaptations need to be very clear before metrics can be defined to track them. These adaptations may relate to specific climate risks, vulnerability reduction (with a climate rationale), climate-resilient development, or transformative adaptation. Several other resources, such as the Tracking Adaptation and Measuring Development approach[46] and UKCIP's AdaptME toolkit, highlight the need to outline a rationale for adaptation. This is similar to the theory of change tool, which defines how certain actions will lead to an intended outcome and how this adaptation will reduce risk in the face of climate change. Other tools that can be useful in defining the adaptation rationale include impact pathways. Graphical representations are helpful in understanding the underlying logic of how certain activities will lead to certain outputs and outcomes, and the assumptions that must hold for these changes to occur. Because adaptation is typically seen as "a good thing," adaptation logic models, or theories of change, are particularly useful for showing where intermediate steps may be needed for one thing to lead to another. When the adaptation logic is clear, it is easier to identify indicators that can be used to measure adaptation progress.

Given the emerging knowledge about what adaptation is or should look like, and the importance of defining an adaptation logic before being able to measure adaptation, there are a number of principles of good adaptation practice that can be distilled.

45 (McGray, et al., 2007)
46 (Brooks, et al., 2011)

4. PRINCIPLES OF GOOD PRACTICE IN ADAPTATION

To overcome the need to define what adaptation looks like as a precursor to being able to measure it, this section outlines some principles for what adaptation should look like, based on a synthesis of adaptation theory, practice, and evidence. These principles do not define what adaptation actions should be chosen or what adaptive capacity should be built, as this depends on the climate risk and context of the places in question. However, they are principles that should underpin the selection of these adaptation actions or inform how these adaptation actions are promoted. They draw on various resources that highlight dimensions of sound adaptation.[47]

4.1 Vulnerability Reduction

At the turn of the century, vulnerability reduction was seen as a key mechanism for adaptation. However, as a result of the overlap between vulnerability reduction and development, and the climate finance imperative not to fund development activities, it has been largely overlooked, as shown in Section 3. Recent analysis, however, confirms that vulnerability reduction is still a very necessary component of adaptation, and that adaptation cannot be achieved by considering only technocratic interventions to address climate impacts (Figure 3).

Vulnerability is a multidimensional concept that determines how exposure to climate hazards is experienced—with high levels of vulnerability meaning that such exposure translates into negative impacts. It has typically been prominent in the risk framings used by the IPCC[48] (Figure 4). A recent conceptualization distinguishes four broad themes that explain the social aspects of vulnerability: access to resources, governance, culture, and knowledge.[49] Access to resources is important because resources underpin the capacity to anticipate, prepare for, and respond to climate stresses. However, access to resources depends on facets of social identity, such as gender, ethnicity, caste, and religion, as well as levels of poverty. Governance through formal and informal institutions also shapes vulnerability, as institutions themselves influence the distribution of resources and the extent to which these institutions are representative and inclusive of different groups within society. Culture reflects social norms (including social identity) and also perceptions of risk, while knowledge reflects the level of awareness of risk, and perceptions and social memory, which are linked to risk perceptions and determine the circumstances under which there may be motivation to act. Understanding vulnerability and its dimensions is essential for designing adaptation actions that address root causes.

47 (Carr & Nalau 2023)
48 (O'Neill et al., 2022)
49 (Thomas et al., 2019)

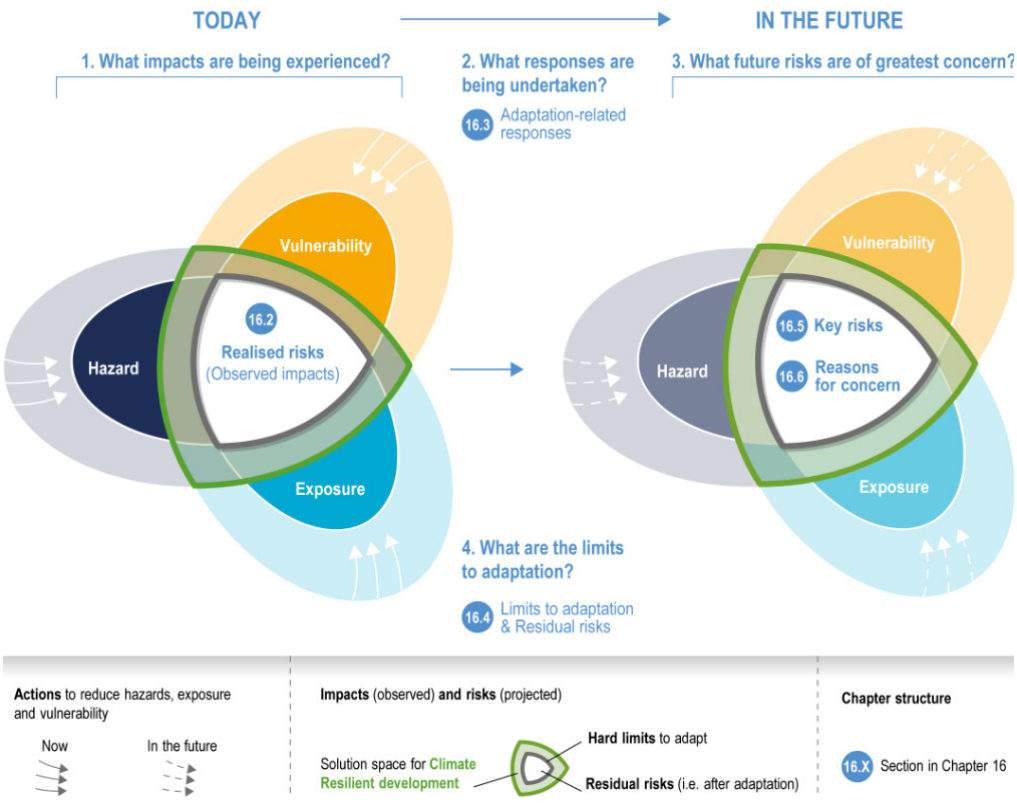

Figure 4: Risk framing in the IPCC Sixth Assessment Report, showing the integral role of vulnerability[50]

4.2 Participatory/Beneficiary-Informed

There is extensive literature and evidence from recent participatory approaches in development that interventions are more successful when they are driven by and directly responsive to the needs of the people they are intended to benefit. Participatory approaches address unequal power relations and avoid the top-down imposition of ideas from outside, which often prove to be inappropriate and thus fail to deliver the intended benefits. Participatory approaches reflect the fact that the intended beneficiaries of interventions have extensive experiential knowledge and cultural realities that should inform activities. Techniques such as participatory rural appraisal can be used to analyze their living conditions and identify these needs and priorities. The same populations should then be involved in leading and managing implementation, so that the process is empowering.

Participatory approaches to adaptation have been incorporated into community-based adaptation, increasingly referred to as locally-led adaptation. A number of international organizations, led by the World Resources Institute and the International Institute for Environment and Development, have outlined a set of principles for locally-led adaptation to which other organizations have committed (Box 5).[51] Of course, there are subtle differences that need to be taken into account when defining participatory adaptation as opposed to participatory development. While people are certainly in the best position to identify their own needs, the solutions to those needs may need to be adapted to projected future climate conditions, which will be different from those

50 (O'Neill et al., 2022)
51 (Soanes et al., 2021)

experienced in the past. In this way, well-facilitated participatory approaches will identify problems and enable the identification of appropriate adaptation actions. For example, if food insecurity due to variable weather conditions is identified as a problem, the adaptation action may require interventions related to the predominant crop in the area. However, given future changes in climate conditions, the solution may require growing a different crop. For example, maize is the common staple crop in southern Africa, but climate change is making some areas unsuitable for growing maize, so food security solutions in these areas may require a shift to promoting more drought-tolerant crops such as cassava. Participatory approaches can link value systems to these risks and ensure that the resulting adaptation actions are appropriate.

Principles of locally-led adaptation

- Devolving decision making to the lowest appropriate level
- Addressing structural inequalities faced by women, youth, children, disabled, and displaced people, Indigenous Peoples, and marginalized ethnic groups
- Providing patient and predictable funding that can be accessed more easily
- Investing in local capabilities to leave an institutional legacy
- Building a robust understanding of climate risk and uncertainty
- Flexible programming and learning
- Ensuring transparency and accountability
- Collaborative action and investment

Box 5: Principles of locally-led adaptation[52]

Ensuring that solutions are beneficiary-driven yet appropriate for the future climate can be achieved through co-production, which is the process of generating new knowledge, typically from different types of knowledge, such as scientific/technical and local/indigenous. Co-production typically involves bringing together holders of different types of knowledge in collaborative spaces, and this process can also address the unequal power relations that exist.[53] Co-production of adaptation actions provides opportunities for participation and for beneficiaries to play a key role in driving the process.

4.3 Robust to Current and Future Climate Risks (Hazard-Specific)

As outlined in Section 3, analysis of many so-called adaptation actions has raised concerns that many address only the current adaptation deficit and do not take into account future climate risks and the adaptation actions that will be required in response. Focusing only on current climate risks could lock people, livelihoods, and places into unsustainable trajectories and create situations of maladaptation. Maladaptation occurs when vulnerability is increased and/or changing future conditions are not taken into account.[54] The primary cause of maladaptation is poor planning for future conditions (and recognition of the variable nature of future conditions).

