Guidelines for Integrating Ecosystem-based Adaptation into National Adaptation Plans: Supplement to the UNFCCC NAP Technical Guidelines

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Note: Led by IUCN, FEBA is a global collaborative network of more than 90 agencies and organizations working together to share experiences and knowledge, to improve the implementation of ecosystem-based adaptation activities on the ground, and to raise awareness and understanding of ecosystem-based adaptation in planning processes and multilateral policy frameworks. The coordination of FEBA is part of the International Climate Initiative (IKI). The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports this initiative on the basis of a decision adopted by the German Bundestag. For more information see: https://friendsofeba.com.

Acronyms and abbreviations

ADB	Asian Development Bank
CAF	Cancun Adaptation Framework
CBD	Convention on Biological Diversity
CBA	Cost-benefit analysis
CCA	Climate change adaptation
CORDEX	Coordinated Regional Downscaling Experiment
CPEIR	Climate public expenditure and institutional review
CSO	Civil society organization
DRR	Disaster risk reduction
DRM	Disaster risk management
EbA	Ecosystem-based adaptation
Eco-DRR	Ecosystem-based disaster risk reduction
ENRTP	Environment and Natural Resources Thematic Programme
ENVSEC	Environment and Security Initiative
FAO	Food and Agriculture Organization of the United Nations
FEBA	Friends of EbA
GCA	Global Commission on Adaptation
GCM	Global climate model
GEF	Global Environment Facility
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICZM	Integrated coastal zone management
IIED	International Institute for Environment and Development
IISD	International Institute for Sustainable Development
IKI	International Climate Initiative (German Government programme)
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LAPA	Local adaptation plan of action
LDC	Least developed country
LEG	Least Developed Countries Expert Group
MA	Millennium Ecosystem Assessment
MCA	Multi-criteria analysis
MEA	Multilateral environmental agreement
MERL	Monitoring, evaluation, review and learning
NAP	National adaptation plan
NAPA	National adaptation programme of action
NAP-GSP	National adaptation plan global support programme
NbS	Nature-based solutions
NDC	Nationally determined contribution (to the Paris Agreement)
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
OMT	Opportunity Mapping Tool
RCM	Regional climate model
SCBD	Secretariat of the Convention on Biological Diversity
S2E	Services to ecosystems
SDGs	Sustainable Development Goals
SEA	Strategic environmental assessment
SEEA EA	System of Environmental Economic Accounting – Ecosystem Accounting
SMART	Specific, measurable, actionable, realistic, and time-bound (indicators)
SOM	Self-organizing maps
TEEB	The economics of ecosystems and biodiversity
UNCCD	United Nations Convention to Combat Desertification
UNDESA	United Nations Department of Economic and Social Affairs
UNEA	United Nations Environment Assembly
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNEP-WCMC	United Nations Environment Programme – World Conservation Monitoring Centre
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
WEF	World Economic Forum
WHO	World Health Organization
WMO	World Meteorological Organization
WCRP	World Climate Research Programme

Photo: @ UNEP

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Building the resilience of Kune-Vaini Lagoon through ecosystem-based adaptation (EbA)

In Albania, UNEP is working with the Ministry of Tourism and Environment to improve the capacity of the Kune-Vaini lagoon ecosystem to adapt to climate change and provide vital goods and services to local communities. The project will improve the technical and institutional capacity of policy- and decision-makers in Albania to implement adaptation interventions, especially ecosystem-based adaptation (EbA). The project is also increasing the awareness among local communities of effective EbA actions.

Learn more about UNEP's work on adaptation.

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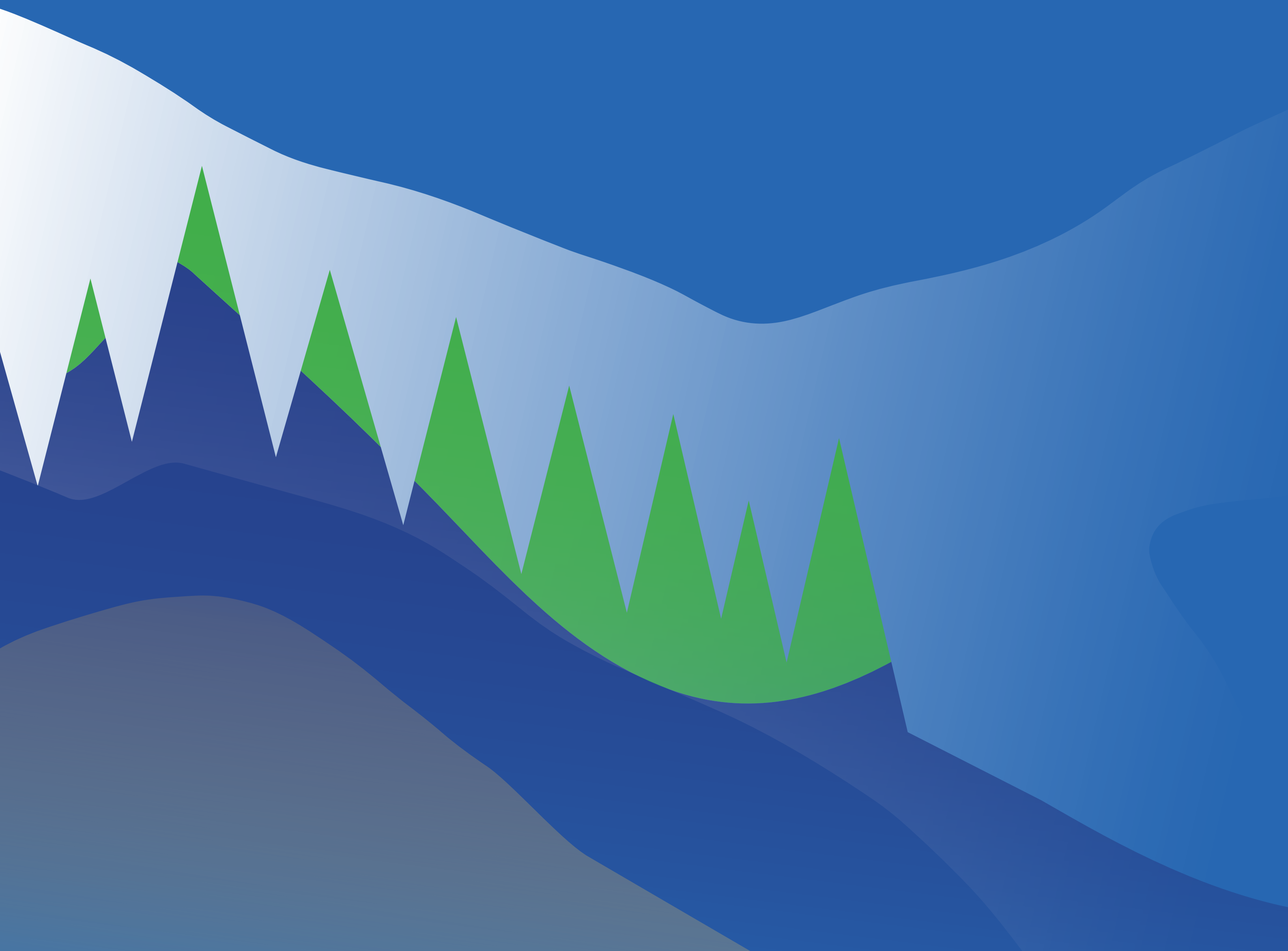
CHAPTER 1

Overview



Key messages from Chapter 1: Overview

These Supplementary Guidelines are intended to guide and motivate countries to adopt ecosystem-based approaches to adaptation.

Under the Cancun Adaptation Framework, NAPs were introduced to identify adaptation needs and develop action plans to address those needs.

As reinforced in the 2020 Adaptation Gap Report, EbA should be a key component of all national climate change adaptation strategies and National Adaptation Plans (NAPs), including Nationally Determined Contributions (NDCs) to the Paris Agreement.

The NAP process entails three stages:

1. Formulation
2. Implementation
3. Review

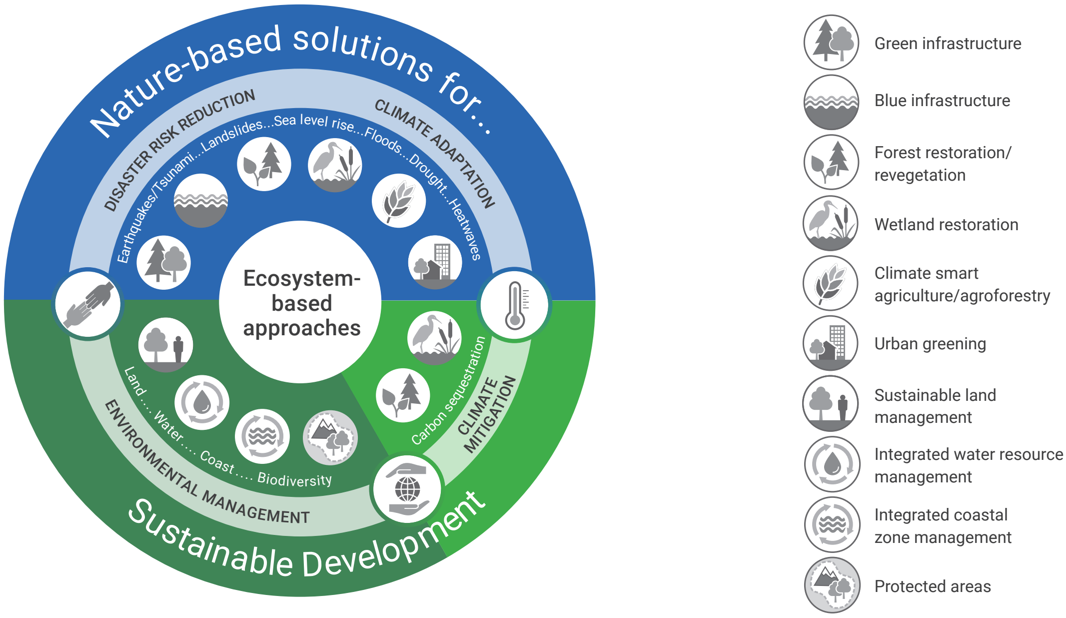
As noted in the 2020 Emissions Gap Report, currently, the NDC mitigation commitments are not ambitious enough, creating ever greater urgency for climate change adaptation.

The Paris Agreement recognizes the protection of the integrity of ecosystems and biodiversity for both climate change mitigation and adaptation actions.

To achieve climate change objectives, EbA is a nature-based solution that protects, sustainably manages, and restores natural or modified ecosystems.

Accordingly, there is strong global agreement on the importance of NAPs and EbA and the need to integrate them.

Figure 1.1. **Nature-based solutions and sustainable development**



Source: Partnership for Environment and Disaster Risk Reduction and Friends of EbA (2020)

1.1. Introduction

Ecosystem-based adaptation (EbA) is "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change" (Convention on Biological Diversity [CBD] 2009). The United Nations Environment Programme (UNEP) has been mandated to work on EbA since 2010, under UNEA Resolution 1/8 on EbA.[1] Networks such as the Friends of EbA (FEBA) further promote global collaboration around knowledge-sharing and strategic policy influence around EbA, including raising awareness and understanding of EbA in adaptation planning processes and multilateral policy frameworks. Over the past decade, EbA has gradually emerged as a unifying force for the objectives shared between the United Nations Framework Convention on Climate Change (UNFCCC), Convention on Biological Diversity (CBD), and the Sustainable Development Goals (SDGs).

In 2013, the Least Developed Countries Expert Group (LEG) of the UNFCCC, invited international actors to draft supplementary sector guidelines to the *NAP Technical Guidelines*. Several of these supplementary guidelines have now been published (Brugere and De Young 2020; Karttunen *et al.* 2017; Meybeck *et al.* 2020). As an activity under the National Adaptation Plan Global Support Programme (NAP-GSP), UNEP was requested to develop Supplementary Guidelines for Integrating EbA into National Adaptation Plans (NAPs). This will feed into the UNFCCC discussions and help countries understand why, where, when and how EbA can be integrated into NAPs.

The ultimate aim of these supplementary guidelines is to inspire and motivate countries to adopt ecosystem approaches when planning for climate-resilient development and when selecting and implementing adaptation options, and also to assist them to scale up and enhance EbA once they are already considering ecosystem approaches.

The Guidelines describe why addressing climate change risk through EbA contributes to achieving wider development goals. By placing people at the centre, EbA involves community-based and fully participatory approaches at the local level that may be scaled up to the provincial and national levels to influence development planning and policy and to multiply adaptation effects (International Institute for Environment and Development [IIED] and International Union for Conservation of Nature [IUCN] 2016).

1 In 2014, the United Nations Environment Assembly (UNEA) adopted Resolution 1/8 which requests UNEP, in partnership with governments and other stakeholders, develop and implement EbA programmes and encourages all countries to include EbA in their policies (UNDP 2015). Available here.

Similarly, national and sectoral policies and adaptation plans adopting ecosystem approaches may guide municipalities and communities to consider ecosystem functions and "adaptation services" as part of their own development and adaptation planning.

The Guidelines build on ongoing NAP processes in which ecosystem approaches are being considered as part of adaptation initiatives, plans and strategies. They illustrate how economic sectors, local governments and communities are addressing adaptation to climate change through different initiatives that include ecosystems. They outline the information and capacities institutions need to (i) make EbA part of ongoing or future adaptation strategies; and (ii) coordinate actions across sectors and across scales to implement EbA. They highlight opportunities and identify the main challenges associated with ecosystem approaches to climate risk management, including the need for an enabling policy and institutional environment as well as access to finance. Tools for advancing EbA are also described throughout the Guidelines, along with case examples where an EbA approach has proven successful.

Target audience: These Guidelines will be of use to all professionals, agencies and organizations working on adaptation and involved in the formulation, implementation and review of NAPs, particularly those interested in considering ecosystems and their functions as part of the NAP process.

OVERVIEW OF CHAPTERS

A basic assumption in the structure of the Guidelines is that dedicated national teams will focus on the NAP document first, while a broader group of stakeholders will assist with the mainstreaming into other national strategies and plans and aligning with regional and international environmental agreements. Therefore, the dedicated NAP team can initially focus on chapters three, four and five, while this broader group of stakeholders will need to follow the guidance in the sixth chapter.

The second chapter provides an introduction to ecosystem functions or services and EbA. First, it describes how climate change affects ecosystems. Second, it addresses the role ecosystems play in climate change adaptation and how different ecosystems deliver "adaptation services" to society. Third, scale issues and benefit sharing are discussed.

The third chapter moves into the core of the Guidelines, focusing on integrating EbA in the different stages of the NAP process (i.e., formulation, implementation and review). During the formulation stage, entry points for EbA, the opportunities EbA brings for adaptation planning, as well as the challenges EbA faces when compared to other adaptation options, are addressed.

The fourth chapter outlines the implementation stage, reflecting on some of the key lessons learned from implementing a wide variety of adaptation projects and the unique challenges and opportunities that an EbA approach brings. Some reflections related to financing of EbA and engaging the private sector close this chapter.

The fifth chapter closes the project cycle loop and focuses not only on the review stage of the NAP process but also on how monitoring and reporting are essential to capture lessons from the implementation experience and feed them back into revision of the NAP, making it a "living" plan.

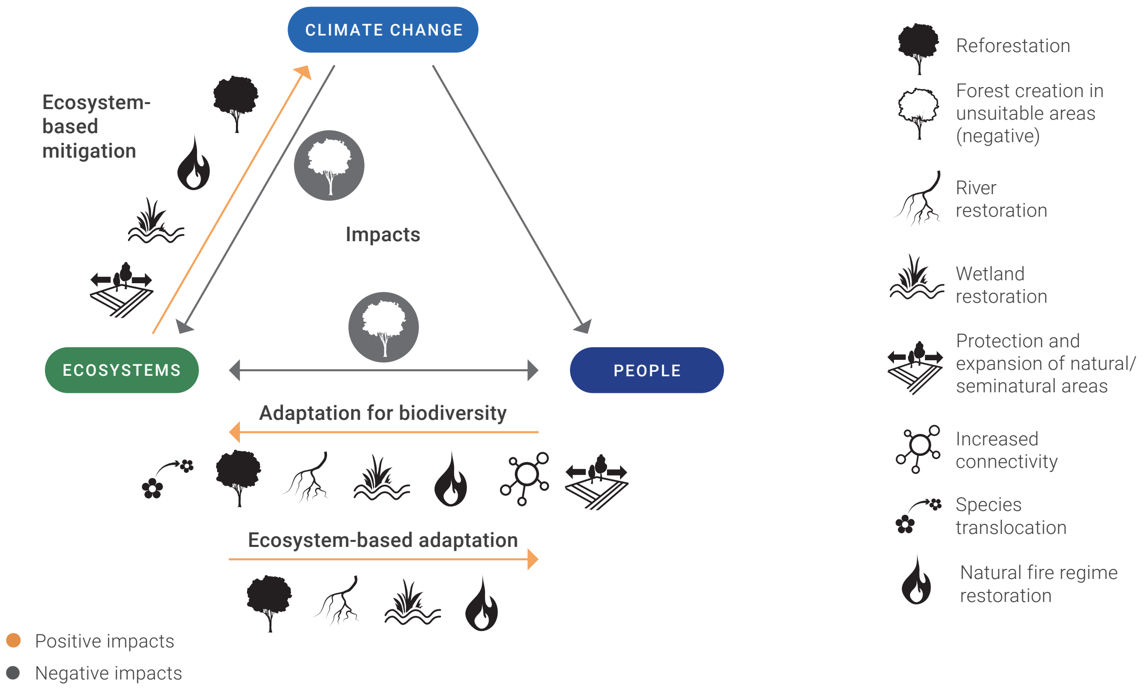
The sixth chapter rounds out the guidance to national adaptation planners and practitioners and other engaged stakeholders by discussing the importance of EbA linkages and alignment. The chapter focuses on the opportunities and challenges for mainstreaming EbA into planning and decision-making processes from the national to the local levels. The challenges associated with creating an enabling environment for mainstreaming EbA across multiple levels of governance are tackled by learning about the barriers and how to overcome them. The chapter outlines elements of an EbA mainstreaming strategy and alignment and synergies between different sectors and development agendas that may be enabled by integrating EbA in NAPs. The chapter also outlines the importance of EbA as a tool to assist in converging national implementation approaches to multilateral environment agreements (MEAs) and the SDGs.

The concluding chapter of the Guidelines provides recommendations for planners and policymakers interested in including EbA in their NAP processes. Lessons learned from countries that are integrating EbA in NAPs are highlighted to better understand the steps and resources used in different national contexts.

1.2. Nature-based solutions and ecosystem-based adaptation

Nature-based solutions (NbS) is an umbrella concept, defined by the International Union for Conservation of Nature (IUCN) as actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g., climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits (IIED and IUCN 2016; IUCN 2020; Friends of EbA [FEBA] 2017). NbS can be a "no-regrets" adaptation measure, providing

Figure 1.2. **The role of ecosystems in climate change adaptation and mitigation**



Source: Morecroft *et al.* (2019)

multiple benefits even if the climate change impacts are not severe (or, indeed, if the climate is restabilized). For example, urban parks can reduce the current heat island effect, absorb floodwater, provide recreation outlets, improve air quality and increase the economic value of surrounding properties (Organisation of Economic Co-operation and Development [OECD] 2020a).

Many of the different approaches under NbS are useful for EbA:

- Ecosystem restoration approaches (e.g., ecological restoration, ecological engineering and forest landscape restoration);
- Infrastructure-related approaches (e.g., natural infrastructure and green/blue infrastructure approaches);
- Ecosystem-based management approaches (e.g., integrated coastal zone management and integrated water resources management/ integrated river basin management); and
- Ecosystem protection approaches (e.g., area-based conservation approaches including watershed management and protected area management).

EbA is a nature-based solution for adaptation to climate change. EbA is inherently people-centric and focuses on reducing vulnerability and building resilience to the impacts of climate change through the use of biodiversity and ecosystem services. Other types of NbS addressing specific issues can be designed and implemented in parallel with EbA (IIED and IUCN 2016), including:

- Ecosystem-based mitigation and natural climate solutions, with a focus on nature conservation and management actions that reduce GHG emissions from ecosystems and harness their potential to store carbon;
- Ecosystem-based disaster risk reduction (Eco-DRR), for addressing overall disaster risk, not only climate-change related; and
- Green infrastructure, a network of natural and semi-natural areas, designed and managed to deliver a wide range of ecosystem services (water purification, air quality, adaptation, etc.).

Figure 1.2 shows the relationships between adaptation for biodiversity, EbA for people, and ecosystem-based mitigation. Negative impacts of climate change are shown in dark grey, and positive responses are shown in orange. Successful ecosystem responses to climate change depend on an integrated approach to ensure that synergistic effects are maximized and harms are avoided.

Table 1.1. **Nature-based solutions with multiple benefits**

ASSOCIATED ECOSYSTEM SERVICE	EXAMPLES OF NbS: Protecting/restoring coastal habitats (mangrove, salt marshes, coral reefs and oyster beds)	Protecting/restoring upland forest	Creating parks and open green space
Coastal Protection	●		
Reduction in riverine flood impacts		●	
Reduction in urban flood impacts		●	●
Filtering pollution	●	●	●
Carbon sequestration	●	●	
Habitat creation	●	●	●
Heat mitigation		●	●
Recreational opportunities	●	●	●

Source: OECD (2020a)

The types of NbS approaches described in figure 1.2 and listed in table 1.1 are often defined in contrast to grey infrastructure (i.e., built structures such as seawalls, dams, dikes, channels or storm surge defences). Hybrid arrangements are often referred to as **green-grey** combinations. These innovative approaches can be very effective at reducing risk from climatic hazards (Browder *et al.* 2019).

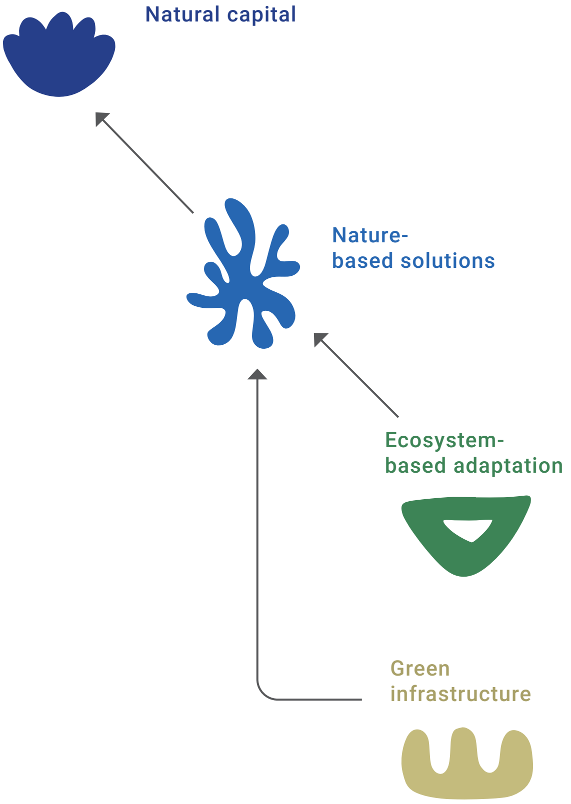
NbS approaches have multiple benefits ranging from carbon sequestration under forest restoration to heat reduction in urban settings (see table 1.1). Often, these multiple benefits of NbS are considered co-benefits of the primary objective. Research on the role of NbS in climate change adaptation has rapidly increased over the past decade (Nalau and Verrall 2021).

Although EbA options do not always directly enhance biodiversity (e.g., stabilization of slopes to stop soil erosion using one type of vegetation, or using a single variety of a fast-growing plant species for wind-breaks), working with nature can contribute to the Paris Agreement goal of holding global average temperature rise to well below 2°C using NbS, such as conservation, restoration and/or improved land management, to increase carbon storage and/or avoid greenhouse gas (GHG) emissions from forests, wetlands, grasslands and agricultural lands. It is estimated that NbS can provide over one-third of the cost-effective climate mitigation needed between now and 2030, with the added benefits of improving soil productivity, cleaning air and water, and maintaining biodiversity, in addition to boosting the natural resource base for achieving the SDGs, climate change adaptation, and disaster risk reduction (DRR) across landscapes (Griscom *et al.* 2017). Hence, EbA not only benefits people but also has significant benefits for ecosystems (see figure 1.2).

There are some important characteristics of NbS that need to be considered when applying EbA (OECD 2020a; IUCN 2020):

- All deliberate NbS are human interventions aimed at addressing societal challenges, such as minimizing disaster risk or improving water quality.
- An NbS often entails a deliberate choice to prioritize a specific ecosystem service(s). As shown in table 1.1, the number of services and the strength of the interactions depend on the selected NbS intervention, its location and the scale of implementation.
- All NbS have a positive impact on biodiversity and, conversely, the effectiveness of an NbS can be impacted by biodiversity decline or improvement.

Figure 1.3. **Hierarchical concepts of natural capital**



The planetary resources (e.g., plants, animals, air, water, soils, minerals) **that sustain life and well-being.** Natural capital underpins clean air, water and energy security, shelter, medicine, and more. Natural capital concepts are increasingly applied in national and corporate accounting to keep track of society's dependence and impact on these vital resources.

An umbrella term referring to actions that protect, manage, and restore natural capital in ways that address societal challenges effectively and adaptively. These include structural and non-structural actions, ranging from ecosystem restoration to integrated resource management, green infrastructure, and more.

The use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change ... It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change. Ecosystem-based adaptation is most appropriately integrated into broader adaptation and development strategies.

A subset of nature-based solutions that intentionally and strategically preserves, enhances, or restores elements of a natural system to help produce higher-quality, more resilient, and lower-cost infrastructure services. Infrastructure service providers can integrate green infrastructure into built systems.

Source: Modified after Browder *et al.* (2019)

- NbS that enhance biodiversity to boost ecosystem services may be more resilient in the long term and provide higher stability against future disturbances or shocks to the system.
- NbS actions range from minimal (e.g., protection, conservation, natural regeneration or monitoring strategies), to highly intensive management approaches (e.g., integrated coastal zone management and integrated water resources management).

Figure 1.3 illustrates that NbS, EbA and "green infrastructure" contribute to a nation's natural capital, often a better metric for socioeconomic progress than Gross Domestic Product (Dasgupta 2021; Browder *et al.* 2019). The valuation of ecosystems has now been formally recognized by the "System of Environmental-Economic Accounting — Ecosystem Accounting" (SEEA EA), a spatially-based, integrated statistical framework for organizing biophysical information about ecosystems, which measures ecosystem services, tracks changes in ecosystems, and values ecosystem services and assets (United Nations Department of Economic and Social Affairs [UNDESA] 2021). SEEA EA complements the environment and economy relationship measured by the System of Environmental-Economic Accounting 2012.

The interconnections between ecosystems and societal vulnerability and the role NbS can play in managing increasing climate risks have been emphasized in the CBD, the Sendai Framework for Disaster Risk Reduction (2015–2030), and the UNFCCC Paris Agreement on climate change. Other MEAs also reflect the interlinkages between ecosystem management, climate change and disaster risk reduction (Secretariat of the Convention on Biological Diversity [SCBD] 2019). The Paris Agreement, for instance, calls on all parties to acknowledge "the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth".[2] Effective implementation of NbS/EbA that increases adaptive capacity while promoting sustainable development and social equity will help countries to meet their obligations under the Paris Agreement as well as other MEAs and the SDGs of Agenda 2030 (IIED and IUCN 2016).

2 Paris Agreement to the United Nations Framework Convention on Climate Change, Dec. 12, 2015, T.I.A.S. No. 16-1104.

1.3. Overview of the NAP process

The NAP process was established under the Cancun Adaptation Framework (CAF)[3] adopted in 2010, which even then reflected an emerging understanding of the importance of EbA, the need to consider vulnerable groups, communities and ecosystems, and the importance of traditional and indigenous knowledge in guiding adaptation activities (Chong 2014). All parties were invited to undertake actions under the CAF, […] by:

- Building resilience of socio-economic and ecological systems, including through economic diversification and sustainable management of natural resources[4]; and
- Enhancing action on adaptation, reducing vulnerability, and building resilience in developing country Parties (Secretariat of CBD 2019, p. 27).

Also promulgated under the CAF, the NAPs were viewed as primary instruments providing Parties to the UNFCCC with the means of (i) identifying medium- and long-term adaptation needs; and (ii) developing and implementing strategies and programmes to address those needs (Secretariat of CBD 2019, p. 87).

The Paris Agreement in 2015 was a milestone in making adaptation an equal priority with mitigation. For the first time, the Parties during COP 21 defined 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" (Article 7, paragraph 1). UNFCCC negotiators took a significant step forward in strengthening the adaptation pillar of global climate policy (Lesnikowski *et al.* 2016), by:

- Widening the normative framing around adaptation;
- Calling for stronger adaptation commitments from Parties;
- Being explicit about the multilevel nature of adaptation governance; and
- Outlining stronger transparency mechanisms for assessing adaptation progress.

The Paris Agreement calls upon all countries to initiate processes to prepare and implement NAPs. It acknowledges that (i) adaptation planning processes are vital to social and economic development; (ii) adaptation action, including NAP processes, should be country-driven, inclusive and transparent; and (iii) the urgent and immediate needs of developing countries that are particularly vulnerable to the impacts of climate change must be recognized. Further, the Paris Agreement (Articles 5-clause 2; 7-clauses 2 and 5; 8-clause 4) recognizes the protection of the integrity of ecosystems and biodiversity for both climate change mitigation and adaptation actions. For adaptation, it lays out principles that take ecosystems into consideration and calls for (i) integrating adaptation into relevant environmental policies and actions, where appropriate; and (ii) building resilience of ecosystems through sustainable management of natural resources, considering the imperatives of a just transition of the workforce.

The Paris Agreement also calls on countries to improve the "effectiveness and durability" of their adaptation actions, supported in part by monitoring, evaluating and learning from adaptation planning and implementation. A "global stocktake" process every five years will start in 2023, providing a clear time frame for action and alignment with political timeframes, which will hopefully complement national planning and coordination of bilateral support for adaptation. The "monitoring, reporting and review" component of the NAP process will inform national contributions to this global stocktake, reporting not only on adaptation needs and priorities, but also on whether sufficient planning is in place and enough action has been taken.

Accordingly, there is strong global agreement on the importance of NAPs and EbA and the need to integrate them. Entry points for integrating EbA (and Eco-DRR) in the NAP include (Secretariat of CBD 2019, p. 50):

- An ecosystem and risk reduction lens should be applied to the NAP process: in assessing vulnerabilities and climate risk, using a landscape or systems approach will help to identify ecosystems that provide critical climate regulation services.
- In reviewing and appraising adaptation options, it is recommended to consider economic, environmental and social costs and benefits: this can aid in making the case for ecosystem-based approaches.
- In implementing adaptation activities, the NAP process could include climate-proofing development interventions (e.g., infrastructure) using ecosystem-based approaches.

3 As part of the Cancun Adaptation Framework, Parties established the Adaptation Committee to promote the implementation of enhanced action on adaptation in a coherent manner under the Convention, inter alia, through technical support, sharing information including good practices and promoting synergies.

4 FCCC/CP/2010/7/Add.1: Available here.

All photos on this page: © UNEP/Hannah McNeish

Building climate resilience through rehabilitated watersheds, forests and adaptive livelihoods

Women and children carry logs, branches and twigs down from the forests on top of Anjouan Island, where UNEP and partners are helping communities restore forests in important watersheds to stop soil erosion and failing harvests

In the Comoros, this project is helping people harvest and retain water by rehabilitating 3,500 hectares of watershed habitat. The project aims to plant 1.4 million trees over the course of four years across the country's three islands. For farmers living within increasingly parched and degraded watersheds, this ecological restoration will prevent their soils from drying-up and being washed downhill. The project is also improving weather forecasting systems and climate knowledge to help people change with the climate.

Learn more about UNEP's work on adaptation.

As indicated by the World Economic Forum (WEF), “biodiversity loss and ecosystem collapse is one of the top five risks in terms of likelihood and impact in the coming 10 years”, and combined with the climate risk, US$44 trillion of economic value is under threat (World Economic Forum [WEF] 2020). The urgency for drastically halting and reversing ecosystem degradation and the loss of ecosystem services and adapting national economies to climate change cannot be overstressed.

The triple crises of climate change, biodiversity loss and the COVID-19 pandemic have driven home our inescapable connection to nature. Almost all countries have committed to green recovery packages from COVID-19. The NAP process offers a ready-made solution to identify multiple EbA options that can be implemented immediately to “build forward better”.[5]

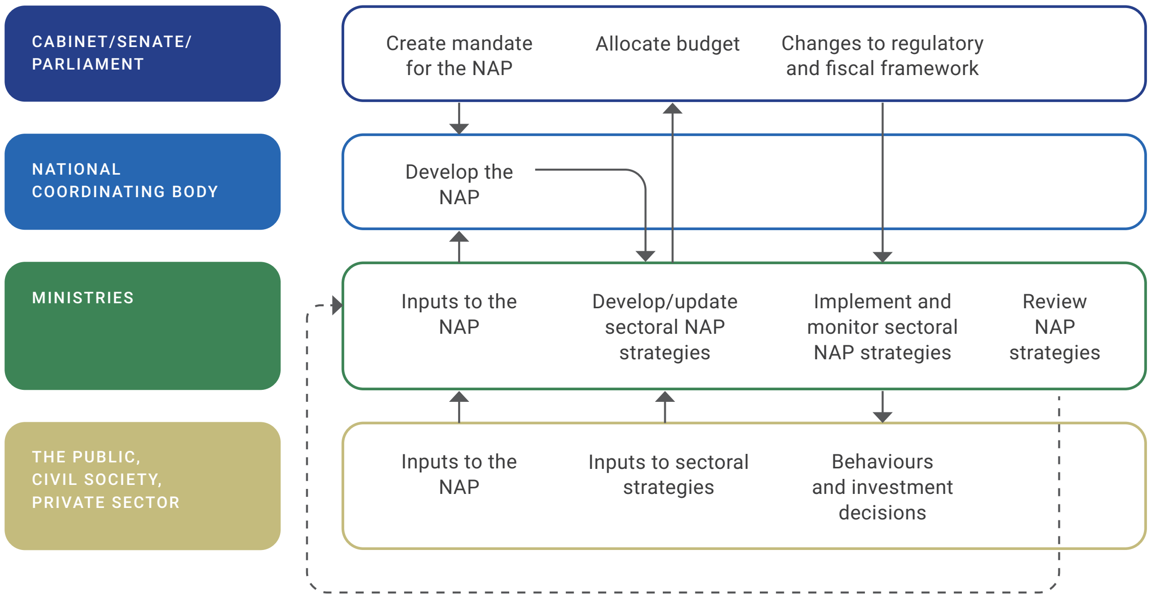
The NAP process was established under the CAF as the primary mechanism for dealing with current and future threats.[6] It enables Parties to formulate and implement NAPs as a means of identifying medium- and long-term adaptation needs and developing and implementing strategies and programmes to address those needs. It is a continuous, progressive and iterative process that follows a country-driven, gender-sensitive, participatory and fully transparent approach. The NAP process is key in prioritizing and implementing “adaptation” or “development” measures to respond to climate change, and EbA principles are uniquely placed to support this process in a holistic way (Deutsche Gesellschaft für Internationale Zusammenarbeit [GIZ] 2017b). To date, about 20 developing countries have submitted their NAPs to UNFCCC, while many others have initiated the process and are well underway.

The objectives of the NAP process are to: (i) reduce vulnerability to the impacts of climate change, by building adaptive capacity and resilience; and (ii) facilitate the integration of climate change adaptation, in a coherent manner, into relevant new and existing policies, programmes and activities, in particular development planning processes and strategies, within all relevant sectors and at different levels, as appropriate (decision 5/CP.17, paragraph 1).

The NAP process helps countries conduct comprehensive medium- and long-term climate adaptation planning.[7] Planning for adaptation at the national level is a continuous, progressive and iterative process, and should be based on and guided by the best available science, as stated in the NAP technical guidelines (United Nations Framework Convention on Climate Change [UNFCCC] 2012). It is a flexible process that builds on each country’s existing adaptation activities and helps integrate climate change into national decision-making. NAPs also help to coordinate cross-sectoral linkages, align with MEA action plans and the implementation of SDGs, and provide essential inputs to national climate strategies, nationally determined contributions (NDCs)[8] to the Paris Agreement, and mobilization of finance for implementation.

5 https://www.iisd.org/articles/climate-adaptation-stimulus?q=blog/climate-adaptation-stimulus
6 A distinction needs to be made between the NAP process and a NAP, as the former involves integrating adaptation priorities in the broadest possible range of policies, plans and programmes, while the latter is a “living” planning document that sets out the priority actions to enhance adaptation at the national level.
7 https://www.wri.org/blog/2014/06/clarifying-unfccc-national-adaptation-plan-process
8 As of January 2021, 72 countries (including the 27 EU countries with a joint NDC) had submitted their updated NDCs (https://climateactiontracker.org/climate-target-update-tracker/).

Figure 1.4. **The National Adaptation Plan process**



Source: Authors

For each country, the NAP process (figure 1.4) aims at fostering adaptation through:

- **An integrated approach:** the NAP process aims to integrate responses to climate risk into national development planning, policies and programmes.
- **Country-specific solutions:** not all NAPs will produce the same type of plan. Each country will develop a national planning process with outputs tailored to their specific needs.
- **Continuity:** medium- and long-term adaptation planning is an iterative, ongoing process, not a one-time activity.

The cross-sectoral nature of EbA, its context-specificity and the need to develop an institutional enabling environment for formulating and implementing EbA, fit very well with the overall NAP process. A fundamental characteristic of ecosystems is the integration of structure, functions and services, thus aligning well with integration of sectoral needs and national and subnational contexts and engagement with institutions, civil society organizations (CSOs), and the private sector in the NAP process.

The Parties to the UNFCCC established the NAP process in 2011 in Durban and agreed that enhanced action on adaptation should:

- Follow a country-driven, gender-sensitive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems;
- Be based on and guided by the best available science and, as appropriate, traditional and indigenous knowledge, and by gender-sensitive approaches, with a view to integrating adaptation into relevant social, economic and environmental policies and actions, where appropriate; and
- Not be prescriptive, nor result in the duplication of efforts undertaken in-country, but rather facilitate country-owned, country-driven action.

Typically, an early step in a country's NAP process is to chart a "roadmap" that specifies the scope of the NAP process, the roles and responsibilities of those involved, and the sequence of planning steps for that country. Most countries have appointed a government agency to lead efforts on climate change adaptation, particularly for NAPs (Food and Agriculture Organization of the United Nations [FAO] 2017). This agency is typically given a mandate to coordinate the cross-sectoral efforts of other agencies, ministries and non-state actors, such as CSOs, and facilitate the adaptation planning, including establishing a national core NAP team, steering group or commission. Political support is also essential. For example, the guiding values endorsed by Fiji's Cabinet at the outset of its NAP process, include inclusivity, equity, indigenous knowledge, and ecosystem-based and gender and human rights-based approaches to adaptation (Government of the Republic of Fiji 2018). When needed, technical committees may assist the national core NAP team with guidance on the governance, scientific, financial and other practical aspects or specific issues.

In 2012, a UNFCCC experts group developed a detailed set of NAP technical guidelines to assist developing countries, especially the least developed countries (LDCs), with adaptation planning, outlining four flexible planning elements: (i) Element A – laying the groundwork and addressing the gaps; (ii) Element B – preparatory elements; (iii) Element C – implementation strategies; and (iv) Element D – reporting, monitoring and review (UNFCCC 2012). The 2012 NAP guidelines are supplemented by additional guidance documents that are intended to offer in-depth coverage of selected steps of the process to formulate and implement NAPs, including this publication on EbA.[9] The NAP guidelines provide broad flexibility to encourage planners to take only those NAP steps relevant to their country, and to do them in whatever order is most appropriate to their national circumstances.[10] The goal of these Guidelines is to guide national teams (of adaptation practitioners and development planners) on integrating ecosystems and EbA in the different stages of the NAP process. This is to ensure that EbA is not only one of several measures in the NAP document but also is mainstreamed into adaptation and development planning at national, subnational and sectoral levels. Considering EbA in each step in the formulation of the NAP will lead to a broader understanding of the multiple benefits of adaptation interventions centred on ecosystem services. Related opportunities and challenges will clearly come to the surface as the reader explores some of the challenges for integrating EbA into NAPs.

As elaborated in chapter 2, besides finding the best entry points in the NAP process, EbA must be integrated in the overall national development planning process. From the cross-scalar and cross-sectoral perspective of EbA, this requires integration within subnational and sectoral planning strategies and instruments. Integration may be achieved by (i) analysing the role of ecosystems and ecosystem services in economic development at different scales and for most sectors; (ii) screening policies and legal frameworks to identify entry points for EbA approaches; and (iii) building key synergies among planning and budgeting actors and processes.

NAPs, as mandated by UNFCCC, represent strategic documents for identifying adaptation strategies, driving implementation after internalization into sectoral plans and budgets, and facilitating integration of adaptation into development planning and budgeting. NAP processes follow a typical policy process: identification, formulation, implementation and review. If ecosystem management aspects and EbA have not been considered during the formulation of the first round of NAPs, they may be factored in during the subsequent NAP review and revision, as evidence of the benefits of ecosystem management for climate-resilient development grows and gains momentum. Experience with EbA at the pilot project stage or subnational or sectoral levels may feed into NAPs through scaling up of lessons learned and good practices in governance, finance, institutional settings, knowledge, and instruments dealing with ecosystem management for climate risk reduction.

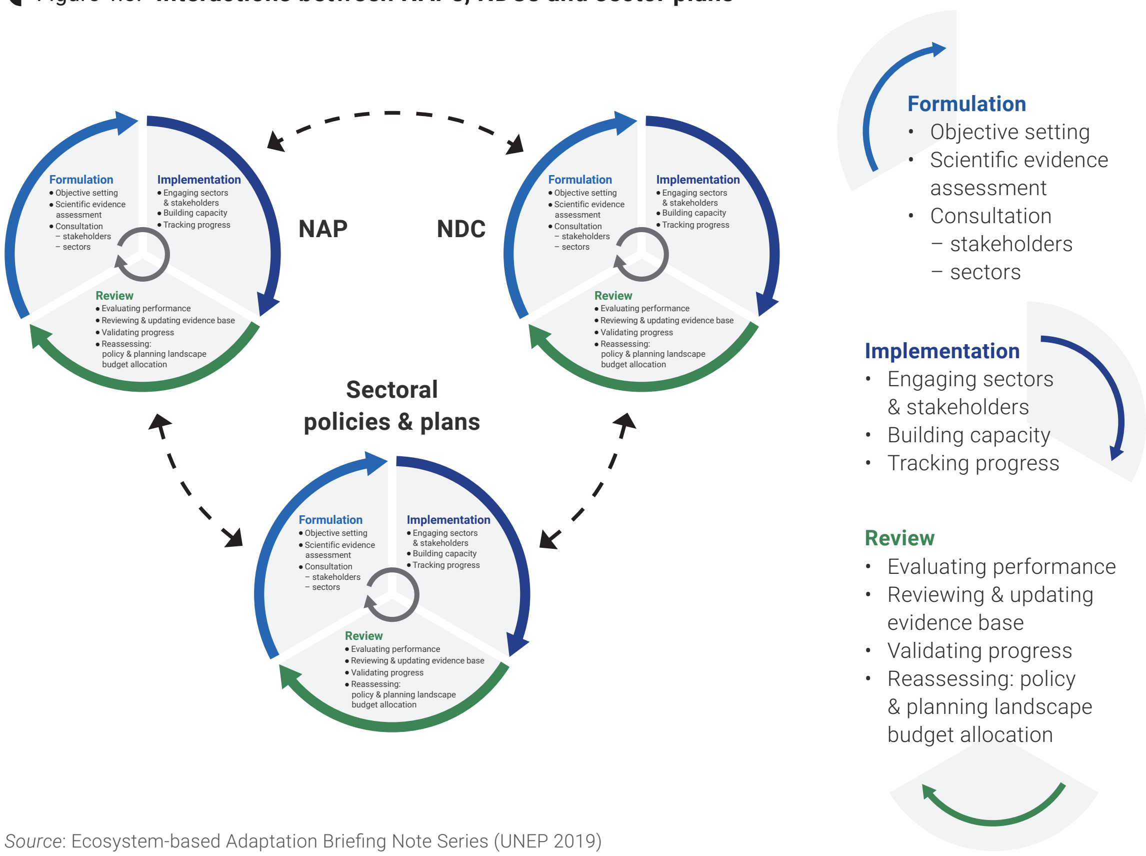
As with integrating all adaptation efforts into development planning, integrating EbA requires incremental and iterative steps and may benefit from learning-by-doing and the experience of other countries.[11] Additionally, the NAP process presents opportunities for national governments to establish longer-term approaches to widely engaging the scientific community in informing adaptation planning and implementation. The scientific community is encouraged to focus on researching climate change risks impacting different socio-economic and ecological processes under escalating emissions scenarios, and how climate change interacts with baseline drivers of vulnerability.

Engaging the scientific community will certainly be advantageous for EbA, as more research on ecosystem functions, socioeconomic and cultural values, climate risks, vulnerability factors and adaptation services needs to be supported by government-funded research programmes. Scientific experts, NGOs, CSOs and indigenous peoples may contribute to (i) collecting and documenting the evidence to support mainstreaming of, and investments in, EbA; (ii) informing EbA planning so that it reflects the local ecological, cultural and socioeconomic context; (iii) managing knowledge for learning about EbA; and (iv) informing a monitoring framework to track progress in mainstreaming and implementing EbA.

Hence, stakeholder involvement is a critical element for the national institutional arrangement: linkages to local governments and bodies are essential, and scientists, non-governmental organizations (NGOs) and CSOs must be involved in the decision-making process. The institutional arrangement needs to ensure an appropriate level of coordination and cooperation among all stakeholders, especially where the ecosystems of interest may involve insecure tenure

9 For detail about the supplementary guidance documents please see: https://www4.unfccc.int/sites/NAPC/Guidelines/Pages/Supplements.aspx
10 See clarifying the UNFCCC NAP process here.
11 Information on the integration of adaptation efforts adapted from Least Developed Countries Expert Group (2016).

Figure 1.5. **Interactions between NAPs, NDCs and sector plans**



Source: Ecosystem-based Adaptation Briefing Note Series (UNEP 2019)
https://www.unep.org/resources/factsheet/ecosystem-based-adaptation-briefing-note-series-unep-wcmc

or usage rights and where knowledge of the ecological processes needs additional investigation.[12] EbA, which looks at complex systems and aspects, can facilitate bringing together the various stakeholders needed in a NAP, as well as their contributions to NDCs.

Although not mandatory, about 131 countries (out of 175) have chosen to include in their NDCs information on adaptation in addition to their mitigation commitments, while the NAP process provides a more intensive and detailed domestic planning process that sets out "how" the broad NDC adaptation goals can be implemented (International Institute for Sustainable Development [IISD] 2021). Accordingly, the NAP process can provide the means of operationalizing the ecosystem-related adaptation commitments and objectives outlined in NDCs and informing future iterations of the NDCs (figure 1.5). A recent analysis of NDC submissions revealed that 104 NDCs have acknowledged that ecosystems and biodiversity are vulnerable to climate change, and 76 countries pointed to conservation of ecosystems as an important motivation for adaptation planning (IISD 2021; Seddon *et al.* 2019).

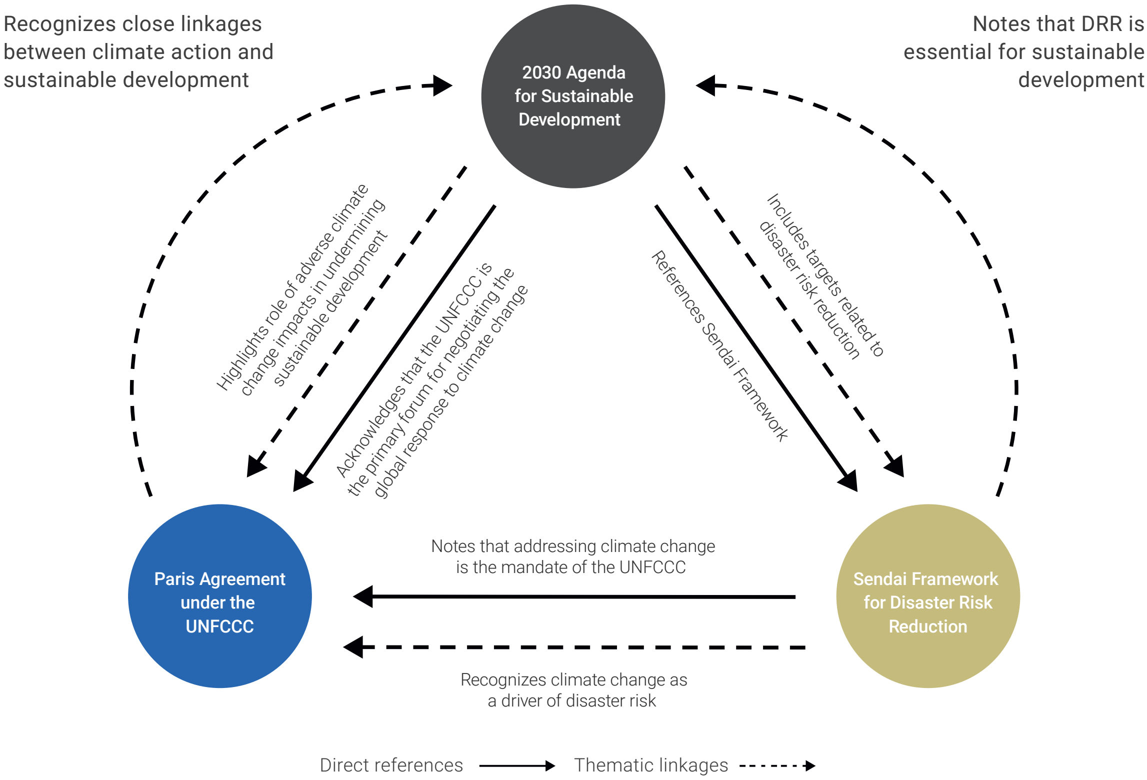
The recent synthesis by UNFCCC of updated NDCs indicates, however, that countries are not on track to meet the Paris Agreement targets of 2030. Instead of the expected 45 per cent reduction in emissions to achieve the 1.5°C target, the current contributions would only provide a 1 per cent reduction (UNFCCC 2021). This sobering assessment strengthens the argument for significantly strengthened national adaptation processes, especially in the most vulnerable countries.

Strong consideration of ecosystems and EbA in the NAP process can help to meet other commitments given the multiple environmental, social and economic benefits that healthy ecosystems provide. Hence, it is useful to explore how proposed EbA solutions contribute to other national strategies and commitments (NDCs, biodiversity strategy, DRR strategy and SDG action plans).[13] This can be an efficient way to identify synergies and powerful entry points for leveraging impacts and financial resources (IISD 2020).

Implementation of global agendas at the national level – such as SDG Action Plans, NAPs and NDCs under the Paris Agreement, and DRR strategies under the

12 Information on tenure and usage rights adapted from Least Developed Countries Expert Group (2016).
13 https://wedocs.unep.org/bitstream/handle/20.500.11822/28179/Eba6.pdf?sequence=1&isAllowed=y

Figure 1.6. **Connections between global agendas**



Source: Dazé *et al.* (2018)

Sendai Framework – needs to be aligned to increase coherence, efficiency and effectiveness towards resilient and sustainable development outcomes.[14] As the EbA perspective provides this cross-cutting view of national development options, it provides the perfect mechanism for such alignment (figure 1.6). The 2030 Agenda for Sustainable Development recognizes that sustainable development will not be possible if climate change continues unabated and if populations are not protected from disasters. As ecosystems and ecosystem services underpin virtually all the SDGs, the contribution of EbA in addressing climate change and disaster risk reduction is integral to achieving the 2030 Agenda. This issue is discussed further in chapter 6.

EbA is central to the adaptation vision of many countries but some of the most biologically diverse and climate-vulnerable countries do not refer to it yet in adaptation plans submitted to the UNFCCC (IIED and IUCN 2016). Few countries that recognize the importance of EbA include clear and measurable targets and/or indicators by which progress of implementation can be assessed, while even fewer acknowledge the importance of local community involvement in designing and implementing adaptation activities. The NDC revisions currently taking place, certainly allow for advancing alignment with NAPs, for incorporating NAP targets in NDCs, and recognizing the important contributions of EbA.

As NAPs help to (i) coordinate cross-sectoral linkages; and (ii) provide essential inputs to national climate strategies, NDCs, and mobilization of finance for implementation, they seem to be optimal planning instruments for creating synergies between the global agendas and the national planning frameworks, especially through NbS and EbA.

14 See NAP Global Network here.

CHAPTER

2

Ecosystems, ecosystem services and ecosystem-based adaptation

Key messages from Chapter 2:
Ecosystems, ecosystem services and ecosystem-based adaptation

Ecosystems are found everywhere and provide **vital goods and services** for everyone on the planet, but approximately 60 per cent of all ecosystem services and up to 70 per cent of **regulating services** are **being degraded or used unsustainably.**

Managing ecosystems to deliver provisioning, regulating and other services to enhance climate resilience is at the core of the EbA concept.

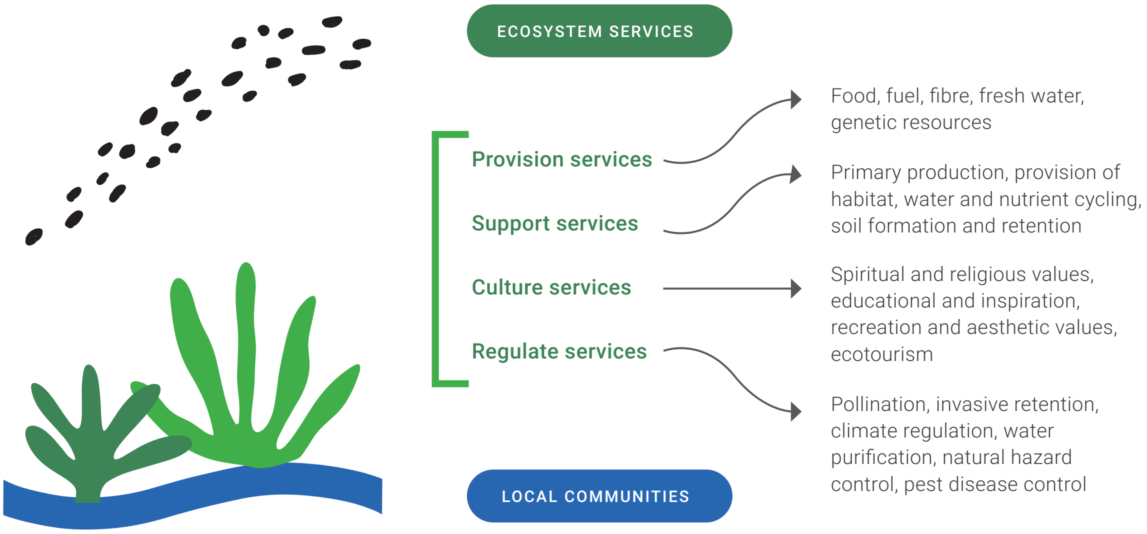
The **biodiversity** in ecosystems provides the raw materials, structures, functions, and processes needed to protect people and livelihoods from climate change impacts.

EbA generates **multiple co-benefits** in addition to protection from climate change impacts.

Ecosystems and ecosystem services are also adversely affected by **climate change.**

If all these benefits are calculated, then EbA becomes a **benefit multiplier** and an essential community **asset**, adding to **social and natural capital.**

Figure 2.1. **Ecosystem services or benefits delivered by wetlands**



Source: Bhatta (2018)

2.1. Introduction

This chapter introduces the basic concepts of ecosystems, ecosystem services and ecosystem-based adaptation. It also highlights that ecosystems are adversely affected by climate change, thus compromising their ability to deliver ecosystem services, and thereby harming livelihoods. Therefore, it is logical for national adaptation efforts to focus on anticipating, accommodating and avoiding climate change impacts on ecosystems and their services. EbA, as per its definition, helps people to adapt to the impacts of climate change through the use of biodiversity and ecosystem services. However, further work to protect ecosystems and species, and not only people, from the adverse impacts of climate change should also be considered.

2.2. Ecosystems and ecosystem services

According to the CBD, ecosystems are dynamic complexes of plants, animals and micro-organisms (or biodiversity), that interact with their environment. Ecosystems can be found from the bottom of the ocean to the highest peaks, comprise essential parts of every landscape and seascape on earth, and have been providing vital goods and services to human cultures throughout history (figure 2.1). Ecosystem functions and interactions generate a variety of benefits, known as ecosystem services or nature's contribution to people.[15]

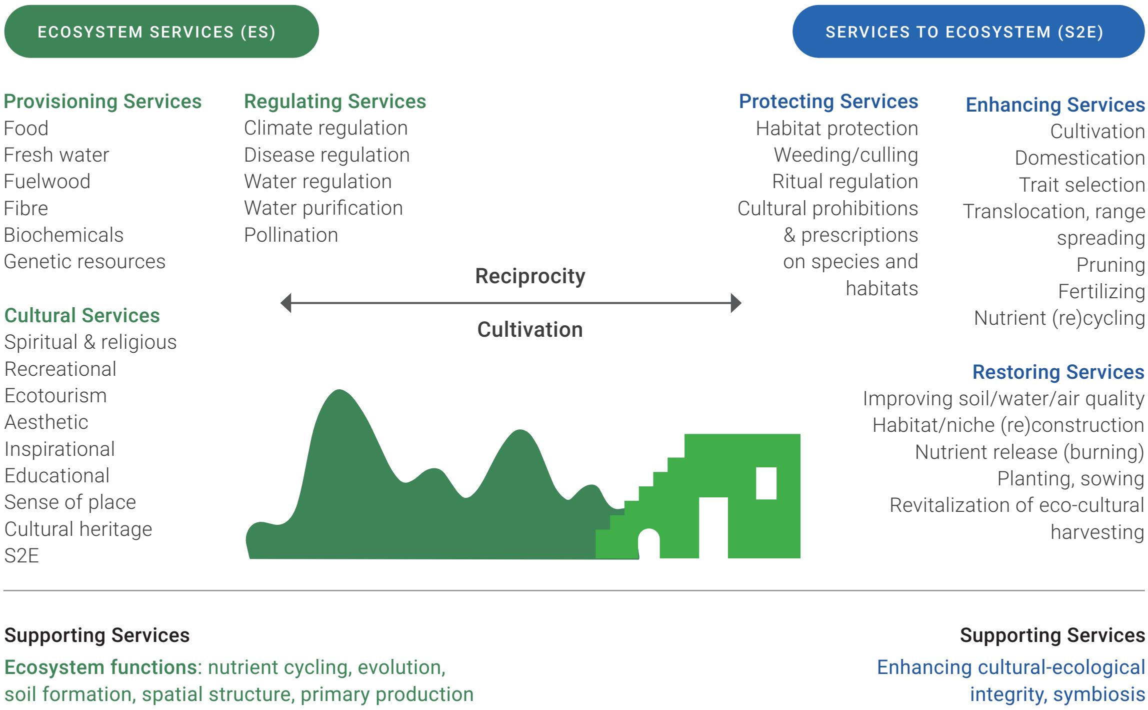
Box 2.1. **Services to ecosystems**

The concept of ecosystem services may also consider that humans often contribute to the maintenance and enhancement of ecosystems, as often evidenced (but not exclusively) in many traditional and indigenous societies. This advances the concept of "services to ecosystems" (S2E), closing the loop of the reciprocal relationship between humans and ecosystems, and summarizing the activities involved in ecosystem protection, enhancement and restoration. S2E seeks to modify ecosystems to enhance the quality or quantity of the ecosystem services they provide, whilst maintaining the general health and resilience of the ecosystem over time.

Source: Comberti *et al.* (2015)

15 For a discussion on a conceptual framework used to understand nature's contribution to people, please see Diaz *et al.* (2015).

Figure 2.2 **Reciprocal ecosystem services and services to ecosystems**



Source: Comberti *et al*. (2015)

The biodiversity in ecosystems provides the raw materials, structures, functions and processes needed to sustain people and livelihoods and protect them from the impacts of climate change.

When the ecosystems delivering these services are protected, enhanced and/or restored, they contribute to resilient communities that have an enhanced capacity to cope with and adapt to the impacts of dangerous weather events and climate change. The concept of ecosystem services, widely understood as the "benefits that humans receive from the natural functioning of healthy ecosystems", (Millennium Ecosystem Assessment [MA] 2005), depicts a one-way flow of services from ecosystems to people. By considering all activities undertaken by communities and institutions to manage and restore ecosystems for safeguarding the natural resource base and strengthening climate resilience (i.e., services to ecosystems), however, the reciprocal relationship between societies and nature becomes clear (figure 2.2).

Development choices can contribute to keeping ecosystems healthy, functional and capable of delivering the four main categories of ecosystem services depicted in figure 2.1: provisioning services such as food, fuel and water; regulating services, such as natural hazard mitigation, erosion control and water purification; supporting services, such as soil formation and nutrient cycling; and providing cultural services, such as recreational and other non-material benefits (Munang *et al.* 2013, p. 47) Millennium Ecosystem Assessment [MA] 2005).

Functionally diverse ecosystems offer a full spectrum of supporting, regulating and provisioning services, each operating according to factors such as climate, geology, successional status, etc. The interaction between adjoining ecosystems supports landscape-scale ecological processes (Castellanos *et al.* 2008) as follows:

- **Forest and woodland ecosystems** provide provisioning services such as food, fibre, fresh water and medicines, as well as important regulating services to purify air, conserve soils, control floods and control disease outbreaks (Núñez *et al.* 2006). Forests and woodlands are also important for carbon sequestration.

- **Dryland ecosystems** provide many of these same services, although to lesser degree as a function of local climate and relative abundance of vegetation.[16]

16 For detail about the services provided by dryland ecosystems, please see Shackleton *et al*. (2007), cited in Castellanos *et al.* (2008).

Box 2.2. Ecosystem loss and degradation exacerbates climate risk

There are important links between development, environmental management, disaster risk reduction and climate adaptation. Approximately 60 per cent of all ecosystem services and up to 70 per cent of regulating services are being degraded or used unsustainably (Munang et al. 2013).

Climate change may further weaken the resilience of vulnerable ecosystems and the IPCC estimates that if the temperature increases by more than 4°C, few ecosystems will be able to adapt. Drivers such as population growth, rapid and inappropriate urban development, international financial pressures, increases in socioeconomic inequalities, failures in governance (e.g., corruption, mismanagement), and environmental degradation are among the main drivers of increased risk and vulnerability (adapted from IPCC 2012:71).

Thus, conservation of biodiversity and maintenance of ecosystem integrity may be a key objective in improving the adaptive capacity of society to cope with climate change extremes (i.e., capability for innovation and anticipation (Armitage 2005); ability to learn from mistakes (Adger 2003); and capacity to generate experience in dealing with change (Berkes *et al.* 2003 – cited in IPCC 2012, p. 443). Maintaining ecosystem integrity may also enhance the adaptive capacity of ecosystems to thrive under climate change impacts.

- **River, lake and wetland ecosystems** are the most valuable sources of water, but they also provide regulating services that control flooding and pollution, retain sediments and reduce disease incidence (Castellanos *et al.* 2008).

- **Coastal wetland ecosystems** provide regulating services, like coastal resilience and buffers for storm surges, as well as provisioning services, like enhanced fish stock.

Biodiversity – from genes, to species, to communities, to whole ecosystems – is often a key determinant of ecosystem functioning and providing ecosystem services:

- Increased biodiversity is generally associated with higher levels of ecosystem services within a given system (Wall and Nielsen 2012).

- Some ecosystem services are provided in part by the abiotic (non-living) components of ecosystems, such as aquifers and inorganic portions of soils.

- Biodiversity increases the chances that one or more species will be able to continue to perform critical functions, even in the event of disturbance or species loss (e.g., natural disaster and human-induced land use change).

- Biodiversity can be considered a form of "biological insurance" that helps to ensure ecosystem performance, including providing ecosystem services.[17]

Healthy ecosystems that are rich in biodiversity deliver multiple services that play a central role in adjusting to climate change (i.e., providing adaptation services) (table 2.1). All the functions of biodiversity and the services provided by the natural processes of healthy ecosystems described above, enhance the overall resilience of society (i.e., their livelihoods and economic sectors) to climate change. They play a central role in adjusting to climate change and buffering extreme events. As described in table 2.1, outcome indicators will assist in monitoring the results of EbA measures so that we learn and constantly improve ecosystem management, facilitating better adaption to a changing environment.

Many ecosystems are facing multiple threats. The International Union for Conservation of Nature (IUCN) has developed a "red list" of ecosystems to complement the endangered species red list. Assessments for the ecosystems red list determine whether an ecosystem is not facing imminent risk of collapse, or whether it is vulnerable, endangered or critically endangered, by assessing losses in area, degradation or other major changes such as land conversion.

Concerning scale, the 2005 Millennium Ecosystem Assessment noted that ecosystem functions and services typically have clearer effects at (i) a particular location or region; and (ii) at a particular moment in time or season. For instance, food production is a localized service of an agroecological ecosystem and changes on a weekly basis; water regulation is regional and changes on a monthly or seasonal basis; and climate regulation may take place at a global scale over decades.

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17 A discussion of biodiversity as a form of biological insurance can be found at the following: Balvanera et al. (2006); Cardinale *et al.* (2012); Naeem and Li (1999) as cited in Garbach *et al.* (2014).

Table 2.1. **Examples of EbA solutions in five ecosystems**

CLIMATE CHANGE IMPACT TARGETED	EBA MEASURE	ELEMENTS OF OUTCOME INDICATORS
Wetlands: Flooding and increased invasive species resulting from extreme rainfall, raising temperatures and increasingly frequent and severe storms	Wetland rehabilitation to reduce flood damage, enable groundwater recharge, improve water quality, and enhance food and income security	Frequency and severity of floods Measures of flood damage Agricultural yields and income
	Wetland protection to encourage growth of spawning nursery grounds and allow vegetation regeneration for flood protection	Measures of species abundance and diversity Measures of water quality Frequency and severity of floods Measures of flood damage Agricultural yields and income
Mountains: Flooding and sediment deposition resulting from extreme rainfall, rainfall variability and increasingly frequent and severe storms	Riparian reforestation/rehabilitation along riverbanks to slow runoff and capture sediment before it reaches the watercourse, thus limiting downstream damage to property and livelihoods	Frequency and severity of floods Sediment load Measures of flood damage (to infrastructure, households, crops)
Drylands: Drought, desertification and soil erosion due to increasing temperatures, reduced and more variable rainfall, and increasingly frequent, severe wind and sand storms	Establishment of a multi-use desert Green Belt to increase water availability, improve soil quality, provide shade and windbreaks, thus improving food and income security	Extent of protective vegetation cover Measures of wind/sandstorm impact Measures of soil quality Water availability Agricultural yields and income (home consumption and market)
Urban: Flooding and soil erosion resulting from extreme rainfall and increasingly frequent and severe storms	Urban reforestation to slow runoff and stabilize soil, thus protecting infrastructure and buildings from flooding, undermining and siltation	Frequency and severity of floods Measures of soil erosion Measures of flood damage to infrastructure and buildings
Coasts: Sea level rise, flooding, coastal erosion and saline intrusion resulting from rising temperatures and increasingly frequent and severe storm surges	Mangrove restoration/ rehabilitation to reduce wave energy, erosion and storm surge water levels, thus limiting coastal flooding, saline intrusion and damage to property and livelihoods	Extent of coastal erosion Frequency and severity of floods Salinity levels in groundwater and farmlands Agricultural yields and income Measures of flood/storm damage

Source: Ecosystem-based Adaptation Briefing Note Series (UNEP 2019)

Understanding the dynamics of ecological systems, the functional interactions, and how they evolve and adapt to changing environments, has been challenging for ecologists and planners (Reuter *et al.* 2010). Gradually, a clearer comprehension of the functioning of landscapes (or social-ecological systems) has emerged, along with how these work as a "dynamic living network" (Ostrom 2007). The management of ecosystems, therefore, requires scale-appropriate information about the condition, dynamics and use of multiple, and often interacting, ecosystem services.[18] The dynamics of ecological systems makes it imperative for NAP implementation managers to practice adaptive management. Adaptive management and resilience were brought to global attention by C.S. Holling, when he famously said, "adaptive management is not really much more than common sense" (Holling 1978). He referred to common practice in product design in which information from the first stages is used to adapt the final outcome to greater advantage.

Some tools, such as the Opportunity Mapping Tool, collect and overlay spatial data on climate hazards, ecosystem functions and exposed communities (box 2.3). This can assist planners and policymakers, for example, by identifying ecosystems providing flood regulation services to people, assets or infrastructure at risk (Sturck, Poortinga and Verbing 2014).

18 For more on using scale-appropriate information to manage ecosystems, please see: Raudsepp-Hearne and Peterson (2016).

Box 2.3. Opportunity Mapping Tool (OMT) assisting EbA actions

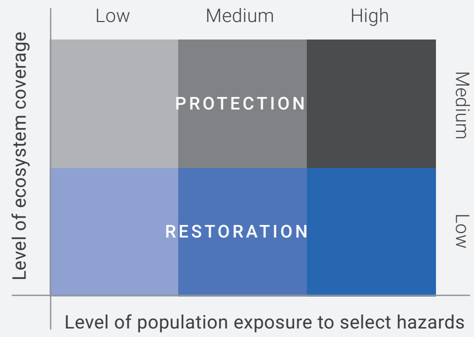
The OMT offers cross-mapping of ecosystem distribution and human exposure to hazards at a global scale. By overlaying global datasets on ecosystem distribution and hazard exposure, the OMT highlights areas where ecosystem restoration and/or protection can be used to protect the greatest number of people globally. Currently, the tool uses information on the distribution of forests, mangroves, seagrasses and coral reefs, although the online tool offers the possibility to add other datasets. The hazards currently in the tool are landslides, tropical cyclones and storm surges, tsunamis and river flooding. These hazards are combined with population density to calculate exposure. Other data sets can be added.

The OMT identifies areas where either ecosystem protection or restoration would be needed to protect people. Areas where there is an overlap between population exposure to hazards and low ecosystem coverage (i.e., because they have been depleted, degraded or damaged), are highlighted as areas with opportunities for restoration to reduce disaster risk. In areas where ecosystem coverage and population exposure to certain hazards is high, ecosystem protection (e.g., through the establishment of protected areas) can further reduce disaster risk by ensuring that ecosystems stay healthy and protect people and assets.

The OMT could assist EbA planning by guiding adaptation practitioners in the selection and prioritization of critical ecosystems to manage to reduce the impacts of climate hazards, such as flooding. Adding climate change scenarios to the tool would ensure that nature-based solutions are sustainable in the long term.

The OMT can facilitate the mainstreaming of EbA in national and local adaptation plans, as well as ensuring coherence with disaster risk reduction plans, by providing a robust, science-based foundation to decision making. See how the OMT is being applied in Colombia in chapter 3.

Ecosystem-based Disaster Risk Reduction/Adaptation opportunity categories (UNEP 2020).



Source: UNEP (2020)

For more information visit: https://pedrr.org/mapping-eco-drr-opportunities/
Contact: Karen Sudmeier at karen.sudmeier@un.org
Further resources: Sudmeier-Rieux, K., Nehren, U., Sandholz, S. and Doswald, N. (2019). *Disasters and Ecosystems, Resilience in a Changing Climate – Source Book.* Geneva: UNEP and Cologne: TH Köln – University of Applied Sciences. https://postconflict.unep.ch/DRR/EcoDRR_Source_Book.pdf
UNDRR (2021) Words into Action Guidelines on Nature-based Solutions for Disaster Risk Reduction. Geneva: UNDRR.

Nature and ecosystem functions are not restricted to political borders, either. In the case of transboundary ecosystems, forests, watersheds, rivers, wetlands and coral reefs, their functions, processes and services may benefit people in two or more countries. Transboundary ecosystems will necessitate increased collaboration between neighbouring countries.

Therefore, adopting a landscape/seascape approach when working with nature is important, because it can help identify competing land uses.

2.3. Impact of climate change on ecosystems and ecosystem services

Climate change impacts, including increased risk of floods, droughts, landslides and soil erosion, are degrading ecosystems and their ability to provide services important to people, as well as directly causing harm to people, their property and production (table 2.2).

This cumulative chain of impacts, in turn, puts people under increased pressure to resort to unsustainable ecosystem use and management, further degrading ecosystems and their capacity to deliver services (box 2.4). Assessing climate change risks requires assessing and modelling the magnitude of impacts in the impact chain to pinpoint the biggest vulnerabilities to climate change and, hence, where solutions might be found.

In marine and coastal ecosystems, fish stocks are declining globally, largely due to overharvesting. Even though, ocean acidification caused by global warming also play its part affecting key biodiversity indicators such as e.g., the distribution and abundance of species.

In drylands, climate change, including rising temperatures and reduced rainfall, interact with human drivers, such as unsustainable land use, exacerbating water shortages, soil erosion and desertification. As a result, dryland-based populations are extremely vulnerable, as they depend on rain-fed agriculture and cattle grazing for their livelihoods.

Table 2.2. **Impacts of climate change on ecosystems**

CLIMATE IMPACTS ON:	EXAMPLES OF ECOSYSTEM CHANGES
Behaviour and morphology changes due to increasing temperatures	Distribution of species – drift to the top of mountains Seeking shade or refuge from extreme temperatures Altering feeding times to avoid the hottest parts of the day Migration of animals to cooler climates, including fish species Morphological changes in body size and wing length in migratory birds
Seasonal timing of recurring biological events	Earlier starts to breeding seasons or migration Altered timing of phytoplankton blooms and coral reef spawning Advances in winter spawning of fish species Possible mistiming of reproduction leading to increased predation
Geographic range shifts	Plant and animal species shift poleward, upward, or to greater depths, with possible negative impacts on recipient communities
Evolutionary changes	Genetic changes in the population and strong selection pressures that may favour adaptation to changing climates or extirpation before the population can effectively evolve
Primary productivity in ecosystems	Increased carbon dioxide in the atmosphere can increase growth of vegetation if other factors are not limiting Phytoplankton growth rates affect carbon dioxide uptake in seawater Melting ice cover can increase vegetative cover at higher latitudes
Species interactions	Food web structures and functions mediated by species interaction may change with species distribution changes Predator-prey relations may change, especially among higher trophic levels Increased spread of alien invasive species that are opportunistic to changing conditions
Ecosystem resilience to extreme events	Climate change may increase the incidence and severity of forest fires, drought, heatwaves and floods, which affect the ability of ecosystems to rebound Coral reef bleaching due to increasing sea temperatures and reduced time for recovery may lead to reef deaths, impacting fish communities and coastlines

Source: Weiskopf *et al.* (2020)

People who depend on wetlands are also vulnerable to the increased incidence of climate hazards. Rainfall variability, rising temperatures and more frequent extreme events cause significant changes to wetland hydrological cycles, impact local wildlife and reduce provisioning and regulating services to local communities.

An important consideration for NAP planners and implementers is to understand how climate change may induce ecosystem changes (table 2.2). Thus, careful monitoring, analysis and adaptive management are essential.

2.4. Rationale for the EbA approach

Despite efforts toward mitigation, climate change is already happening and projected to get worse and we are not on track to meet our mitigation goals, therefore adaptation is urgently needed. In addition to those mitigation efforts, countries have been undertaking increasing steps towards adapting to the current and projected effects of climate change. The NAP process is merely the latest phase of planning and prioritizing adaptation strategies and measures. The most vulnerable countries are urgently searching for the best adaptation approaches through capacity building and technology transfer.