52 Ibid.
53 (Vincent, 2022)
54 (Schipper, 2020)

Certain situations are particularly susceptible to maladaptation if future climate risks are not considered. Variable water availability is a major current stress on natural resource-based livelihoods, which are the mainstay of livelihoods in much of the Global South. It is tempting to see irrigation as a solution to mediate the natural variability of rainfall. However, the future sustainability of irrigation depends on the availability of the surface or groundwater on which irrigation relies, and this depends on rainfall (and other sources of extraction). Typically, irrigation suitability has been planned based on extrapolation of past conditions without consideration of future climate projections and impact models.

There are many examples of small-scale irrigation schemes in southern Africa that have been abandoned because water availability has made them unviable. Thus, short-term gains in adaptive capacity have been lost to long-term water availability. This is a particular risk because irrigation infrastructure is expensive, so the decision to install it locks farmers into a particular trajectory that is then undermined. Small-scale sugar farmers in southern Africa working under contract for multinational companies have installed irrigation at great expense, but are already finding that it is insufficient to cope with emerging climate risks and the increasing frequency of extreme events.[55] This is not to say, of course, that all irrigation is maladaptation—but it does underscore the need to consider current and future climate conditions and to select adaptation actions that are robust in light of context-specific projected futures.

4.4 Equitable and Contributes to Social Inclusion and Equality

There is strong evidence that adaptive capacity is socially differentiated and gendered. This is because adaptive capacity reflects access to assets, and social constructions of identity affect access to assets such as land, capital, and education. Failing to apply a social inclusion and equality lens to the identification of adaptation actions risks selecting examples that reinforce or, at worst, exacerbate the status quo of inequality and marginalization of particular identities, such as women, people of color, the elderly, and indigenous groups. For example, building a bridge in a flood-prone area may benefit men more than women because gender norms and roles mean that men are likely to travel farther for work, while women stay closer to home and take responsibility for the family. Thus, by benefiting men more than women, the bridge may reinforce gender inequality.

Most adaptation funders, including international climate finance, have gender and social inclusion strategies to ensure that access to adaptation actions is equitable and that their implementation contributes to gender equality. The Green Climate Fund, the Global Environment Facility family of funds, and the Adaptation Fund all have gender strategies and require applicants to explain how their plans take gender into account. The Green Climate Fund goes so far as to mandate gender-responsive adaptation, meaning that interventions not only do not exacerbate inequality, but actively contribute to reducing it. Particular attention must be paid to ensuring that the gender lens is applied at the stage of identifying adaptation actions that will provide equitable benefits—as opposed to trying to ensure equal access after the fact, when gender norms and roles have been ignored. International climate finance funds also require that indigenous groups be given particular consideration.

55 (Henriksson, et al., 2021)

4.5 Adaptable (Consistent with Adaptation Pathways, Adaptive Learning)

As outlined in Section 2, adaptation should be viewed as a process rather than an endpoint. This reflects the fact that future climate conditions will vary, at least in part as a result of policy decisions made now and the magnitude of greenhouse gas emission reductions, and therefore there will need to be regular points of reassessment to ensure that adaptation actions are in line with these changes. The adaptation pathways approach is one that helps manage this uncertainty—either by mapping different futures and thresholds that may require a shift from one trajectory to another, or by reassessing which pathways should be taken to reach a desired end goal.

Either way, an adaptable and/or adaptation pathways approach requires a more flexible monitoring and evaluation methodology. Typically, a theory of change (or adaptation logic) is used to define a results framework and indicators to track progress toward the goal. However, adaptable approaches leave room for revising and updating the end goal based on the best available knowledge of both the climate and the progress of the intervention. This may require revisiting the end goal and targets.

Recognizing that adaptation is a process rather than an endpoint, and that there may need to be capacity to adapt to different future conditions, the focus is often on building adaptive capacity rather than adaptation per se. Focusing on building the capabilities that enable future adaptation is a more flexible approach that can also take into account the changing nature of climate risk, as many of these capabilities can be applied to different circumstances. Adaptive capacity approaches can focus on building access to information and knowledge that enables the modification of livelihoods, access to health care that enables the absorption of health risk, strengthened social support and networks, and inclusive governance structures that also reduce vulnerability.[56]

4.6 Consideration of Multiple Scales and Embeddedness

Projects and programs are the main vehicles through which (externally supported) adaptation actions are implemented and through which progress is monitored and success measured. Projects and programs typically select one scale of operation (e.g., national or local) and do not adequately consider the interrelationships between scales. Drawing boundaries around a project or program area can also inadvertently discourage decisions that do not consider impacts elsewhere. Many examples of past adaptation projects have served to redistribute vulnerability elsewhere or to increase vulnerability in places outside the project area.[57]

Examples of redistributed vulnerability as a result of adaptation actions are a particular risk for water-related interventions. This is because infrastructure that may be considered an adaptation in one spatial area is likely to have consequences upstream, downstream, or along the coast. Flood embankments that protect one community may increase the vulnerability of downstream communities, and coastal infrastructure designed to reduce risk in one location may affect adjacent coastal areas or the local ecology.[58] Other examples of redistributed vulnerability occur when populations are displaced to allow adaptation actions to take place. For example, in Vietnam, hydropower and forest protection policies regulate flooding in the lowlands, but these policies impede access to land for people in mountainous areas, thereby reducing their adaptive capacity at the expense of those living downstream.[59]

Similar challenges arise when the vertical linkages of governance structures are not well considered in adaptation actions. A review of community-based adaptation actions found that a major barrier to success was a lack of coordination between governance structures.[60] For example, community-based interventions that are not supported by and integrated with sub-national governance

56 (Dilling et al., 2019)
57 (Eriksen et al., 2021)
58 (Donner & Webber, 2014)
59 (Beckman, 2011)
60 (Piggott-McKellar, et al., 2019)

structures can be undermined. Conversely, interventions at the national level that do not take into account practices at the sub-national level are unlikely to be successful. Thus, even though the nature of projects and programs is typically spatially delimited, there is a need to recognize how activities in that area affect and are affected by the broader context. Systems lenses can help to better account for multiple scales and embeddedness by recognizing that no intervention works in isolation.

5. ILLUSTRATION OF ADAPTATION PRINCIPLES

This section takes two different sectors, education and natural resource management, and shows how programming in these areas could be linked to climate change and made more adaptive.

5.1 Climate Change and Education

The links between education and climate change are significant and multi-faceted. The education sector is vulnerable to climate change. Education programming therefore needs to be climate-resilient in order to continue to maintain educational outcomes, and education can also support broader adaptation.

CURRENT AND ANTICIPATED IMPACTS	
DIRECT	**INDIRECT**
• Damage to education infrastructure • Reduced accessibility to education infrastructure (for teachers and students)	• Reduced capacity for learning (due to heat or weather impacts on food security) • Reduced access to education (due to weather impacts on household income and affordability of school fees) • School buildings repurposed as evacuation centers

5.1.1 WHY IT IS IMPORTANT TO CONSIDER CLIMATE CHANGE IN EDUCATION PROGRAMMING

Climate change poses risks to education by directly and indirectly affecting the availability and accessibility of educational opportunities. Extreme events such as floods and storms can damage education infrastructure and disrupt the delivery of education services. If not directly damaged, school buildings are often used as evacuation centers. This repurposing can lead to situations of prolonged closure during which education cannot be provided (see Box 6 for an example from Zimbabwe).

Other climate hazards may have relatively less impact on education infrastructure, but more on accessibility and utility. High temperatures beyond the range that buildings can withstand can lead to unsafe teaching and learning conditions for teachers and students. More and more countries are resorting to closing schools during extreme heat events. Similarly, hazards with a slower onset but longer duration, such as drought, are often associated with food insecurity and limited household spending. Poorly nourished children are less likely to learn effectively, and there is a risk that families will pull children out of school to reduce the cost burden.[61] Evidence has typically shown that girls are particularly at risk due to the often widespread perception that education is more important for boys, although the ability of boys to work can also lead to their withdrawal.

61 (Nordstrom & Cotton, 2020)

Case study: Climate impacts on education – Tropical Cyclone Idai in Zimbabwe

In Zimbabwe, Tropical Cyclone Idai not only caused immediate damage to school buildings, but also led to a longer delay in educational services as undamaged buildings were repurposed for evacuation and temporary shelter.

A rapid assessment of sector needs was conducted through SMS-based surveys that allowed school leaders to report casualties and damage to buildings and learning materials. There was a particular need for mental health and psychosocial support for people who had lost loved ones and possessions.

The education cluster used the rapid assessments to prioritize needs and coordinate the delivery of assistance where it was most needed. In Zimbabwe, development partners coordinated their efforts on a geographic basis, with each organization taking responsibility for a different area and addressing the needs that arose there.