First introduced into the UNFCCC negotiations at the fourteenth session of the Conference of the Parties to the UNFCCC in 2008, EbA has been described as:

> *the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change . . . It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change. Ecosystem-based adaptation is most appropriately integrated into broader adaptation and development strategies.*[19]

19 For information about the history of EbA and the role the Secretariat of the Convention on Biological Diversity played to advance the concept, see: Lo (2016).

Box 2.4. Climate impact-chain analysis at the Kigoma region, Tanzania[1]

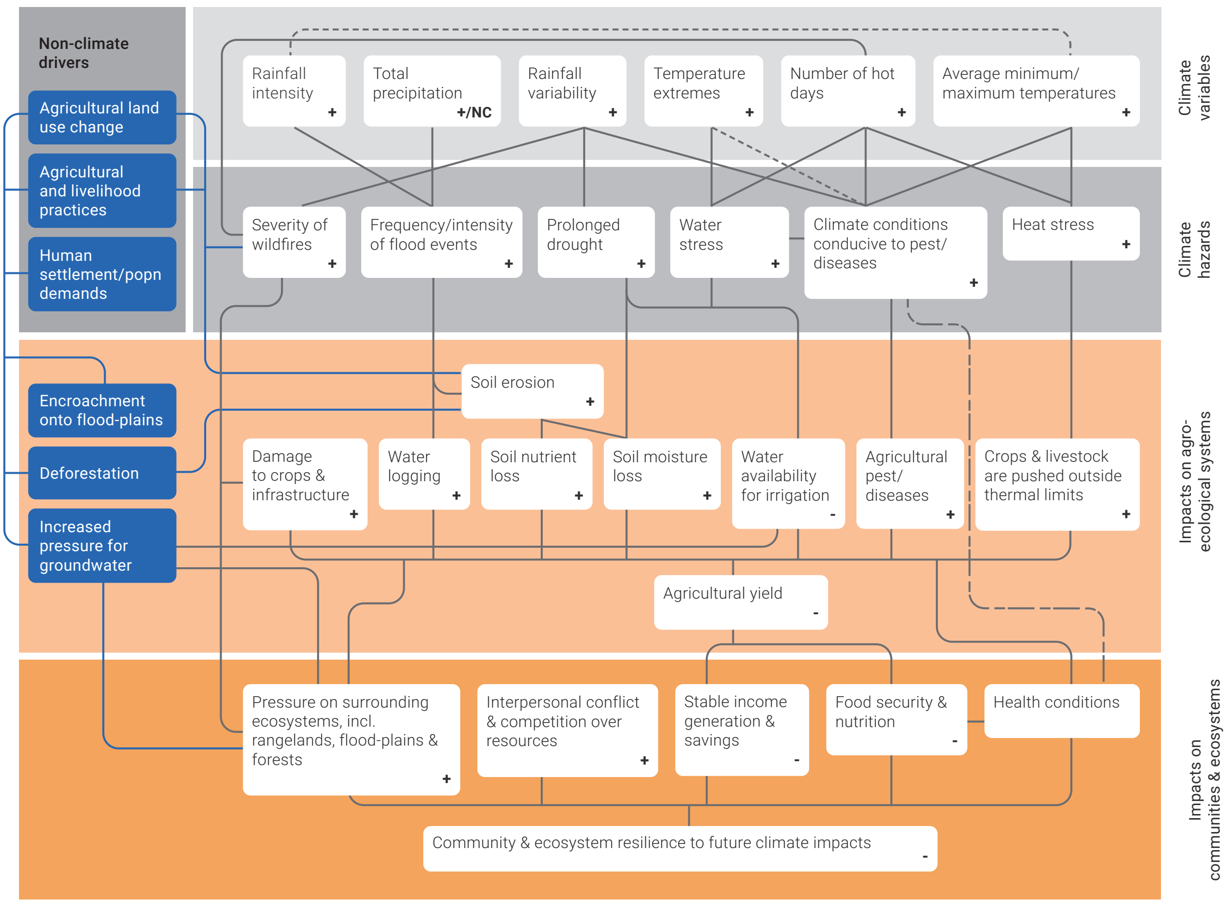
Ecosystem functioning and livelihoods in the Kigoma region, Tanzania are adversely affected by climate variability and climate change, in conjunction with unsustainable land use change and agricultural practices. Long-term accumulation of multiple, sometimes extreme, climate phenomena impact nature and society, increasing the vulnerability of communities to climate hazards and impacts on agriculture and livelihoods. As summarized in the impact chain below, rainfall and temperature change interact to amplify climate hazards such as drought and floods.

Examples of the impact chain include (i) the potential failure of early season rainfall increasing the likelihood of severe and prolonged drought, damaging crops and affecting soil moisture and water availability, further shrinking agricultural yields thus threatening food security; and (ii) increasing frequency and intensity of floods, enhancing waterlogging and soil erosion, leading to increasing pressure on surrounding ecosystems and even conflict over scarce resources.

The region's rainfall-dependent and flood-exposed livelihoods, communities, ecosystems and smallholder income and food supply are particularly fragile. These pressures on livelihoods and impacts on agriculture, also contribute to perpetuating ecosystem degradation through (i) fuel-wood consumption, a historical driver of deforestation, which may increase as climate impacts on agricultural yields compel farmers to seek alternative incomes; and (ii) agricultural land use conversion, which contributes to soil erosion and localized waterlogging associated with high precipitation events.

Impact chain maps are one way of illustrating the potential impacts of climate change pressures in a more holistic and system-oriented way.[2] "A climate impact chain is a general representation of how a given climate stimulus propagates through a system of interest via the direct and indirect impacts it entails".[3] As for the Kigoma region, impact chains can be used to illustrate the current and projected impacts that are, or can be, triggered by the different climate-related hazards.

Climate change impact chain for agroecological systems and smallholder farmers in the host communities in Kigoma region. The **+/-** symbols in each cell represent the directionality of the projected changes. **NC** for 'no change'. Dark grey lines for climate variable-driven impacts; blue lines for the compounding impacts from non-climate drivers. Dashed lines indicate indirect relationships.



Sources: Green Climate Fund (2020); Pramova *et al.* (2013).

All photos on this page: © UNEP

Ecosystem-based adaptation in Tanzania

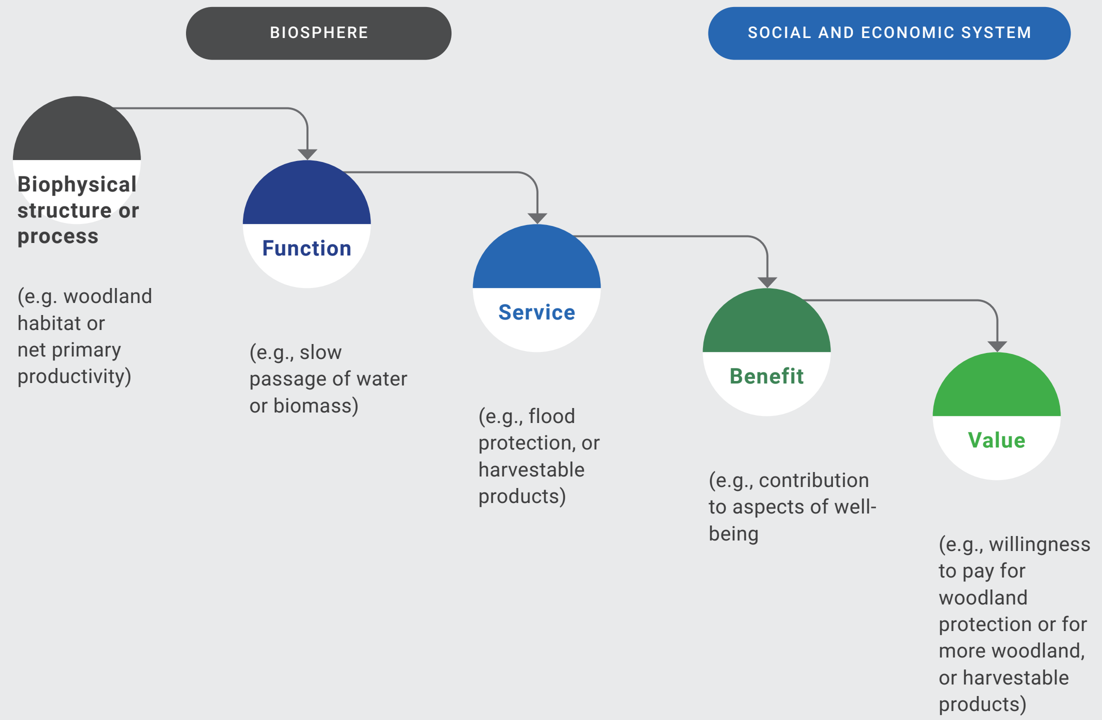
Before a UNEP-supported rainwater harvesting project was set up at Kingani secondary school in the coastal town of Bagamoyo, the drinking water used to be so salty that students would complain of headaches, stomach-aches and ulcers, and they would refuse to drink it or choose to fetch water from natural pools shared with animals that caused widespread diarrhoeal disease

Engineers attach pipes to collect rainwater to large concrete and plastic storage tanks from the roof of Kingani Secondary School in Bagamoyo, to provide students with fresh water for drinking, cooking and washing.

Students at Bagamoyo Secondary School now have more time to study and fewer days off sick thanks to a UNEP-supported rainwater harvesting system providing fresh water to an area where climate change is turning the ground water increasingly salty.

Learn more about UNEP's work on adaptation.

Figure 2.3. **Ecosystem service cascade**[28]



Source: Adapted from Potschin and Haines-Young (2016), cited in Dasgupta (2021)

Managing ecosystems to secure the delivery and flow of provisioning, regulating and other services to enhance the climate resilience of societies and ecosystems is at the core of the EbA concept (figure 2.3). For example, restoring a wetland or a woodland with the aim to mitigate increased frequency of current and future flash foods due to climate change damaging community livelihoods or property, is an example of EbA. Substantial synergies with DRR, and co-benefits for poverty reduction, livelihood diversification, food and water security, carbon sequestration and urban and coastal protection, are among the salient features of EbA.[20]

Despite the multiple benefits to socio-economic systems, which often make EbA cost-effective compared to hard infrastructure adaptation options, this approach is only beginning to be systematically formulated and endorsed at national levels. This should pave the way for EbA to be properly mainstreamed into the policies of all development sectors (e.g., land use, disaster risk management, health, food and water security, and energy among others).

20 For more detail on the salient features of EbA, see Munang *et al*. (2013); Nalau (2018).
21 Conceptual frameworks, such as the cascade, serve several purposes. They can be used, for example, as a communication tool, a jumping-off point for discussion between experts and laypeople. Additionally, they can be used as a way of mapping out basic concepts that can be applied to solving problems (Potschin and Haines-Young 2016, p. 2).

Box 2.5. **Valuation of ecosystem services of wetlands**

The Mapping Ocean Wealth project for south-eastern Australia found the following benefits of ecosystem services provided by coastal wetlands:

- A$35.5 million/year to Australia's nearshore commercial fisheries
- A$33.1 million/year for recreational fishing
- Carbon sequestration by 2050, valued at A$65 million
- Property protection from wave damage of A$2.7 billion
- Protecting 1.02 million people from relocating, saving A$3.6 billion by 2090
- Combined values for Port Phillip and Western Port of A$36.5 million per year, with carbon stocks and coastal protection valued at A$526 million

Source: Carnell, P.E, Reeves, S.E, Nicholson, E., Macreadie, P. Ierodiaconou, D., Young, M., Kelvin, J. *et al.* (2019)

Box 2.6. **Gender and EbA**

The gender dimension of the environment, and in this case EbA, is not obvious to everyone, and thus UNEP has a responsibility to make this knowledge clear to its targeted audience. In 2016, the UN Economic and Social Council adopted a resolution calling on the UN system "to continue to work collaboratively to enhance and accelerate gender mainstreaming". The 2030 Agenda for Sustainable Development envisages "a world in which every women and girl enjoys full gender equality and all legal, social and economic barriers to their empowerment have been removed". In fact, the Paris Agreement is the first universal climate change agreement to call on Parties to promote gender equality and the empowerment of women when taking actions to address climate change. As expressed by OECS (2020) "the unequal burden and differentiated impact [of climate change] are influenced by power dynamics, roles and responsibilities in the household, at community levels and in the labour market with gender norms as a root cause".

Lofty intentions at the global level, therefore, need to be backed up with concrete actions. Some of the barriers that need to be overcome include:

(a) The challenge of bringing local knowledge and experience of diverse groups to influence national and regional policies and strategies;

(b) Territorial, natural resource assets and land ownership challenges when engaging with indigenous groups;

(c) EbA is often too top-down and poorly integrates lessons learned from community-based adaptation; and

(d) Guidelines on integration of gender considerations and local knowledge into adaptation actions have not been integrated sufficiently into previous principles and guidelines for EbA.

This latter challenge has been attempted to be addressed throughout these Supplementary Guidelines. Some of the key steps for gender mainstreaming in EbA projects/programmes include:

(a) Applying an ecosystem and gender equality and social inclusion (GESI) lens to analyse the adaptation context;

(b) Assessing the gender-differentiated vulnerability and risks before deciding on the most effective EbA option;

(c) Demonstrating how the ecosystem services protected provide benefits to women and girls, disadvantaged groups and the disabled;

(d) Designing a GESI action plan to be included as an integral part of the EbA project design;

(e) Ensuring that the GESI action plan is adequately resourced in the project financing; and

(f) Combining EbA and GESI indicators in the monitoring and reporting system.

Source: Organisation of Eastern Caribbean States (2020) Building resilience with nature and gender in the Eastern Caribbean: A toolkit to mainstream EbA, gender equality, and social inclusion.

Many countries have already mapped ecosystems and have taken stock of biodiversity and the existing "natural capital" in their territories, declared protected areas and their buffer zones, and restored productive agroecosystems (box 2.5). Meanwhile, the main socio-economic drivers of land-use change affecting key ecosystems are being identified and evaluated along three dimensions: environmental impacts; actors involved; and policy, governance and financial factors. Therefore, much of the knowledge base of EbA needed to inform decision-making processes and gauge the contribution of ecosystem services to climate-risk reduction is gaining momentum, but much work remains to be done. UNEP stock-taking on climate risk information shows that climate risk is often based on trend analysis rather than simulated risk; is based on large-scale resolution rather than on a planning-unit resolution; does not cover all sectors; and does not incorporate all benefits streams.

EbA can help to achieve the shift from vicious cycles of ecosystem degradation, now being exacerbated by climate change, to the more virtuous dynamics of resilient social-ecological systems. As outlined in chapters 3–5, well designed and implemented EbA approaches generate multiple benefits in addition to protection from climate change impacts, including improved biodiversity protection, enhanced water and food security, alternative livelihood opportunities, improved community health, and reduced disaster risk. If all these benefits are calculated, then EbA becomes a benefit multiplier and an essential community asset, adding to social and natural capital, particularly if the gender dimension of EbA is considered (box 2.6).

CHAPTER

3

Formulation stage in the NAP process

Key messages from Chapter 3: Formulation stage in the NAP process

The NAP process enables countries to formulate and implement NAPs that identify medium and long-term adaptation needs and then develop and implement strategies and programmes to address those needs.

Climate change risk assessments are the key entry points for EbA into NAPs and sector planning and budgets. Use an **ensemble of climate models** to get a spread of results to reduce uncertainty and to help decide which models to select for the climate risk assessment.

The *NAP Technical Guidelines* cover Element A – laying the groundwork and addressing the gaps; Element B – preparatory elements; Element C – implementation strategies; and Element D – reporting, monitoring and review. The EbA Guideline has combined Elements A&B into a “formulation stage”.

For any uncertain future **impacts on biophysical systems**, use analogues of past experience and extrapolate to the range of possible climate change impacts.

The **formulation stage** covers taking stock of climate risk and vulnerability assessments, identifying information gaps, finding entry points for EbA, **engaging with stakeholders,** capacity building, selecting adaptation options, assessing costs and benefits, and documenting the strategies, plans and priority projects.

Use **ecological economics** to demonstrate the economic viability of EbA measures, especially in justifying concessional loans and private sector investment.

Engage with a **wide range of disciplines** and beneficiary groups in the formulation stage.

3.1. Introduction

With the aim of guiding national adaptation practitioners and other stakeholders (such as land or water managers) in charge of the formulation and implementation of the NAPs, this section describes how to start integrating EbA in formulating the NAP. This section highlights the main variables that come into play when integrating EbA into NAPs and points to information that may assist planners, answering some critical questions that may rise when considering EbA (e.g., scales for integrating ecosystem functions and services into national and subnational planning; contribution of nature to resilient development; how to value ecosystem functions, etc.). Building on the previous chapters, key actions to consider for integrating EbA into the formulation stage of the NAP process will be suggested. Box 3.1 highlights some of the key experiences of integrating EbA into completed NAPs to date.

The *NAP Technical Guidelines*[22] set out four steps, from laying the groundwork to reporting, monitoring and review, but for the sake of simplicity, the "formulation" stage in these EbA Guidelines merges Elements A and B, thus providing three complementary phases of the NAP process - formulation, implementation and review.

Some of the basic actions for integrating EbA in the first steps of the NAP process, and for generating an enabling environment for EbA, are addressed here (see summary in table 3.4). Many of these actions also have relevance to subsequent steps and will be reiterated in those stages.

Box 3.1. **Uptake of EbA in NAP processes – a review of 19 completed NAPs**

To understand the extent to which NAPs have incorporated EbA solutions as tool, a NAP Global Network review examined 19 NAPs submitted by national governments to the UNFCCC from 2014 to March 2020. It included six countries from Latin America, seven from Africa and the Middle East, two from the Pacific, one from Asia, and three from the Caribbean.

The NAP documents clearly show that the vulnerability of people and ecosystems is a serious concern, and many countries are seeking adaptation actions that will protect both in a changing climate. All countries made efforts to integrate ecosystems and identified ecosystem services in their submitted NAPs. More importantly, the vulnerabilities of ecosystems to climate change (and sometimes other causes of degradation) and the impact on services they provide were well covered in all NAPs.

Most countries included EbA actions to reduce the threats to —and vulnerabilities of — ecosystems and people they identified in their NAP. However, it was often not made explicit how the individual measures described are linked to (or expected to address) climate-related hazards and risks and deliver measurable adaptation outcomes. For example, the risk of habitat or biodiversity loss might be clearly identified as a vulnerability to climate change, but corresponding EbA actions were not explicit enough to reveal how exactly this climate risk would be addressed, often making it challenging to categorize them as adaptation actions versus business-as-usual conservation measures.

The EbA actions proposed mostly addressed forests and freshwater and coastal ecosystems (also most commonly identified as vulnerable). Marine and coastal ecosystems along with forests were often highlighted as stand-alone sectors or as specific subsectors within a larger ecosystem sector. While mountains/highlands, grasslands and deserts or arid regions were mentioned when characterizing a country's vulnerability, fewer references were made to specific adaptation actions for these ecosystems.

Some countries are starting to link the NAP process and ecosystems to other relevant national strategies and global agendas. All NAP documents published from 2017 onwards, aside from Kiribati, have included a link or direct reference to the SDGs and all Latin American countries connected their NAP to a national biodiversity strategy. This highlights the strategic role the NAP process can play in enhancing coherence between multiple climate-related planning processes.

To accelerate scaling up of ecosystem-based approaches, NAPs must prioritize EbA solutions across sectors as part of an overall strategy to help people adapt to climate change, in particular non-conservation sectors. Further strengthening of monitoring and evaluation of outcomes related to EbA solutions is needed to build the evidence base. Importantly, to ensure EbA solutions are designed to help people adapt (as well as build resilience of ecosystems), they must address a specific climate hazard, generate adaptation benefits for vulnerable groups, build ecosystem resilience, and make sustainable use of biodiversity. Use common EbA effectiveness criteria during the design and appraisal stage of adaptation options to ensure that identified vulnerabilities and adaptation needs are addressed.

Source: IISD (2020)

22 Elements A and B" have been grouped in the "Formulation" stage; "Element C" corresponds to "Implementing" and "Element D" to the "Review" stage (UNFCCC 2012).

3.2. Climate risk assessment

Taking stock: A first step during the formulation stage of the NAP is taking stock of existing climate risk assessments for key economic sectors and regions of the country. To start integrating EbA, verify whether the vulnerability of ecosystems to climate change has been adequately appraised and to what degree. Recognizing the limitations of data and national capacities, the degree of appraisal may encompass spatial coverage, resolution of the risk assessment, which indicators are modelled and analysed, analysis of trend data or modelling/simulations of risks, triangulation of methods, and downscaled climate modelling, as well as stakeholder views.

Taking stock should enhance the scope of risk assessments by identifying fragile ecosystems and sensitive livelihoods exposed to climate variability and climate change hazards (box 3.3). Involve a wide range of disciplines and stakeholders; a climate risk assessment benefits not only from scientific knowledge but also from local, traditional and indigenous knowledge and practices (box 3.2).

The standard approach adopted by UNEP follows the impact chain approach highlighted in chapter 2 and includes (i) developing a national climate change scenario in collaboration with relevant ministries; (ii) preparing downscaled/area-based climate risk projections; (iii) conducting climate risk assessments for primary impacts to ecological parameters; (iv) using those assessments to analyse second-order impacts on economic, social or sector-based parameters; and (v) summarising the findings for decision makers.

Climate change projections: The first step is to establish climate change projections for the country or project/programme area within the country. The most powerful tools used in the simulation of historical and future climate conditions are global climate models (GCMs). GCMs have a relatively coarse spatial resolution, typically 100 kilometres (km) or more. The most advanced GCM projections currently available are those in the CMIP5 data set, which includes outputs from around 40 models in some representative concentration pathways (RCPs). GCMs work at the largest scales (i.e., for climate projections at scales of perhaps 100 km or more), but adaptation planners, risk managers, infrastructure developers and other end users of climate services want climate projections at smaller spatial (and sometimes temporal) scales. Various techniques, both dynamical and statistical, have been used to downscale information from GCMs to regional or smaller scales.

Box 3.2. **Stakeholder engagement: lessons learned from Bonaire**

Marine and terrestrial ecosystems are at the core of Bonaire's tourism industry. Coral reefs, for example, have been coping with the pressures of nutrient-rich runoff from land, overfishing and invasive species. Hurricanes, development and climate change are further altering the island's natural treasures and may continue to do so in the Southern Caribbean, as increased climate variability is expected, along with more frequent and stronger tropical storms, floods, drought and sustained sea level rise.

As part of the TEEB-Netherlands, the Dutch Ministry of Economic Affairs, Agriculture and Innovation commissioned a consulting firm to conduct a study aiming to understand the economic value of nature in Bonaire, and how public interventions could affect ecosystem's health and the island's economy. More than 1,500 citizens, tourists and business leaders were surveyed to understand their reliance on local nature and to calculate the total economic value (TEV) of the island's marine and terrestrial ecosystem services, including the damage that reefs and mangroves prevent by protecting the coast from storms.

The engagement process, designed by the firm, aimed to educate stakeholders on socio-economic valuation and the relevance of ecosystems and ecosystem services to their areas of interest while also giving them the opportunity to provide continuous feedback on the research methods and outcomes. Local and national policymakers, non-profits and industry representatives – including those from tourism, financial services and waste management services – participated. They were also given the chance to review progress throughout the study, enabling all affected groups to understand ecosystem service valuation and the value of nature to the Bonaire economy.

"Champions" were also identified in the community among government and civil society; they spread the word about the results of the study, proselytizing the remarkable value of Bonaire's unique ecosystems… and they were heeded. In 2013 after receiving the TEEB study results, the Dutch government allocated €7.5 million for "overdue maintenance of nature" in the Caribbean Netherlands. The money was destined for coral preservation and improving the synergy between nature, agriculture and tourism. The business, non-profit and governance communities of Bonaire came out of the study with greater knowledge of how to use ecosystem valuations, and the study continues informing decision-making on the island.

Source: TEEB Impact Report, 3rd draft – 22 July 2020 for internal review only.

Dynamical downscaling through regional climate models (RCMs) can resolve more atmospheric processes than GCMs, and at smaller scales, than GCMs. Therefore, RCMs can potentially better resolve local processes involving topography, land surface feedbacks, and convection. The degree to which they "add value" to the driving GCMs varies considerably spatially. Results strongly depend on the GCM boundary conditions used (as those are from statistical downscaling). The Coordinated Regional Downscaling Experiment (CORDEX) experiment, coordinated by the World Climate Research Programme (WCRP), provides a partial set of dynamical downscaling (not all RCMs downscale all GCMs) results forced by the CMIP5 model ensemble on a 25–50 km grid. It provides projections for two RCPs, 4.5 and 8.5, in an ensemble of nine models.

Statistical downscaling, on the other hand, employs statistical methods to determine the state of various surface climatic variables at the local level based on GCM results and observed climate data. Statistical downscaling assumes that regional climate is driven by the state of the climate at the large scale together with the local topography and land cover. Statistical approaches assume that any relationships identified in the observed climate today will also hold in the future under different climatic conditions, and that any changes in regional feedbacks or climate processes will not change those relationships.

Self-organizing maps (SOMs) is a statistical technique that identifies clusters of general circulation models with similar temperature and precipitation results. For example, the relationship between precipitation change and average temperature change can be mapped across an ensemble of general circulation models; clusters of these models reporting similar results can be easily seen, enabling a view on the most likely direction and magnitude of change.

Climate change scenario analysis should determine the hazard indicators and parameters most important to the impacts and risks being assessed, such as the following:

INDICATORS/EVENTS	PARAMETERS TO BE ASSESSED AND MODELLED
Temperature (T)	Minimum, mean and maximum
Precipitation (P)	Minimum, mean and maximum
Evapotranspiration (ETP)	Mean
Wind	Direction and speed
Heatwaves	Consecutive days with T>X°C
Heavy rain	Number of days with P>X mm
Drought	Consecutive number of dry days
Water balance deficit	Average P-ETP

Key messages in addressing uncertainty:

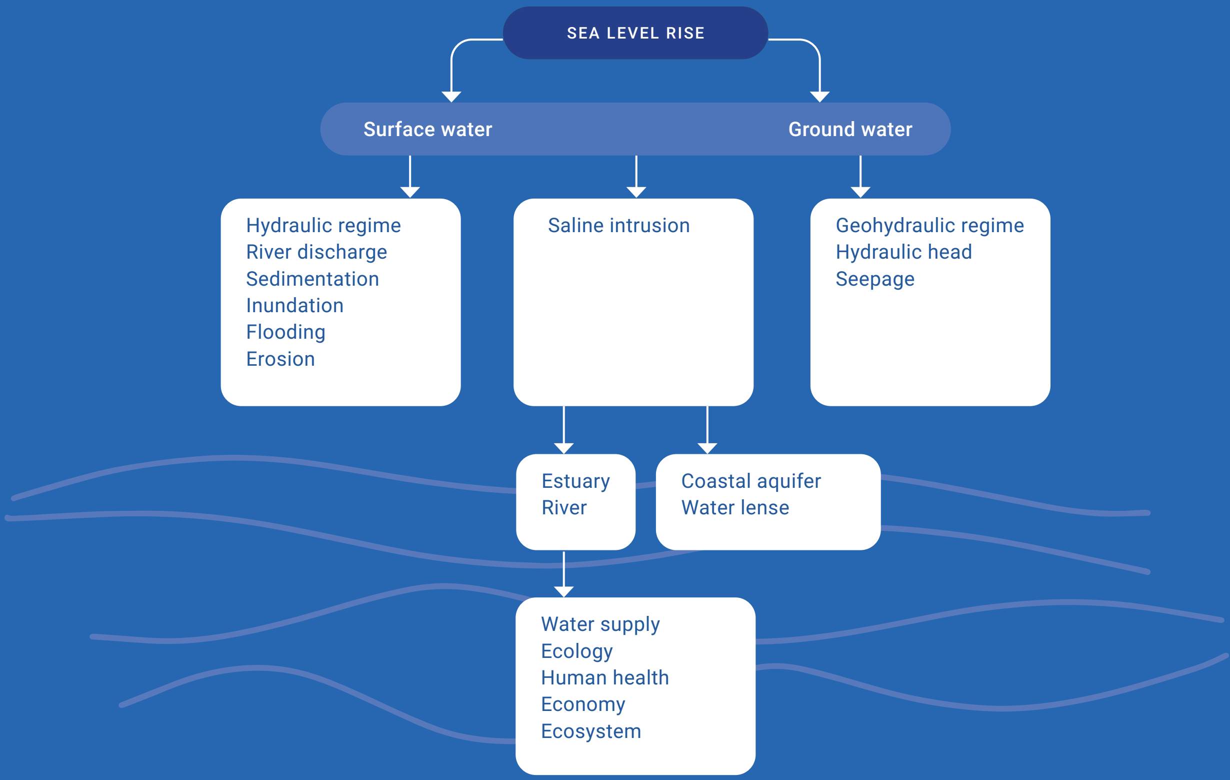
- **Uncertainty in climate projections:** use an ensemble of climate models to get a spread of results, and to help decide which models to select for the climate risk assessment; and
- **Uncertainty in impacts on biophysical systems:** use analogues of past experience and extrapolate to the range of possible climate change impacts.

Climate change risk assessment: Impact assessment should consider the different impact pathways. For example, sea level increase will have implications on the coastal dynamics of the nearshore environment, such as river baseline, discharge and energy for erosion and sedimentation. Implications will extend beyond the physical dynamics: for example, sea level rise can increase salinization further upstream in the estuaries and facilitate saline intrusion. Saline intrusion leads to a decline in water quality in surface and groundwater, impacting long-term water supply and the ecological balance. The extent of saline intrusion in an estuarine system is influenced by: (i) fresh water flow and tidal mixing; and (ii) anthropogenic activities such as clearing of mangroves. Salt-sensitive habitats, and associated plants and animals, could also be negatively impacted as saline waters intrude upstream of the estuary.

Next steps would be to establish impacts and risks using (i) trend data and/or expert opinion on impacts from climatic events; and (ii) evaluate changes in return periods and risks arising from climate change scenario analysis, based on expert knowledge and information of historic impacts and/or using future climate change scenario results in impact assessment models to assess risk at the local area level.

All impact causes – environmental, social and economic- should be studied as the basis for consideration of adaptation strategies that could be followed to mitigate the risk. For example, in an assessment of impacts and risks for a coastal location in Mozambique, the following were assessed to be the main causes of saline intrusion – a mix of climate change and socio-economic drivers (see table 3.1).

Figure 3.1. **Impacts of sea level rise on coastal ecosystems**



Source: Provision of Specialist Consultancy Services for a Climate Modelling Specialist and GIS Mapping Expert to Support GCF Full Funding Proposal Development in Mozambique, 4 August 2020.

Table 3.1. **Saline intrusion causes in Mozambique**

CAUSE	INDICATORS
Sea level rise	Result of salt intrusion trends (1990–2050)
Drought	Result of salt intrusion trends (1990–2050) Below-average rainfall for the period 1998–2018 Community survey indicated irregular rainfall and drought
Storm surge	Result of salt intrusion trends (1990–2050) Vulnerability of the Mozambican coast to cyclones, tropical depressions, and storms
Urbanization/habitation in mangrove forests	Expansion of villages into mangrove forests, including Liberdade; Torrone velho; Icidua, Chirangano; Janeiro; Cualane A. 7 de Abril; Sangariveira; Bazar; Micajune A; Micajune B; Manhaua B; Chuabo Dembe; Bairro Novo and Filipe Samuel Magaia

Source: Provision of Specialist Consultancy Services for a Climate Modelling Specialist and GIS Mapping Expert to Support GCF Full Funding Proposal Development in Mozambique, 4 August 2020.

Box 3.3. Indices for climate change vulnerability/risk assessment

Given the complexity of vulnerability, a single aggregate measure of climate-related vulnerability or risk is probably not the best approach to provide useful, comprehensive information for climate change adaptation planning, because it is not possible to disaggregate precise factors contributing to vulnerability or risk. Good measures of vulnerability or risk should be able to simultaneously capture the dynamic nature (changes over time and places), severity (including risk and thresholds), and perception of vulnerability. FAO Technical Paper No. 597 has summarized innovations that have been made to capture such complexity through the development of composite indices.

INDEX NAME	DESCRIPTION, COMPONENTS	ORIGIN AND EXAMPLE REPORTED APPLICATIONS
Livelihood Vulnerability Index (LVI)	Combines seven components: livelihoods, sociodemographics, social networks, health, natural disasters and climate variability, food and water security.	Hahn, Riederer and Foster (2009)
Coastal Vulnerability Index (CVI)	Incorporates geological and physical indicators (geomorphology, shoreline change rate, mean significant wave height, mean tide range, coastal slope and sea level rise) to identify risks related to sea level rise.	Gornitz (1990) ; McLaughlin, McKenna and Cooper (2002); Dwarakish *et al.* (2009); Duriyapong and Nakhapakorn (2011)
Multiscale CVI	Integrates the impacts of coastal erosion in the CVI. Uses indicators of coastal characteristics, coastal forcing and socio-economic status.	Mclaughlin and Cooper (2010)
Climate Sensitivity Index (CSI)	Includes two components that represent the influence of extreme events on agriculture (dryness and monsoon dependence) in order to measure sensitivity under exposure to climate change.	O'Brien *et al.* (2004)
Physical Process Vulnerability Index (PVI)	Formed by four variables: coastal erosion rate, coastal slope, mean tidal range, and mean wave height. Used combined with the SVI to assess coastal vulnerability.	Duriyapong and Nakhapakorn (2011)
Composite vulnerability Index	Incorporates 16 separate natural and socio-economic variables to measure the disparity between communities and regions exposed to related hazards.	Szlafsztein and Sterr (2007)
Socio-economic Vulnerability Index (SVI)	Composed of four variables: land use, population density, roads/railways, and cultural heritage. Used combined with the PVI to assess coastal vulnerability.	Ebert *et al.* (2008); Duriyapong and Nakhapakorn (2011)

Source: Brugère and De Young (2015)

For more information, please read: FAO Technical Paper No. 597: http://www.fao.org/3/i5109e/i5109e.pdf
EAF-Nansen Programme contribution towards climate change risks and vulnerability assessments in fisheries and aquaculture (21 December 2020): http://www.fao.org/in-action/eaf-nansen/news-events/detail-events/en/c/1366117/

Assess the contributions healthy ecosystems have been making to health, livelihoods and key economic sectors. These may be at risk already due to ecosystem degradation and loss and may come under additional stress due to climate change. Assessing degradation would actually be really useful for pinpointing areas for EbA as suggested by opportunity mapping (box 3.4). The contributions made by healthy ecosystems to society will assist in making the case for the value of sound ecosystem management and EbA not only for NAPs but also for broader development agendas related to the SDGs, disaster risk management, and resilient development planning. While there is no standard approach for measuring ecosystem health, some of the key factors are measures of ecosystem functions such as respiration, primary productivity, metabolism and decomposition, high biodiversity or provision of specific ecosystem services (O'Brien *et al.* 2016).

Box 3.4. Using the Opportunity Mapping Tool in Colombia

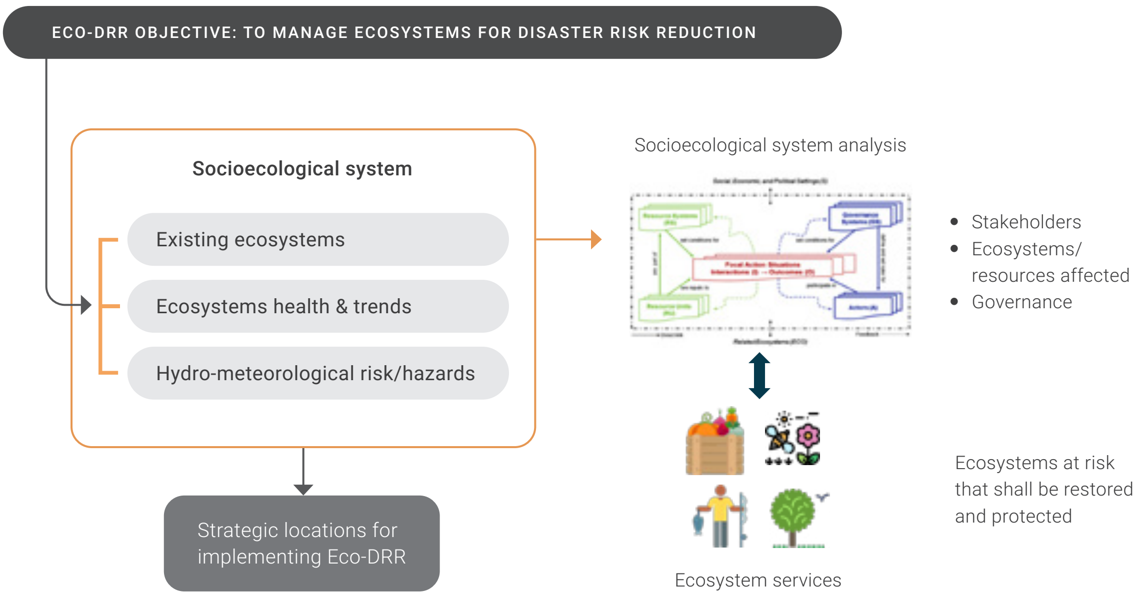
Colombia has one of the highest biodiversity indices in the world, generating a great wealth to the country but also making planning of the different territories challenging. The Ministry of Environment and Sustainable Development has been adapting the Opportunity Mapping Tool (OMT) to the national context, by developing a methodology using existing data and information generally produced at the watershed scale. Three key aspects are being considered for the implementation of ecosystem-based risk reduction actions (Eco-DRR): (i) the types of hydrometeorological hazards affecting a given territory and causing the greatest losses and damages in recent decades; (ii) which ecosystems exist in each region; and (iii) the status of these ecosystems.