New schooling arrangements had to be made for displaced children, some of whom had to be moved to (more expensive) boarding facilities. Organizing schools into clusters of five to seven schools accelerated the return to full functionality, as materials could be pooled and shared within the clusters. However, 40 days of teaching and learning were still lost in the worst-affected province of Manicaland, as the reopening of schools was delayed until alternative accommodation could be found for those sheltering there.

Zimbabwe also took the opportunity to build back better, with school buildings and hygiene facilities rebuilt to be more resilient. Another project focused on promoting disaster preparedness and early response education, including facilitating access to community and home-based learning through solar radios, offline programming, and a variety of self-learning materials to minimize disruption.

Source: https://cdkn.org/story/short-and-long-term-response-extreme-weather-events-education-sector-zimbabwe

Box 6: Case study: Climate impacts on education – Tropical Cyclone Idai in Zimbabwe

5.1.2 HOW EDUCATION PROGRAMMING CAN BE MADE CLIMATE RESILIENT AND CONTRIBUTE TO ADAPTATION OUTCOMES

While the education sector is at risk from climate change, adaptation actions in education programming can build climate resilience. The education sector has a key role to play in contributing to adaptation outcomes by raising awareness of risks and possible responses. There are also gender dimensions. While socially constructed gender roles can make girls more vulnerable to the risks that climate change poses to education, at the same time, investing in girls' education creates empowerment and reduces vulnerability.[62]

There are several ways in which education initiatives can incorporate adaptation.

1. Strengthen the resilience of education infrastructure

To ensure the continued availability of education, there is a role for strengthening the climate resilience of education buildings, for example through "green schools," as appropriate to the particular context of current and future climate risks. This could include the use of appropriate roofing materials to reduce the risk of extreme heat or cold, as well as ensuring that the building is appropriately sited and, where possible, (un)shaded by natural materials (e.g., trees). This could also include building on plinths/stilts to reduce the risk of flooding. Choosing low-carbon building materials, for example other than concrete and cement, which have high embodied carbon, also provides an opportunity to simultaneously contribute to climate change mitigation by reducing greenhouse gas emissions.

62 (Sims, 2021)

Modifications are important for school buildings, but also for hygiene facilities, where rainwater harvesting can be used to ensure water availability. Deeper, long drop toilets in flood-prone areas can reduce the risk of contamination; or composting toilets can be used in areas where water availability is limited. In some cases, ensuring the continuity of educational services means not only improving current physical facilities, but also exploring alternative classrooms, including the use of digital technology.

Examples

- The Global Platform for Education has a blog series on the role of education in addressing climate change, including climate-smart classrooms in Sierra Leone (https://www.globalpartnership.org/blog/carbon-smart-schools-mitigate-climate-change-and-improve-learning).
- UNESCO has developed a guide for schools on how to become climate ready (https://unesdoc.unesco.org/ark:/48223/pf0000246740.locale=en).
- UNICEF has produced a guidance note on how its regional and country offices can shift to climate resilient WASH programming (https://www.unicef.org/media/109006/file/UNICEF-guidance-note-climate-shift.pdf).

2. Increase the availability of educational materials to support climate change awareness and response

Raising awareness of climate change, including the threats it poses and how to reduce risk and adapt, is a critical step in building more resilient populations. Climate change awareness can be addressed from pre-school through tertiary education, yet less than half of national curricula around the world incorporate climate change.[63] Current rates of climate change literacy on the African continent, for example, have recently been shown to be very low, ranging from 22% to 63% overall, with lower numbers and even greater variation within some countries.[64] However, given that more people complete primary education than secondary or tertiary education, this has relatively greater potential for impact. In addition, in many developing countries, the messages transmitted from schools through children to their parents and community members is also an important avenue for adult learning.

Educational materials on climate change can take different approaches. Understanding the causes and consequences of climate change, how to adapt to expected changes, and how to address the causes of climate change are key priorities. A number of organizations have now produced teaching resources on climate change for use in schools, including WaterAid (https://www.wateraid.org/uk/get-involved/teaching-resources/climate-change), the US Environmental Protection Agency (https://www.epa.gov/climate-change/climate-change-resources-educators-and-students), and Oxfam (https://www.oxfam.org.uk/education/classroom-resources/human-impact-climate-change/resources-for-primary-schools/). However, most of these resources focus on the Global North. For developing countries, UNITAR and CC:LEARN have worked to develop teaching and learning materials on climate change for use in schools, as has GADRRRES on disaster risk reduction. There is also the possibility of more targeted skills training to build a workforce equipped to take up green jobs and to promote youth empowerment and agency for change.

63 (UNESCO, 2021)
64 (Simpson et al., 2021)

Examples

- The Global Platform for Education has a blog series on the role of education in addressing climate change, including how education can empower children to be active agents in climate action (https://www.globalpartnership.org/blog/towards-pedagogy-climate-action).
- UNESCO has a variety of resources on climate change as part of its commitment to education for sustainable development, including promoting green citizens (https://www.unesco.org/en/education-sustainable-development/climate-change).

3. Support the development of appropriate teacher skills

To effectively teach climate change in the classroom, teachers need to have the appropriate skills to understand and deliver the content. As climate change is a cross-cutting and relatively new topic, it is likely that many teachers have not encountered it in their training, or have only been exposed to when teaching science subjects such as biology or geography. The positioning of climate change as an issue has shifted over time, with increasing recognition that it is as much a social and development issue as a scientific and technical one. As a result, there is greater potential to address it through social studies and critical thinking. Of course, in the case of practical responses to climate change, less conceptual and more tangible skills are required for effective vocational training, which also requires appropriate training for teachers.

Examples

- A teacher training program in India won a UNFCCC Global Climate Action Award for innovation in training teachers on climate and sustainability (https://unfccc.int/climate-action/momentum-for-change/activity-database/teachers-training-program-on-climate-change).
- The Keep It Cool project in South Africa developed curriculum materials and supported teachers' professional development (https://www.vvob.org/en/programmes/south-africa-keep-it-cool-climate-change-education).

5.1.3 ALIGNMENT WITH PRINCIPLES OF GOOD PRACTICE (SECTION 4)

PRINCIPLE	ALIGNMENT WITH EDUCATION PROGRAMMING
Vulnerability reduction	Strengthening the resilience of education infrastructure, increasing the availability of educational materials to support climate change awareness and response, and supporting the development of appropriate skills for teachers can all contribute to vulnerability reduction by raising awareness of the risks and possible responses to a changing climate.
Participatory/ beneficiary-informed	Strengthening the resilience of education infrastructure, increasing the availability of educational materials to support climate change awareness and response, and supporting the development of appropriate skills for teachers can all be designed in a participatory and beneficiary-informed manner, ensuring input from relevant local communities and teachers.
Robust to current and future climate risks (hazard-specific)	Strengthening the resilience of education infrastructure should be done in conjunction with knowledge of what the future climate will look like; in this case, it should be robust to current and future climate risks.
Equitable and contributes to social inclusion and equality	Strengthening the resilience of education infrastructure can be equitable and contribute to equality, as current social norms provide unequal access to education (e.g., between girls and boys). Supporting the development of appropriate skills for teachers can also be designed to include consideration of the social dimensions of climate change vulnerability and response, which, when applied in the classroom, can stimulate debate that contributes to equality.
Adaptable (consistent with adaptation pathways, adaptive learning)	Strengthening the resilience of education infrastructure can be made adaptable if a robust decision-making approach is applied that selects an option that will be robust in the face of a range of potential climate futures, or if the design process recognizes critical thresholds that may activate future change. Increasing the availability of educational materials to support climate change awareness and response, and supporting the development of appropriate skills for teachers can be made adaptable by building in review points and opportunities for updating and revision as new information becomes available.
Consideration of multiple scales and embeddedness	Strengthening the resilience of education infrastructure should consider local impacts (e.g., the effects of shading and water capture), although the spatial extent of schools is so small that these are unlikely to be significant.

5.2 Climate Change and Natural Resource Management (Sustainable Landscapes and Biodiversity)

There are significant and multifaceted links between natural resources management (sustainable landscapes and biodiversity) and climate change. The availability and quality of natural resources is strongly linked to weather conditions; at the same time, ensuring the integrity and sustainable management of natural resources can support adaptation, in particular through Ecosystem-based Adaptation and nature-based solutions.

CURRENT AND ANTICIPATED IMPACTS	
DIRECT	**INDIRECT**
• Species loss (plant and animal) • Habitat degradation/loss	• Species changes as a result of changing disease burden • Species changes as a result of wildfires due to increasing extremes

5.2.1 WHY IT IS IMPORTANT TO CONSIDER CLIMATE CHANGE IN NATURAL RESOURCE MANAGEMENT PROGRAMMING

Climate change poses a risk to natural resource management programming. Changes in temperature and precipitation patterns affect the range of both animal and plant species, and there is strong evidence that the changes observed to date are linked to climate change.[65] These changes are also reflected in shifts in the ranges of plant and animal disease vectors, which in turn affect species distribution. In the most extreme cases to date, there is evidence of local population extinctions, more in temperate than in tropical regions, more in freshwater than in marine or terrestrial habitats, and more in animals than in plants.[66] These are often associated with extreme events, typically heat waves, but also sea level rise. These changes will continue into the future, with the risk of biome shifts and species loss. Box 7 provides some examples of climate impacts on biodiversity in nine countries in southern Africa.

Case study: Climate impacts on biodiversity in nine countries in southern Africa

Southern Africa is home to a diverse range of ecoregions: tropical and subtropical moist broadleaf forests, tropical and subtropical grassland savannahs and dry forests, montane grasslands and shrublands, and dryland desert and Mediterranean woodlands. Much of the region's land and water is protected through national parks, reserves, and game management areas, including transfrontier conservation areas such as Kavango-Zambezi (Angola/Botswana/Namibia/Zambia/Zimbabwe), Iona-Skeleton Coast (Angola/Namibia), Malawi-Zambia (Malawi-Zambia), and Lubombo (Mozambique/South Africa/Eswatini). The region is also home to important transboundary freshwater ecosystems such as the Okavango Delta, Orange River Basin, Cuvelai Basin, Zambezi Basin, and the marine ecosystem of the Benguela Current along the coasts of Angola, Namibia, and South Africa.

The climate is largely arid and semi-arid with high interannual climate variability, especially in rainfall. Regular floods and droughts, as well as tropical cyclones, trigger wildlife mortality, cause habitat degradation, reduce the abundance of various species, and jeopardize conservation objectives.[67]

Studies of climate impacts in the region have focused on several categories: local extinctions, increased mortality, habitat loss and/or changes in distribution, and other specific impacts, including changes in species ranges and the emergence of harmful species (Figure 5). Responses to these impacts include active vegetation and wildlife management (particularly relevant for habitat loss and range contraction), policy (particularly relevant for increased mortality), and research and monitoring (particularly relevant for local extinctions and other impacts).

65 Parmesan et al., op. cit.
66 Ibid.
67 (Kupika et al., 2017; Sintayehu, 2018)

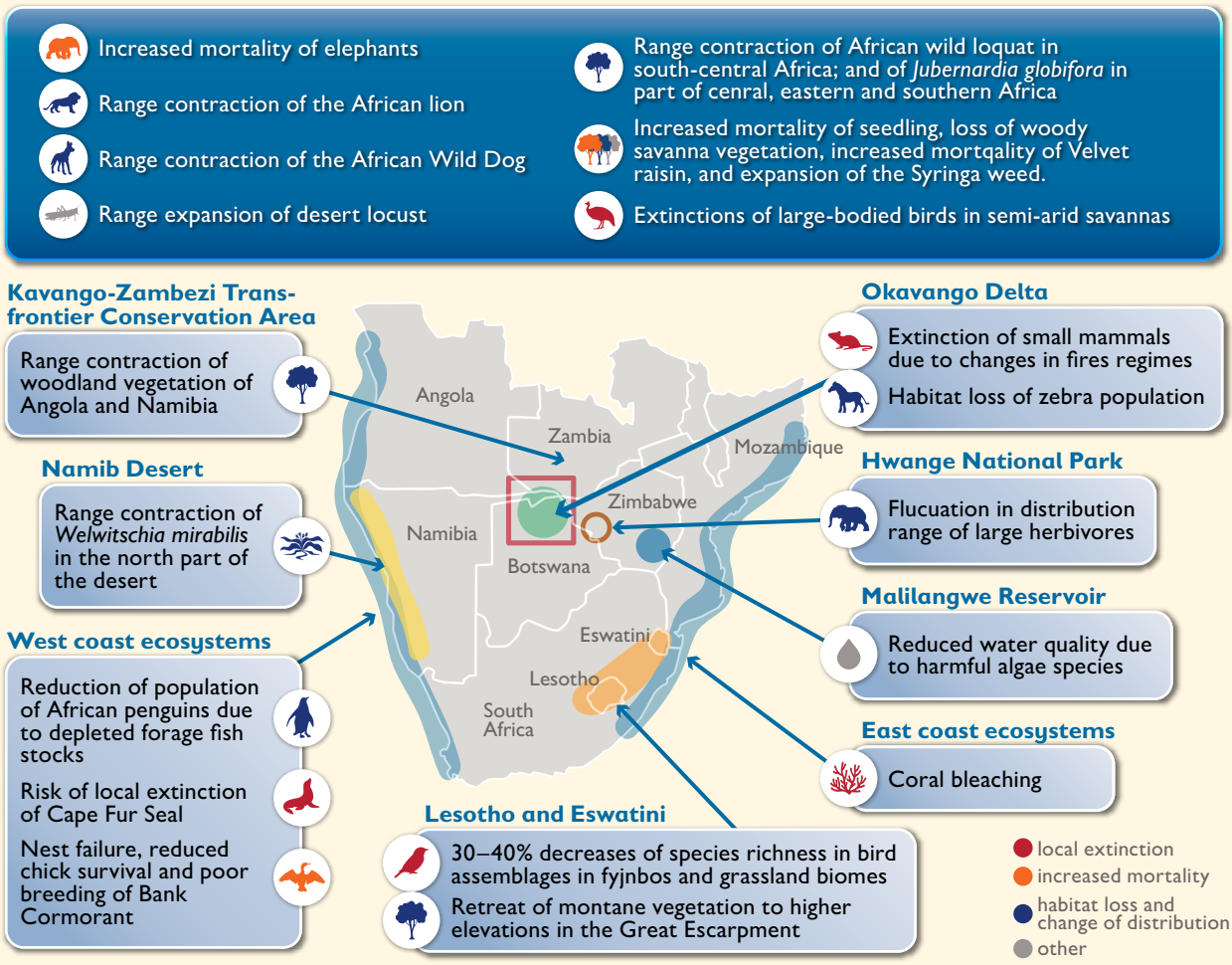

Figure 5: Summary of climate impacts on biodiversity in southern Africa (Source: Kapuka and Hlásny, 2021)

Box 7: Climate impacts on biodiversity in nine countries in southern Africa

5.2.2 HOW NATURAL RESOURCE PROGRAMMING CAN BE MADE CLIMATE RESILIENT AND CONTRIBUTE TO ADAPTATION OUTCOMES

While natural resource sectors are vulnerable to climate change, adaptation actions in natural resource programming can build climate resilience. Given the carbon sink potential in natural ecosystems, natural resource management often provides an opportunity to support both adaptation and mitigation goals.

There are several ways to integrate adaptation into natural resource initiatives.

1. Ensure that natural resource programming is appropriate for anticipated climate conditions

At a minimum, adaptation actions should adjust natural resource activities in light of anticipated climate conditions to ensure that they continue to meet their intended objectives. This requires a vulnerability assessment that considers future conditions in relation to the natural resource base. The ways in which natural systems respond to change can be taken into account—for example, species can adapt through their size and shape or through movement. Such actions ensure that "adaptation for biodiversity" takes place.

If the goal is to conserve a particular species, it may be necessary to change the area or location of the activities. In particular, the most commonly cited adaptation action for species conservation is increasing connectivity to facilitate colonization of new areas, which is particularly important given existing fragmentation from other land uses. Thus, species conservation may require a different approach in the context of a changing climate. Habitat protection, whether through protected areas, patches, or microrefugia, remains important. Ex situ protection, such as seed banks, or intensive management may also be important adaptation actions for species protection.

If the goal is to conserve a particular location or ecosystem type, there may need to be some flexibility in terms of what species and assemblages are expected within it, and what management options are appropriate for them. Restoring natural vegetation dynamics or hydrological processes may promote species diversity—even if this diversity is different from that which would have existed in a previous climate.

Examples

- USGS has published a guide to integrating climate change into natural resource planning (https://pubs.usgs.gov/tm/6c2/tm6c2.pdf).

2. Identify opportunities for natural resource management to contribute to Ecosystem-based Adaptation

In addition to ensuring the sustainability of existing natural resource management strategies, there are opportunities to modify natural resource management to incorporate Ecosystem-based Adaptation (EbA). EbA is an approach that ensures that biodiversity contributes to adaptation outcomes—not only for the ecosystem, but also for the people who depend on it. EbA is a component of nature-based solutions, which are increasingly advocated as actions to protect and manage ecosystems to address societal challenges. The key difference with EbA is that it also focuses on biodiversity benefits, which is not the case with all nature-based solutions.

EbA recognizes that balanced and healthy ecosystems, including forests and wetlands, can act as buffers against extreme weather and help maintain critical ecosystem services, including those on which humans depend. EbA therefore reduces climate risks for people while simultaneously benefiting biodiversity and ecosystems. To achieve this, appropriate EbA measures must be selected that are consistent with current and future environmental and social conditions. This requires consideration of climate conditions and the active engagement and participation of the communities that will manage and benefit from the EbA. Box 8 provides some examples of EbA.