Due to the geographic and ecosystem complexity of the country, the tool has been adapted not only to consider the vegetation coverage but also to define the ecosystems in each watershed planning unit that can contribute to climate-risk reduction. For example, wetlands, riparian forests and, to a lesser extent, basal forests, play a fundamental role in buffering flood hazards. Hence, planners need to (i) appraise the ecosystem health to assess the flood risk reduction capability and the necessity for restoration, rehabilitation, recovery or protection to enhance the flood regulation capacities; and (ii) to assess the socio-ecological system in which the climate risk is developing.

This twofold analysis can reveal the underlying causes of climate risk, the factors influencing it, the ecosystem services affected, the key actors related to the ecosystems and the associated hazards, as well as the different formal and informal rules and norms that affect land use, risk reduction and adaptation options for that region. The OMT analysis helps to prioritize sectors and ecosystems to manage, contributing to risk reduction and strengthening the adaptive capacity of local communities. Furthermore, the analysis enables actors to learn and prepare ecosystems, institutions and budgets to adapt to the long-term effects of climate change. According to Colombia's NAP Roadmap, adaptation planning shall include, along with information on disaster risk and climate variability, climate trends and scenarios describing the changes expected in the different regions of the country.

Source: Directorate of Climate Change and Risk Management of the Ministry of Environment and Sustainable Development of Colombia (2020). For more information, please contact: onieto@minambiente.gov.co – ngarzon@minambiente.gov.co.
Ministry of Environment and Sustainable Development of Colombia: www.minambiente.gov.co

Key aspects for developing Eco-DRR in Colombia



Source: Olga Nieto Moreno (Ministry of Environment and Sustainable Development-Colombia)

Box 3.5. Climate Information Platform @climateinformation.org

Using climate science to identify how climate variability and change contribute to climate impacts, and selecting effective actions based on that knowledge, prevents actors from selecting actions that may inadvertently lead to maladaptation. Avoiding maladaptation requires paying attention to multiple climate and non-climate contributing factors and to future impacts of proposed interventions to ensure that their selection and implementation do not somehow erode sustainable development.

As a resource for developing the climate science basis for climate action, the WMO, GCF and the Swedish Meteorological and Hydrological Institute have collaborated to develop a Climate Information Platform (CIP) for users to access site-specific climate data and information. The Climate Information Platform (CIP) provides access to:

- Pre-calculated climate and water indicators (from CMIP5 and CORDEX at different grid resolutions and catchment scales), key summaries, confidence metrics, guidance and visualizations.
- Climpact, to help users generate sector-specific climate information from daily observed historical temperature and precipitation data to calculate context-specific and high-impact event indicators. Climpact indices, for example, describe the frequency, duration and intensity of various climate extremes at monthly and annual resolution. The indices can also be calculated to identify high-impact events, or climate extremes, including heatwaves, cold spells, meteorological droughts and precipitation extremes.
- The Site-Specific Report, in which the user can select a location by filling in a city, coordinates, or by clicking directly on the integrated global map. This tool provides a climate overview for a specific region where it is possible to sort indicators by magnitude of change and robustness.

Planning frameworks and adaptation/EbA activities are enhanced, as the CIP assembles and provides access to the most reliable hydroclimatic data and technical resources for climate science inputs. The CIP offers guidance on relevant data and tools needed to prepare a climate science basis for climate actions, including EbA. It provides easy access to many climate and water indicators produced from quality-assured, state-of-the-art climate models from global and regional model inter-comparison projects. These come in the form of interactive maps, charts and summary reports concerning climate change for any location on the globe, as well as instructions on how to combine global sources with locally generated data. CIP ensures a better understanding of climate impacts useful to select scientifically grounded actions that will improve associated EbA outcomes.

The tool is freely accessible: https://climateinformation.org. Four pilot countries have successfully used it to develop the climate science basis for climate action, including EbA, for GCF-funded activities. Several LDCs are currently being supported to develop their NAPs through the CIP.

For more information, contact: wmo@wmo.int
Website: public.wmo.int

Identify the main information gaps in climate and ecosystems. For example, identify the extent that policies and planning instruments for agriculture and livestock, protected area management, coastal zone management and tourism, among others, have considered ecosystem functions and services, the impact of climate change on ecosystems important for each sector, and the potential contribution that EbA can make to alleviate the climate risks.

The multilateral development banks (MDBs), for example, routinely screen potential projects for risks resulting from factors related to changes in temperature, rainfall, wind speed, solar radiation, water availability, flooding, tropical storms, wildfire, permafrost, sea ice, snow loading, landslides and wind speed. The MDBs and other international organizations are always prepared to offer advice on risk assessment and climate projections.

The Climate Information Platform is one of many such sources of climate-risk information (box 3.5), while the ecosystem-based climate-risk assessment tool (box 3.6) is contributing to national climate change scenarios and risk assessments, and science-based climate risk assessment in marine ecosystems assists in planning marine protected areas (box 3.7).

Regarding the use of tools for EbA, many organizations have delivered guides that are accessible online. Finding the right tool for the national context remains complicated. But fortunately, there is emerging guidance, such as the EbA Tools Navigator described in box 3.8.

Photo: @ UNEP

Box 3.6. **Ecosystem-based climate-risk assessments and downscaling climate change scenarios as part of the NAP process in Iraq**

As part of "Building Capacity to Advance National Adaptation Plan (NAP) Process in Iraq", the GCF-funded NAP project aims to address knowledge gaps by (i) developing downscaled/area-based climate change projections and applying a cost-effective and replicable methodology; and (ii) producing and developing ecosystem-based climate risk assessments, at the national and subnational levels, in one or two types of ecosystems.

The ecosystem-based climate risk assessments (Eb-CRA) tool focuses on the impacts of climate change on natural factors and ecosystems, such as soil erosion, river flows and forest and rangeland productivity as well as agricultural variables such as crop production and livestock productivity and health. Some advantages of the Eb-CRA tool are:

- The Eb-CRA tool is applicable to all ecosystems, from agricultural parcels to watersheds and whole landscape units.
- Eb-CRA may prove useful for adaptation initiatives, assisting with the identification of vulnerable ecosystems in terms of their exposure and sensitivity to climate hazards.
- Eb-CRA will assist at prioritizing specific biomes to be managed and restored and shall guide zoning exercises to improve the effectiveness of land use planning instruments at any scale and contributing to mainstreaming of a systemic approach to development planning.
- Eb-CRA will contribute to developing nationally owned climate change scenarios and risk assessments, based on best available techniques and data, to be used as the basis for national and subnational climate change adaptation planning.

The downscaled climate change projections and scenarios may become key sources of information to the risk assessments and in the selection of the most suitable adaptation measures to respond to spatially localized hazards, and for better understanding of ecosystems functions and services for adaptation. Downscaling is intended to reduce the degrees of uncertainty regarding climate change impacts and guide towards the most cost-effective adaptation options.

In terms of capacity building needs for the use of these tools, adaptation practitioners are to be trained on accessing and using climate modelling applications and the methods for assessing the vulnerability of ecosystems. Further, capacities are to be strengthened in the analysis, interpretation and communication of spatial and climatic data. Strengthening skills for carrying out risk assessments at local level and linking results to spatial land use planning is to be considered.

UNEP and its partner institutions expect to apply these tools in the NAP portfolio (16 countries), thus facilitating the integration of EbA into development planning, budgeting processes and NAPs.

Box 3.7. Science-based climate risk assessment: fisheries and marine ecology in Saint Lucia

Climate science contributes to a better understanding of the susceptibility of socio-ecological systems to climate change and to the selection of EbA measures. It assists at making clear the relationships among the Earth system's components and their disturbances and perturbations. It further helps users identify past, present and future climate conditions affecting society and the environment and select effective actions under current and anticipated climate conditions.

Some of the impacts of climate variability and change affecting SIDS include coral bleaching, increasing intensity of storms together with increased sea level, and the formation of Sargassum rafts - particularly in the wider Caribbean region. These climate impacts have damaged critical fish habitats and fishery assets and disrupted fishing and tourism operations. Derived impacts hit the economy (tourism, fisheries, nautical activities), the environment (perturbation of marine species, beach erosion) and health aspects of the communities (decomposition of algae and release of H_2S).

EbA science-based solutions may assist in addressing these types of impacts and shall have implications for improving biodiversity and the livelihoods for fisherfolk, people and assets in the tourism and fishery sector of SIDS. To apply science-based solutions, an ongoing project led by WMO at the Caribbean island of Saint Lucia is following a four-step process that draws on three categories of climate indicators: (i) state of the climate indicators; (ii) context-specific climate indicators; and (iii) high-impact events indicators.

Photo: Katrina Mulfati

These categories of indicators can be used to describe the past and current state of climate, as well as to project future climate conditions. In this project, science-based solutions are building a robust base for selecting and prioritizing the following EbA options:

- **Coral reef restoration:** selecting massive coral species; training local scientists and marine stakeholders in micro fragmentation techniques; propagating 5,000 fragments of coral; out-planting exercises to nearby coral reefs; and a three-year monitoring program of the growth, survival and resilience of fragments facing extreme heat stress events.

- **Establishment of a network of Marine Managed Areas (MMA):** each MMA is divided into: Marine Reserves, Fishing Priority Areas, Multiple Use Areas, Yacht Mooring Areas and Recreational Areas designated to conserve the natural marine environment and ensure sustainable use and development of the fishing and tourism sectors. A sustainable financing mechanism would be needed to support MMA, such as public-private partnerships that involve the tourism sector.

- **Sargassum early warning and management:** communicating reliable long and medium-term forecasts of Sargassum arrivals is critical. Hence, integrating predictions from the sub-regional Sargassum outlook bulletin into the Fisheries Early Warning and Emergency Response (FEWER) mobile app, can communicate the implications of forecasts to the fisheries sector in a simple format so that stakeholders can easily understand and benefit from the forecasts.

EbA grounded on context-specific climate information increases the likelihood of EbA achieving its intended results. A climate science basis for EbA action draws on climate-related priorities through NAPs. This creates an opportunity for enhancing the contribution of climate information services to the NAP process and the implementation of EbA options by countries. An evidence-based approach allows addressing risks arising from climate variability and change: (i) provides greater certainty that an intervention is more likely to address impacts in any given area of focus; (ii) accommodates for better upfront planning and design of investments; and (iii) mitigates potential risks. These advantages constitute opportunities for fostering the science-policy interface and removing hindrances to accessing climate finance.

Source: WMO-GCF (forthcoming), Guide for Developing the Climate Science Basis for GCF Funded Activities, Annex II – Case Study Report – World Meteorological Association [WMO]; Chatenoux and Wolf (2013).

THE STAGE OF THEIR INTERVENTION
(e.g., assessment, planning, design, M&E, etc.)

ECOSYSTEM TYPE

TARGET AUDIENCE AND LANGUAGE

SCALE OF IMPLEMENTATION

TYPE OF RESOURCE
(e.g., guidance, training material, computer applications, etc.)

Box 3.8.

The EbA Tools Navigator: a catalogue of ecosystem-based adaptation tools for planning and decision-making

There are many tools and methods available to support EbA, but it is challenging for planners and practitioners to access information about these options and decide on the right tool for their context and needs. The tools covered in the Tools Navigator, put together by IIED, IUCN and GIZ, can be applied in a range of contexts, and information is provided to help EbA practitioners choose the tools most appropriate to their needs.

Currently, the Navigator includes a collection of more than 240 different tools, methodologies and guidelines designed for people working at global, regional, national, subnational and local levels in a variety of ecosystems. Tools for specific ecosystems are also available, such as for: agricultural areas; drylands and deserts; forests and woodlands; inland waters; coastal/marine wetland ecosystems; mountains; rangelands and grasslands; and urban settings.

Tools in the catalogue are relevant to a range of sectors for (i) addressing a variety of vulnerabilities, hazards and impacts; and (ii) planning, implementing and mainstreaming EbA. The catalogue currently includes around 50 tools designed to support mainstreaming of EbA into policies and plans. Furthermore, EbA planners and practitioners can search for tools according to categories such as:

For each tool, the Navigator also provides information on aspects such as (i) objectives and level of skills/training required; and (ii) examples of user experiences.

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For more information on the EbA Tools Navigator please refer to: Tool Navigator website: https://www.iied.org/tools-for-ecosystem-based-adaptation-new-navigator-now-available

Project webpage: www.iied.org/ecosystem-based-approaches-climate-change-adaptation

All photos on this page: © UNEP

CityAdapt: building climate resilience of urban systems through ecosystem-based adaptation (EbA) in Latin America and the Caribbean

This project aims to address the vulnerability of urban communities to climate change in three medium-sized cities: San Salvador (El Salvador), Kingston (Jamaica) and Xalapa (Mexico) through the implementation of EbA approaches and their integration into urban planning.

In Xalapa, revegetation and soil conservation will be undertaken along a stream using species adapted to flooding. At the urban landscape scale, permeable walkways will be constructed to promote rainwater infiltration, and an artificial wetland and a riparian park will be established. At the household scale, ecological sanitation plans will be developed, and rainwater harvesting systems constructed at schools and public buildings.

In San Salvador, a degraded watershed will be restored with reforestation and conservation agriculture approaches. This will reduce runoff and erosion during heavy rainfall and increase ground water recharge.

Learn more about UNEP's work on adaptation.

3.3. Formulating and choosing adaptation options, including EbA

Entry points for EbA: Look for entry points, or opportunities to insert EbA approaches, in different policy-making processes at national and subnational levels and in adaptation planning and sector planning processes. Periodic reviews and updates of national policies and plans are suitable entry points for incorporating ecosystem-based approaches, which can then be referred to in the NAP. The national plans, allocation of resources, and the institutional processes that govern resource allocation all play a particular role in shaping a country's risk profile as well as its development and climate change adaptation priorities. Climate public expenditure and institutional reviews (CPEIR) look at the extent of mainstreaming climate change into government-wide budgeting processes. Understanding a country's planning and budgeting processes allows entry points to be identified and ecological concerns mainstreamed. Hence, they also offer different opportunities during the NAP process, for considering the role of nature and mainstreaming EbA into adaptation and development planning.

Stakeholder mapping: Once entry points have been identified during the formulation stage, fully engage with relevant stakeholders, including those who may provide the required information on climate and ecosystems and those well-positioned to influence the planning, budgeting and policy-making processes. Setting the political scene for mainstreaming EbA in the NAP process, informing policies and plans with the best available science, and having an impact at sectoral and subnational levels, depend on engaging with the right people (including those who may not be convinced of the value of the EbA approach). Power and influence mapping is a useful tool to guide the stakeholder engagement strategy, based on where each group's influence is mapped.

Capacity building: Most developing countries do not have extensive human resources available to study ecosystems or the impact of climate change on ecosystems, let alone the capacity to fully integrate EbA into NAPs. With the assistance of a local university or other experts, conduct a capacity needs assessment to identify training needs and opportunities. Begin the process of strengthening capacities responding to the national context and the country's priorities in development planning, ecosystem management and adaptation, bearing in mind that this will be an ongoing requirement. Capacity building may start with (i) climate risk assessment; (ii) vulnerability assessment of ecosystems to climate change; (iii) ecosystem services assessment; and (iv) the institutional enabling environment for EbA, among others.

Selection of adaptation options: the following criteria can be considered to help to choose an EbA option ahead of a hard infrastructure option, bearing in mind that the optimal arrangement may be a hybrid "green-grey" adaptation combination:

- Can the EbA option be mobilized quickly or is there a long gestation time (e.g., requiring a nursery to be established to grow out planting material)?
- Does the local community have the necessary capacity to implement the EbA option or is it necessary to bring in external experts (e.g., using Lidar mapping and coastal dynamic modelling to plan effective beach replenishment)?
- Are the operation and maintenance requirements more difficult (or more costly) than the alternative infrastructure approach (e.g., do fire-sensitive species need regular maintenance of fire breaks)?
- Is the EbA measure sufficiently robust to alleviate longer term climate impacts or is it likely to provide only short-term relief?
- Can the EbA measure be given a trial, without incurring large costs, and potentially scaled up if the trial proves successful?
- Has a similar EbA approach been adopted elsewhere (in the same country or internationally) and proven to be superior to the infrastructure approach in that context?
- Are the co-benefits of sufficient magnitude to outweigh the direct benefits of the alternative infrastructure option?

Once the entry points for mainstreaming EbA are identified, a key challenge is to identify and prioritize the adaptation options available. There is no single, unified source of information on all adaptation options, although there are several useful compilations. A good starting point may be the UNFCCC Nairobi Work Programme's knowledge-to-action hub for climate resilience and adaptation.[23]

Generally, adaptation options can be categorized into (i) increasing adaptive capacity (or resilience); (ii) reducing vulnerability to climate risks; and (iii) creating opportunities while also minimizing climate risks and reducing exposure. Adaptive capacity may be increased by providing climate change information and raising awareness about the potential of EbA, creating, or strengthening supportive social structures, and improving governance through laws, regulations, and institutional strengthening that mandate consideration of EbA options.

23 For more information on the UNFCC Nairobi Work Programme, please see: https://www4.unfccc.int/sites/NWPStaging/Pages/NWP-knowledge-resources.aspx

Other ways of categorizing adaptation options are (i) by sector (e.g., the FAO Adaptation Toolbox, which is set out in Poulain *et al.* (2018) providing a portfolio of climate adaptation tools and methods recommended and currently available to governments, industries and individual fishers and fish farmers); (ii) by urgency of action; or (iii) by the distinction between reactive or precautionary actions and between planned or autonomous actions. Sometimes there is also a largely artificial distinction between adaptation that addresses natural systems (e.g., coral reef restoration) and human systems (e.g., early warning systems). Planned adaptation results from a specific policy or strategic decision (usually by government), whereas autonomous adaption is often the kind of action that a private company or household might take to protect their assets against looming damage.

While it is impossible to cover all sectors here, some examples will illustrate the wide range of options that sector managers will need to consider, as they attempt to mainstream EbA into national development and sector plans. The options that may fall under EbA are in the majority and are identified in italics.

Agriculture: In the agriculture sector, typical adaptation options include (i) *changing to more climate resistant crops and/or livestock*; (ii) *changing key cropping dates*; (iii) *soil conservation measures*; (iv) water storage and/or irrigation systems for drought periods; (v) *flood protection through wetland management*; (vi) *stubble management*; (vii) land levelling; and (viii) alternate wetting and drying for rice production; (ix) *creation or designation of refuge/aquatic environments for propagation, juvenile nursing and restoration of damaged habitats* that play a key role in fisheries production and livelihoods; and (x) *promotion of Integrated Multi-Trophic Aquaculture (IMTA)*, among others. Collectively, these options are often referred to as climate-smart agriculture. For fisheries and aquaculture, options include (i) creation or designation of refuge/aquatic environments for propagation, juvenile nursing and restoration of damaged habitats that play a key role in fisheries production and livelihoods; and (ii) promotion of Integrated Multi-Trophic Aquaculture, among others. FAO Technical Paper No. 627 has provided a comprehensive Adaptation Toolbox that offers a consolidated summary of available adaptation tools and strategies for capture fisheries and aquaculture (Watkiss *et al.* 2019).

Water Resources: Some key water resource adaptation options include (i) *water storage and conservation*; (ii) *wastewater reclamation and reuse*; (iii) drip irrigation; (iv) desalination; (v) *watershed management*; (vi) *flood-plain management*; (vii) *riverbank erosion prevention*; (viii) evaporation control; (ix) *riparian vegetation management*; and (x) rainfall seeding. Most of these options fall under the general term climate smart water resources management.

Tourism: Many of the world's tourism destinations, especially in SIDS, are on the coast, which is being affected by sea level rise, storm surges, coastal erosion and saline intrusion into groundwater. Typical adaptation options for the coastal zone include (i) *beach replenishment*; (ii) *mangrove planting*; (iii) *ridge-to-reef conservation*; (iv) seawalls and revetments; (v) *dune replanting*; (vi) *coral reef protection and/or restoration*; (vii) relocation away from the coast; (viii) rainwater tanks; and (ix) desalination. Highland tourism, especially in ski resorts, is also being devastated by increasing temperatures due to climate change, with few adaptation options available other than artificial snow and changing from winter to summer tourism attractions. Some mountain-related adaptation options include control of landslides/rockfall and sustainable forest management.

Cities: As most of the world's population is moving to live in urban areas, the impacts of climate change through increased temperatures (e.g., heatwaves), urban flooding, water scarcity and health impacts (e.g., from water-borne diseases and insect disease vectors) are increasingly of concern to cities around the world. Various adaptation options have been identified for cities including (i) *increased tree planting to reduce temperatures*; (ii) cooling stations; (iii) changes to building codes; (iv) *flood protection bunds*; (v) *improved drainage systems*; (vi) *rooftop greenery and water storage*; (vii) changes to zoning ordinances; (viii) improved groundwater management; (ix) *absorptive pavements and increased infiltration* (sometimes referred to as sponge cities); (x) *sustainable drainage systems*; (xi) *green belts and corridors*; (xii) *urban wetlands* (table 3.2).

Infrastructure: In the past, infrastructure engineering design used historical weather and flood information (return period probabilities). But with the rise of climate change, this is no longer possible – all infrastructure now needs to be climate-proofed against future climate conditions. Climate proofing includes options such as (i) increased bridge and road surface heights; (ii) increased culvert and drainage dimensions; (iii) climate-resistant road surface materials; (iv) *increased protection against wind shear*; (v) relocation away from hazardous areas like flood-plains or coastal zones; (vi) elevating electrical and control equipment; (vii) retrofitting infrastructure; (viii) changing maintenance schedules; (ix) *using, enhancing or recreating natural or semi-natural systems such as wetlands, riparian vegetation or dune revegetation to protect vital infrastructure*; (x) *eco-safe roads that use slope vegetation to protect road cuttings in mountainous areas*; and (xi) physical protection such as seawalls or flood protection bunds. Note that climate-proofing refers to the process, not the outcome, as some residual damage may still occur (OECD 2018).

Table 3.2. **Ecosystem-based adaptation options for cities and intended outcomes**

EBA REMEDY	URBAN CHALLENGE	OUTCOME INDICATORS	ECOSYSTEM SERVICE	SDG
Urban reforestation: Boulevards, greenbelts, arboretums, grove cooperatives	Flooding and soil erosion Air quality Shade	Severity of flooding Soil erosion metrics Flood damage metrics	Supporting: nutrient cycling, soil formation Provisioning: clean air, fuel Regulating: climate, flooding	11, 3, 9,13, 15,16, 17
Green space creation: Parks, conservation areas, stream restoration, community gardens, groves	Heat islands, heat stress Droughts Air quality Shade	Canopy cover Microclimate temperature and humidity	Supporting: nutrient cycling, soil formation Provisioning: clean air, heat relief, fuel Regulating: climate, water purification Cultural: aesthetic, educational, spiritual, recreationa	11, 3, 4, 9, 10, 13, 15, 16, 17
Flood risk management zones: Walkways, bikeways, community gardens, playing fields	Flooding Transportation blockage	Infrastructure damage due to flooding; Compare commuting times	Supporting: nutrient cycling, soil formation Provisioning: transport corridors, food growing space Regulating: climate, flood Cultural: aesthetic, educational, recreational	2, 3, 4, 6, 9, 10, 11, 13
Rainwater harvesting: Grey water supply, run-off diversion, urban gardens, community gardens,	Drought Flooding	Measure of rain accumulated and diverted from drains; usage domestically or for specific purpose	Supporting: nutrient cycling, soil formation Provisioning: water, food Regulating: climate, flood Cultural: aesthetic, educational	11, 2, 3, 4, 5, 6, 9, 10
Permeable pavements Aquifer recharge and water storage, runoff diversion, walkway safety	Drought Flooding Land subsidence	Groundwater levels; recharge rates; run off; subsidence rates as compared to baselines	Provisioning: water Regulating: flood, water shortages Supporting: nutrient cycling, soil formation Cultural: aesthetic, recreational	3, 6, 9, 11, 12, 13
Water purification: Urban gardens, water features in parks, artificial wetlands	Water and sanitation	Measurement of contaminant counts as sediments settle, algae and bacteria, etc.	Supporting: nutrient cycling, soil formation Regulating: climate, flood, water purification Cultural: aesthetic, recreational	11, 6
Nature connecting corridors: Conservation areas, bird and plant habitats, pollinators, water features, community gardens	Biodiversity loss Habitat fragmentation Water quality	Inventory of biodiversity Measure water and air quality	Supporting: nutrient cycling, soil formation Regulating: climate, flood, water purification Cultural: aesthetic, spiritual, educational, recreational	3, 4, 9, 10, 11, 15
Urban design/layout: Zoning for air circulation and 15-minute city; resilience design; planning connectivity; green spaces; food production	Urban canyons Air pollution Food deserts	Compare wind speeds and air pollution before and after or unrestored vs. restored	Supporting: nutrient cycling, soil formation	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13
Green ventilation corridors: Conservation areas, green hinterland	Inversion layer formation Heat islands	Measure temperatures at bottom of corridor vs. blocked areas	Supporting: nutrient cycling, soil formation Provisioning: clean air, heat relief Regulating: climate, flood Cultural: aesthetic, recreational, educational	3, 4, 7, 9, 10, 11, 13, 15
Urban utility services: Composting biodegradable by-products; extracting biogas; production of biosolids from water treatment processes; providing quality fertilizer to food producers	Accumulation of biological waste and subsequent pollution Health issues from decomposing material	Amount of fertilizer sold to outlying farm enterprises; amount of fuel produced; savings of circular economy approach over dumping or landfill	Supporting: nutrient cycling, soil formation, primary production Provisioning: clean water, air, fuel, fertilizer Regulating: climate, disease regulation, water purification Cultural: aesthetic, educational	2, 3, 5, 6, 7, 11, 12, 13

Source: Based on UNEP (2021b)

Adaptation options can also be defined according to ecosystems. For example, in mountain ecosystems, climate impacts affect not only mountain communities but also all downstream communities that may be at risk of glacial lake outburst floods, flash floods, avalanches, landslides and sediment flows (box 3.9). Accordingly, as part of a landscape approach, whole watersheds or river basins must be treated as the adaptation planning unit (box 3.10).

Box 3.9. **Examples of EbA actions for mountain ecosystems**

- Disaster risk reduction: flood-plain protection and management, community-based early warning for preparedness and reducing flood impact on mountain ecosystems; reforestation or forest conservation to stabilize slopes and reduce the risk of landslides and avalanches.
- Watershed protection: reforestation or forest conservation in watersheds to enhance water provision and soil conservation.
- Reforestation along riverbanks and flood-plains to reduce flooding and siltation.
- Water conservation, management and harvesting.
- Agroforestry to enhance soil fertility and moisture and shade for crops.
- Agroecological farming practices, including enhancing habitats for natural pest control, and using organic fertilizers and compost to boost soil fertility and moisture.
- Mixed cropping to enhance soil fertility and nutrition; and genetic diversification using resilient local landraces to reduce the risk of crop failure.
- Plant/animal breeding and selection by farmers and participatory breeding with scientists.
- Use of medicinal plants and wild foods to boost health and nutrition.
- Restoration and management of highland pastures for livestock and carbon storage.
- Sustainable landscape management for conservation of wild resources, water, agroecosystems and grazing lands, including strengthening collective land tenure and institutions.

Source: Swiderska, K, King-Okumu, C and Monirul Islam, M (2018) Ecosystem-based adaptation: a handbook for EbA in mountain, dryland and coastal ecosystems. IIED, London.

In dryland ecosystems, the absence or scarcity of water may be the dominant climate change impact, rather than increases in precipitation and flooding (box 3.11). Overuse of dryland ecosystems combined with climate change may lead to desertification, so much of the attention in dryland ecosystems is on maintaining or restoring healthy vegetation coverage.

While the physical adaptation options listed above are important, equal importance should be given to non-physical and behavioural change options. These include (i) changes to laws, regulations, planning restrictions and zoning plans; (ii) information and awareness raising; (iii) education and training; (iv) early warning systems; (v) research and development of new tools and techniques; and (vi) financial innovations, incentives and insurance schemes. Behavioural changes may include avoidance of outside work and exercise in heatwave conditions, changes in cultural norms (e.g., Japan's change to CoolBiz clothing instead of suit and tie), public participation in climate change planning, and increased volunteering to assist more vulnerable community members.

Costs and benefits: Become fully informed about the potential costs and benefits of EbA to facilitate comparison between costs and benefits of EbA options against hard infrastructure approaches to adaptation (box 3.12). Note that "costs and benefits" covers economic, social and environmental assessments in addition to financial assessments. EbA costs may include long-term operation and maintenance costs, relocation of existing land users, park ranger costs, planting materials, earth-moving equipment (e.g., for reshaping sand dunes, or soil conservation works), monitoring and surveillance, etc. Benefit streams may include enhanced biodiversity, livelihood improvements, improved community cooperation, environmental pollution control, etc. Note that many of the EbA costs and benefits will not be market-based or have an established price, so economic analysis may need to use proxy measures, such as willingness to pay or willingness to accept compensation.

For the EbA approach to gain momentum during the formulation stage, it must be supported by evidence. Assess and verify the multiple benefits and cost-effectiveness of including healthy ecosystems as part of an overall adaptation strategy. Where EbA proves to be a practical option, articulate this approach within the national NAP long-term vision, building on subnational and national planning processes. A strong case will make EbA attractive to subnational governments, economic sectors and communities concerned about the impacts of climate change on their natural resources base and their own development pathways. Also address EbA potential trade-offs and managing the uncertainty associated with climate change and ecosystem functions in the long term, bearing in mind that ecosystems will undergo changes with or without being exacerbated by climate change.

Box 3.10.

Floods, communities and ecosystem-based adaptation in the Hindu Kush

Background:
The Hindu Kush Himalaya (HKH) is one of the most dynamic and complex mountain systems in the world. Floods, particularly flash floods, are major hazards threatening mountain communities. The dangers are compounded by climate change. Communities along tributaries are especially vulnerable because they receive less attention from governments and other agencies. Community-based Flood Early Warning Systems (CBFEWS) can provide flood information and offer remedies to seasonal hazards, but only if the information reaches those vulnerable communities.

Community flood preparedness across borders in the Koshi River basin:
The Koshi River drains a large region in the east-central Himalayas, flowing from Tibet through Nepal and joining the Ganga in India. In 2015, the International Centre for Integrated Mountain Development (ICIMOD) initiated the Community Based Flood and Glacial Lake Outburst Risk Reduction Project (CFGORRP) in partnership with Nepal's Department of Hydrology and Meteorology (DHM) to implement CBFEWS along a Koshi tributary, the Ratu. The CBFEWS approach, developed and implemented by ICIMOD, is an integrated system of tools managed by and for communities. When the system detects rising flood waters, monitoring caretakers send real-time early warnings downstream using phone calls, SMS or online messaging apps. Those receiving the warnings convey the alert to communities, as well as to other relevant stakeholders and disaster management authorities, to mobilize the necessary flood response measures. In 2017, a caretaker sent early warning information, generated by a transboundary CBFEWS, down the Ratu tributary, saving lives and livelihoods. The system provided almost eight hours of lead time for downstream communities in India to prepare and evacuate.

"Our settlements and farms would have been completely inundated and left covered with sand and sediment if not for the embankment and the training we received."

Chandra Giri, after the 2017 flood event in, Udaypur District, Nepal

Connecting with ecosystem-based adaptation:
CFGORRP and DHM, supported by UNDP/GEF, integrated nature-based interventions like embankments, gabion revetment, and several bioengineering measures when implementing CBFEWS in Udaypur District, Nepal. ICIMOD, in close consultation with vulnerable communities and local line agencies, also worked to raise awareness on flood risk management. For example, a flood-proofing drainage system draws water away from fields and homes in Nainhi Village, Nepal. In dry seasons the system can switch to irrigation, raising villager's agricultural productivity through all seasons. These flood-plain protection and management approaches are further strengthened by integrating EbA approaches like soil amendments, watershed management and land use planning to reduce vulnerability. ICIMOD is working to enhance the resilience of communities and ecosystems by supporting thorough assessments, gender integration and nature-based interventions that benefit biodiversity and sustain ecosystem services for people. With improved, low-cost technology, community engagement and integration of ecosystem-based adaptation approaches, ICIMOD aims to work with governments and other agencies to deliver CBFEWS to more communities. The CBFEWS also contributes to Sustainable Development Goal 13 on climate action by addressing climate risks. The system contributes to national adaptation planning through its long-term programmatic approaches.

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Box 3.11.

Examples of EbA actions for dryland ecosystems

- Watershed planning and conservation to integrate urban water needs and supply systems with the surrounding watersheds and user groups.
- Disaster preparedness and early warning to prevent and ensure alternatives for damaging maladaptation that occur during drought emergencies – such as vegetation removal, overextraction of water, breaking resource-use conventions, invasion of reserves and private properties or conflicts.
- Water harvesting: conservation and recharge of groundwater for use during dry periods and droughts using water-harvesting practices and configuration of vegetation to maximize water capture and percolation.
- Flood-plain management to harness and conserve floodwaters and prevent damage due to flash flooding.
- Conservation and restoration of forests and other natural vegetation to stabilize slopes (including sand dunes), prevent landslides, protect and restore watersheds and regulate water flows to prevent flash flooding.
- Conservation and restoration of rangelands to enhance vegetation cover, hydrological processes, carbon sequestration, livestock productivity and landscape amenities.
- Agroecological farming and agroforestry systems to cope with increasingly variable and extreme climates (such as shade trees to create microclimates or soil improvements using manure).
- Integrating human settlements with well-adapted low-energy vegetation and drainage systems.
- Integrating plants and water for cooling and air conditioning within settlements and buildings.

Box 3.12. Economic analysis of EbA and engineering options for climate change adaptation in Lami Town, Republic of the Fiji Islands

Guiding decision makers in the selection of adaptation options is critical for implementing the most efficient adaptation approaches for every local context. Cost-benefit analysis (CBA) is useful for comparing adaptation options such as infrastructure and EbA.

Located between steep mountains to the north and extensive mangroves on the coastline, Lami Town is part of the greater Suva area, where half of Fiji's urban population resides. The mountainous terrain and small river system make flooding events common at the Lami Town, particularly when the island is hit by tropical cyclones. Flooding, erosion and landslides damage property, infrastructure and cause the loss of human life.

Climate change projections indicate that Fiji might expect higher temperatures, sea level rise of 11–21cm by 2025, and increased intensity and frequency of extreme rainfall. The town's geographical situation presents several options for climate change adaptation, including the use of Lami's natural capital: mangrove forest, mudflats, seagrass meadows and coral reefs. Some of the services provided by these ecosystems along the shoreline include protection from cyclones, storm surges and flooding, as well as support of subsistence and commercial fisheries and pollutant filtration.

The Lami Town Council proposed several adaptation responses: (i) EbA; (ii) social/policy options; and (iii) engineering options. The CBA team conducted a least-cost analysis for ranking the adaptation options and calculated avoided damages and the estimated value of ecosystem service benefits of each type of ecosystem. For the CBA analysis, four scenarios ranging from EbA to engineering adaptation options for storm protection were developed (table below).

The CBA suggests that one of the best alternatives to protect Lami from storm damage is by combining EbA and engineering actions. Lami Town could implement targeted engineering options, but within a general EbA approach, as the results of the benefit-cost analysis shows that the EbA scenario offers the highest benefit-to-cost ratio.

This strategy would allow for preserving the high benefits from the EbA interventions as well as enhancing the protection from storms given by hybrid and engineering options using a mix of adaptation solutions.

Benefit-cost ratio for each scenario

SCENARIO		BENEFIT-TO-COST RATIO ($FJD)	ASSUMED DAMAGE AVOIDANCE
1	**Ecosystem-based options**	19.50	10–25%
2	**Emphasis on ecosystem-based options**	15.00	25%
3	**Emphasis on engineering options**	8.00	25%
4	**Engineering options**	9.00	25–50%

Source: Rao *et al.* (2013)

Whatever the selected range of possible adaptation options, the tools and techniques for prioritization generally fall into the following categories (i) economic, least cost, cost-effectiveness, or cost-benefit analysis; (ii) multi-criteria analysis; (iii) qualitative matrices; (iv) scenarios; and (v) barrier analysis. These are briefly described below.

Cost-benefit analysis (CBA): Economic analysis of climate change adaptation options is an input to decision making, but it should not be the only ranking process. Economic analysis tells us nothing about the political, legal, social, environmental or cultural acceptability of the options. CBA does provide information on the contribution of an adaptation project to society's overall welfare, but not all impacts can be reduced to monetary terms. While CBA for climate change adaptation projects is, in principle, no different than the economic analysis of any development project, it should be acknowledged that the uncertainty surrounding climate change projections does suggest that additional sensitivity analysis and inputs from various stakeholders may be needed, not least to accommodate the non-economic aspects of decision-making.

Table 3.3. **Ecosystem services valuation methods**

VALUATION METHOD	APPROACH
Choice modelling (discrete choice experiment; conjoint analysis)	Ask people to make trade-offs between ES and other goods or income to elicit willingness to pay
Contingent valuation	Ask people to state their willingness to pay for an ES through surveys
Damage cost avoided	Estimate damage avoided due to ecosystem service
Defensive expenditure	Expenditure on protection of ES
Group valuation (participatory valuation)	Ask groups of stakeholders to state their willingness to pay for an ES through group discussion
Hedonic pricing	Estimate influence of environmental characteristics on price of marketed goods
Input-output modelling	Quantifies the interdependencies between economic sectors in order to measure the impacts of changes in one sector to other sectors in the economy. Ecosystems can be incorporated as distinct sectors
Market prices (gross revenue)	Prices for ES that are directly observed in markets
Net factor income (residual value; resource rent)	Revenue from sales of ecosystem-related goods minus cost of other inputs
Opportunity cost	The next-highest valued use of the resources used to produce an ecosystem service
Production function	Statistical estimation of production function for a marketed good including an ES input
Public pricing	Public expenditure or monetary incentives (taxes/subsidies) for ES as an indicator of value
Replacement cost	Estimate the cost of replacing an ES with an artificially generated service
Restoration cost	Estimate cost of restoring degraded ecosystems to ensure provision of ES
Social cost of carbon	The monetary value of damages caused by emitting one tonne of CO_2 in a given year. The social cost of carbon (SCC), therefore, also represents the value of damages avoided for a one tonne reduction in emissions
Travel cost	Estimate demand for ecosystem recreation sites using data on travel costs and visit rates
Value transfer (benefits transfer)	Estimate the ES value for a "policy site" using existing information from a different "study site(s)"

Source: Brander *et al.* (2018)

In essence CBA is quite simple – identify all the costs and all the benefits of each adaptation option, then convert the sum of each to a ratio, referred to as the benefit-cost ratio. If the ratio is greater than 1, then the option is judged to be economically viable. The option with the highest benefit-cost ratio becomes the logical first choice from an economic perspective. Of course, the devil is in the details – obtaining accurate data for every cost and every benefit is hard enough for items with a market price; it is doubly hard for non-marketed goods, services and benefits. Proxy prices, like willingness to pay or willingness to accept compensation, can be used where there are no market prices, and this approach is often essential for EbA options. Table 3.3 provides a non-exhaustive list of ecosystem services valuations methods.