Examples of Ecosystem-based Adaptation (EbA)

- Conserving and restoring forests to stabilize slopes and regulate water flows
- Restoring natural wetlands to regulate water availability
- Planting trees to act as firebreaks on bare land, especially heat-resistant species
- Planting trees in urban areas to provide shade and counteract the urban heat island effect
- Maintaining or restoring mangroves and coral reefs to act as natural sea walls/breakwaters to reduce the risk of flooding and erosion
- Restoring or planting ground cover/trees in dryland areas to reduce degradation and erosion, such as Africa's Great Green Wall, which will span 21 countries and 8,000 km

Box 8: Examples of Ecosystem-based Adaptation (EbA)

Examples

- Conservation International has developed guidelines for developing, implementing, and monitoring Ecosystem-based Adaptation (https://www.conservation.org/docs/default-source/publication-pdfs/guidelines-for-designing-implementing-and-monitoring-eba.pdf).
- IUCN has developed a handbook system for the design and implementation of EbA (https://www.iucn.org/sites/default/files/2022-11/handbook_system_mountains_final_04112022_high_1.pdf).
- The Convention on Biological Diversity has issued voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction (https://www.cbd.int/doc/publications/cbd-ts-93-en.pdf).
- GIZ, in collaboration with Friends of Ecosystem-based Adaptation and UNEP's World Conservation Monitoring Centre, has developed a guidebook for monitoring and evaluating Ecosystem-based Adaptation interventions (https://www.adaptationcommunity.net/download/ME-Guidebook_EbA.pdf).

5.2.3 ALIGNMENT WITH PRINCIPLES OF GOOD PRACTICE (SECTION 4)

PRINCIPLE	ALIGNMENT WITH NATURAL RESOURCE PROGRAMMING
Vulnerability reduction	Ensuring the integrity of natural resources, whether specifically for EbA or not, contributes to reducing the vulnerability of ecosystems themselves to climate change and, in the case of EbA, can reduce the vulnerability of people who depend on those ecosystems.
Participatory/ beneficiary-informed	Decisions on natural resource management, particularly EbA, should be made at the appropriate level of governance, with the participation of civil society actors and all relevant communities, and with a particular focus on the inclusion of often marginalized groups.
Robust to current and future climate risks (hazard-specific)	Selecting the appropriate natural resource management action/EbA for the location is critical and requires appropriate analysis of current and future climate conditions to ensure that the selected goals will be achieved.
Equitable and contributes to social inclusion and equality	Ensuring appropriate and inclusive natural resource management and EbA offers opportunities for more equitable benefits. This can be achieved through inclusive decision-making and consideration of socially differentiated vulnerability.
Adaptable (consistent with adaptation pathways, adaptive learning)	Natural resource management lends itself to a systems approach, which provides opportunities to recognize that changes in one part of the system will lead to changes elsewhere (over space and time). These changes provide ideal opportunities to observe thresholds and decision points that allow management options to be adjusted. Applying monitoring and evaluation approaches to EbA ensures that special attention is paid to identifying such thresholds and providing opportunities for course correction and adaptation.
Consideration of multiple scales and embeddedness	Natural resource management lends itself to a systems approach, which is recommended to explicitly consider multiple scales and embeddedness, as decisions made at one scale will have implications for other scales and locations.

6. CONCLUSION

As efforts to adapt to the impacts of climate change increase, so does the need to measure the effectiveness of these interventions. Over the past decades, there has been a dedicated effort to do so, taking into account international policy commitments under the Paris Agreement and the need for accountability and learning from the best practices of development partners.

Despite the recognized need, there are significant challenges that make it very difficult to track, monitor, and evaluate adaptation. Adaptation is context-specific, a process rather than an endpoint, a future state, and often shaped by normative definitions, and together these characteristics mean that it defies typical measurement options. Various organizations have developed frameworks for measuring adaptation for use at different levels. As is typical of cross-scalar aggregation, there is a trade-off between more generic indicators that can be used at the international level to capture variability and the context-specific indicators that are more appropriate at higher resolutions.

Effective measurement of adaptation requires a sound adaptation logic or theory of change that defines what adaptation looks like. With this in place, it is easier to develop indicators to measure the process. This requires identifying sound principles for adaptation design, which are outlined here to include:

- vulnerability reduction;
- participatory/beneficiary-informed;
- robust to current and future climate risks;
- equitable and contributes to equality;
- adaptable (consistent with adaptation pathways, adaptive learning); and
- considers multiple scales and embeddedness.

Finally, the report concludes by illustrating how these principles might be applied to the design of adaptation projects in two sectors, namely education and natural resource management. In particular, it highlights the need for programming in these sectors to consider climate risks to the achievement of objectives. At the same time, it is often possible to modify these activities slightly to achieve the original sector objectives while supporting adaptation to climate change.

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ANNEX A: MEASURING ADAPTATION AT THE INTERNATIONAL LEVEL: THE PARIS AGREEMENT TO THE UNFCCC

The Paris Agreement was agreed to in 2015 and entered into force in November 2016. It commits countries to limit the global temperature increase to 2°C, with the aim of limiting it to 1.5°C. For the first time, the Paris Agreement sets a target for adaptation, without specifying exactly what form it should take. Article 7.1 of the Agreement states that the Paris Agreement establishes a "global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2."

Monitoring, evaluation, and reporting are critical components of the Paris Agreement to track progress, but also to refine and strengthen commitments for both adaptation and mitigation. There are a number of processes for this under the transparency framework, which requires countries to clearly outline their actions. Each country publishes a Nationally Determined Contribution (NDC) outlining its mitigation and adaptation commitments. Adaptation needs and commitments can be included in NDCs and National Adaptation Plans (NAPs).

To monitor progress and allow for increasingly ambitious commitments over time, the global stocktake (described in Article 14) is designed to track progress as a precursor to revised commitments. Starting in 2023, the global stocktake will take place every five years to monitor progress with NDCs and NAPs and to allow for the setting of new targets for the following period to continue progress. The objectives of the global stocktake are to:

- recognize adaptation efforts of developing country Parties;
- enhance the implementation of adaptation action taking into account adaptation communications;
- review the adequacy and effectiveness of adaptation and support provided for adaptation; and
- review the overall progress made in achieving the global goal on adaptation.

Discussions on how to operationalize the global stocktake have been ongoing, informed by the subsidiary bodies, the Adaptation Committee, and the Least Developed Countries Expert Group. These groups have produced various studies on how to measure adaptation, including under the Nairobi Work Programme on adaptation (Adaptation Committee, 2016, 2018, 2021) and in the academic literature (e.g., Tompkins et al., 2018). At its twelfth session in Bonn in September 2017, the Adaptation Committee and the Least Developed Countries Expert Group highlighted that reviews of adaptation adequacy and effectiveness could consider the extent to which:

a) the ability and capacity to adapt to the adverse impacts of climate change has been increased;

b) climate resilience has been fostered/strengthened and vulnerability to climate change has been reduced;

c) contributions to sustainable development were made; and

d) adaptation actions are adequate in the context of the temperature goal referred to in Article 2.[68]

Technical dialogues are also ongoing to promote the participation and input of non-state actors.

68 (Adaptation Committee/Least Developed Countries Expert Group, 2017)

ANNEX B: KEY FRAMEWORKS

TRACKING ADAPTATION AND MEASURING DEVELOPMENT

NAME	TRACKING ADAPTATION AND MEASURING DEVELOPMENT
Originating institution/program	International Institute for Environment and Development (IIED)
Scale of operation	Multiple – cross-country (regional), national, local
Concept	"Twin-track" framework that evaluates adaptation success as: • how widely and how well countries or institutions manage climate risks (Track 1); and • how successful adaptation interventions are in reducing vulnerability and in keeping development on course (Track 2).
Method	Domains of quantitative indicators for each track, e.g., Track 1 has a set of nine indicators: Indicator 1: Climate change integration into planning Indicator 2: Institutional coordination for integration Indicator 3: Budgeting and finance Indicator 4: Institutional knowledge and capacity Indicator 5: Climate information Indicator 6: Uncertainty Indicator 7: Participation Indicator 8: Awareness among stakeholders Indicator 9: Vulnerability/resilience
Gender and social inclusion	No explicit inclusion
Data	Quantitative
Advantages	• Domains of indicators provide an overview of the situation without overriding existing indicators (e.g., at country or project level)
Disadvantages	• Data must be collected (at a minimum) at baseline and endline, which can be costly (one analysis showed significant start-up costs that decrease over time, but significant benefits if adaptation needs are then addressed, Barrett, 2014)
Key references	Brooks, N., Anderson, S., Ayers, J., Burton, I., and Tellam, I., 2011. Tracking adaptation and measuring development. Working paper 1, IIED, London. https://www.iied.org/10031iied IIED (International Institute for Environment and Development), 2012. TAMD: A Framework for assessing climate adaptation and development effects. Briefing paper, IIED, London. Brooks, N., Anderson, S., Ayers, J., Burton, I., and Tellam, I., 2013. An operational framework for tracking adaptation and measuring development (TAMD). Working paper 5, IIED, London.
Examples of application	Ethiopia (Awaris et al., 2014) Uganda (Kajumba et al., 2020) Cambodia (Rai et al., 2015) Kenya, Mozambique, Nepal, Pakistan (Rai, 2013)
Further operational guidance	Brooks, N. and Fisher, S., 2014. Tracking Adaptation and Measuring Development (TAMD): a step-by-step guide. Toolkit. IIED, London. https://www.iied.org/10100iied Guidance for indicators: https://www.iied.org/tracking-adaptation-measuring-development-tamd-framework