An economic comparison between the hard infrastructure options and the ecosystem-based options does not always favour the latter (Black *et al.* 2016). In South Africa, the comparison of wetland restoration to the usual approach of drilling boreholes and supplemental feeding for livestock found that EbA from the perspective of the landowners was twice as costly as the existing practice. In other situations, the reverse is true! For example, in Fiji, EbA options such as

Table 3.4. **Framework of EbA benefits, costs and impacts**

BENEFITS	COSTS	IMPACTS
Primary adaptation benefits	**Direct implementation expenses**	**Temporal impacts**
The benefit of reducing direct climate change-related risk, such as improved and sustained agricultural productivity	Staff, equipment, transport, infrastructure, materials, operation and maintenance, among others	When do costs and benefits fall over time? For example, the rate at which habitat recovery can restore ecosystem services, when intervention costs are incurred, and interests of future generations, etc.
Additional adaptation benefits	**Core institutional and enabling costs**	**Spatial impacts**
Mitigation of storm and flood damages, year-round water supply, sustained farmland productivity in the face of drought, maintenance of species habitat, etc.	Training, development of plans, laws, policies, incentives, etc.	Where do costs and benefits fall spatially? For example, gains and losses for upstream and downstream communities, costs and benefits to ecosystem providers and users, cross border effects, etc.
Co-benefits	**Opportunity costs**	**Distributional impacts**
Improved health, better food supplies, new and diversified income opportunities, DRR, watershed protection, enhanced biodiversity, etc.	Foregone income and output due to land use restrictions, etc. **Social and environmental losses** Negative impacts on women, downstream communities, etc.	Where do costs and benefits fall demographically? For example, changes in resource access or income opportunities for women and men, rich and poor, urban and rural, regions, sectors, communities, etc.

Source: Adapted from Emerton (2017)

planting riparian buffers to counter flooding was much more cost effective than dredging, building levees and constructing spillways. Planting riparian buffers had benefit-cost ratios of 2.8–21.6, depending on the climate change scenario, but the absolute level of protection provided by this option was low (Daigneault *et al.* 2016). Nevertheless, both riparian and upland afforestation may also be adopted as "no-regrets" strategies, as they provide benefits regardless of future climate change outcomes, and there are significant co-benefits.

"No-regrets" adaptation options yield net positive benefits regardless of the climate change outcomes. Other approaches ("win-win options") may not only minimize the risk of climate impacts but also have other social, environmental or economic co-benefits. Low-regret options may have a small investment cost now but potentially large economic benefits well into the future if society is not successful in mitigating climate change. Other readiness options may simply lay the foundation for future adaptation projects if climate change continues to worsen (e.g., by legally acquiring and setting aside land for a future reservoir, if and when needed). Accordingly, these variations show that not all adaptation options can be reduced to, and compared on the basis of, a cost-benefit ratio alone (United States Agency for International Development [USAID] 2013; Asian Development Bank [ADB] 2015).

Valuing EbA and comparing it with engineered adaptation measures requires consideration of (i) the primary adaptation benefits of both, engineered and EbA measures; and (ii) the wider potential of EbA measures, including co-benefits, that, perhaps, are not connected to adaptation but nevertheless benefit people (table 3.4).

Using a standard cost-benefit analysis, planners shall also consider the full range of costs associated with engineered and EbA options, such as: (i) establishing the adaptation measures; (ii) costs of building institutional capacity; (iii) opportunity costs, such as foregone income from intensive land use; and (iv) environmental and social losses or costs. In table 3.3, impacts refer to when, where and upon whom the costs and benefits of different adaptation options fall and should assist in understanding who gets the benefits (i.e., wins) and who pays the costs (i.e., loses) with EbA. The Global Commission on Adaptation (2019) estimated that a US$1.8 trillion investment in the areas of early warning systems, climate-resilient infrastructure, improved dryland agriculture, global mangrove protection, and resilient water resources could generate US$7.1 trillion of benefits.[24] These benefits mostly concern avoided costs and include non-monetary social and environmental benefits.

Multi-criteria analysis (MCA): A structured framework for comparing defined adaptation options across multiple criteria, MCA breaks complex decisions into smaller components. A simple explanation of the steps involved is as follows: (i) examine the context in which the decision needs to be made (which institutions, stakeholders, statutory powers etc.); (ii) identify the full range of feasible adaptation options to be ranked; (iii) list the decision criteria to be considered, including any quantitative targets or triggers (e.g. cost-benefit ratio); (iv) identify the expected outcome or goal of the adaptation intervention (e.g. a medium-term infrastructure fix, or a change in the community's behaviour); (v) discuss and reach a consensus on the assigned weights of each criterion; (vi) score each criterion and sum the results; (vii) conduct the assessment in an inclusive, participatory manner and discuss the results; and (viii) in case there is still some uncertainty, conduct a sensitivity analysis.

To help least developed countries to prepare their national adaptation programmes of action (NAPA), the UNFCCC suggested the following criteria (i) efficiency; (ii) effectiveness; (iii) equity; (iv) urgency; (v) flexibility; (vi) robustness under a range of future climate projections; (vii) practicality; (viii) legitimacy, including social acceptability; and (ix) synergy and coherence with other strategic objectives. The process of formulating and implementing NAPs is intended to build on this NAPA experience and the criteria remain equally applicable.

MCA allows qualitative and quantitative evidence to be combined with subjective assessments by stakeholders and/or experts. By involving multiple actors, a real benefit of MCA is creating space for an inclusive, transparent dialogue that allows all stakeholders to make a judgement on the fairness of the ultimate decisions. There is no single, universally agreed approach on how to conduct MCA – some variations include (i) a simple qualitative assessment against the criteria; (ii) different weights for each criterion; (iii) quantitative analysis for each criterion; and (iv) complex computational models involving sensitivity testing and error bands. Whichever method is used, however, an individual or group makes the final choice, informed by the results of the MCA.

Some challenges with the MCA method are (i) deciding which criteria are most important[25]; (ii) ranking and weighting the criteria; (iii) reaching consensus on the scores for each criterion if members of the decision-making group hold widely divergent but strongly held values or opinions; (iv) possibly allowing bias towards individuals or groups with more power in the decision-making hierarchy; and (v) consuming a lot of time if done thoroughly. Comparing green (EbA) and grey (infrastructure) options requires careful attention to the criteria selection and weighting, as co-benefits of EbA may be equally as important as the primary adaptation objective.

Qualitative matrices: Various qualitative methods are used to rank the adaptation options being considered such as using expert opinion for scoring each factor out of 10 and summing all the factors, or using colour codes like a traffic light, or using symbols like multiple plus and minus signs. Some of the factors that may be considered include (i) cost-effectiveness; (ii) equity concerns; (iii) inclusiveness; (iv) gender considerations; (v) technical feasibility; (vi) available resources, including human resources; (vii) positive or negative environmental impacts; (viii) operations and maintenance costs; and (ix) expected impact or contribution to resilience. This approach is best suited to a small group setting where no individual is able to dominate or claim rank. If many options need to be considered, then a stepwise process of elimination may be used, until a shortlist remains for the final ranking. This method has the advantage of being quite simple to understand, as it is based on subjective assessments of the criteria, but the results can be easily challenged.

Scenario analysis: In much of the modelling for predicting future climate change impacts, scenarios are chosen as the best way to handle future uncertainty. The Intergovernmental Panel on Climate Change (IPCC) uses global climate models to devise scenarios for its projection of future climate change. The technique of using scenarios for adaptation planning has not had as much attention paid to it as has mitigation, but it is still an important tool. Essentially all scenarios start with the question "what if" – for example, what if the coastal roads were all moved inland by one km? Would that adaptation option be sufficient to guard against sea level rise for the next 50 years? Ideally, scenario analysis for climate change adaptation options should consider quite different options. For example, the option of relocating roads could be compared with requiring all houses in the coastal zone to be built on stilts, rather than comparing 1 km with 0.5 km for the relocation of the roads. Scenario planning is probably the method of choice when there is considerable uncertainty over the drivers of change and relatively little control over those drivers.

24 For more information on early warning systems, please see: https://public.wmo.int/en/media/news/invest-early-warning-deliver-climate-adaptation

25 FEBA has published a technical paper describing five criteria that may be of use when deciding which criteria are most important for EbA; find it here and summary is available here.

Box 3.13. **Tackling coastal climate hazards in Tanzania with green-grey adaptation options**

In Tanzania, multiple mechanisms link ecosystem services to human well-being, as the country hosts a variety of ecosystems including rivers, mountains, drylands, savannah, coastal and marine ecosystems, and wetlands. These ecosystems support the livelihoods of the population and much of the country's economy (DFID 2010).

Despite being a country rich in biodiversity, approximately two-thirds of the Tanzanian population still suffers from multi-dimensional poverty, and lives on less than US$1.25 per day, while one-third of the population lives in conditions of severe poverty. As of 2018, almost 60 per cent of Tanzanians (33.78 million) lived in urban areas (Crawford 2016, p. 4).

The country's coast is hot and humid; it contains Tanzania's largest city, Dar es Salaam, and is home to mangrove swamps that provide important habitat for wildlife and offer coastal protection from the impacts of climate change. Coastal wetlands, such as coral reefs and the mangrove forests along the coast, are under pressure due to deforestation, drought and desertification among other factors (Ministry of Water, 2002 cited in Crawford, 2016, p. 4).

The coastal zone of Tanzania was selected as a priority area for adaptation investment in the NAPA and *National Communications to the UNFCCC* because (i) it is home to 75 per cent of industries and at least 32 per cent of its national income; (ii) at least 25 per cent of the country's population depends on its resources; and (iii) it is where all aspects of vulnerability can be found – and addressed – simultaneously.

Since 2010, *LDCF* and *Adaptation Fund & UNEP* projects have been addressing the climate risk faced by coastal people, ecosystems and livelihoods in Tanzania. The priority has been on the impacts of climate change on key infrastructure and settlements along the coast, with a particular focus on sea level rise and impacts related to water availability. Since 2010, these projects have combined EbA options such as mangrove restoration, with hard infrastructure (sea-wall construction). They sought to address gaps in the adaptive capacity of local communities and governments that suffer from limited technologies, human capacity, and financial resources, as well as fostering Ecosystem-Based Integrated Coastal Area Management (EBICAM).

Project Documents Developing core capacity to address ACC in Productive Coastal Zones of Tanzania – LDCF – LDL/PMS: 00522. Tanzania Government, Vice President's Office – Division of Environment. "Implementation of concrete adaptation measures to reduce vulnerability of livelihoods and economy of coastal communities of Tanzania" Project in Tanzania – Adaptation Fund & UNEP (2012).

As for other prioritization methods, scenario analysis should be a participatory, inclusive process, involving key stakeholders. The general approach is to (i) identify shared adaptation goals; (ii) brainstorm the most important drivers of change and their importance to the management decision; (iii) define several plausible scenarios, based on the most important or uncertain drivers and the potential options for mitigating the impacts of those drivers; (iv) develop a narrative and name for each scenario; and (v) compare the likely outcomes of each scenario to assess which scenario gives the greatest certainty about achieving the adaptation goal. If none of the scenarios meet the adaptation goal, then revise the scenarios to be a little more ambitious. As the scenarios read like a storyline, they are easy for the public to understand, but they may be insufficiently nuanced if the options being considered are quite similar. Scenario analysis can also be a useful adjunct for strategic environmental assessment (SEA) for policies, plans and programmes.

Barrier analysis: Barrier analysis is widely used in climate change mitigation projects but can be applied to adaptation projects. It aims to identify any barrier that might prevent successful implementation either of a project or specific adaptation options. Barrier analysis can build on scenario analysis and assess which alternative scenarios are prevented by these barriers and can be used in conjunction with CBA and MCA. Adaptation options can be prioritized based on their feasibility by estimating which barriers can be overcome most easily. "Easy wins" or "low-hanging fruit" options can be prioritized for short-term implementation, while options requiring more analysis and consultation (or additional funding) can be shifted to mid- and long-term plans (box 3.13).

Barriers can be categorized into: (i) technological (lack of infrastructure, skilled workforce, risk of technological failure, absence of technology); (ii) investment (delays in raising finance, lack of private capital); (iii) prevailing practice (unwillingness to try something new); (iv) traditional or cultural (lack of indigenous or traditional knowledge); (v) ecological (prevailing weather conditions, endangered species and protected areas); (vi) social conditions (potential community conflict); and (vii) legal (land tenure, property ownership, inheritance and usage rights).

The key steps of barrier analysis are:

i. identify the adaptation alternatives/options;

ii. identify all possible barriers through literature survey, interviews and/or workshop brainstorming;

iii. screen the long list of barriers to select the most essential ones for the project location;

iv. classify the selected essential barriers into a hierarchy of categories;

v. if necessary, allocate a numerical score for each type of barrier, then rank the options against the aggregate scores;

vi. once the barriers have been identified and prioritized, consider possible solutions to overcome the barriers and create an enabling framework to proceed. This method has the advantage of simultaneously ranking the options and identifying any additional measures needed to overcome the barriers.

Some difficult questions need to be answered before deciding which adaptation option should be adopted, especially where EbA is the preferred alternative. For example, which entity has the primary responsibility for implementation, especially when so much adaptation is highly local, EbA cuts across multiple sectors and may involve protecting both public and private sector assets. Does that entity have the necessary expertise and staff resources to design and implement EbA measures, or should there be a prior step of increasing the capacity needed? While external finance may be available for the capital costs of the chosen adaptation option, who is responsible for operation and maintenance of EbA measures (or what if no one "owns" them), and do they have the necessary resources for these costs in the medium- to long-term? How time-critical is the adaptation intervention, as many impacts are referred to as slow-onset disasters? EbA measures may be most effective in the medium- to long-term, and there may be more urgent issues to consider. Are there significant trade-offs that need to be considered, such as losing a unique cultural or historical asset? How have the equity considerations been dealt with and will some people or communities feel that they have been abandoned, disadvantaged or unfairly treated by the selection of the specific option? These challenges apply irrespective of the method used to rank the climate change adaptation options.

As outlined above, there are numerous barriers to adaptation – but there are also many opportunities. For example, creating the enabling conditions to allow or incentivize adaptation to proceed may be one of the more important adaptation actions that governments can pursue. This may extend to increasing the institutional capacities of national and local governments to plan for, and implement, EbA. There are also multiple opportunities to collect additional information, strengthen knowledge management systems, and raise community awareness of the need for and available options to achieve climate change adaptation. The possibility of climate change mitigation as a co-benefit (and vice versa) is referred to above. But other co-benefits of EbA – such as protecting natural ecosystems, fisheries, protected areas or forests – are also possible as additional contributions that climate change adaptation can make. By involving project beneficiaries in planning and implementing climate change adaptation, there is also an opportunity to increase awareness of the urgency surrounding climate change, the need for ecosystem protection, and other environmental concerns in the local, regional and global context (Simpson *et al.* 2008).

TIPS

Many approved climate change projects will have already conducted climate risk and vulnerability assessments in specific areas. Aggregate these to the national level in the NAP, as they are likely to share several common elements.

As not all adaptation measures can be implemented immediately, consider prioritizing the most vulnerable ecosystems and/or the ecosystems that provide the greatest ecosystem services.

Ensure that information gaps are documented in the NAP, along with priority research programmes, so that additional information will be available when the NAP is revised/updated.

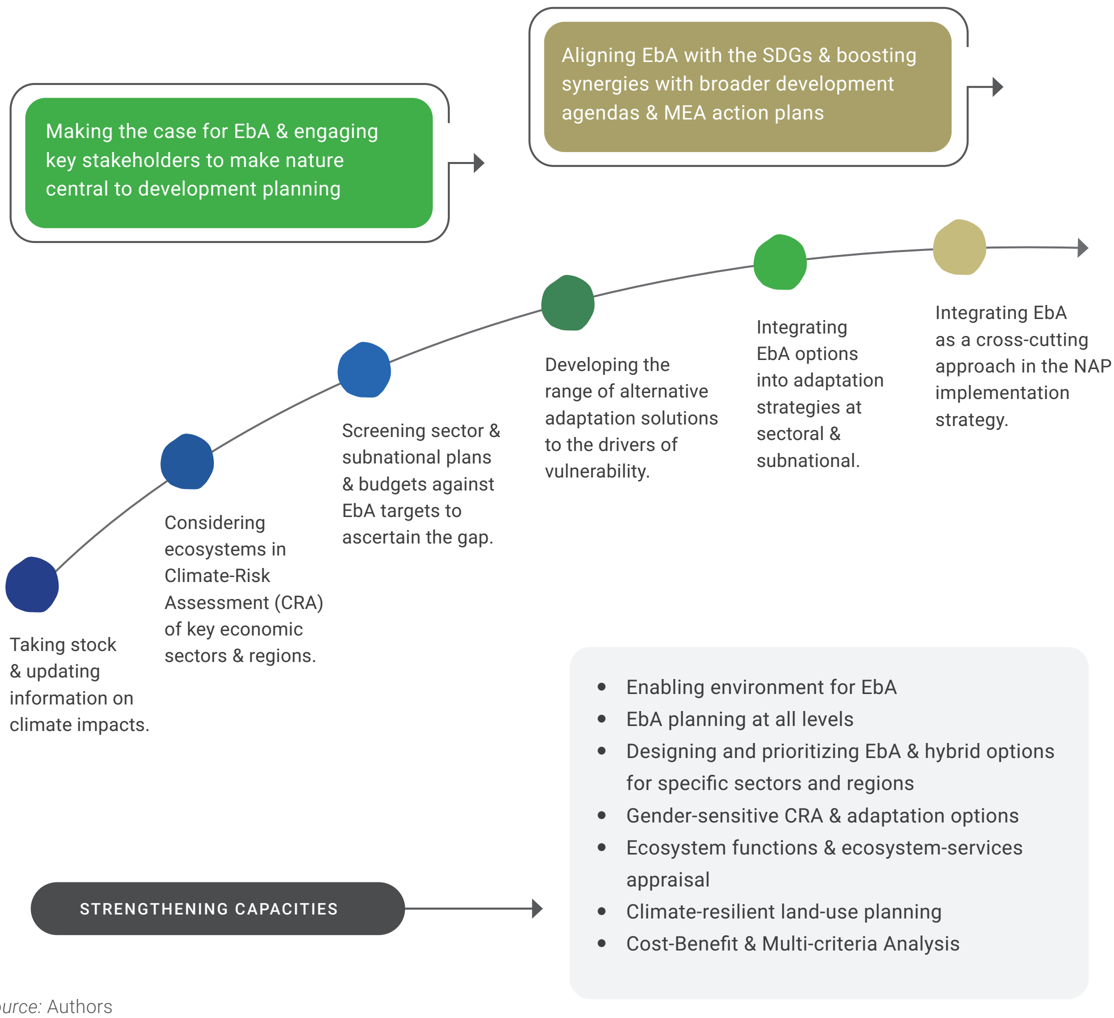
When selecting adaptation options, consider the methods and tools outlined in chapter 3, and select the most appropriate approach for your national context.

Not every situation requires a comparison of "green" and "grey" adaptation options, so do not waste scarce planning resources where the choice of adaptation measure is obvious (e.g., natural regeneration of forests does not have an infrastructure equivalent).

Table 3.5. **FAQs on EbA in the formulation stage of the NAP process**

	COMMON FAQS OF PLANNERS	SECTIONS; TABLES AND BOXES	CASE STUDIES ILLUSTRATING THE POINTS
1	**How does climate change affect lives and livelihoods?**	See table 2.1. See section 2.3 on impacts of climate change on ecosystems & ecosystem services. See section 3.2 on climate risk assessment.	Box 2.4. Climate impact-chain analysis at the Kigoma region, Tanzania.
2	**How is climate change affecting nature? Why does it matter to us?**	See table 2.2 on impacts of climate change on ecosystems. See section 3.2 on climate risk assessment.	Box 3.6 on climate risk assessment in Iraq.
3	**How can uncertainty in climate change, CCA and EbA be treated?**	See section 3.2 on climate risk assessment.	
4	**How do ecosystem services contribute to key economic sectors and adaptation?**	See figure 1.2. See sections 2.2; 2.3; 2.4.	Box 3.2 Stakeholder engagement: lessons learned from Bonaire.
5	**How do we plan for EbA at the watershed level?**	See sections: 3.3 on formulating and choosing adaptation options. 4.2: Opportunities and challenges (for implementing EbA). 6.2. Mainstreaming ecosystem-based adaptation: opportunities and challenges.	Box 6.2 Dniester Basin watershed level NAP planning. Box 3.4 Using the Opportunity Mapping Tool in Colombia. Box 3.9. Examples of EbA actions for mountain ecosystems.
6	**How do we integrate local and national level NAPs?**	See table 6.2 on barriers for mainstreaming EbA.	Box 6.5 Nepal local and national NAP planning.
7a	**Which stakeholder groups should be involved in consultations?**	For stakeholder involvement & engagement see sections: 1.3; 3.3.	Box 4.1 Stakeholder engagement in the Philippines; Box 4.6 Stakeholder engagement & PES in Bhutan.
7b	**What information should be considered?**	See table 3.1: Saline intrusion causes in Mozambique.	Box 3.5 on the Climate Information Platform, and box 3.7 on Science-based CRA in Saint Lucia.
8	**How do we select adaptation options including EbA?**	See section 3.3 on formulating and choosing adaptation options. See table 3.2 on EbA options for cities, and table 3.4: Framework of EbA benefits, costs and impacts.	Box 3.8 on the EbA Tools Navigator, and box 3.11: Examples of EbA actions for dryland ecosystems.
9	**What are the best methods for selecting and prioritizing the EbA options included in NAPs to be implemented in specific sectors and regions?**	See box 3.4 on the Opportunity Mapping Tool; box 3.9 on examples of EbA actions for mountain ecosystems; box 3.11 on examples of EbA actions for drylands; box 3.12 on economic analysis of EbA in Fiji. See table 3.2 on EbA options for cities.	
10	**Is EbA cost-effective (co-benefits vs. other CCA options)?**	For cost-effectiveness see: table 1.1 on NbS with multiple benefits; see section 3.3.	Box 3.12 on Economic analysis of EbA in Lami Town, Fiji. Box 3.13 on tackling climate hazards in Tanzania.
11	**How do we conduct economic valuation including multi-criteria analysis of EbA options?**	For economic valuation, see box 3.12. For valuation methods, see table 3.3.	

Figure 3.2. **Formulation stage: entry points & opportunities for integrating an EbA approach**



Source: Authors

Figure 3.2 summarizes the key steps in NAP formulation stage where EbA should be considered:

- While taking stock of the existing situation at the national or subnational level, identify the key ecosystems and ecosystem services that are likely to be affected by climate change.
- In the conduct of the critical climate-risk assessment of key sectors and regions, identify the possible contribution that ecosystems could make to reducing those risks.
- In the process of screening sector and subnational strategies, plans, and budgets, identify specific gaps that can be filled with EbA interventions.
- When developing the range of possible adaptation options, compare the effectiveness of EbA and infrastructure measures, and consider the possibility of hybrid approaches.
- Integrate the promising EbA options into climate change strategies and plans at all levels.
- In the design and institutional arrangements for implementation, ensure that EbA options, and ways of overcoming the specific challenges that EbA approaches will entail, are adequately addressed.
- As the challenges of EbA may be relatively new in the national context, consider the specific capacity-strengthening needs – not only for the formulation stage but also for the implementation and review stages – and acquire the necessary resources to build the necessary capacity.

CHAPTER

4

Implementation stage in the NAP process

Key messages from Chapter 4: Implementation stage in the NAP process

As much climate change adaptation is highly **local**, ensure that the national plan is fully devolved to the local government level for implementation and reflected in district development strategies, plans and budgets.

Include local stakeholders in the data collection that is necessary for progress and performance monitoring reports.

As the NAP process transitions from formulation to implementation, a new team of **actors** with different capacity needs becomes involved.

Although EbA may not generate financial returns, use **ecological economics** to demonstrate the economic viability of EbA measures and, therefore, the ability to be funded by concessional loans and the suitability for private sector investment.

As implementation of EbA measures will take place at the local level, ensure that there is adequate **capacity** for implementation, e.g., make sure enough local contractors are familiar with “green approaches”.

Climate finance for EbA can be sourced from domestic and international sources.

Ensure that local stakeholders are **empowered** to participate in implementation and ensure that no one is excluded.

To the extent possible, include the private sector in investment in EbA, at the very minimum where it involves protecting their own assets and income generation from the adverse impacts of climate change.

Establish the framework for monitoring the EbA strategies from the outset of implementation, ensuring that a robust baseline is captured for subsequent M&E.

4.1. Introduction

The "Implementing" stage captures Element C of the UNFCCC Technical Guidelines for the NAP process, which includes (i) prioritizing CCA in national planning; (ii) developing a national adaptation implementation strategy; (iii) enhancing capacity; and (iv) promoting coordination and synergy at the regional level and with other MEAs[26] (UNFCCC 2012). Some of the basic actions for implementing EbA options as part of overall adaptation strategies in the NAP process, and for overcoming the potential barriers for EbA, are addressed here (see summary in table 4.2). The key issue of implementing EbA through mainstreaming of the NAP process is addressed in chapter 6.

4.2. Opportunities and challenges

Entry points for implementing EbA: As most implementation will be local, at the subnational level, link the NAP strategies and plans to local climate change action plans and subsector plans, while identifying specific ecosystems for implementing the national strategies, policies and programmes. As most adaptation is localized, local governments and stakeholders need to be fully engaged in implementing EbA measures that are appropriate for the local context. Ensure that all local stakeholders are fully empowered to participate in implementation, as their buy-in may be essential for the long-term sustainability of EbA measures long after a specific project is implemented. As funding for the local government often depends on national allocations, also examine budget applications for local climate projects to identify possible EbA approaches.

26 It is notable that the Technical Guidelines do not explicitly refer to the actual implementation process, although issues like detailed project design, consultant terms of reference, procurement arrangements, and project supervision are often the cause of limited progress being made in the NAP process.

Box 4.1. **Stakeholder engagement in the Philippines: lessons learned from the ENRTP project – TEEB**

The Environment and Natural Resources Thematic Programme (ENRTP) was part of the core work of the TEEB office between 2012 and 2017 (funded by the EU). One of the key lessons learned from the study carried out in the Philippines was the high value of stakeholder engagement when the aim is having long-term impacts on policy and governance.

After many years of hard work, the valuation of ecosystem services has been institutionalized in the Philippines, where the TEEB study was conducted by the Biodiversity Management Bureau (BMB) and the Resources, Environment and Economics Centre for Studies (REECS). It assessed coastal development around Manila Bay, a fragile ecosystem interwoven with mangroves, that has been pushed to the brink of overdevelopment in the name of the tourism industry (i.e. decreased ecosystem resilience).

As a result of the study, the Philippines Reclamation Authority, the Manila Bay Coordination Office, and the Department of Natural Resources developed a think tank to bring together a wide range of data and management options for Manila Bay. What's more, by getting the key engineer on planning involved since the beginning of the study, the main findings have been integrated into planning and, at the end of 2019, the President put out a moratorium to put on hold any further reclamation of land, aiming at maintaining the environmental integrity of the bay.

Previous projects in the Philippines had built awareness and recognition of natural capital and ecosystem services. The work on Natural Capital Accounting (NCA) delivered a road map on NCA, which was designed as a multi-stakeholders and multi-agency programme. Under the National Economic and Development Authority (NEDA), there is the Philippine Agenda for Development. As a result of the NCA work, the Philippines Statistics Authority (PSA) created an environment division, and there is regular communication between that division and Agriculture, Natural Resources and Environment Staff (ANRES), to inform the Agenda for Development.

Furthermore, the BMB wants to improve the financing of biodiversity management in all protected areas of the country. Finally, the REECS is suggesting that any development planner shall include valuation of ecosystem services and NCA into project design and plan, and NEDA had a project to incorporate climate change and disaster risk reduction in the Project Development and Evaluation Manual. These advances will certainly pave the way for including ecosystem approaches in the Philippines NAP, which will be fully aligned with the National Risk Reduction & Management Plan & the Philippine Development Plan (PDP).

Source: TEEB Impact Report, 3rd draft – 22 July 2020 for internal review only; *The Philippines NAP Approach* at the NAP Global Network website here.

Box 4.2. Building the capacity of Rwanda's government to advance the national adaptation planning process (Rwanda NAP 2020–2023)

The Rwanda NAP project aims to advance the country's NAP process by increasing the capacity of government authorities and local communities to plan, fund, implement and monitor climate change adaptation (CCA) solutions in the medium- to long-term. A special focus is enhancement of the CCA knowledge base, guiding adaptation planning based on technical and financial effectiveness of adaptation measures to inform funding of the NAP.

Project sites for testing EbA approaches for "learning by doing" as part of the long-term research programme target five locations including Shagasha Tea Estate in Rusizi District; Ibanda-Makera Natural Forest in Kirehe District; Muvumba River in Nyagatare District; the savanna ecosystems in Nyagatare District; and wetlands around Kigali City. The project leverages EbA experiences from the Rwanda LDCF II project, which has sites in different locations and establishes buffer zones and rehabilitates ecosystems around wetland and forest areas, removes invasive species, and constructs terraces for erosion control. Additional EbA training for district-level representatives will continue the inclusion of EbA and good natural resources management in district planning frameworks, such as the District Development Strategies (DDS), a practice expected to be continued in the NAP project.

In the past 30 years, climate change in Rwanda has resulted in a shift in the timing, duration and intensity of the rainfall seasons. This has resulted in an increased threat of erosion in mountainous areas (where rains have become more extreme), and in reduced agricultural production in those areas where below-average rainfall has prevailed. Furthermore, a rise in extreme events has also been observed. They have been associated with El Niño Southern Oscillation (ENSO) that, according to global and regional climate models, may intensify and become more frequent in the future.

Some of the climate risk issues being addressed through EbA are increased flood risk, landslides, erosion and drought, especially in the eastern part of the country. Ecosystem services protected by EbA include flood erosion control (Umuvumba River and wetland in Kigali); increased water storage and water filtration (wetland in Kigali); and support for increased production of tea (Shagasha Tea Estate).

The Rwanda LDCF II project has demonstrated a strong, participative process of collaboration between REMA and district-level institutions. EbA measures and targets were included in most DDS, and now most districts have sufficient capacity and are considering ways to effectively manage the natural resources required for transforming agriculture and increasing access to modern energy services.

Initiative: Rwanda NAP 2020-2023; Rwanda LDCF II 2016–2021

Organizations leading the initiative: Rwanda Environment Management Authority Project Manager: Fabrice Mugabo fmugabo@rema. gov.rw Website: www.rema.gov.rw

Partner institutions and organizations:
UNEP Climate Change Adaptation Unit Website: https://www.unenvironment.org/explore-topics/climate-change/what-we-do/climate-adaptation/national-adaptation-plans

Capacity building: The skills and capacities required for implementation of EbA measures are quite different from those required at the formulation stage. Implementation will move from "top-down" to "bottom up" and will involve completely different actors, such as farmers, fisherfolk, forest managers or city engineers (box 4.2). Conduct an additional capacity needs assessment of this new set of actors and implement more practical capacity building programmes, often best facilitated by demonstration rather than classroom exercises. Also, assess the capacity of local contractors, who may be unfamiliar with implementation of EbA measures. Arrange visits to successful EbA pilot sites and rely on peer-to-peer learning. Where such pilot sites are not available in-country, consider sending young, enthusiastic staff for additional training to countries that are proven leaders in developing EbA initiatives.

Synergies: Identify EbA initiatives, as part of adaptation strategies implemented in the country, that would benefit from collaboration among economic sectors and actors sharing similar climate-risk and sustainability concerns. Synergies boosted through inclusive dialogue facilitate effective coordination among stakeholders and the efficient use of human and financial resources for implementing EbA at different scales. For example, the skills of career foresters who have been tasked with identifying climate-adapted tree species can find common ground with city engineers tasked with providing street-level shading to combat the urban heat island problem. Farmers who have successfully implemented climate-smart agriculture can be called on to assist in developing city-level community gardens, beehives, watershed and groundwater management projects, and urban biodiversity measures (box 4.3).

Box 4.3. Anchoring EbA in Thailand: from the NAP to integration in climate-sensitive water management practices

The Global Climate Risk Index 2019 ranks Thailand 13th in the "extreme risk" category of the countries most vulnerable to climate change impacts over the next 30 years. To prepare and respond to more frequent and intense climate impacts in the future, the Office of Natural Resources and Environment Policy and Planning (ONEP), Thailand's climate change focal point, developed the country's first NAP in 2019 to guide nationwide adaptation implementation. EbA is incorporated as one of the key guiding principles in the NAP, building a strong foundation to enhance adaptive capacity and long-term co-benefits of sustainable natural resources management.

The EbA approach is highlighted prominently in the natural resources and water management sectors – two of the six vulnerable sectors identified in the NAP. These sectors have set out to integrate EbA into their broader adaption response. To this end, they have started undertaking different initiatives, such as (i) promoting multi-functional green spaces in urban areas; (ii) developing EbA implementing guidelines for watershed management; or (iii) providing capacity building for local communities on sustainable forest management in Thailand.

With support from GIZ through the International Climate Initiative (IKI)-funded Risk-NAP project and the Thai-German Climate Programme (TGCP), ONEP and local stakeholders are promoting EbA in subnational adaptation planning processes. In Udonthani province, located in Northeastern Thailand, the concept of EbA has been set forth through capacity development and planning workshops. To enhance urban adaptation, provincial, municipal, as well as civil society stakeholders were introduced to various EbA solutions. These included urban catchment management and the preservation of wetlands outside the city to increase absorption capacity for urban flash floods, as well as the concepts of multi-purpose use of public areas around wetlands or green corridors to reduce heat island effects and boost urban biodiversity.

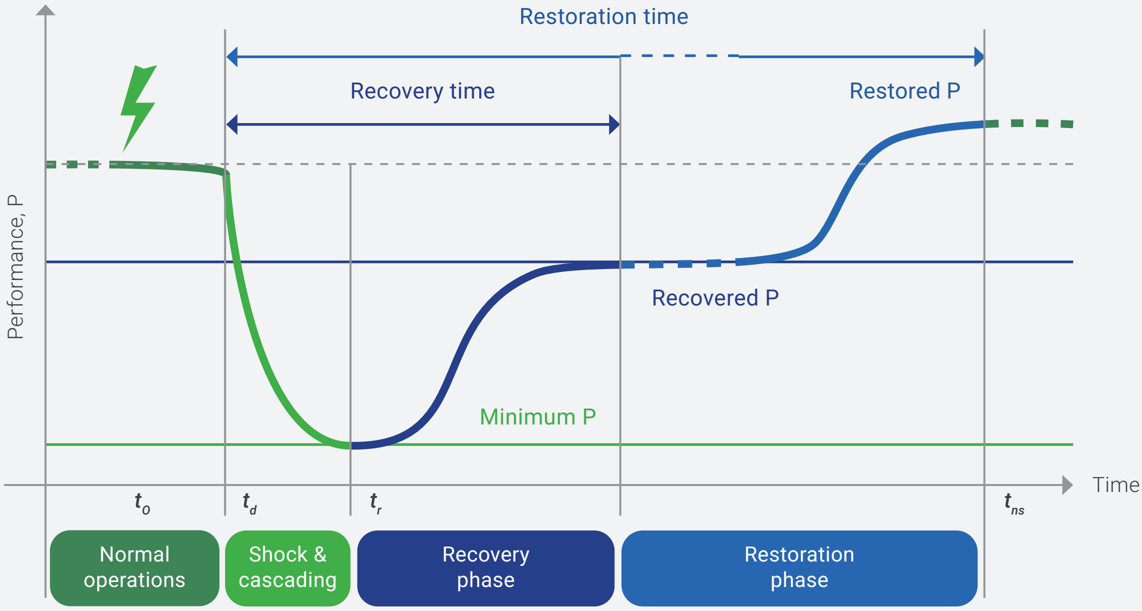
Beyond this, operationalization of EbA is already happening in Thailand's water sector. The lead regulatory agency, the Office of the National Water Resources (ONWR), is systematically integrating EbA into watershed management. Two river basins were designated to pilot the selection, prioritizing and planning the use of EbA as an integral step within the periodical river basin planning process. Based on these experiences, a national guideline will stipulate directions for the country's 22 river basins on how to set up a planning process that is climate-sensitive and includes EbA as a key adaptation strategy. A strong participatory approach and comprehensive capacity development, combined with a series of EbA knowledge products such as an EbA Guidebook and Code of Practice for the Thai water sector context, will help to enhance understanding and facilitate mainstreaming of EbA as an integral part of climate-sensitive water resource management in Thailand.

Source: The projects Risk-NAP and TGCP are implemented by GIZ Thailand. They are funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) under its International Climate Initiative.