LDCF/SCCF ADAPTATION MONITORING AND ASSESSMENT TOOL (AMAT)

NAME	LDCF/SCCF ADAPTATION MONITORING AND ASSESSMENT TOOL (AMAT)
Originating institution/program	Global Environment Facility
Scale of operation	Project/program (typically sub-national, can be national or sub-national across national boundaries)
Concept	Tracking tool designed to measure adaptation achievements from projects and programs funded through the LDCF/SCCF in alignment with the results framework.
Method	Indicator 1: Number of direct beneficiaries Indicator 2: Type and extent of assets strengthened and/or better managed to withstand the effects of climate change Indicator 3: Population benefiting from the adoption of diversified, climate-resilient livelihood options Indicator 4: Extent of adoption of climate-resilient technologies/practices Indicator 5: Public awareness activities carried out and population reached Indicator 6: Risk and vulnerability assessments, and other relevant scientific and technical assessments carried out and updated Indicator 7: Number of people/geographical area with access to improved climate information services Indicator 8: Number of people/geographical area with access to improved, climate-related early-warning systems Indicator 9: Number of people trained to identify, prioritize, implement, monitor and evaluate adaptation strategies and measures Indicator 10: Capacities of regional, national and sub-national institutions to identify, prioritize, implement, monitor and evaluate adaptation strategies and measures Indicator 11: Institutional arrangements to lead, coordinate and support the integration of climate change adaptation into relevant policies, plans and associated processes Indicator 12: Regional, national and sector-wide policies, plans and processes developed and strengthened to identify, prioritize and integrate adaptation strategies and measures Indicator 13: Sub-national plans and processes developed and strengthened to identify, prioritize and integrate adaptation strategies and measures Indicator 14: Countries with systems and frameworks for the continuous monitoring, reporting and review of adaptation

NAME	LDCF/SCCF ADAPTATION MONITORING AND ASSESSMENT TOOL (AMAT)
Gender and social inclusion	Encourages disaggregation of indicators
Data	Quantitative
Advantages	• Enables aggregation of findings from projects/programs to fund level
Disadvantages	• Data must be collected (at a minimum) at baseline and endline • Fund level means that not all projects/programs will contribute to all indicators
Key references	Global Environment Facility, 2014. Updated Results-Based Management Framework for Adaptation to Climate Change under the Least Developed Countries Fund and the Special Climate Change Fund. GEF, Washington, DC. https://www.thegef.org/sites/default/files/council-meeting-documents/GEF-LDCF.SCCF_.17-05%2C_Updated_RBM_Framework_for_Adaptation_to_Climate_Change%2C_2014-10-08.pdf
Examples of application	All projects under the LCDF and the SCCF report against AMAT: project details can be found on the GEF website at https://www.thegef.org/what-we-do/topics/climate-change-adaptation
Further operational guidance	Global Environment Facility, 2014. LDCF/SCCF Adaptation Monitoring and Assessment Tool (AMAT). https://www.thegef.org/documents/gef-climate-change-adaptation-tracking-tool

CLIMATE INVESTMENT FUNDS (INCLUDING PILOT PROGRAM FOR CLIMATE RESILIENCE)

NAME	PPCR MONITORING AND REPORTING TOOLKIT
Originating institution/program	Climate Investment Funds
Scale of operation	From project to country to global program (multi-scale)
Concept	The PPCR M&R system is structured to allow annual tracking and reporting of PPCR progress at multiple levels. It is based on the principles of national ownership, participatory approach, use of mixed methods, and learning by doing. It allows for country reporting and MDB reporting.
Method	Core Indicator 1: Degree of integration of climate change in national, including sector, planning Core Indicator 2: Evidence of strengthened government capacity and coordination mechanism to mainstream climate resilience Core Indicator 3: Quality and extent to which climate responsive instruments/investment models are developed and tested (optional) Core Indicator 4: Extent to which vulnerable households, communities, businesses, and public-sector services use improved PPCR-supported tools, instruments, strategies, and activities to respond to climate variability or climate change Core Indicator 5: Number of people supported by PPCR to cope with the effects of climate change
Gender and social inclusion	Encourages disaggregation of indicators
Data	Scorecard (judgment against a scale with qualitative explanation)
Advantages	• Judgment approach makes the scorecard easier to complete than when quantitative data collection is required
Disadvantages	• Spatial comparison (e.g., project to project) may be impeded by the judgment approach
Key references	CIF, 2012. Revised PPCR Results Framework. Meeting of the Sub-Committee, Istanbul, Turkey. https://www.cif.org/sites/default/files/meeting-documents/ppcr_5_revised_ppcr_results_framework_0.pdf
Examples of application	All projects under PPCR report against this. Project details and a summary of progress against the indicators can be found on the CIF website at https://www.cif.org/topics/climate-resilience
Further operational guidance	CIF, 2018. PPCR Monitoring and Reporting Toolkit. CIF, Washington, DC. https://www.cif.org/sites/cif_enc/files/knowledge-documents/ppcr_mr_toolkit_july_2018.pdf

ADAPTATION FUND

NAME	ADAPTATION FUND MONITORING FRAMEWORK
Originating institution/ program	Adaptation Fund
Scale of operation	From project to country to global program
Concept	The RBM framework includes monitoring the efficiency and effectiveness of the Adaptation Fund, or process monitoring, which assists the Board in tracking efficiency and effectiveness based on the set indicators and targets. Process monitoring takes place on an ongoing basis to track whether the Fund's portfolio is being implemented as intended, standards are being met, and resources are being used efficiently.
Method	Projects collect data that reflect a number of indicators (below), which in turn feed into the Adaptation Fund level output and outcome indicators. Indicator: Number of beneficiaries Indicator: Number of Early Warning Systems Indicator: Assets produced, developed, improved, or strengthened Indicator: Increased income, or avoided decrease in income Indicator: Natural assets protected or rehabilitated
Gender and social inclusion	Encourages disaggregation of indicators
Data	Absolute numbers or, if this is not possible, a scorecard (judgment against a scale with qualitative explanation)
Advantages	• Flexibility of absolute numbers or judgment approach makes completion more realistic
Disadvantages	• Spatial comparison (e.g., project to project) may be hindered when the judgment approach is used
Key references	Adaptation Fund, 2019. Strategic Results Framework (updated). Adaptation Fund, Washington, DC. https://www.adaptation-fund.org/wp-content/uploads/2019/10/Adaptation-Fund-Strategic-Results-Framework-Amended-in-March-2019.pdf
Examples of application	All projects under the Adaptation Fund report against this. Project details and a summary of progress against the indicators can be found on the Adaptation Fund website at https://www.adaptation-fund.org/projects-programs/project-performance/
Further operational guidance	Adaptation Fund, 2011. Results Framework and Baseline Guidance: Project-level. Adaptation Fund, Washington, DC. https://www.adaptation-fund.org/document/methodologies-for-reporting-adaptation-fund-core-impact-indicators-march-2014/

GREEN CLIMATE FUND

NAME	INTEGRATED RESULTS MONITORING FRAMEWORK
Originating institution/program	Green Climate Fund
Scale of operation	From project/program (sub-national to national to regional) to portfolio (fund)
Concept	Tracking tool designed to measure (mitigation and) adaptation achievements towards (mitigation and) adaptation results areas (4 mitigation and 4 adaptation)
Method	Core indicator 2: Direct and indirect beneficiaries reached 2.1 Beneficiaries (female/male) adopting improved and/or new climate-resilient livelihood options (number of individuals) 2.2 Beneficiaries (female/male) with improved food security (number of individuals) 2.3 Beneficiaries (female/male) with more climate-resilient water security (number of individuals) 2.4 Beneficiaries (female/male) covered by new or improved early warning systems (number of individuals) 2.5 Beneficiaries (female/male) adopting innovations that strengthen climate change resilience (number of individuals) 2.6 Beneficiaries (female/male) living in buildings that have increased resilience against climate hazards (number of individuals) 2.7 Change in expected losses of lives due to the impact of extreme climate-related disasters in the geographic area of the GCF intervention (number of individuals) Core indicator 3: Value of physical assets made more resilient to the effects of climate change and/or more able to reduce GHG emissions 3.1 Change in expected losses of economic assets due to the impact of extreme climate-related disasters in the geographic area of the GCF intervention (value in USD) Core indicator 4: Hectares of natural resource areas brought under improved low emission and/or climate-resilient management practices 4.1 Hectares of terrestrial forest, terrestrial non-forest, freshwater and coastal-marine areas brought under restoration and/or improved ecosystems 4.2 Number of livestock brought under sustainable management practices 4.3 Tonnes of fish stock brought under sustainable management practices
Gender and social inclusion	Encourages disaggregation of indicators
Data	Quantitative
Advantages	• Enables aggregation of findings from projects/programs to fund (portfolio) level and results area
Disadvantages	• Data must be collected at baseline, annually during implementation and endline • Fund level means that not all projects/programs will contribute to all indicators
Key references	Green Climate Fund, 2021. Integrated Results Management Framework. Songdo. https://www.greenclimate.fund/sites/default/files/document/irmf-policy.pdf
Examples of application	All projects funded by the Green Climate Fund report against at least one core adaptation (and/or mitigation) indicator. The dashboard shows projects under each results area (of which 4 are adaptation) https://www.greenclimate.fund/projects/dashboard; and individual project sites show reports with indicators
Further operational guidance	Integrated Results Management Framework Handbook, 2022. https://www.greenclimate.fund/sites/default/files/document/draft-results-handbook-v11-01092023.pdf