Project design: Experience from implementation of the NAPAs showed that many countries had difficulty in moving from identification of a project idea in the NAPA to the project design requirements and templates of the funding agencies (Least Developed Countries Expert Group [LEG] 2009). The developing countries also learned that not all projects identified in a long list of priorities can be funded, necessitating a rigorous process of screening and prioritization against the selection criteria of the funding agencies. Preparing terms of reference for consultants to carry out feasibility studies and detailed project design is also an identified aspect of implementation that may need to be strengthened. The specific emphases of the funding agencies, such as gender equity, environmental and social safeguards, or governance arrangements need to be clearly identified and incorporated in the terms of reference. EbA projects may require unusual areas of expertise in the consultant team, such as botanists, ecologists or indigenous knowledge specialists.

Procurement: Once the budget has been allocated or external financing has been accessed (see section 4.3 below), note that EbA requires some special attention at the procurement stage, as the adaptation measures are not as simple as pouring concrete for a sea-wall, for example. Any human intervention in an ecosystem runs the risk of interfering with the natural processes that maintain ecological equilibrium. Some of the key procurement issues to be careful of include (i) selection of climate-adapted species; (ii) avoidance of alien invasive species; (iii) differential growth rates of different species; (iv) shade or full sunlight requirements for optimal growth; (v) temperature sensitivity; (vi) access to non-timber forest products; and (vii) ecosystem maintenance requirements. These aspects will need to be incorporated in a detailed procurement plan that, in turn, will need to be included in detailed contracts of selected implementing agencies.

Figure 4.1. **Stages of ecosystem performance in response to and recovery from a disturbance**

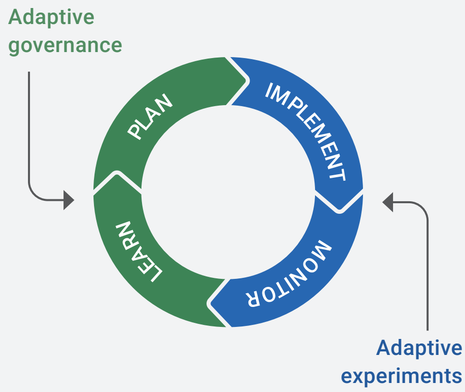


Source: Sansavini (2017)

Supervision: As for procurement, supervision of EbA interventions is critical. While a sea-wall contractor may skimp on the cement or reinforcing steel rods, shoddy implementation of an EbA project may not only fail to achieve the adaptation objective but may also damage the ecosystem irreparably. Also, as noted above, ecosystems are dynamic, and they are constantly changing with or without human intervention (figure 4.1). Accordingly, careful, continuous supervision is required when EbA projects are being implemented (and subsequently monitored). Actions during the recovery time may be quite different from those required once the ecosystem is fully restored.

As experience is gained, some implementation modalities may have to change, using an adaptive management approach (box 4.1). Adaptive experiments involve a structured approach to trying different implementation activities and monitoring to distinguish what works and what does not; adaptive governance involves use of the outcomes of these adaptive experiments in subsequent planning phases (figure 4.2).

Figure 4.2. **Simple conceptualization of an adaptive management cycle**



Source: Bahri *et al.* (2021), adapted from Allan (2007)

Table 4.1. **Data collection on EbA during the implementation phase**

MONITORING DOMAIN	POSSIBLE INDICATORS	SOURCES OF DATA
Ecosystem health	Condition and status of soils, vegetation cover, pollinators, biodiversity	Satellite imagery, forest cover inventories, permanent biodiversity monitoring plots, camera traps
Ecosystem services delivered to vulnerable populations	Provision of water, food, erosion control, air quality	Household surveys, remote sensing, air and water quality sampling equipment
Economic/livelihood variables	Income levels, employment, food security	Labour surveys, household surveys, census data
Governance	Institutional capacity, decision-making structures, distribution of costs and benefits	Climate public expenditure and institutional reviews, budget tracking
Adaptive capacity	People's ability to respond to or recover from climate shocks, social networks, access to information	Focus group interviews, civil society networks, religious congregations, aid workers
Disaster risk reduction	Trends in damage to assets from landslides or flooding, crop failure	Crop production trends, crop prices, damage surveys
Impacts of key climate hazards that are already occurring	Damage to assets resulting from drought, temperature extremes, heavy rainfall	Insurance pay-outs, damage assessments, extreme weather event records
Co-benefits	Health, biodiversity, carbon mitigation	GHG inventories, health data, Red List inventories
Context	Factors in the wider environmental, socio-economic and political landscape that can affect the project; information on current climate conditions may be needed to interpret observed changes in ecosystems and livelihoods	Social and economic data for the project areas, interviews with political leaders, external influences such as the COVID-19 pandemic

Source: Based on GIZ, UNEP-WCMC and FEBA (2020)

For some funding agencies, such mid-course corrections are problematic as they expect the project design document to be strictly followed. At the outset, therefore, there should be an understanding that such corrections may need to be made and sufficient funding flexibility is provided to allow these changes.

An important activity in the implementation phase is to start collecting and analysing the data needed for the sector-based monitoring frameworks and progress/performance measurements (GIZ, United Nations Environment Programme – World Conservation Monitoring Centre [UNEP-WCMC] and FEBA 2020). Table 4.1 outlines some of the possible data that will have been delineated in the formulation stage and that needs to be collected during implementation to report to funding agencies on project progress and performance and also for evaluation, review and learning in the review stage, and for feedback into any subsequent revision and updating of the NAP.

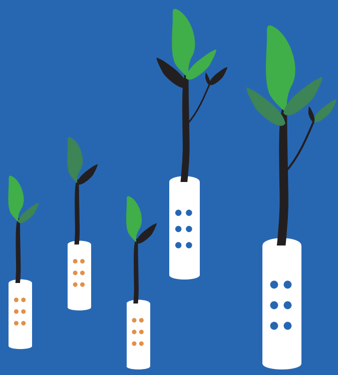
Synergies: Information sharing is critical for strategies to successfully integrate EbA in the NAP process. Monitoring integration and implementation of EbA into adaptation and development strategies, will benefit from collaboration among sector agencies, local governments, civil society organizations and private sector actors. Establish clear responsibilities in monitoring EbA approaches and facilitate the effective coordination among actors for efficiently designing, financing and implementing monitoring systems to track EbA. The broader national agendas in which EbA is being considered, such as contributions to the SDGs, CBD, UNCCD, Sendai, etc., may also be appraised for sharing information and data.

Box 4.4. **Implementing EbA: lessons learned from the EbA South Project**

The objective of the EbA South Project was to enhance the climate resilience of communities in the drylands of Mauritania, the Nepali forests, and the coastal zone of the Seychelles by building institutional capacity, mobilizing knowledge and transferring EbA technologies based on China's experience in successfully implementing landscape-scale restoration. All EbA interventions implemented by the project were carefully monitored by researchers to generate scientific evidence of the impacts of EbA.

Key lessons learned from the EbA South Project underline the fact that, while implementing EbA as part of any adaptation strategy, practitioners must be prepared to adjust the course of the project to respond to all possible contingencies. Accordingly, adopting an adaptive management approach is essential for implementing EbA initiatives. Some of the lessons from the EbA South Project are:

- It is critical for EbA projects to invest in quantifying the full suite of ecosystem goods and services generated through EbA at a landscape scale. Collecting data, modeling ecological processes and carrying out an objective assessment of ecosystem services will be of the highest value for taking on adaptive management and keeping the EbA project on track despite contingencies.
- Project staff need to be devoted full-time to the management of EbA projects and be informed with in-depth socio-economic analysis before the project starts to understand community and individual decisions regarding investments and land-use choices. They should also (i) build capacities to make the case for EbA, raise awareness and facilitate informed decision-making among local communities and individual landholders; in the case of Nepal and Mauritania for example, some landholders prefer using degraded ecosystems for existing livelihoods rather than waiting for the (uncertain) benefits of restoring ecosystems; and (ii) take on adaptive management to enable the project to respond to any contingency.
- Projects should incorporate an analysis of the benefits and trade-offs of EbA options, stakeholder consultations and foster agreements at project sites for successful implementation; for example, agreements should be crafted on how land users should be compensated while land is being restored.
- EbA projects require an agile flow of funds from the central level to the field level (or even across government departments) to implement EbA interventions on time (Nepal and Seychelles).
- EbA projects also require constant supervision of contractors, for example to ensure that they are not planting trees upside down.
- Decision making on the use of EbA or non-EbA options should be finalized before the start of the project to avoid time and resource-consuming debates during project implementation.
- In contrast to other development projects, EbA projects need a large contingency budget for managing delays and covering unexpected expenses. Budget in advance for managing time-consuming and unplanned activities such as dealing with rough environmental and / or weather conditions that delay EbA interventions, including vegetation planting schedules.
- Undertaking long-term research for adaptive management and documenting the project's successes is needed, as most EbA results are not immediately obvious; this will require agreements between government agencies, universities and research centers.
- Maintaining the ecosystems restored during the project requires regularly adjusting the EbA project exit strategy throughout the implementation of the project, as more information becomes available on long-term needs in terms of: ecosystem protection and trends; land-use decisions and agreements; maintenance costs and funding needs; and willingness of different stakeholders to invest in the maintenance of EbA landscapes (Nepal).
- Finally, at the landscape scale, EbA should be regarded as a large experiment, as not all sites may prove viable in the long-term.



Source: Mills *et al.* (2020). Available here.

All photos on this page: © UNEP/Aidan Dockery

EbA South – Seychelles
A 'super solution' to climate change

UNEP is working with conservationists like Victorin Laboudallon to restore mangrove forests to provide natural defences against coastal erosion and flooding on Praslin Island, Seychelles. "If the mangroves are gone, the nation of Seychelles will be gone," says Laboudallon.

Applying the approach of nature-based solutions, local tree planters use compostable tubing made from sugarcane to protect the mangrove seedlings from crabs.

UNEP has called mangroves a "super solution" to climate change because they act as cost-effective defences against coastal erosion and flooding, while providing breeding grounds for economically valuable fish species. If all of today's mangroves were lost, the global damage from flooding alone would be an extra US$82 billion per year.

Learn more about UNEP's work on adaptation.

4.3 Financing EbA measures

A key role in implementing EbA is to identify financing opportunities, mobilize domestic and international funding, and promote private sector investments in EbA. There is a misperception that because adaptation does not generate market-based revenues, only concessional or grant funding should be used. There is abundant evidence that EbA is a sound investment – provided the economic analysis is done properly, following the guidance of the Economics of Ecosystems and Biodiversity initiative and using ecological economics methodologies.[27]

4.3.1. Domestic financing

In many cases, financing EbA measures requires long-term planning to achieve the desired adaptation benefits as well as the associated socio-economic and environmental co-benefits (GIZ 2017). Financing from domestic public sources can serve as a relatively consistent and predictable source of financing that provides allocation flexibility. One of the easiest ways to prioritize budgets for climate change is to increase allocations for climate change actions within ministries. An important strategy to free up funds within a ministry is to reduce or eliminate interventions, such as subsidies, which are contributing to non-climatic pressures on ecosystems (Lukasiewicz *et al.* 2015).

Some recommendations to address key issues dealing with the funding aspects of EbA and its integration into climate-resilient development planning instruments include the following:

- Assess DRR and CCA benefits and co-benefits of habitat restoration and conservation to facilitate funding being channelled to EbA;
- Strategically include EbA in regional and municipal budgetary planning (e.g., for DRR, health and food security, infrastructure):
    - by including EbA into key local plans, like district development plans or local climate action plans, delivering the National Development Plan and/or NAP[28];
    - by making the case for including ecosystem management into sectors such as infrastructure that are better funded (e.g., promoting hybrid grey-green engineering).
- Engage with the Ministry of Environment, Ministry of Finance and Economy, and regional and district governments during their annual budgeting processes to:
    - make the case for financing EbA from public finance sources;
    - guide public investment in biodiversity and ecosystems;
    - facilitate mainstreaming EbA in public investments across sectors; and
    - enable public investment to shift from traditional grey infrastructure to EbA-type measures (Lukasiewicz *et al.* 2015).

At the community level, consider development of innovative financial instruments such as a reward/compensation mechanism for undertaking EbA measures, or a Payment for Ecosystem Services (PES) model (box 4.6). For example, upstream farmers investing in soil conservation measures that reduce sediment delivery to downstream drinking water storages may be rewarded through a PES scheme, thus offering additional incentives for carrying out the EbA measures.

At the national level, allocating domestic funding mechanisms to accelerate implementation of EbA actions, through climate change resilience funds or Trust Funds, could be a valid strategy. These funds may be co-funded by governments and donors (Tye *et al.* 2020) and generated by fiscal instruments (e.g., taxes, levies and fees, bonds, new subsidies, subsidy reform or strategy ecological fiscal transfer) (GIZ 2018). National adaptation funds are often part of a country or development plan to drive climate policy implementation.

4.3.2. International Financing

The 2016 Adaptation Finance Gap Report by UNEP (Olhoff *et al.* (eds.) 2017), found: "The costs of adaptation could range from US$140 billion to US$300 billion by 2030, and between US$280 billion and US$500 billion by 2050." This report found that total bilateral and multilateral finance for climate change adaptation reached US$25 billion in 2014, with US$22.5 billion targeted to developing countries. The 2020 Adaptation Finance Gap Report reinforced these observations, observing that annual adaptation costs in developing countries alone are currently estimated to be in the

27 For details on this global initiative, please see: http://teebweb.org/
28 For more on including EbA in local plans, please see: UNDP (2015a), p. 97.

Box 4.5. Climate finance for meeting Lao PDR's adaptation needs

The Ministry of Natural Resources and Environment (MoNRE) of Lao PDR recently submitted a proposal to the Least Developed Countries Fund to implement the "Building the Capacity of the Lao PDR Government to Advance the National Adaptation Planning Process" project. The project seeks to address the growing pressures on natural resources currently compounded by climate change, advance the NAP process, as well as to enhance the availability of climate finance for meeting the country's adaptation needs.

The country experienced widespread flooding in 2018, which impacted key sectors such as agriculture, water resources, transport and infrastructure, energy and health and altered lives, livelihoods and the economy. Loss and damage due to these floods have been estimated to be around US$370 million (about 2 per cent of 2017 GDP and 10 per cent of the government budget). Climate change forecasts for Lao PDR consistently predict increasing temperatures and rainfall, more frequent and extreme storms, and increasing long-term climate volatility.

To advance the NAP in Lao PDR with a cross-sectoral and systemic approach and improve the country's adaptive capacity, the project will foster the integration of climate change adaptation into national and sectoral planning, financing and coordinated implementation, based on medium- to long-term scenarios. Furthermore, it will aim at increasing access to international and domestic sources of funding, such as the Environment Protection Fund (EPF). Lao PDR was one of the first developing countries to introduce an EPF. Established in 2005 by Prime Minister's Decree, as a "financially and administratively autonomous organisation" with initial grants from the World Bank and ADB, the EPF is unique because it has over 13 years of experience in managing grant funding windows, with a strong network of national and subnational project developers and project beneficiaries.

In terms of EbA, the proposed project will assist policymakers to take long-term decisions on: (i) where best to prioritize EbA interventions on a national scale; (ii) how to implement EbA effectively; and (iii) where best to allocate resources and investments in climate change adaptation. This will enable the Ministry of Finance and the Ministry of Planning and Investment to play critical roles in adaptation planning, to develop a CCA finance strategy, and to seek partnerships with the private sector for leveraging resources. Adaptation priorities, identified through risk and vulnerability assessments, will be incorporated into national, sectoral and provincial strategy and development action plans as well as into the budgeting processes. Cross-sectoral institutionalization of EbA will make Lao PDR an example for its decision to incorporate EbA as a part of its NAP process and its long-term planning for climate resilience by seeking its integration in the sectoral and provincial five-year plans and annual action plans, budgeting processes and monitoring systems.

As part of the project, the availability of climate financing for meeting the country's adaptation needs defined in the NAP will be determined. Different options, such as coding/ tagging of climate change items in the national budget, could be used for identifying climate change-related financing in the country's budget and for monitoring trends in allocations. Also, implementing a climate financing framework could be used for ensuring effective use of domestic and international climate finance within the national budget process. It identifies the demand and supply of national climate finance (domestic and external public funds, fiscal policies/green banking) as well as forecasting future climate financing needs for the country.

Source: DCC (MoNRE) (2020)

range of US$70 billion, with the expectation of reaching US$140–300 billion in 2030 and US$280–500 billion in 2050 (UNEP 2021). In 2009, developed countries committed to provide US$100 billion per year for climate change by 2020 (now extended to 2025) to address the needs of developing countries – needs that are overwhelmingly related to climate change adaptation. Be aware, however, that there is still a massive financing gap for adaptation, let alone for EbA.

Decision 1/CP.21 accompanying the Paris Agreement "strongly urges developed country Parties to scale up their level of financial support, with a concrete roadmap to achieve the commitment of jointly providing US$100 billion annually by 2020 for mitigation and adaptation while significantly increasing adaptation finance from current levels". In OECD's latest report, total climate finance increased to US$71 billion in 2017, with US$13.3 billion (19 per cent) for adaptation, and US$5.5 billion for cross-cutting (OECD 2019). OECD projections of climate finance for 2020 estimated US$45 billion (67 per cent) for mitigation only, US$16 billion (24 per cent) for adaptation only, and over US$6 billion for cross-cutting (9 per cent) (OECD 2016a). Oxfam estimates: "Public climate-specific net assistance is much lower than reported figures, increasing slightly from $15–19.5 billion per year in 2015–16, to $19–22.5 billion per year in 2017–18." This does not look like a major effort to plug the adaptation financing gap (Oxfam 2020).

Fortunately, some funding agencies have recognized this funding gap and are making a concerted effort to address it. For example, the Government of Germany, through the German Development Bank (KfW) with

Box 4.6.

Stakeholder engagement & Payment for Ecosystem Services (PES) in Bhutan: lessons learned from the ENRTP project – TEEB

The Environment and Natural Resources Thematic Programme (ENRTP) was part of the core work of the TEEB Office between 2012 and 2017 (funded by the EU), whereby TEEB studies were conducted in five countries, Bhutan, Philippines, Tanzania, Liberia and Ecuador. A key lesson learned from the studies carried out in Bhutan and Philippines was the high value of stakeholder engagement when the aim is having long-term impacts on policy, governance and finance.

In Bhutan for example, the study coordinated by the Ministry of Agriculture and Forests and the Ugyen Wangchuk Institute for Conservation and Environment (UWICE) focused on ecosystem services provisioning under hydropower development and is a good example of capacity development and stakeholder ownership.

All levels of stakeholders were involved from the start of the process up until the end. The actual study report had a set of reviewers representing the affected institutions including: the Druk Green Power Corporation; Department of Agriculture; Department of Renewable Energy; National Environment Commission; Ministry of Finance, Forest Resources Management Division; among others. All reviewers gave input and helped shape the report, which showed a high level of engagement. The final workshop also had the Minister of Agriculture commit to bring up the results of the study in Cabinet and a plan was formulated to integrate the results into the development of their 12th year development plan, with a case being made that a 1 per cent royalty fee from hydropower goes to afforestation and/or a Payment for Ecosystem Services (PES) scheme.

Source: TEEB Impact Report, 3rd draft – 22 July 2020 for internal review only.

resources from the International Climate Initiative (IKI), has provided seed funding of US$26.5 million to the EbA Facility of the Caribbean Biodiversity Fund to support EbA projects in Antigua & Barbuda; Cuba; Dominica; Dominican Republic; Grenada; Haiti; Jamaica; Saint Lucia; and Saint Vincent & the Grenadines.[29]

As an adaptation practitioner interested in integrating EbA into the NAP process, look for all the information available about the international sources of funding for adaptation, especially those that have a track record in funding EbA (box 4.7). In the NAP documentation, draw attention to these funding sources and encourage high level political intervention to increase the supply of funds for EbA.

29 For more on how Caribbean nations are adapting to climate change, please see: https://www.caribbeanbiodiversityfund.org/programs/climate-change

Box 4.7.

Debt-for-nature swaps

In the absence of globally sufficient funding for adaptation, consider alternative, innovative funding arrangements such as debt-for-nature swaps. In the most recent of these, Seychelles, with the assistance of the Nature Conservancy, used private funding to buy back US$21.6 million in sovereign debt at a discount. That money goes into the Seychelles Conservation and Climate Adaptation Trust, which will repay US$15.2 million in loan capital over 10 years while funding US$5.6 million for marine conservation and climate adaptation and giving US$3 million to an endowment to fund similar activities on an ongoing basis. As a result, the Seychelles has now protected 32 per cent of its seas, with half of the area designated as a high-level biodiversity protection zone.

With debt in developing countries soaring over US$10 trillion and worsened by the economic collapse in the wake of COVID-19, resources for addressing the joint climate and biodiversity crisis may be running dry. Further depleted by post COVID-19 economic recovery costs, the option of swapping debt-for-nature and climate protection may provide a bridge to greater debt sustainability, potentially benefitting both agendas.

Source: World Ocean Initiative (2020) Seychelles swaps debt for nature, Available here.
Steele and Patel (2020). Tackling the triple crisis. Using debt swaps to address debt, climate, and nature loss post-COVID-19. IIED, London. Available here.

Table 4.2. **FAQs on EbA in the implementation stage of the NAP process**

COMMON FAQS FOR NAP IMPLEMENTERS	SECTIONS; TABLES AND BOXES	CASE STUDIES ILLUSTRATING THE POINTS
1 **What optimal institutional arrangements are needed for implementing and upscaling EbA?**	See sections: 1.3 on institutional arrangements for the NAP process; 4.2 on opportunities & challenges for implementing EbA. See box 6.1 on vertical & horizontal integration.	Box 6.2. Ecosystem-based adaptation in the Dniester basin
2 **What are the available sources of EbA finance and how can they be accessed?**	See sections: 4.3 on financing EbA measures; 4.4 on engaging the private sector.	Box 4.7 on Debt-for-nature swaps at the Seychelles
3 **What convincing evidence on EbA cost-benefit analysis is available that will change the attitudes of decision makers?**	See section 3.3 on formulating and choosing adaptation options. See table 4.1 on data collection on EbA during the implementation phase.	Box 3.12 Economic analysis of EbA in Lami town, Fiji
4 **What do we know about success factors for EbA projects?**	See boxes: 4.2 on the Rwanda LRTP informing iterative NAP processes; 4.4 on lessons from learned EbA projects from EbA South Project; 5.2 on resilience rating system to manage climate change risks. See figure 5.2 on Hierarchical system of EbA indicators contributing to NAP performance monitoring.	Box 5.2. Resilience rating system to manage climate risk

4.4. Engaging the private sector in the NAP process

Although public investments continue to provide the foundation for adaptation investments, the private sector needs to invest more significantly in the implementation of adaptation interventions, including EbA, and leverage its resources to complement national and international finance.[30] Attention must be focused on making EbA finance more relevant for the private sector so that there is increasing willingness to either invest voluntarily in EbA measures or to comply with regulation (GIZ 2017b). Use protection of the private sector's own assets, such as climate vulnerable properties, as an initial entry point.

Also, consider promoting public-private partnerships with local government, companies, international funders and NGOs to secure additional funding to initiate adaptation. Of course, each of the partners should be part of the NAP process from the outset, playing a clear role in the adaptation planning of each sector and at the most convenient scale, aligning with and supporting the enforcement of climate-risk regulations.

As climate risk threatens all businesses, entrepreneurs worldwide are being increasingly engaged in developing risk management strategies.[31] Investors aim to reduce their exposure to climate risks and comply with government regulations and policies by protecting company employees, operations and supply chains, and developing new goods and services to support climate resilience. Engage with the banks and insurance companies concerned about climate risk to explore the potential for EbA in their investment policies and strategies. Assist private financiers to (i) factor climate risks into investment portfolios and financing products; and (ii) better quantify, compare and track the adaptation returns on investments.

Explore new and innovative sources of private sector funding[32], such as:

- **Certification schemes:** For implementing EbA in forest, peatland and coastal ecosystems use voluntary carbon markets and certification schemes to generate additional revenues by selling carbon credits.
- **Crowdfunding:** National and international NGOs can support EbA projects by aggregating private donations and green investments.
- **Market-debt operations:** The largest source of potential private finance for CCA stems from investment and financial lending operations. To overcome the barrier of non-concessional market rates, EbA can increase the interest of ethical lenders and investors through Green Bonds.

30 Constraints of private investments to invest in adaptation measures are due to uncertainty of investment returns, limited access to finance, or overall risk aversion. However, companies are interested to contribute to adaptation finance in their self-interest (GIZ 2018).

31 This section is based on GIZ (2018c).

32 For a discussion of private sector funding, please see: GIZ (2018c).

To effectively engage the private sector, focus on four enabling factors: information sharing, financing, institutional arrangements and capacity building.

Information sharing: Provide the private sector with clear information on (i) impacts of climate change on the economy and on each sector; (ii) adaptation needs of small-, medium- and large-size businesses, including new business opportunities; (iii) the risks of inaction and future access to finance; (iv) cost-efficient adaptation options already implemented in similar business contexts; and (v) how ecosystem approaches may provide the best long-term adaptation solutions.

Financing: Assist the private sector in overcoming the financial barriers to engaging in the NAP process by:

- Identifying all available funding sources and financial instruments for adaptation;
- Strengthening and enabling market mechanisms that encourage the private sector to invest in climate resilience and/or to provide services and products for the adaptation needs identified in the NAPs;
- Using financial incentives, such as tax breaks, risk guarantees, favourable conditions for investing in CCA; taxes, levies, fees and royalties to raise funding for CCA and EbA;
- Linking the NAP priority areas to investments in green and hybrid infrastructure; and
- Consulting the private sector on the financing strategy for the NAP, so that adaptation priorities, funding sources and private sector opportunities are clearly identified.

Institutional arrangements: Identify the steps and resources needed to create and sustain the enabling environment for engaging the private sector in the NAP process, including:

- Strengthening the legal and policy framework as well as the institutional arrangements that support private sector investment in CCA and EbA;
- Opening transparent communication channels between technical committees, decision makers, and the private sector in the NAP process; and
- Reviewing the existing policy frameworks to eliminate existing policies, incentives and regulations that may promote maladaptation.

Capacity building: Identify capacity building needs amongst private sector actors to make sure they become fully equipped to:

- Participate in all stages of the NAP process
- Access, understand and use current and forecasted climate change information;
- Reduce their exposure to climate risks
- Access suitable financing for adaptation investments
- Adopt CCA technologies, including EbA
- Develop business models to commercialize adaptation products and services

Besides multilateral and bilateral funding sources for EbA, the implementation of EbA as part of broader adaptation strategies may be financed through a series of innovative mechanisms, such as impact investing[33] and innovative ways of engaging the private sector and national/regional financial institutions, such as REDD+[34] or biodiversity offsets and debt-for-nature swaps.[35]

TIPS

Not all priority actions identified in the formulation stage can be implemented immediately, as they may depend on strengthening the necessary local capacity or mobilizing large amounts of funding. Therefore, focus on the low-hanging fruit in the first year or two while arranging the necessary human and financial resources for other priorities.

Engage with sector managers to find opportunities within their sector plans and budgets for implementation of priority EbA measures identified in the NAP.

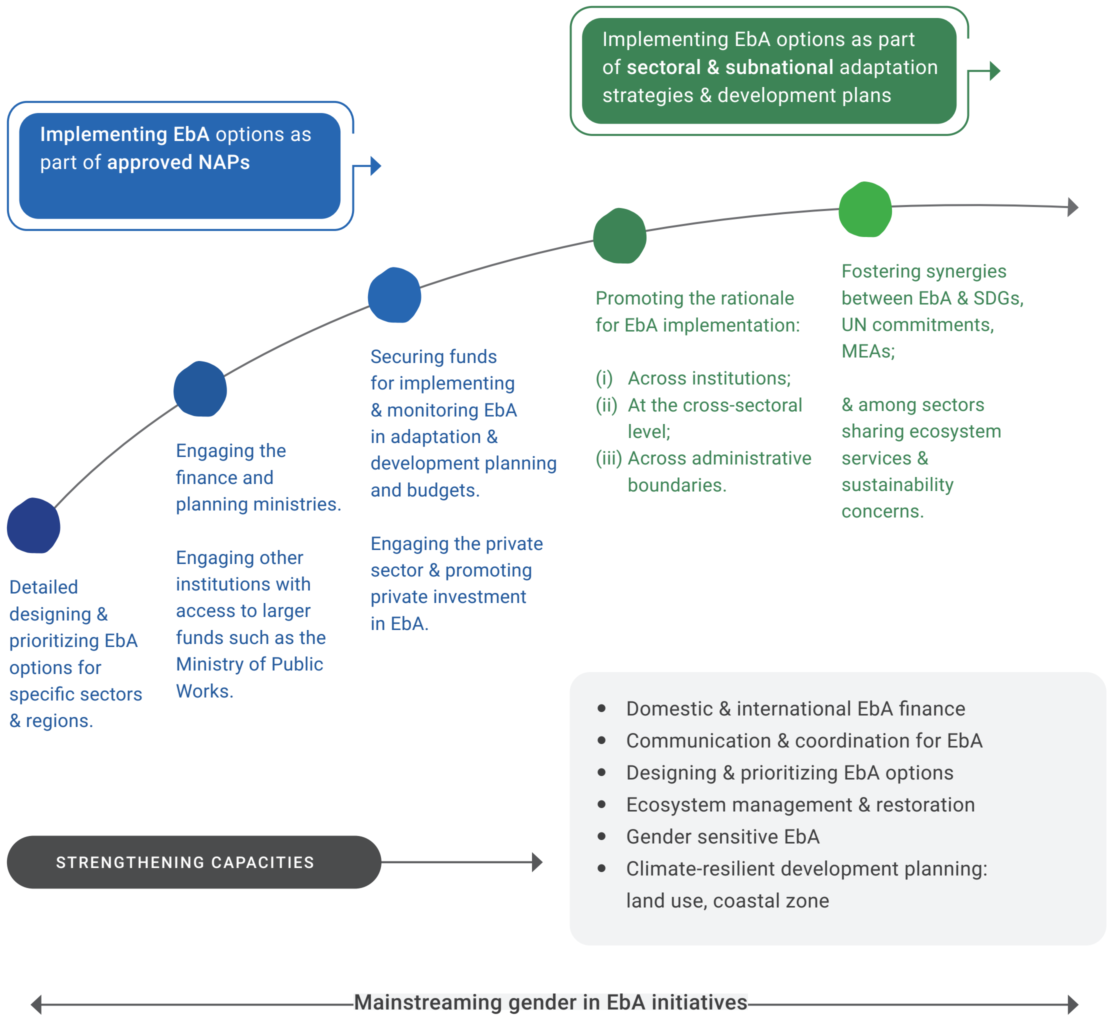
As most adaptation is local, assist local governments to prepare local adaptation plans, as this will open up opportunities for implementation of priority EbA measures at the local level.

Use an adaptive management approach to implementation, driven by careful observation of the ecosystem dynamics and responses to EbA interventions.

Discuss financing concerns with bank managers, insurance agents and financial planners as they may be able to suggest innovative financing options that were not part of the standard finance arrangements articulated in the NAP.

33 Impact investments are investments made with the intention to generate positive, measurable social and environmental impact alongside a financial return. Impact investments can be made in both emerging and developed markets and target a range of returns from below market to market rate, depending on the investors' strategic goals. See: https://thegiin.org/impact-investing/need-to-know/#what-is-impact-investing
34 For information on this web platform, please see: https://redd.unfccc.int/
35 For a discussion of debt relief and conversion for nature, please see: https://www.cbd.int/financial/debts.shtml

Figure 4.3 **Implementation stage: entry points and opportunities for integrating an EbA approach**



Source: Authors

Figure 4.3 summarizes the steps involved in implementation of EbA measures in carrying out the NAP process.

- Typically, adaptation plans only briefly identify the proposed interventions, so detailed design of the EbA measures is necessary, as this will clarify the costs and the necessary implementation arrangements.
- Once a good analysis of the costs is available, accessing the necessary funds for implementation is the next step, either from domestic or international climate financing sources.
- The next step is to procure the materials and labour to implement the EbA measures, generally involving the private sector and public procurement rules.
- Depending on the national institutional arrangements, there may be a need to convince other sector agencies to become involved in implementing EbA measures.
- At each step, collect the necessary data on EbA investment that will subsequently inform the evaluation of EbA progress and effectiveness in the review stage.
- Also explore the synergies with ecosystem-related activities in SDG and MEA action plans.
- As the implementation actors may differ from those involved in the formulation stage, conduct additional capacity strengthening for effective EbA implementation.

All photos on this page: © UNEP

Building the resilience of Kune-Vaini Lagoon through ecosystem-based adaptation (EbA)

In Albania, UNEP is working with the Ministry of Tourism and Environment to improve the capacity of the Kune-Vaini lagoon ecosystem to adapt to climate change and provide vital goods and services to local communities. The project will improve the technical and institutional capacity of policy- and decision-makers in Albania to implement adaptation interventions, especially EbA. The project is also increasing the awareness among local communities of effective EbA actions.

Learn more about UNEP's work on adaptation.

CHAPTER

5

Review stage in the NAP process

Key messages from Chapter 5: Review stage in the NAP process

The important review stage focuses on the evaluation process and methods, implementation of participatory methods, identifying gaps and demonstrating how effective reviews and **lessons learned** can lead into continuous updating and revision of the NAP.

Strengthen engagement in the NAP review process of Ministries of Finance and of Planning, along with local governments, to influence the development vision and budget allocation process for EbA.

Periodic revision of NAP targets should be part of the NAP process. The lack of a quantified **global target** for adaptation (compared to mitigation) should not impede national authorities from setting and updating quantified targets for EbA in the NAP process and tracking progress towards achieving those targets. The Aichi targets for biodiversity (https://www.cbd.int/sp/targets/) and their expected updating in 2021 may provide a guide.

The NAP should become a living document that is routinely **revised and updated** in a new formulation stage as conditions change, as more information becomes available, and as mainstreaming is pursued with greater vigour, in line with the principles of adaptive management.

5.1. Introduction

The "Review" stage captures Element D of the UNFCCC Technical Guidelines for the NAP process: (i) monitoring the NAP process; (ii) reviewing progress, effectiveness and gaps; (iii) updating the NAPs; and (iv) outreach and reporting. This stage focuses on the evaluation process and methods; implementation of participatory methods; identification of gaps; and demonstration of how effective reviews can lead into continuous updating and revision of the NAP.

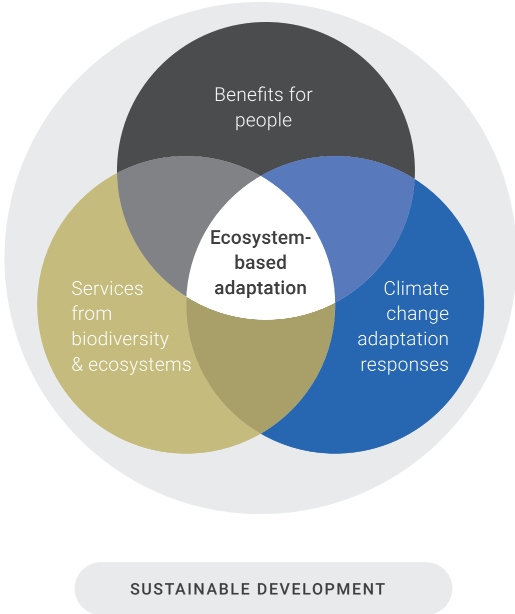
Building effective monitoring, review and reporting systems will allow adaptation practitioners to assess:

- The effectiveness of integrating EbA in the formulation and implementation of the NAPs, as well as the outcomes of the NAP process;
- Progress, effectiveness and gaps in identifying and prioritizing EbA options in other national and subnational adaptation planning instruments and economic sectors; and
- Success at implementing EbA options and collecting experiences, evidence and lessons learned through monitoring and review of the adaptation process at national, sectoral and subnational levels.

Entry points for reviewing EbA: Aim to assess the extent to which EbA options have been effectively integrated and implemented as part of the NAP implementation plan and other relevant national, sectoral and subnational adaptation and development plans (with a focus on the extent to which EbA has achieved the intended adaptation goals and objectives). Build on the previous two stages of the NAP process, including the data collected in the implementation phase, and assess to what extent ecosystem approaches have been considered and/or implemented. For subnational adaptation processes, also review the integration of EbA as part of land use planning and other "local" planning instruments (e.g., for agriculture, tourism, coastal restoration plans or protected area management plans). The purpose of reviewing successful integration of EbA into more than the NAP implementation plan alone is to gauge the progress in mainstreaming EbA through the whole of government, as well as the results of that integration.

Reviewing EbA interventions may have a broader scope if sustained by transdisciplinary research in areas such as (i) biodiversity benefits for people; (ii) climate change adaptation strategies for people; and (iii) biodiversity resilience to climate change (figure 5.1). While each of these research areas remains important in its own right in supporting EbA, EbA development requires transdisciplinary research linking these three areas.

Figure 5.1. **Integration of EbA interventions in the context of sustainable development**



Source: UNEP (2021). Rwanda GEF-LDCF NAP Project: LTRP Proposal

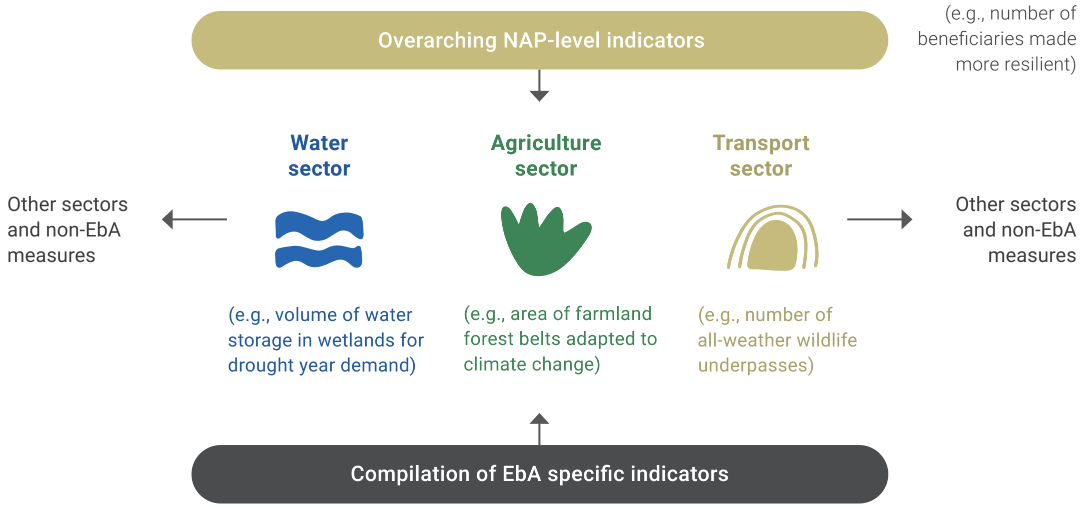
The following are examples of the types of research questions that may strengthen the review stage of the NAP process – some of which will be addressed in this chapter:

- What are the key indicators to measure EbA effectiveness?
- What evidence exists regarding the outcomes of EbA initiatives?
- What are the livelihood benefits for EbA?

Capacity building: As for the formulation and implementation stages, the human resource capacities for monitoring, reviewing and reporting are quite distinct and may be somewhat limited in developing countries. Where necessary, establish an ongoing training programme to build capacity in these fields, noting that a clear understanding of EbA, and an ability to interpret the data and information, is needed by the review personnel. Aim to strengthen capacities in topics such as formulating monitoring systems, methods, and techniques for collecting, storing, analysing and interpreting data.

Participation: As for all other aspects of the NAP process, community participation at the review stage is essential. Once the project funding has ceased and the contractors have moved on to their next project,

Figure 5.2. **Hierarchical system of EbA indicators contributing to NAP-level performance monitoring**



Source: Authors

the local community members benefiting from the EbA project can be the most important actors ensuring long-term sustainability of the adaptation interventions. By engaging the project beneficiaries in the review process, they will gain a better understanding of the importance of maintenance needs, like replacing dead trees or filling gaps in the mangrove cover.

Evaluation design and options: As part of making the M&E system operational, a good evaluation design is key. It will assist in understanding what changes have occurred because of integrating EbA options into adaptation and development planning, and/or as a result of other contextual factors. An effective evaluation design[36] should assist in answering the following questions (GIZ, UNEP-WCMC and FEBA 2020):

- What difference did the intervention make?
- How did it make this difference?
- What other factors were relevant?

5.2 Indicators and metrics

Metrics: Although the institutions and organizations integrating and implementing EbA approaches may have their own monitoring systems, devise a comprehensive set of indicators and metrics for documenting progress in EbA and assessing the effectiveness of EbA options in an inclusive and participatory manner. Examples of the type of indicators that could be used to measure EbA outcomes are growing in the literature (see Donatti *et al.* 2020). Aim to harmonize these indicators across sectors and governance levels, seeking their integration with existing monitoring frameworks, such as the Sendai Framework or SDG action plans. Harmonization will minimize financial and human resources, centralize critical information on adaptation, development and climate risks, and strengthen synergies between these planning frameworks. The Aichi targets for CBD (and the 2021 update) may provide national governments with a guide.[37]

As most monitoring will take place at the project level, consider establishing a hierarchical system of indicators that will allow aggregation to the NAP-level comprising (i) a compilation of possible EbA indicators; (ii) application of the relevant EbA indicators in sector projects and aggregation to the sector level; (iii) inclusion of non-EbA indicators at the sector level; and (iv) aggregation of EbA and non-EbA indicators at the NAP level, drawing attention to the extent that EbA measures have contributed to overall NAP outcomes (figure 5.2).

Some basic principles of the EbA metrics system are that it should be:

- Conceptually sound, yet simple and operationally feasible;
- Capable of measuring the impact of a single project but also be scalable to a programme, sector or NAP level;
- Based, wherever possible, on data already being collected at project level; and

36 For more information see: Dickson *et al.* (2017).
37 For a discussion of biodiversity targets, please see: https://www.cbd.int/sp/targets/

Figure 5.3 **The NAP as a living process boosted by monitoring, evaluation, review and learning**

Source: NAP Global Network

- Able to be incorporated into the project development cycle so that EbA data are monitored during implementation and available at the post-evaluation stage.

For the Global Environment Facility (GEF) Least Developed Countries Fund/Special Climate Change Fund (LDCF/SCCF) and the Adaptation Fund, expected resilience result indicators cover (i) reduction of vulnerability; (ii) strengthened institutional and technical capabilities; and (iii) integration of adaptation into relevant sectoral and development policies, plans and processes (Möhner 2018). For example, reduced vulnerability indicators include number of beneficiaries, assets strengthened and livelihood improvements. Qualitative information (such as mainstreaming into policies and plans) is expected to be provided by implementation agencies during the project cycle rather than through specific indicators. EbA indicators will need to go to a deeper level than these portfolio level indicators, however.

5.3. Revision of the NAP

Updating and revision: Revision of the NAP as part of the project cycle loop should focus on how monitoring (evaluation and learning) and reporting are essential to capture lessons from the implementation experience and feed them back into the NAP, making it a "living" plan and process.

Monitoring the right processes, building the human resource capacities, and fostering synergies will lead to progressively updating NAPs and integrating new information on a regular basis (box 5.1). Regular updating and revision of the NAP provides an opportunity for reviewing the extent of mainstreaming EbA into relevant adaptation and development strategies for key sectors and/or specific regions of the country, as well as the outcomes of the adopted interventions. Policy alignment, institutional coordination and cooperation, as well as synergies for EbA can be monitored to properly keep EbA on track and deliver the desired adaptation results.

Successful M&E systems aim to (i) demonstrate the effectiveness of EbA as a viable adaptation approach; (ii) help with learning and contribute to adaptive management; and (iii) assist in reframing adaptation and ecosystem management approaches when the monitoring system indicates this might be necessary to prevent unintended maladaptation results.

Structuring the monitoring and evaluation (M&E) system involves three key steps corresponding to the three stages of the NAP process: (i) design of the M&E system in the formulation stage; (ii) data collection and monitoring in the implementation stage; and (iii) evaluation and learning in the review stage (figure 5.4).

Box 5.1. Kiribati – climate change adaptation plans under constant review and revision

As an atoll nation, a least developed country, and with a fragile economy and environment, Kiribati is extremely vulnerable to climate change and has little capacity to cope with either natural or human-caused disasters. The country is especially vulnerable to climate hazards such as coastal floods, tropical cyclones, droughts, increased sea surface temperatures and sea level rise. To address these vulnerabilities, Kiribati is prioritizing adaptation actions in key sectors as part of its NAP process, continuing a process of review and revision that started in 2004.

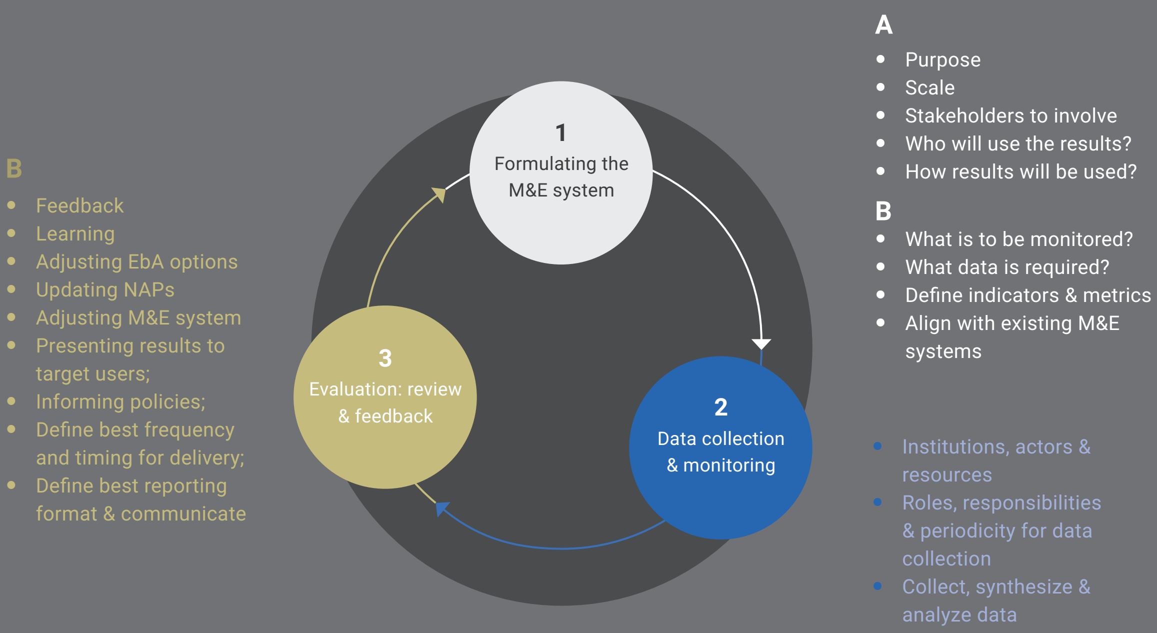
In 2004, with assistance of GEF and UNDP, Kiribati started preparation of the National Adaptation Program of Action (NAPA - 2007) concurrently with the World Bank's Kiribati Adaptation Project. In 2011, following consultation with regional organizations, Kiribati, initiated the process of developing a Joint National Action Plan on climate change and disaster risk management. This became the *Kiribati Joint Implementation Plan* (KJIP) in 2014 (equivalent to the country's NAP) which has been revised and updated recently (KJIP 2019–2028). The new version has enhanced its alignment with strategic documents released after 2014, namely: the *Kiribati Development Plan 2016-2019*, the *Kiribati 20-Year Vision*, and the *Climate Change Policy*, and has also included the strengthening of gender considerations. From the outset of the NAPA, the importance of ecosystems has been recognized in the nation's adaptation efforts.

A strong knowledge base exists to generate momentum for including EbA in the future revisions and updates of Kiribati's NAP, such as:

- EbA has been considered in previous initiatives such as (i) the *Kiribati Adaptation Project* – co-funded by the World Bank and the Government Japan; and (ii) the Australian Aid/ SPREP project on coastal EbA. In these projects, EbA has focused on restoration of habitats and ecosystems for agriculture and beach, mangrove and coral reef rehabilitation and protection for increasing Kiribati's coastal resilience.
- The KJIP/NAP identifies EbA measures, financial resources for EbA (or ecosystem activities), and acknowledges potential trade-offs or negative impacts from hard adaptation solutions on ecosystems (IISD 2020).
- The KJIP/NAP includes the promotion of healthy and resilient ecosystems for increasing water and food security (Government of Kiribati 2014; Government of Kiribati 2019).

Additional sources:
Climate change knowledge portal – World Bank. Available here.
Office of Te Beretitenti (2013). Available here.

Figure 5.4. **Suggested steps for M&E of EbA as part of the NAP process**



Source: Authors

All photos on this page: © UNEP/Hannah McNeish

Enhancing climate change resilience of rural communities living in protected areas of Cambodia

In Cambodia, UNEP and partners are helping people adapt to climate change by improving agricultural resilience, reforesting vast swathes of natural land, and establishing "home-gardens." Unabated deforestation and climate change have dried out soils and caused a decrease in rainfall in some parts of the country. In response, this project trained people to grow trees in specially constructed nurseries and carry out patrols to halt illegal logging. The project is restoring at least 1,875 hectares of land; as a consequence, forests are regenerating, wildlife is returning and water is being replenished.

Help build alternative livelihoods:
People living around one the community-protected areas make roof fronds out of leaves, toothpicks and sticks.

A man works on his home garden around a community-protected area. The project helps people rely less on rain-fed agriculture and forestry for a living by providing livestock, poultry and crickets to farm, and properly irrigated and fertilized vegetable gardens and fruit trees.

A woman prunes trees in the community-protected area and help safeguard key areas of forest in rural Cambodia.

Learn more about UNEP's work on adaptation.

- During the formulation stage, define the purpose and scale of the M&E system (e.g., checking if EbA plans are on track and/or learning about the evolving adaptation context); identify which stakeholders should be engaged in the design and implementation of the monitoring activities; and agree on the indicators for EbA and the data that need to be collected. Aligning with existing M&E systems will save resources, enhance buy-in of EbA in NAPs, foster synergies across sectors and increase learning opportunities (see learning and outreach and synergies below).

- Clearly defining how stakeholders can be involved in the M&E data collection process is key during the implementation stage. Ensure that all stakeholders understand how the data of interest for EbA will be collected, stored, analysed and interpreted to be of use for the NAP process. Also ensure that issues like privacy, protection of individual data and data security concerns are properly addressed. Feedback the results of the M&E to stakeholders so that they can see how their contribution was used and how it is valued as part of the NAP process.

- During the review stage, communicate the results of the monitoring activities to all interested parties and decide if the adaptation plans are on track or if there is a need to adjust the EbA interventions. This feedback is crucial for learning what works and what does not, and for adjusting the EbA options adopted and implemented during the NAP process. The evaluation and review allow for updating the NAPs with enhanced EbA options. That, in turn, may require the review, update and – if needed – the reformulation of the M&E system to respond to an evolving context and the adaptive management of EbA options.

Learning and outreach: Use the review stage as an opportunity to learn from experience in implementing EbA. Consider using a resilience rating system to evaluate the success of EbA projects in creating the desired level of resilience (box 5.2). Resilience rating will (i) provide valuable outreach material for enhanced transparency and disclosure on EbA project outcomes; and (ii) identify EbA best practices to be scaled up across sectors and countries.

In addition to applying this learning in the reframing and revision of the NAP and other national planning processes, reporting the results should be regarded as an essential outreach function. Outreach materials may comprise short videos, brochures, blogs or webinars in addition to the standard progress reports to funding organizations.

Synergies: Information sharing is critical for strategies to successfully integrate EbA in the NAP process. Monitoring integration and implementation of EbA into adaptation and development strategies, will benefit from collaboration among sector agencies, local governments, civil society organizations, and the private sector. Establish clear responsibilities in monitoring EbA approaches and facilitating the effective coordination among actors for efficiently designing, financing and implementing monitoring systems to track EbA. The broader national agendas in which EbA is being considered, such as contributions to the SDGs, CBD, UNCCD, Sendai, etc., may also be appraised for sharing information and data.

TIPS

Monitoring, evaluation, review and learning (MERL) cannot be an afterthought but must be built into the framework of the NAP during the planning stage, as the outcome targets and indicators are needed to assess achievement of the NAP goals and objectives.

While qualitative targets and indicators may be the only option in circumstances in which uncertainty exists around ecosystem processes, they will prove to be problematic at the review stage (e.g., improved forest cover might mean completely different things to an urban planner and a forester). Wherever possible, set quantitative goals, time-bound targets and SMART indicators, preferably in a hierarchical schema that will allow aggregation of indicators to the NAP level.

The absence of a baseline is not an excuse to avoid measuring progress in that ecosystem. Include baseline data collection as a first-year priority and ensure that funding is available.

Identification of gaps in data should be viewed as an opportunity for improved data collection rather than an insurmountable problem.

Consider developing an EbA resilience rating system for implemented projects, as this will help to identify best practices for replication and scaling up.

Design the communication strategy at the planning stage but fine-tune it during the review stage so that the most effective narrative on progress and remaining effort can be communicated to decision makers and other stakeholders.

Box 5.2. Resilience rating system to manage climate risk

Resilience is the capacity to prepare for disruptions, recover from shocks, and grow from a disruptive experience. The World Bank Group has developed a Resilience Rating System (RRS) method that can be applied to any investment, including private sector projects, and provides guidance and specific criteria to assess resilience along two complementary dimensions:

1. **Resilience of the project** rates the confidence that expected investment outcomes will be achieved, based on whether a project has considered climate and disaster risks in its design, incorporated adaptation measures, and demonstrated economic viability despite climate risks. For example, the project design for a bridge accounts for increased severity of storms due to climate change.
2. **Resilience through the project** rates a project's contribution to adaptive development pathways based on whether investments are targeted at increasing climate resilience in the broader community or sector. For example, the project aims to improve a community's resilience to extreme rainfall by improving landscape management through EbA.

Besides guiding project developers on the best ways to manage risk and improve the quality of projects, the RRS aims to (i) create incentives for more widespread and effective climate adaptation through enhanced transparency and simpler disclosure; and (ii) identify best practices to allow proven lessons on resilience to be scaled up across sectors and countries.

Resilience rating system

Resilience of the project

C The project has conducted a basic climate and disaster risk screening and provides a qualitative estimate of residual risks and a justification for the level of risk.

B The project has conducted a multi-model risk assessment and considered adaptation options for identified risks.

A The project has conducted a quantitative stress test to ensure that plausible risks do not make it economically unviable.

Rating +
The project explicitly discusses the possibility of unexpected impacts and performs a systematic analysis of uncertainties that informs contingent planning in case of unanticipated changes.

Resilience through the project

C The project is a development project that increases local incomes, reduces poverty, or provides beneficiaries with improved infrastructure or financial services.

B The project includes resilience-building activities and reduces identified vulnerabilities (adaptation co-benefits).

A The project is transformational in improving resilience, with impacts beyond direct outputs through improved institutions, policies, incentives, technologies or capacities.

Rating +
The project monitors and tracks the progress of resilience-building activities through at least one climate indicator that is embedded in the project's monitoring and evaluation strategy.

The methodology rates projects from C through to A+ in each dimension, where a high rating (A+) denotes higher confidence that an investment will achieve its expected rate of return and the project will remain beneficial, despite climate change. For example, a project (in the environment sector) likely to get an A+ would be one supporting resilience through (i) community-led watershed and landscape management; (ii) green infrastructure and ecosystem restoration; (iii) strengthening land tenure security; and (iv) enhancing institutional capacities to support resilient landscapes. The full methodology note available here provides more details on how to determine a project's rating.

Box 5.3. **Links between the NAP process and a country's budget allocation process**

A country's budgeting process is how decisions about the use and funding of public resources are made. The budget can be regarded as a plan stating how the government intends to meet its policy goals. There are several steps in the country's budgeting process: planning, approval, implementation and accountability (account auditing). It is typical for line ministries to receive written policy guidelines and the budget circular, which establishes the terms on which ministries must prepare their budget proposals. It is at the planning stage of national budget preparation that the NAP process can influence both the guidance provided by the Ministry of Finance and the budget plans put forward by sector ministries to the Ministry of Finance. Sectoral policy reviews, in which NAP review processes can be an input, can determine future sector budget plans.

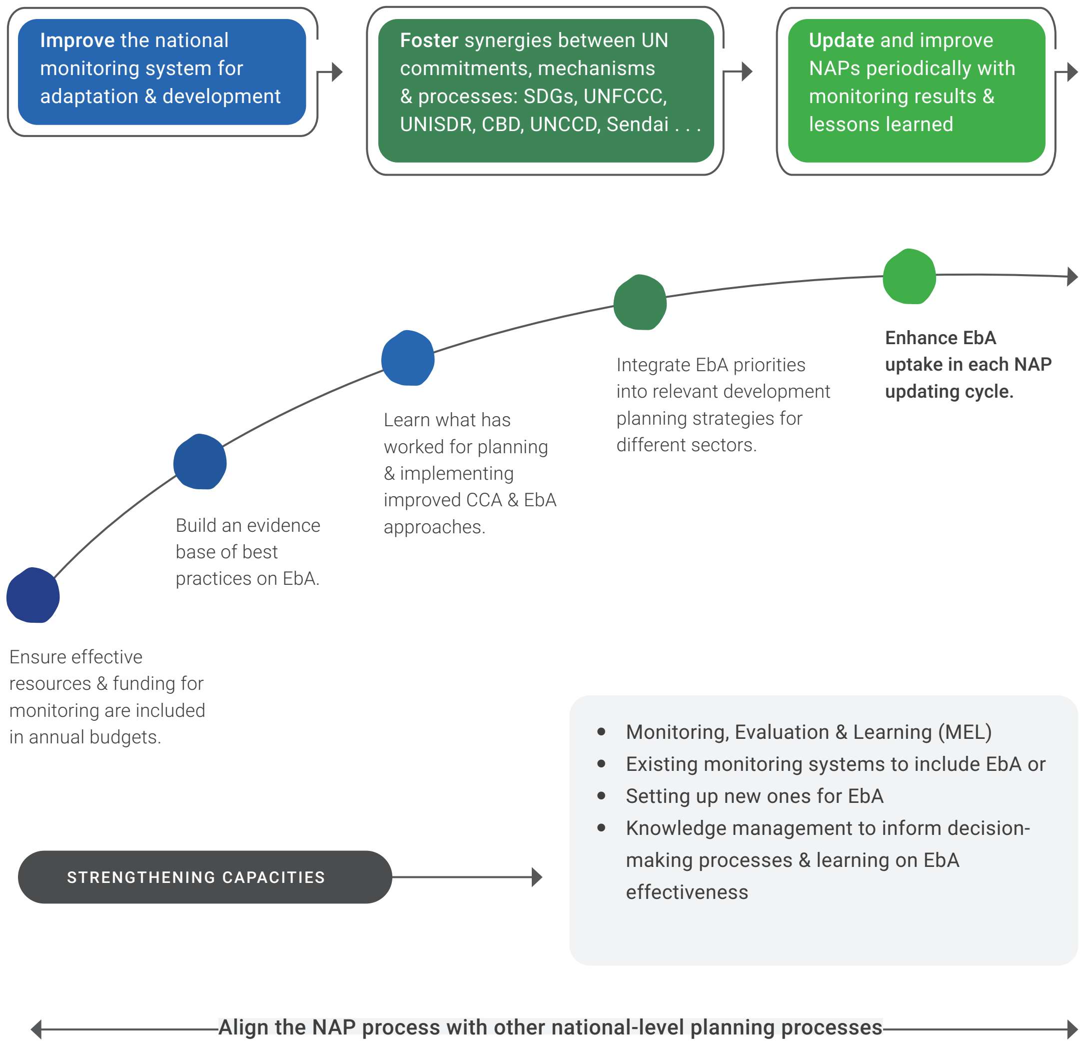
This link between the NAP review and budget preparation is especially true for allocation of M&E finance, which is often underestimated and under-resourced. The Guidelines recommendations are to use the "Review" stage of the NAP process to measure and evaluate adaptation outcomes; raise awareness of how adaptation strategies deliver development outcomes and to use the formulation and implementation phases to mainstream adaptation into sector plans and budgets.

Source: Authors

Table 5.1. **FAQs on EbA in the review stage of the NAP process**

FAQS	SECTIONS; TABLES AND BOXES	CASE STUDIES ILLUSTRATING THE POINTS
1. How do we involve the Ministry of Finance in NAPs?	1 & 2 – See section 4.2 on opportunities & challenges for implementing EbA; section 4.3.1 on domestic financing (for EbA); section 6.2 on opportunities & challenges for mainstreaming EbA	Box 5.1 on Kiribati adaptation plans constantly under review
2. How do we secure national budget allocations for EbA through NAPs?		
3. How should an iterative process for NAPs be designed?	Section 1.3 on overview of the NAP Process; box 4.2 on the Rwanda LRTP informing iterative NAP processes	
4. How should a review processes for EbA-NAPs be carried out?	See the details in chapter 5	

Figure 5.5. **Review stage: entry points and opportunities for integrating an EbA approach**



Source: Authors

Figure 5.5 summarizes the key steps related to EbA in the review stage of the NAP process.

- Importantly, the resources for effective MERL need to be budgeted from the outset and not left as a late decision.
- The monitoring activities throughout the implementation stage should not only provide evidence of progress but also help to build an evidence base of the cost-effectiveness of EbA interventions.
- Use the evidence base to learn about the most effective EbA approaches, understand how the ecosystems have continued to change and recognize the need for adaptive management.
- Pass on these lessons to sector managers so that they can progressively adjust their own development strategies to incorporate effective EbA.
- Most importantly, as they become available, use the EbA lessons gained to update and revise the NAP, so that it becomes a living document, rather than waiting until the completion of a four- or five-year planning period.
- As for the previous stages, a new set of actors and skills may be needed for the review stage, triggering the need for new capacity strengthening activities.

All photos on this page: © UNEP

Large-scale EbA in the Gambia: developing a climate-resilient, natural resource-based economy

In 2017, UNEP and partners launched the Gambia's largest natural-resource development project to help the country adapt to climate change. The overarching objective is to build climate resilience by restoring and rehabilitating at least 10,000 hectares of forests, protected areas, wildlife areas and farmland, all of which are affected by rising temperatures, erratic rainfall and deforestation.

The six-year project aims to benefit up to 11,550 Gambian households directly and 46,200 households indirectly in four regions along the Gambia River. The project is funded by a grant from the Green Climate Fund, along with contributions from the Gambian government.

Learn more about UNEP's work on adaptation.

CHAPTER

6 Linkages and alignment

Key messages from Chapter 6: Linkages and alignment

EbA can be implemented through **sectoral plans** and adaptation strategies at all governance levels and scales, and through regular or innovative sources of funding. A **stand-alone NAP** is not the only pathway to implementing EbA.

EbA, through its **cross-cutting** characteristics and ability to intertwine ecological, social and economic dimensions, is a valuable approach to enhancement of local, national and international strategies and plans, as well as NAPs.

The same amount of attention should be paid to these **linkages and alignment** as there is to formulation, implementation and review of the NAP document.

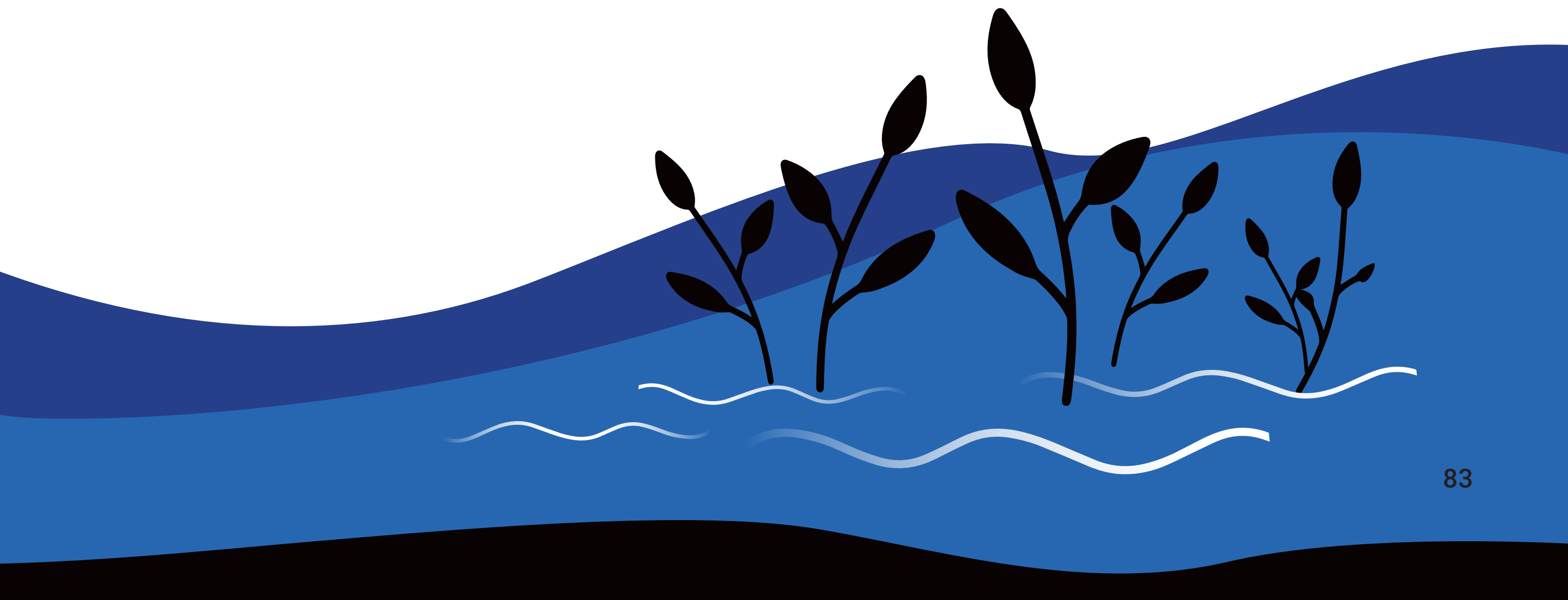
Sector plans should be **screened** for climate change risks and identification of entry points for integrating CCA/EbA.

Mainstreaming EbA involves **vertical coordination** (national and subnational) and **horizontal coordination** (because of cross-sectoral linkages in adaptation responses).

Mainstreaming EbA is challenging, however, because it involves a **paradigm shift** in the culture and practices of institutions, so it has both a political dimension and an information and analytical dimension.

EbA is recognized as a cross-cutting policy instrument, with the Rio+20 Action Plan on Adaptation describing it as a **planning tool for unifying all three Rio Conventions:** Convention on Biological Diversity, United Nations Framework Convention on Climate Change, and United Nations Convention to Combat Desertification.

EbA is acknowledged to be essential to **achieving the SDGs,** so integrating EbA in sustainable development policy processes at a national level is an important enabler for implementation at all other levels.



6.1. Introduction

By now it should be clear that EbA is not only a strategic approach to climate change adaptation but also has major advantages in linking with and aligning to other local, national and international strategies and plans. It is strongly recommended to integrate the EbA options developed and prioritized in the formulation stage of the NAP process into other national development plans, biodiversity action plans, land use plans, infrastructure plans and other sectoral plans, as all sectors are affected by climate change. National obligations for nature-related international agreements and treaties also provide an opportunity for EbA alignment and coherence. As much attention should be paid to these linkages and alignments as is paid to formulation, implementation and review of the NAP document.

Box 6.1. Vertical and horizontal integration in national planning

The process of creating intentional and strategic linkages between national and subnational adaptation processes for planning, implementation and M&E is known as "vertical integration". The enabling factors of vertical integration include institutional arrangements, information sharing and capacity development. The institutional arrangements provide the mechanisms for coordination, capacity development and communication between the different levels. Information sharing promotes efficiency and effectiveness of the process and ensures that both indigenous and scientific climate knowledge is applied, while capacity development ensures that actors at different levels have the knowledge and skills they need to engage in the process.

Horizontal integration occurs across sectors and involves finding ways to cooperate and collaborate with stakeholders who may not share the same perspective on ecosystems. Often this is achieved by creating a multi-sector taskforce, where shared experience brings the disparate views together to achieve a common goal. For example, climate change will impact water resources, which can impact a country's energy sector, so water and energy line ministries should engage in joint planning.

Source: Dazé *et al.* (2016)

6.2. Mainstreaming EbA: opportunities and challenges

Mainstreaming EbA refers to the process of integrating ecosystem-based approaches into planning and decision-making processes at different governance levels. The ultimate goal of mainstreaming is to enhance the effectiveness, efficiency and longevity of climate change adaptation (CCA) by embedding its principles and practices into local, municipal and national policies, planning, financing, training and awareness campaigns, among other policy tools.[38] Mainstreaming is addressed here as a crucial addition to integrating EbA into the NAP documentation, as EbA should be incorporated into all planning processes and institutional changes may be needed to facilitate that. The opportunities and challenges of mainstreaming also elucidate some of the issues that need to be addressed in integrating EbA into the NAP formulation, implementation and review (chapters 3–5).

Mainstreaming EbA is important, as it helps to enhance long-term sustainability and opens possibilities for funding, which are external to climate-specific funding sources. Mainstreaming is challenging, however, because it involves a paradigm shift in the culture and practices of institutions.[39] Hence, it requires strengthening institutions and capacities.

To effectively mainstream EbA into planning processes and strategies, adaptation practitioners must be prepared to deal with the existing barriers, such as fragmented national policies and the prevailing "silo effect" of sector agencies. A whole new approach is needed to foster communication and coordination horizontally and vertically, across sectors and ministries or departments, as well as from national to local levels, and with effective participation of civil society (Tye 2020).

Countries are increasingly realizing that, in the long-term, CCA needs to be supported by an integrated, cross-cutting policy approach and incorporated into national development planning (UNDP and UNEP 2011).

Mainstreaming begins with attaining a broad understanding of the political and institutional set-up, which enables the identification of potential entry points for EbA (Secretariat of CBD 2019). Mainstreaming depends on having a suitable enabling policy environment, allowing governance arrangements to scale up EbA from the local level, where it usually takes place, and integrate it into broader adaptation and socio-economic development strategies or, vice versa from national strategies into local adaptation plans (box 6.1).

38 For a discussion of mainstreaming EbA, please see: Secretariat of the Convention on Biological Diversity (2019).

39 For an explanation of the importance and challenges of mainstreaming EbA, please see: Department for International Development *et al.* (2002), as cited in United Nations Development Programme-United Nations Environment Programme (2015).

Box 6.2. Ecosystem-based adaptation in the Dniester Basin

The Dniester basin, one of the largest basins in Ukraine and the largest in the Republic of Moldova, is shared by those two countries. Rising in Ukraine's Carpathian Mountains, the Dniester River crosses into Moldova and then comes back to Ukraine before flowing into the Black Sea. The basin supplies water to about 10 million people and supports a wide range of industries, including food, forestry and hydropower. The basin is also quite vulnerable to climate change, which is causing the following impacts:

- an increase in the flow of water and intensity of flooding;
- a gradual decline in the volume of water resources available, especially during periods of low water levels in tributaries of the Dniester, affecting the Talmaza wetland – the core area of international importance in Moldova's National Ecological Network;
- a corresponding decline in water quality; and
- further deterioration in the condition of aquatic and wetland ecosystems, particularly in the lower reaches of the Dniester, where the Lower Dniester Ramsar Site, on the Moldovan side adds to the conservation of the Dniester delta transboundary wetland, with two Ramsar sites downstream in Ukraine.

Since climate change does not recognize borders, transboundary cooperation is needed to address it. Cross-border cooperation in the basin started in the early 2000s with an aim to involve all basin stakeholders in river basin management, including adaptation to climate change and biodiversity conservation. Such cooperation has resulted in several tangible policy and practical achievements.

In 2015, high-level government representatives from the Republic of Moldova and Ukraine jointly signed the Strategic Framework for Adaptation to Climate Change, developed by experts in consultation with environment, water, climate and sectoral authorities from both countries and with support of international organizations. The Strategic Framework and its Implementation Plan identify joint adaptation options at the basin level, including EbA actions that require transboundary cooperation. Activities involving reforestation, low-scale restoration of flood-plains, fish conservation and dedicated awareness-raising have already been implemented to better adapt to climate change. These EbA-related activities have not only increased basin resilience, but they have also improved and promoted transboundary water cooperation more broadly, such as the entry into force of the *Treaty between the Republic of Moldova and Ukraine on Cooperation in the Field of Protection and Sustainable Development of the Dniester River Basin* in 2017 and the establishment of the bilateral Dniester Commission in 2018. Currently under the Dniester Commission, there are dedicated working groups on ecosystems, biodiversity and river basin planning and management, which include joint activities on EbA.

Transboundary climate change activities in the Dniester basin were executed in close coordination with the national climate processes and supported development of national adaptation planning in both countries. The entire process has been supported by the United Nations Economic Commission for Europe, the Organization for Security and Cooperation for Europe, UNDP/GEF and UNEP.

Strategic Framework for Adaptation to Climate Change in the Dniester River Basin https://dniester-commission.com/wp-content/uploads/2019/09/Dniester_English_web-1-1.pdf;

Implementation Plan for the Strategic Framework for Adaptation to Climate Change in the Dniester River Basin https://dniester-commission.com/wp-content/uploads/2018/12/ImpPlan_Engl_web.pdf

A special case of vertical and horizontal integration applies to transboundary EbA, where issues of national security, border controls, boundary demarcation, and innovative financial cooperation mechanisms may be involved, necessitating more complex institutional arrangements (box 6.2). Even greater complexity may be found in conflict-affected states (box 6.3).

To prepare for mainstreaming, adaptation practitioners should consider:

- The multilevel nature of EbA, that requires involvement of key stakeholders and concerted coordination among different ministries and agencies (box 6.1); and
- Clarity on who holds the decision-making power and leads the articulation of initiatives from local to regional/national/international levels to inform policy and planning processes (box 6.2).

As a tool for mainstreaming EbA, adaptation practitioners should analyse whole-of-government strategies, plans, regulations, programmes and development initiatives through a "climate-risk and ecosystem lens", to identify suitable entry points in the policy cycle. This entails climate-risk assessment, gauging vulnerability to the impacts of climate change, the extent to which climate risks and ecosystem services have been taken into consideration, whether a proposed plan or initiative could inadvertently exacerbate vulnerability or ecosystem

Box 6.3. EU-UNEP Climate Change and Security Project

Input to: Climate change adaptation, conflict resolution and peacebuilding input to NAP

Climate change is increasingly impacting human security and undermining peace. Both slow and sudden impacts of climate change can affect political stability, food and water security, economic growth, livelihoods and even human mobility. At the same time, insecurity decreases communities' capacities to cope with climate change risks, trapping communities in a cycle in which climate change risks and insecurity negatively reinforce each other.

Crisis-affected countries are more susceptible to being overwhelmed by the security risks posed by climate change. However, adaptation and resilience-building efforts often do not consider the impacts of insecurity on the adoption and ultimate success of climate change adaptation measures, especially within the most vulnerable communities.

National adaptation planning processes provide excellent opportunities to scale up and mainstream integrated approaches to climate change adaptation, conflict prevention and peacebuilding. Provided that NAP processes systematically take into account conflict risks, particularly around access, use and control of land and natural resources, environmental degradation and livelihood insecurity, they can play a crucial role in ensuring that climate-related security risks are addressed and reduced.

UNEP has developed assessment tools and piloted integrated approaches to climate change adaptation and peacebuilding that offer good examples of innovative programming in this area. EbA approaches were at the centre of all these activities. They provide entry points for both climate change adaptation and peacebuilding, and particularly so around sustainable livelihoods and natural resource management.

In Sudan's Darfur, communities in the Wadi El Ku catchment area saw their livelihoods threatened by climate change and an increasing number of conflicts around natural resources. Local communities established community-based natural resources management institutions to improve access to land and water and rebuild relationships between conflicting groups.