UNITED KINGDOM CLIMATE IMPACTS PROGRAMME (UKCIP) ADAPTME TOOLKIT

NAME	ADAPTME TOOLKIT
Originating institution/program	UKCIP
Scale of operation	Organizations
Concept	The AdaptME toolkit supports organizations in thinking through adaptation logic or theory of change (i.e., is the goal to build adaptive capacity or to implement an adaptation action?), which then allows for appropriate evaluation design and selection of indicators to track progress toward these goals. It recognizes that adaptation should be effective, efficient, and equitable.
Method	It encourages explicit identification of the adaptation logic (or theory of change) as the underlying motivation for selecting appropriate indicators. The toolkit is not explicit about the use of quantitative or qualitative indicators, but it does highlight a role for participation and participatory methods.
Gender and social inclusion	No explicit mention of gender and social inclusion
Data	Scorecard (judgment against a scale with qualitative explanation)
Advantages	Context specificity Enables tracking of progress over time (from baseline to endline)
Disadvantages	Spatial comparison (e.g., organization to organization) may be hindered because of the context specificity
Key references	Pringle, P. 2011. AdaptME Toolkit: Adaptation Monitoring and Evaluation. United Kingdom Climate Impacts Programme, Oxford, UK. https://www.ukcip.org.uk/wp-content/PDFs/UKCIP-AdaptME.pdf
Further operational guidance	CIF, 2018. PPCR Monitoring and Reporting Toolkit. CIF, Washington DC. https://www.cif.org/sites/cif_enc/files/knowledge-documents/ppcr_mr_toolkit_july_2018.pdf

CARE'S PARTICIPATORY MONITORING, EVALUATION, REFLECTION AND LEARNING (PMERL)

NAME	PARTICIPATORY MONITORING, EVALUATION, REFLECTION AND LEARNING (PMERL)
Originating institution/program	CARE
Scale of operation	Community/grassroots
Concept	Designed for practitioners to measure, monitor, and evaluate changes in local adaptive capacity for better decision-making in community-based adaptation. Highly participatory and driven by beneficiaries of community-based adaptation.
Method	Based on a qualitative and participatory assessment of vulnerability, resilience and adaptive capacity, and the definition of community-appropriate indicators for these concepts. Provides a variety of participatory tools to elicit these.
Gender and social inclusion	Process can be managed to ensure input from men, women, and all social groups
Data	Qualitative
Advantages	• Context specificity • Empowering for beneficiary communities whose knowledge plays a key role in the process
Disadvantages	• Collecting qualitative data is burdensome
Key references	CARE, 2014. PMERL. A Revised Manual for Local Practitioners. https://careclimatechange.org/pmerl/

ANNEX C: OVERVIEW OF INVENTORY OF ADAPTATION MEASUREMENT RESOURCES

An inventory of existing adaptation measurement resources has been compiled in an accompanying Excel spreadsheet. The inventory was compiled in December 2022 and includes resources identified through online searches for a number of keywords, including 'adaptation measurement,' 'adaptation tracking,' 'adaptation metrics,' 'adaptation M&E,' 'adaptation indicators,' 'assessment of adaptation progress,' and 'progress on the goal of adaptation.' Resources were extracted for inclusion in the inventory if they contained one or a combination of these keywords in the title and/or if they had an explicit focus on adaptation measurement. This search is biased towards resources published in English.

The resulting inventory of 156 resources includes journal articles (included only if they are open access and thus not behind a paywall), reports (technical reports, working papers, briefing notes), tools (M&E toolkits, guidance documents, manuals, and frameworks), conference presentations, book chapters, and books.

Resources date back to 2004, with an increase in the number of publications until 2014–2017, after which the number of publications declines (Figure 6). The period of peak publications coincides with the preparation and adoption of the 2015 Paris Agreement to the UNFCCC. The Paris Agreement sets adaptation targets for the first time. Under Article 7, the Paris Agreement established a global goal on adaptation "of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal" (i.e., to limit the global average temperature increase to 2°C, with a view to limiting it to 1.5°C). The global stocktake proposed under Article 14 is intended to recognize adaptation efforts of developing country Parties, enhance the implementation of adaptation action, review the adequacy and effectiveness of adaptation, and review the overall progress made in achieving the global goal. Thus, the international policy framework created an imperative to measure adaptation, which has led to many proposals on how this should be done, as reflected in the number of publications.

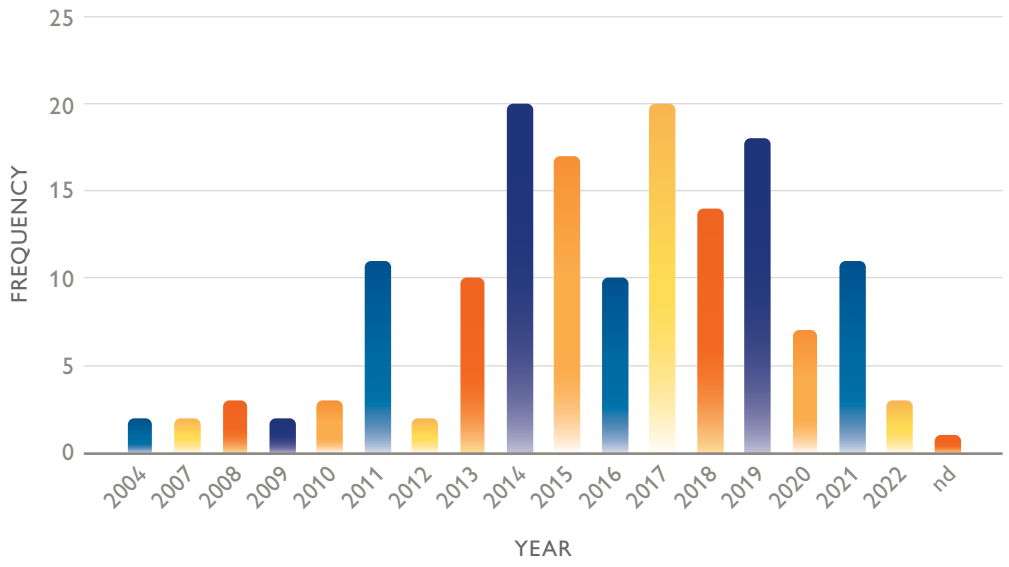

Figure 6: Number of publications on adaptation measurement per year

An assessment of the scale focus of the publications in the inventory also reveals clear divisions (Figure 7). A significant number of publications focus on the international level, considering how to measure adaptation for the global goal on adaptation and/or the global stocktake. An even larger number focus on the national level, where the aim is to establish or strengthen national-level monitoring and evaluation systems for adaptation (except where this is specifically for reporting to international agreements). Recognizing the context-specificity of setting (and measuring) adaptation targets, there are also publications that focus on specific sectors, including city/sub-national government/community, Ecosystem-based Adaptation/nature-based solutions/environment/watersheds, health, coasts, infrastructure, and agriculture.

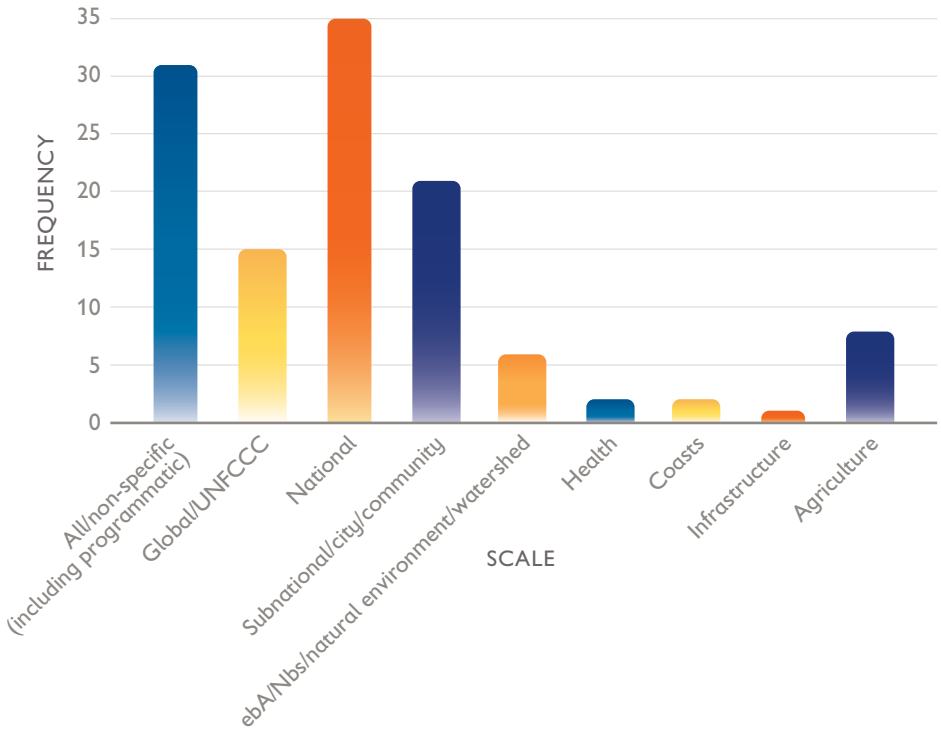

Figure 7: Scale focus of adaptation measurement publications

There is a very uneven geographical distribution of national/sub-national and geographically explicit sector-based examples (Figure 8). The country with the most measurement examples is Kenya with five, followed by Nepal and the United Kingdom with four each, and Australia, Germany, and Morocco with three each. Cambodia, Ethiopia, Finland, France, Mozambique, Pakistan, the Philippines, and Vietnam have two examples. Many countries have only one example, including Austria, Bolivia, Canada, Mali, Mexico, Norway, Senegal, South Africa, Uganda, and the United States. The fact that there is a very even split between countries in the Global North and Global South reflects the fact that all countries have reporting obligations under the Paris Agreement that are reflected in national-level policies and plans, as well as sub-national program examples.

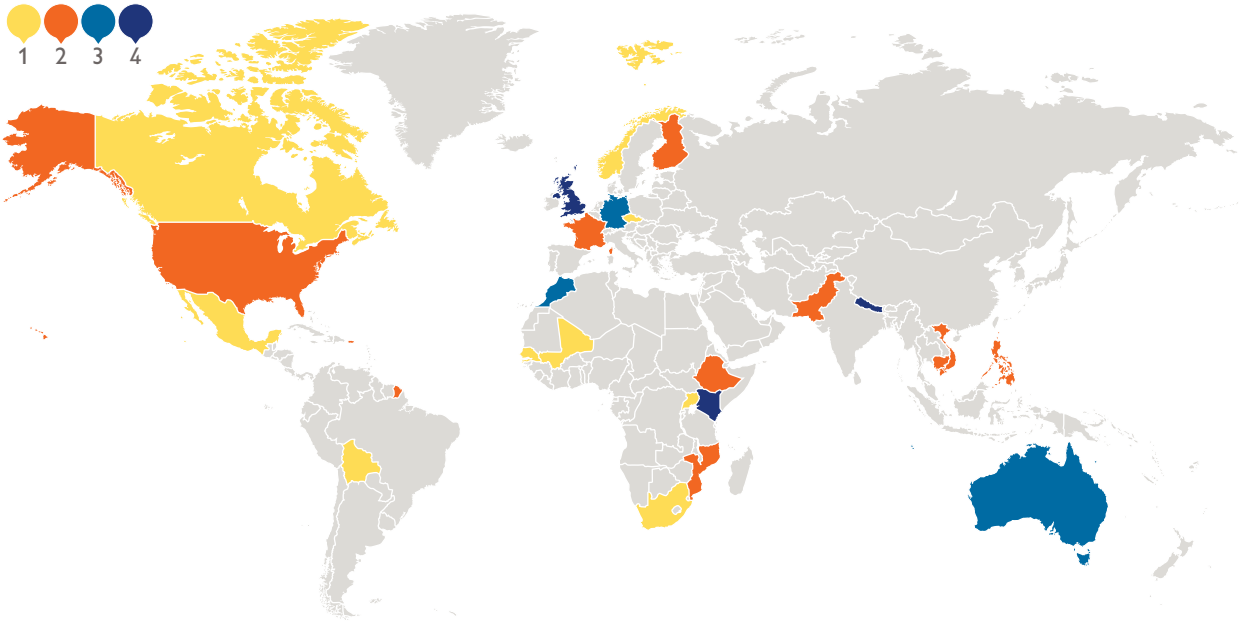

Figure 8: Geographical location of national and sub-national examples of adaptation measurement

A large number of publications—especially those focusing on conceptual and methodological approaches and frameworks—do not explicitly specify scale or sector. Almost a third of the 156 publications (30%) are frameworks for measuring adaptation (including meta-analyses and reviews of existing approaches). These frameworks have different objectives, often related to the scale of analysis shown in Figure 7. Some focus on the global goal for adaptation and the global stocktake of the Paris Agreement (e.g., Magnan et al., 2019; Tompkins et al., 2018) and some present named frameworks, such as TAMD, AMME, and TAAS. Frameworks are presented for use at the national, continental (e.g., Europe), and sub-national (e.g., Alpine) scales. Many of the frameworks also reflect specific programmatic efforts. UNDP was one of the first organizations to focus on adaptation measurement, with its Adaptation Policy Framework written from 2004–2009. CARE developed a Community-Based Adaptation Framework to inform its grassroots programming, first proposed in 2010. The international climate finance funds have also all developed adaptation measurement frameworks to varying degrees: the Climate Investment Funds, for example, published their framework in 2012 and the Global Environment Facility first published its framework in 2010, but it has since been revised (in 2014).

Given the interest of various organizations in applying adaptation measurement, there are also many examples of operationalizing frameworks through explicit tools (including toolkits, guidance, and manuals). Almost 20% of the 156 publications fall into this category. Guidance documentation comes from programs, institutions, and countries and relates to specific sectors. Examples of programs and institutions that have developed tools for measuring adaptation include the World Bank, PROVIA, GIZ (through the Adaptation M&E Navigator tool and the Adaptation Made to Measure program), SIDA, and CARE (through Participatory Monitoring, Evaluation, Reflection and Learning, PMERL). Countries that have issued tools include Canada (intended for internal use) and Sweden (intended for external use through programs it supports in other countries). Tools have also been issued through the National Adaptation Plan (NAP) Global Network to support countries in their monitoring and evaluation efforts as part of their National Adaptation Plans. Sector-specific guidance has been produced for Ecosystem-based Adaptation (GIZ, UNEP-WCMC, and FEBA), communities (USAID and CARE), cities (USAID and C40 Cities/Ramboll), Climate-Smart Agriculture (FAO), and agriculture in general (FAO/UNDP).

An assessment of the range of frameworks and tools shows that many different organizations have embraced the idea of measuring adaptation (Figure 9). This reflects not only international commitments that many organizations are seeking to align with, but also national commitments to evaluating effectiveness and maximize accountability, particularly where donor funding is concerned. GIZ has been particularly active and pioneering in further discussions on how to measure adaptation through its Adaptation Made to Measure program, which explains the fact that it has 25 publications. This program developed and promoted a framework for measuring adaptation in projects, studied its application, and conducted an analysis of how national adaptation plans and policies are being monitored and evaluated. IIED pioneered the Tracking Adaptation and Measuring Development framework, which has also been piloted in a variety of contexts, which is why IIED has 15 publications. OECD and UNFCCC have sought to advance measurement in practice by sharing reviews and lessons learned. UNEP DTU (now the UNEP Climate Change Centre) publishes the annual Adaptation Gap Report, which has had editions explicitly focused on adaptation measurement, but always draws on assessment and tracking type approaches. USAID has developed a toolkit and sector-specific application guidance for cities under the Adaptation Thought Leadership and Assessments (ATLAS) program.

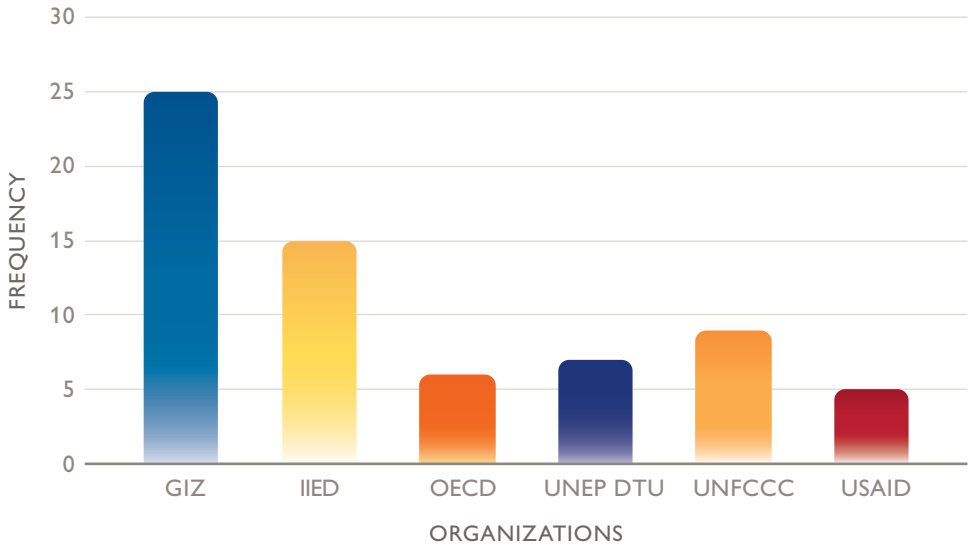

Figure 9: Number of publications on adaptation measurement per organization (including those with more than three publications)