In the Karnali River Valley, in western Nepal, local communities and municipalities established participatory water management institutions to prevent conflict over water that crossed federal boundaries, effectively involving local and regional stakeholders at different levels, to address water access and potential upstream/downstream conflicts simultaneously.

In South Sudan, UNEP has been working with the Ministry of Environment and Forestry to strengthen the country's capacity to identify and assess climate change-related security risks, and to develop a strategy to improve access to climate finance, in particular the Green Climate Fund. In order to ensure that climate-conflict links were reflected within in-country programmes and project proposals, training was carried out to equip participants with tools to identify climate-related security risks and identify entry points for integrated programming.

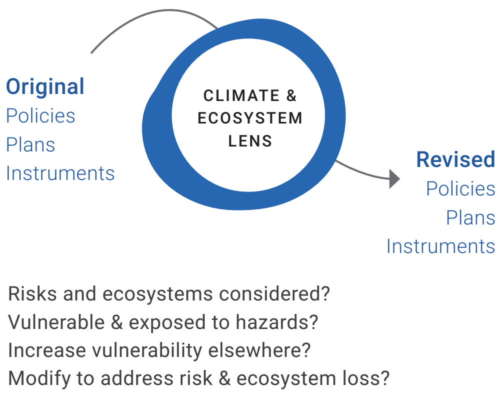
More information at: https://www.unep.org/resources/toolkits-manuals-and-guides/addressing-climate-fragility-risks
https://www.unenvironment.org/explore-topics/disasters-conflicts/what-we-do/risk-reduction/climate-change-and-security-risks

damage, and whether the initiative or plan could be modified to better respond to climate risks and/or opportunities (figure 6.1). Table 6.1 outlines some of the key steps in mainstreaming EbA into national and subnational development and adaptation planning processes.

Adaptation practitioners should look for opportunities or entry points for mainstreaming EbA into national and subnational planning frameworks and decision-making processes, bearing in mind that responses to climate change are often political and not all decision makers will be convinced of the value of EbA solutions (figure 6.2), including:

- Development or revision of policies and plans, e.g., socio-economic development or sectoral plans, NDCs, national biodiversity strategies and action

Figure 6.1. **Applying a climate-risk and ecosystem lens for mainstreaming EbA**



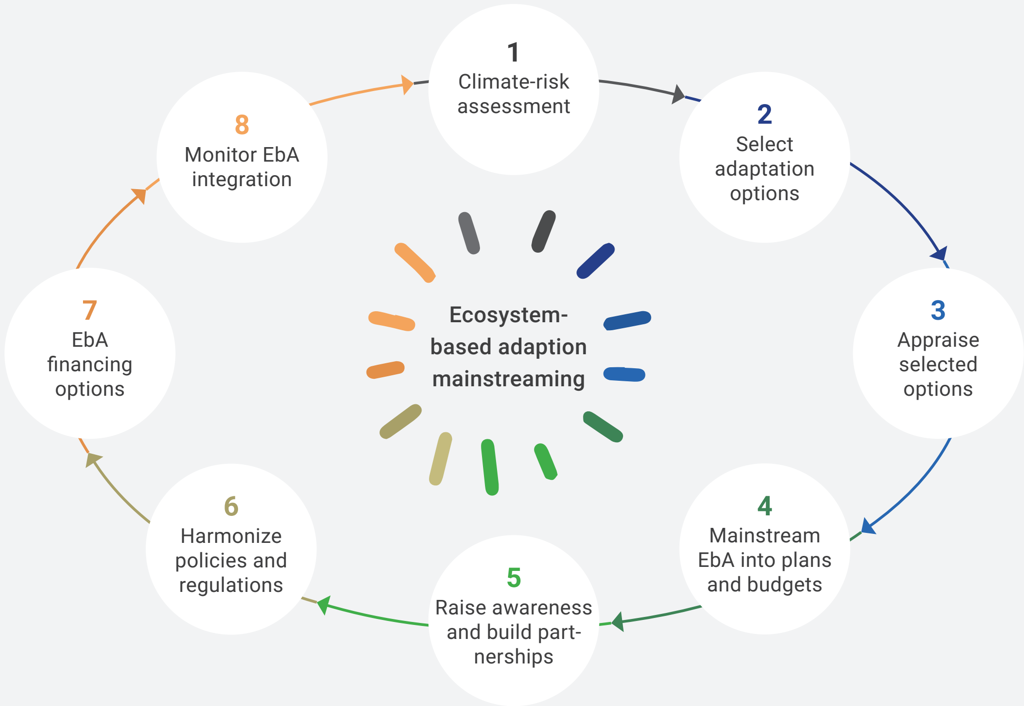
Source: Modified after Lebel *et al.* (2012)

Table 6.1. **EbA mainstreaming strategy: actions and results**

ACTIONS		DESCRIPTION	EXPECTED RESULTS
1	**Carry out a comprehensive assessment, including climate-risk assessment**	Carry out a biophysical, social and climate-risk assessment to understand the linkages between resilience and climate change, ecosystem services and development: understanding climate change vulnerability and the ways in which ecosystem services can build resilience.	This will highlight the impact of climate change on valuable ecosystem services and the value of healthy ecosystems in adaptation policies and frameworks. During the formulation stage of the NAP process, countries need to take stock of existing information and lead the necessary assessments to fill in the gaps.
2	**Select alternative adaptation options and investments**	Identify adaptation priorities that may be enhanced with proven ecosystem-based options.	Policy, plans and institutional entry points for EbA options are identified and agreed upon. This action is addressed in more detail in the formulation stage described in chapter 3.
3	**Appraise the selected options and identify economically justified EbA interventions**	EbA measures are not always optimal, so the possibility of "do nothing", hard infrastructure and green-grey hybrid options need to be compared with EbA approaches, recognizing that factors other than economics are also important.	The situations where EbA and/or green-grey hybrid are fully justified are agreed by sector planners and managers and incorporated into policies, plans and programmes.
4	**Mainstream EbA into sector plans and budgets**	National and subnational sector development plans and budgets (and international agreement strategies and action plans) are enhanced by adopting EbA actions and strategies.	EbA investments align with and are incorporated in subnational, national and international action plans and integrated into their respective monitoring and reporting schemes.
5	**Raise awareness, strengthen capacity and build partnerships**	Planning processes for SDGs, climate change and DRR, open opportunities to (i) raise awareness and build capacities on how ecosystems may enhance national resilience; and (ii) build partnerships to face common risks.	EbA measures are taken up in a wide range of related planning processes and lasting partnerships are created. This action is addressed in more detail in the formulation and implementing stages in the next chapters.
6	**Harmonize policies and regulations to ensure that EbA is always considered as a possible option**	Building on the outcome of the previous actions and the amount of credibility generated by ecosystem approaches, EbA should become part of key development policies and regulations.	Ecosystem approaches will always be featured in national development plans, climate change policies, environment and conservation strategies, sectoral plans, policies and regulations.
7	**Integrate EbA into current and pipeline investment financing**	Demonstrating the business case for attention to ecosystem services will help to mobilize national and sector finance for ecosystems and green investments.	Risk-informed development contributes to protecting healthy natural infrastructure and promoting EbA through green investment and safeguarding natural capital.
8	**Monitor EbA integration and implementation progress**	Review the process of integration of EbA into national and subnational adaptation and development planning and implementation processes, with a view to capturing valuable lessons to integrate into subsequent updating and revisions.	As ecosystems are naturally dynamic and always changing, EbA measures need to be constantly monitored. Accordingly, adaptive management and "living" plans will ensure that EbA measures continue to provide the necessary level of protection as the climate changes.

Source: Modified after World Wildlife Fund (2013); Secretariat of the Convention on Biological Diversity (2019); and United Nations Development Programme-United Nations Environment Programme (2015)

Figure 6.2. **EbA mainstreaming strategy: actions and key entry points for EbA**



Source: Based on Secretariat of CBD (2019, p. 50); and UNDP-UNEP (2015)

plans, strategic environmental assessments and municipal or district land-use plans;

- Promulgation or revision of command and control instruments, e.g., climate change and environmental laws, engineering and building standards, environmental impact assessment and disaster risk-management regulations; and

- Economic and fiscal instruments, e.g., investment programmes, funds, subsidies, taxes, fees, public-private partnerships and national-level incentive structures.

A basic consideration for mainstreaming EbA into the policymaking, planning and budgeting processes is learning how to seek coherence across relevant national strategies and plans (OECD 2020b). Understanding how the different elements of adaptation and EbA interact with international frameworks and national agendas – such as biodiversity, sustainable development and disaster risk management – is at the core of policy alignment. Synergies need to be found among different policies or plans with similar objectives to attain the best possible outcomes, while overlaps and conflicting approaches need to be recognized and avoided. For example, EbA measures in forested watersheds may synergize with the CBD's Aichi targets (and their proposed update), while infrastructure plans, like road construction, may conflict with EbA measures designed to control soil erosion in those same watersheds.

Many of the current NAPs show how adaptation (and especially EbA) is being mainstreamed in line with the approaches shown in table 6.1 and figure 6.2:

- Brazil's NAP identifies the need for EbA in (i) cities, through sustainable urban drainage; (ii) strengthening resilience of the industry sector; (iii) addressing the impact of climate change on transport infrastructure; and (iv) urban mobility plans (Brazil Ministry of Environment 2016).

- Grenada's NAP identifies a specific goal to integrate "climate change adaptation within the process of the National Sustainable Development Plan 2030 (formulation and implementation)" (Government of Grenada 2017).

- Kenya is mainstreaming climate adaptation in both national and county (subnational) level development planning, budgeting and implementation, as well as ensuring that sectoral agencies have the necessary staff and financial resources to coordinate mainstreaming (Government of Kenya 2016).

- Kiribati's NAP states that "climate change and disaster risks are mainstreamed in a whole-of-government approach that covers a range of measures from planning for risks through assessments, identifying threats, to actual implementation" (Government of Kiribati 2019).

- Sri Lanka's NAP has a specific sector action plan on ecosystems and biodiversity and aims to mainstream climate change adaptation into national sustainable development plans (Climate Change Secretariat Ministry of Mahaweli Development and Environment 2016).

Ethiopia declared in its Intended NDC that its "long-term goal is to ensure adaptation to climate change is fully mainstreamed into development activities. This will reduce vulnerability and contribute to an economic growth path that is resilient to climate change and extreme weather events". In Ethiopia's NAP, the most vulnerable sectors are agriculture, forestry, health, transport, power, industry, water and urban (Federal Democratic Republic of Ethiopia 2019). Among 18 adaptation options selected for that NAP, EbA features strongly as:

- enhancing food security with climate smart agriculture
- access to potable water
- sustainable natural resource management through safeguarding landscapes and watersheds
- ecosystem resilience through conserving biodiversity
- sustainable forest management
- urban resilience
- mainstreaming indigenous adaptation practices

In addition to the steps outlined in table 6.1, and to reinforce those steps, adaptation planners may enhance coherence by considering coherence, efficiency and effectiveness (see box 6.4) as well as the following approaches:[40]

- Reviewing national policies, strategies and plans in a consultative and coordinated manner, with engagement from all relevant ministries, civil society organizations and other key stakeholders, and determining how adaptation is being incorporated;

- Encouraging greater policy coherence by ensuring that medium-term (i.e., 5–10 years) national strategies and plans have clear objectives, actions and targets, taking into account future climate projections.[41] This would help to identify any policy misalignment or conflicts;

- Developing adaptation-related indicators against which progress towards the targets can be assessed, for enhancing transparency and accountability; and

- Enhancing coordination between national institutions (horizontal coordination) and national and subnational institutions (vertical coordination), by creating, for example, a cross-departmental steering group for adaptation and EbA (box 6.1).

Once policies and plans considering EbA are translated into budget allocations and expenditures, they may become part of the annual national budgeting process[42] (figure 6.3). In the pursuit of alignment, planners and adaptation practitioners will need to address some of the following issues depicted in figure 6.3. The EbA entry points in figure 6.3 are both "bottom-up" - via community consultation and local adaptation plans – and "top-down" – via national policies, plans and regulations. Creating the appropriate enabling environment

Box 6.4.

Coordination among government actors for better alignment

The process of alignment necessitates intentional coordination among government actors across ministries and levels. Alignment can increase:

- Coherence, by facilitating analysis of shared objectives, co-benefits and trade-offs between differing objectives, leading to more strategic investments and ensuring that efforts in one area do not undermine progress in another.

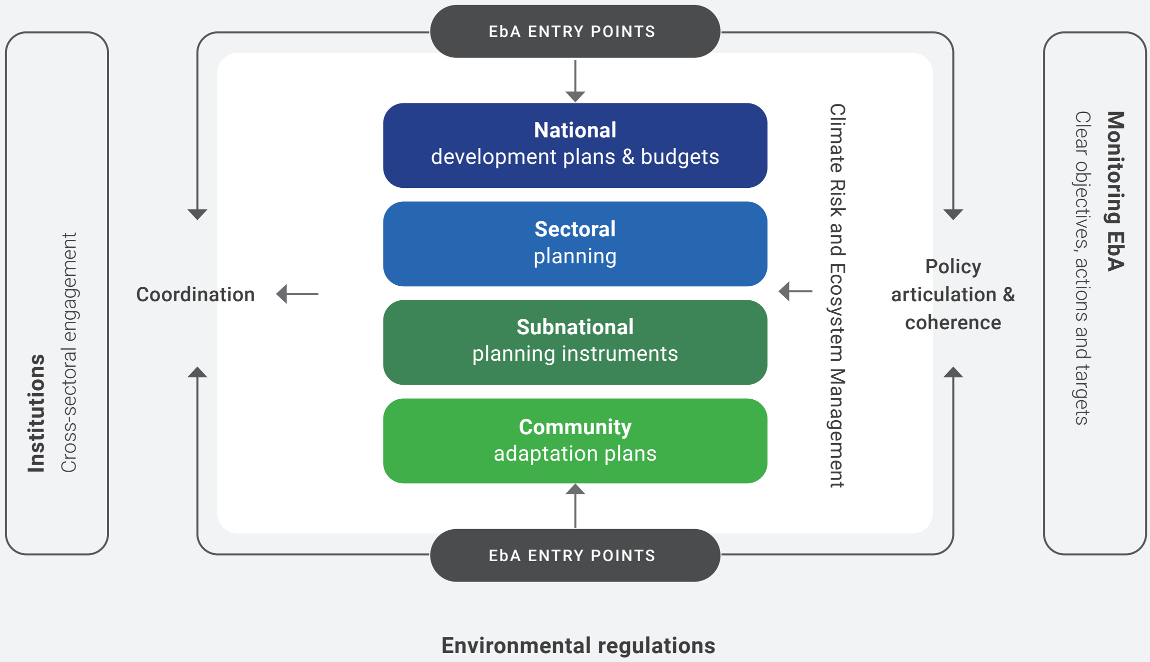
- Efficiency, by avoiding duplication of efforts and enabling smart use of resources, including financial and human resources.

- Effectiveness, by approaching climate-resilient development in an integrated way, leading to improved quality of planning, implementation, and measurement and evaluation processes for better results.

Source: Dazé *et al.* 2018

40 For a discussion of the approaches, please see: Organisation for Economic Co-operation and Development (2020b).
41 Targets should be specific, measurable, actionable, realistic and time-bound (SMART); more specific and measurable targets will improve the ability to assess the coherence between them.
42 For a discussion of EbA and national budgeting processes, please see: Adelante *et al.* (2015), cited in UNDP (2015).

Figure 6.3. **Enabling environment for integrating EbA at different scales**



Source: Authors

requires coordination of the institutions responsible for planning and implementation at the various levels and across sectors as well as coherent policies, strategies and plans at all levels. A fully coherent and aligned institutional and policy setting approach at all levels of government will make the task of justifying increased budget allocations so much easier. In addition, consider the following actions:

- Map out the environmental regulations (plus laws, policies, strategies and plans) such as national climate change strategies and national biodiversity strategy and action plans (NBSAPs), that are already making the case for strengthening environmental resilience and sustainability in national development plans and influencing government priorities and public sector financing (UNDP and UNEP 2015);
- Engage with the lead institution coordinating the planning process (providing guidance on how to incorporate cross-cutting issues) and sector working groups involved in the planning process (e.g., providing content for the national plans);
- Link planning and budgeting processes to national, subnational and sectoral priorities; factor in climate risk and ecosystem management issues at each level;
- Find opportunities in a timely manner for integrating EbA in the different steps of the formulation, review and update cycle of: (i) national development plans; and (ii) national budget—from formulation to execution and monitoring;
- Strengthen the relevant institutions and arrangements needed for including and consolidating ecosystem approaches both at the core of the NAP and at subnational level;
- Strengthen capacities and resources for environmental regulations, institutional settings and policy implementation processes to prevent environmental degradation and poverty exacerbation and enhance monitoring, evaluation and learning systems; and
- Engage with and empower the affected vulnerable communities to participate at all planning levels but, most importantly, in the preparation and implementation of community adaptation plans.

Wherever adaptation is being prioritized – whether in the NAP, local climate action plans, or national development plans – use an ecosystem lens to examine the validity of adopting an EbA approach. If the local government has been building seawalls for many years and they continue to collapse as sea levels rise and storm surges increase in intensity, treat this as an opportunity to suggest that EbA, such as beach sand replenishment, might be a more effective approach. If the national road authority spends millions of dollars every year removing windblown sand from a coastal road, ask if the roads

Table 6.2. **Barriers for mainstreaming EbA into development frameworks: country experiences**

BARRIER		DESCRIPTION
1	**Difficulty finding a common language and methods for EbA.**	Different agencies involved in promoting ecosystem management and adaptation use distinct terminology and separate methodologies, which can hinder coordination.
2	**Overlap of institutional mandates.**	While national-level mandates on climate change adaptation and ecosystem management are usually clear, at the regional and local levels, institutional responsibilities for carrying out those mandates often overlap. Especially in bottom-up cases with a potential to mainstream EbA, it often is unclear who leads the articulation of initiatives from local to regional level, and then on to the national level to inform policy processes.
3	**Limited horizontal coherence of policies.**	There is limited alignment between policies and sectoral action plans with regards to adaptation measures but also disaster risk reduction.
4	**Lack of articulation with policies across governance levels.**	A great difficulty is the articulation of policies and plans at local, provincial and national levels. When EbA is integrated in the NAP, it needs to be further articulated with provincial and local planning processes to be effectively implemented. Often, this proves to be challenging.
5	**Monitoring and evaluation of EbA measures is challenging.**	Indicators for M&E of EbA measures are challenging to find, because processes depend on time frames, actions and planning across sectors and regional or administrative entities, with complex interactions and interdependencies. In addition, available information is limited with regards to baselines or construction and monitoring of indicators.
6	**Limited capacity of national institutions to support the validation and implementation of EbA initiatives.**	Due to limited technical human and financial resources and technical skills, national entities often cannot respond to the need for technical assistance (e.g., revision and approval of EbA project proposals pursuing public investment).
7	**Effective mainstreaming is a resource-intensive and long-term process.**	However, project timelines and budgets rarely take this into account. Often project leaders, e.g., institutional and community stakeholders, are forced to initiate the adaptation planning process in a vacuum. The planning and implementation process in many cases is a multi-year participatory initiative, which needs to secure trust and establish long-term relationships among a range of actors. This can be a demotivating factor for initiating such processes.

Source: GIZ (2019)

engineers would consider a sand dune rehabilitation project as part of the EbA content of the NAP. With an ecosystem lens and an open mind, opportunities will abound.

As countries aim to strengthen their resilience to more variable and extreme weather events, they face many challenges. For example, how best to integrate or mainstream climate change-related information on risks, hazards and vulnerabilities into development planning, and how to choose the best adaptation measures in response (table 6.2) (Tye *et al.* 2020).

Integrating EbA into the NAP process and other national development planning processes is not simple, however, and there are multiple potential pitfalls that adaptation practitioners need to be aware of.

First, our knowledge of ecosystems and ecosystem services is often rudimentary and new knowledge is constantly being developed. Do not assume that you know how an ecosystem will change over time, especially as climate change continues to exacerbate ongoing natural changes. Carefully monitor those changes and use adaptive management to implement fine-tuning as needed. Additional funding for ecosystems research and the training of ecologists is also needed.

All photos on this page: © UNEP

Adapting coastal zone management to climate change in Madagascar

Along with other women in Mangatsiotra village in Madagascar's coastal Vatovavy Fitovinany region, Vivienne Rakotoarisoa (left) takes carefully crafted mats, hats and baskets made from a reed known locally as rambo to sell at a nearby market.

Having previously relied heavily on rice farming – where harvests have been hampered by unpredictable rainfall in recent years – this climate resilient crop is able to withstand periods of erratic rainfall, providing Vivienne and her family a more stable source of income in the face of a changing climate.

Vivenne is one of 300 community members who were provided with "rambo" seeds and trained in how to cultivate, care for and maximize yield as a springboard towards diversifying their livelihoods. This exciting initiative is part of a five-year project launched in 2015 by UNEP and its partners, entitled, 'Adapting Coastal Zone Management to Climate Change in Madagascar'. Focusing on four coastal sites which have been identified as being particularly vulnerable to climate change, the project aims to build the long-term resilience and capacity of target communities through various ecosystem-based adaptation interventions.

Learn more about UNEP's work on adaptation.

Second, EbA is not always the best choice of adaptation options. For example, a green wall of ivy plants on high-rise buildings may look great on the architect's blueprints as a way of reducing the urban heat island effect, but the ongoing maintenance difficulties and costs may be prohibitive compared to the double glazing of windows. Do not be an EbA purist and insist that every adaptation option should be ecosystem-based. Always consider the option of combining green and grey adaptation options, as this may be the optimal approach.

Third, the economics of EbA are often problematic, as many of the costs and benefits reside outside markets and therefore have no established price. The difficulty of establishing shadow prices for these costs and benefits may disadvantage EbA, as infrastructure costs and benefits are much easier to establish. In addition, some environmentalists oppose the idea of putting dollar values on ecosystems and ecosystem services. These challenges can be overcome as "The Economics of Ecosystems and Biodiversity" (TEEB) initiative has shown, but extra effort is required.

Once these challenges of planning, budgeting and governance structures and mechanisms are understood, integration of EbA into development planning at different scales may benefit from the following actions:[43]

- Plan integration of ecosystem approaches into development and adaptation plans as a series of milestones to be achieved along a timeline reflecting the periodic updates of the NDCs, NAPs and national, subnational and sectoral development plans.

- Connect EbA with other issues seeking to be mainstreamed into development planning, e.g., poverty reduction, gender equality, disaster-risk reduction and environmental sustainability. Identifying synergies will contribute to enhancing impacts and leveraging financial resources.

- Extend, link and increase the scale and speed of biodiversity conservation measures already taking place as part of environmental planning and existing management approaches (Lukasiewicz *et al.* 2015).

- Take stock of ongoing ecosystem management initiatives to establish a baseline for measuring progress in mainstreaming EbA.

- Build monitoring and evaluation into the institutional arrangement at an early stage (LEG 2016).

Communicating progress in CCA, both nationally and globally, may assist in raising awareness on the role of ecosystem services in climate-resilient development and enhancing political will among planners and decision-makers for increased attention to EbA:

- Engage political leaders, civil society organizations (CSOs), non-governmental organizations (NGOs) and the media in advocating for the strategic importance of ecosystem services for climate resilience and the advantages of integrating EbA into socio-economic and spatial planning (box 6.5).

- Engage climate champions, such as youth leaders, to lead the mainstreaming of adaptation into policies and legislation.

While there is a relatively sound policy framework in place in most countries, implementation of adaptation policies remains dependent on an adequate enabling environment, supportive legal frameworks, sufficient human resource capacities and adequate financial resources (UNDP 2015b).

6.3. Links to other Multilateral Environmental Agreements

In recent years, all global and regional commitments, including the 2030 Agenda for Sustainable Development, the Paris Agreement under the UNFCCC, and the Sendai Framework for Disaster Risk Reduction, have advocated for:

- Putting human development on a more sustainable and resilient pathway by setting adaptation and disaster risk management at the base of sustainable development; and

- Providing important entry points not only to scale up EbA (and Eco-DRR) approaches but also to ensure greater coherence through integrated approaches for conservation, DRR and CCA (Secretariat of CBD 2019).

43 Information on integrating EbA at different scales adapted from United Nations Development Programme-United Nations Environment Programme (2015).

Box 6.5. **From principles to action: adaptation services in Nepal's NAP**

Ranked fourth in the Global Climate Risk Index (2019)[1], mean annual temperatures in Nepal are expected to increase up to 1.8°C by 2100. Currently, erratic rains cause flash floods that alternate with prolonged periods of extreme drought, affecting livelihoods and hydropower, and setting the scene for increased climate risk, including uncertain future flows and quality of water derived from glaciers, snow-melt and rainfall.

Since the UNFCCC was ratified in 1992, the Government of Nepal has been paving the way towards adapting to climate change. Key milestones include (i) NAPA (2010) with ecosystem and community adaptation through integrated watershed management[2]; (ii) *Local Adaptation Plans of Action* (LAPA) and the first *Climate Change Policy*, both in 2011; (iii) launch of the NAP process (2015); and (iv) a *new Climate Change Policy*[3] (2019). Since 2010, the government's budget for climate change actions increased from 6 per cent to about 25 per cent of the total annual budget, funding a wide range of adaptation interventions ranging from community-based adaptation practices, to scaling up climate-smart agriculture, to influencing climate-resilient development planning, with a strong emphasis on EbA. The use of LAPAs has aimed at ensuring the integration of adaptation into every level of the national planning process.

The combination of the bottom-up approach of LAPA with the landscape approach of EbA has been instrumental in safeguarding water catchment areas with their ecosystems and adaptation services, actions considered critical for enhancing climate resilience in Nepal.[4] Adaptation services include the buffering capacity of ecosystems against change and incorporate valued ecosystem services such as crop diversification for food security (Karki and Kunwar 2020). The LAPA framework (2019) presents an approach for "delivery of adaptation services to the most climate-vulnerable areas and people".

To consolidate climate change adaptation interventions in the country, the Climate Change Management Department of the Ministry of Forests and Environment, has established inter-sectoral working groups to guide the NAP process (Eckstein *et al.* 2019). Nepal's efforts in strengthening its institutional capacities with clear roles and mandates and creating an enabling environment for EbA, will facilitate transition towards climate-resilient development pathways. An inclusive process of formulation and implementation of its NAP, abundant in ecosystem approaches, may turn it into a reference for other countries interested in mainstreaming ecosystem approaches to climate change adaptation.

Sources: Eckstein *et al*. (2019); Government of Nepal (2019, p. 29); Lavorel *et al*. (2015).

All MEAs provide strong policy support to EbA and pave the way to mainstream ecosystem-based approaches in adaptation planning processes at all levels. Shared objectives of MEAs to strengthen resilience, build adaptive capacity and reduce vulnerability to climate change and disasters create a strong rationale for alignment (box 6.6). As mentioned above, alignment can increase coherence, efficiency and effectiveness for implementing the national components of these and other international agenda. Design of EbA interventions to provide multiple co-benefits can contribute to achievement of other MEA and SDG targets.

THE RIO CONVENTIONS

Mainstreaming EbA delivers additional benefits to adaptation and development planning in the post-2015 policy agenda. EbA is recognized as a cross-cutting policy instrument, with the Rio+20 Action Plan on Adaptation describing it as a planning tool for unifying all three Rio Conventions: Convention on Biological Diversity (CBD), United Nations Framework Convention on Climate Change (UNFCCC) and United Nations Convention to Combat Desertification (UNCCD). The unifying power of EbA is illustrated by:

- The emphasis on maintaining or restoring biodiversity and ecosystem services and increasing habitat connectivity conserves biodiversity and, thereby, helps countries meet their obligations under the CBD.
- Increasing resilience to climate change and simultaneously providing co-benefits such as carbon sequestration, EbA helps countries meet mitigation targets mandated under the UNFCCC.
- EbA often involves maintaining or restoring the capacity of an ecosystem to regulate water cycles or rehabilitate degraded land and thus aligns with the goals of the United Nations Convention on Combating Desertification (UNCCD).

Box 6.6. Advantages of systematic integration of ecosystem-based approaches into tspatial planning

Multiple benefits: Besides risk reduction, ecosystem-based approaches provide a multitude of benefits to society and the economy, including provision of natural resources (food, fibres and medicine), water regulation, climate change mitigation through carbon sequestration, recreation and provision of habitats for species.

Cost-effectiveness: As natural risk buffers, natural and sustainably managed ecosystems are often less expensive to maintain and could be more effective than physical engineering structures. Depending on local conditions, condition of ecosystems and climate projections, hybrid green-grey infrastructure solutions that combine ecological infrastructure (e.g., forests, wetlands) with a built infrastructure (e.g., dams, water retention ponds) may work best in terms of public health, social cohesion, biodiversity and mitigation, creating win-win solutions for the environment, society and the economy (NWP 2017).

Adaptive management: Due to the fixed design and purpose of built physical "grey" infrastructure measures, they often cannot be modified afterwards. By contrast, ecosystem-based or hybrid approaches, combining both grey and green infrastructure, can be adapted and managed more easily to fulfil their functions for society.

Social inclusion, participation and employment: The rural poor and marginalized societal groups are especially and directly dependent on ecosystems and their services for sustaining their livelihoods. Ecosystem-based approaches help marginalized people to participate in ecosystem management and livelihood improvement, which requires local ownership, knowledge and resources, including labour. Participatory spatial planning enables governments and local stakeholders to jointly identify priority areas for improving land tenure and access to key resources.

Using local knowledge: Ecosystem-based approaches are often built on local, traditional or indigenous knowledge. They acknowledge and utilize this knowledge in combination with scientific knowledge in the context of using land and marine resources.

Addressing various development goals: Implementation of ecosystem-based approaches has the potential to address various international, national and local development goals around food security, employment creation, water supply, poverty reduction, education, economic diversification, nature protection, climate change, disaster risk reduction, etc.

Source: Secretariat of CBD (2019)

Box 6.7. Linking poverty alleviation and economic growth with climate change adaptation

While climate change clearly presents a significant threat to development, actions to reduce poverty and increase economic growth in developing countries can also help tackle climate change. For example, sustainable urban transport systems, such as bus rapid transit, can reduce emissions while enhancing access to transport services for the poor; agricultural practices that integrate forestry can boost resilience to climate impacts whilst also storing carbon; and distributed solar power can often provide cost-effective access to electricity for the poor. Ensuring access to energy, building sustainable cities and ensuring food and water security can also reduce greenhouse gas emissions and build resilience to future climate impacts.

Source: CDKN (2014)

The Convention on Biodiversity in Article 8(d) states, “promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings” and in Article 8(f) “rehabilitate and restore degraded ecosystems”. The Strategic Plan for Biodiversity 2011–2020 and the Aichi Biodiversity Targets under the CBD[44] aim to (i) halt the loss of biodiversity by mainstreaming biodiversity across government and society; (ii) ensure ecosystems are resilient and continue to provide essential services to all; and (iii) enhance implementation through participatory planning. National Biodiversity Strategies and Action Plans (NBSAPs) are the principal instruments to implement the Convention at national level, and thus provide key entry points for mainstreaming EbA. The fifteenth meeting of the Conference of the Parties to the CBD, to be held in 2021, will adopt a post-2020 global biodiversity framework as a stepping stone towards the 2050 vision of "Living in harmony with nature". In 2021, the United Nations will be launching a Decade on Ecosystem Restoration and restoration of 3.5 million km^2 of land at an estimated cost of US$1 trillion (Lawton 2021).

Land stewardship is considered one of the most mature carbon dioxide removal methods. Options to mitigate climate change by increasing carbon sequestration and reducing emissions of carbon and other greenhouse gases have been assessed in the framework of the UNFCCC and the IPCC assessment reports. Nature-based solutions stand out as some of the best options and are completely aligned with EbA. For example, conservation, restoration and improved management practices in forest, wetland and grassland biomes are fully aligned with EbA and provide additional entry points in national planning (Griscom *et al.* 2017).

Synergy with the 10-year Strategic Plan and Framework (2008–2018) of the UNCCD is also clear, as it seeks to reverse and prevent land degradation and desertification, recognizing the key services provided by ecosystems, especially for drought mitigation in drylands. By adopting the Land Degradation Neutrality target, Parties have agreed that the amount of healthy and productive land should remain stable, starting in 2030, enhancing land resilience to climate change and halting biodiversity loss linked to ecosystem degradation. The UNCCD 2018–2030 Strategic Framework states a goal of achieving “a future that avoids, minimizes, and reverses desertification/land degradation and mitigates the effects of drought in affected areas at all levels ... to achieve a land degradation-neutral world consistent with the 2030 Agenda for Sustainable Development”.

THE RAMSAR CONVENTION

The Ramsar Convention at Article 3(1) states, “the Contracting Parties shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory”. Resolution XI.14 at the Ramsar COP11 on *Climate Change and Wetlands*[45], expressed the Parties’ commitment to develop and implement policies that take advantage of the regulatory services provided by wetlands to the global climate system while also contributing to improving human livelihoods, eradicating poverty and meeting biodiversity goals. The wise use approach adopted by the Ramsar Convention is an example of an ecosystem approach for integrated environmental management. Examples of ecosystem approaches include integrated coastal zone management and integrated catchment management, which can be instrumental for implementing EbA options at a landscape scale.

Representatives of the Ramsar convention at the Conferences of the Parties to the UNFCCC have repeatedly stressed the critical role of wetlands in climate change adaptation and building resilience, and the urgent need to redouble actions for restoration, sustainable use and management of all wetlands (box 6.8).[46]

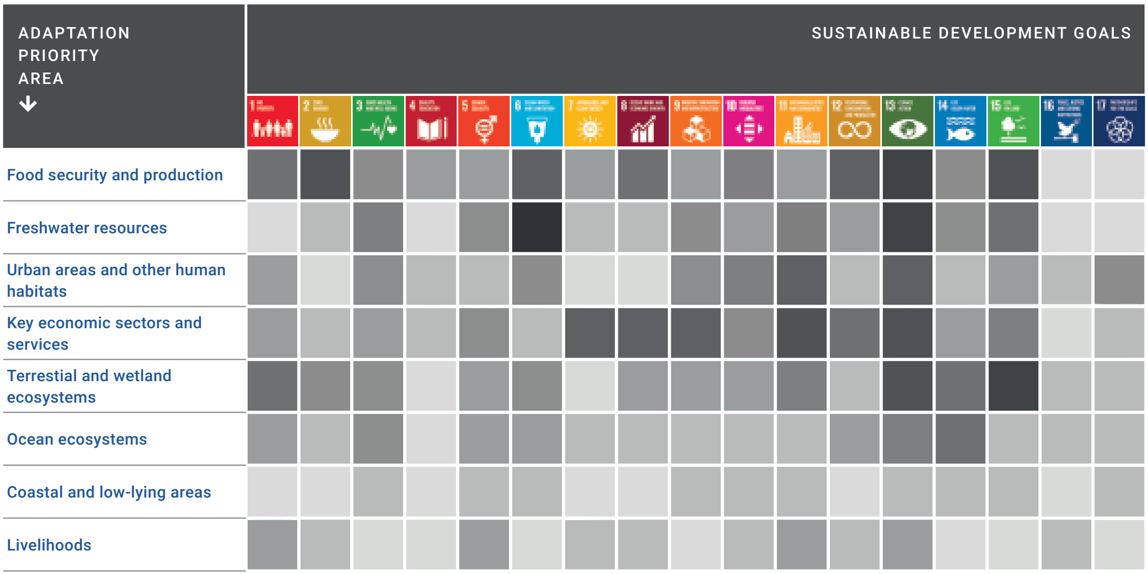
Box 6.8. **Wetland ecosystems and the SDGs**

Wetlands are essential to human well-being, inclusive economic growth and climate mitigation and adaptation. They provide water for human consumption and agriculture. They protect our shores and help make cities and settlements safe and resilient. They are the Earth’s greatest natural carbon stores. They support biodiversity and abundant and unique nature. They are vital to mitigate and adapt to climate change. They provide sustainable livelihoods and are essential to human health and well-being. Wetlands provide myriad benefits and services, essential in achieving the SDGs.

Source: Wetlands and the SDGs – here.

44 See: Convention on Biological Diversity – Aichi Targets, here.
45 See: Resolution XI.14 here.
46 See: Ramsar Convention at UNFCCC COP 22 here.

Figure 6.4. **Synergies between adaptation priorities and SDGs noted in NDCs**



Note: The shading of the boxes reflects how frequently linkages were identified by Parties: the darker the shade, the more frequently linkages were identified.
Source: UNFCCC (2021)

Similarly, in 2018, Parties to the Ramsar Convention on Wetlands agreed to measures that protect, restore and sustainably manage peatlands and coastal ecosystems, as a recognition of the important role of wetlands in mitigation and adaptation to climate change. Restoration and wise use of wetlands can be a cost-effective strategy for climate adaptation with strong benefits for poverty reduction and biodiversity conservation. Assessing climate risk faced by wetlands, along with sustaining and restoring wetlands to reduce the climate risk of exposed communities and livelihoods, are common EbA options currently being implemented worldwide to safeguard wetlands services for climate change adaptation.[47]

THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

Effective EbA promotes sustainability across multiple sectors, from agriculture and forestry, energy and water to social justice, education and livelihood diversification, and could help countries meet the SDGs. Table 6.3., for example, shows how city-level EbA options contribute to multiple SDGs.

EbA is acknowledged to be essential to achieving the SDGs (figure 6.4), particularly SDG 2 (zero hunger); 6 (clean water and sanitation); 11 (sustainable cities and communities); 13 (climate action); 14 (life below water); and 15 (life on land). Thus, integrating EbA in sustainable development policy processes at the national level is an important enabler for implementation at all other levels. In the currently updated (or new) NDCs, the connection between EbA and the SDGs is clear (UNFCCC 2021).

47 A framework for assessing the vulnerability of wetlands to climate change. Ramsar Technical Report N°5 – CBD Technical series N°57. Available here.

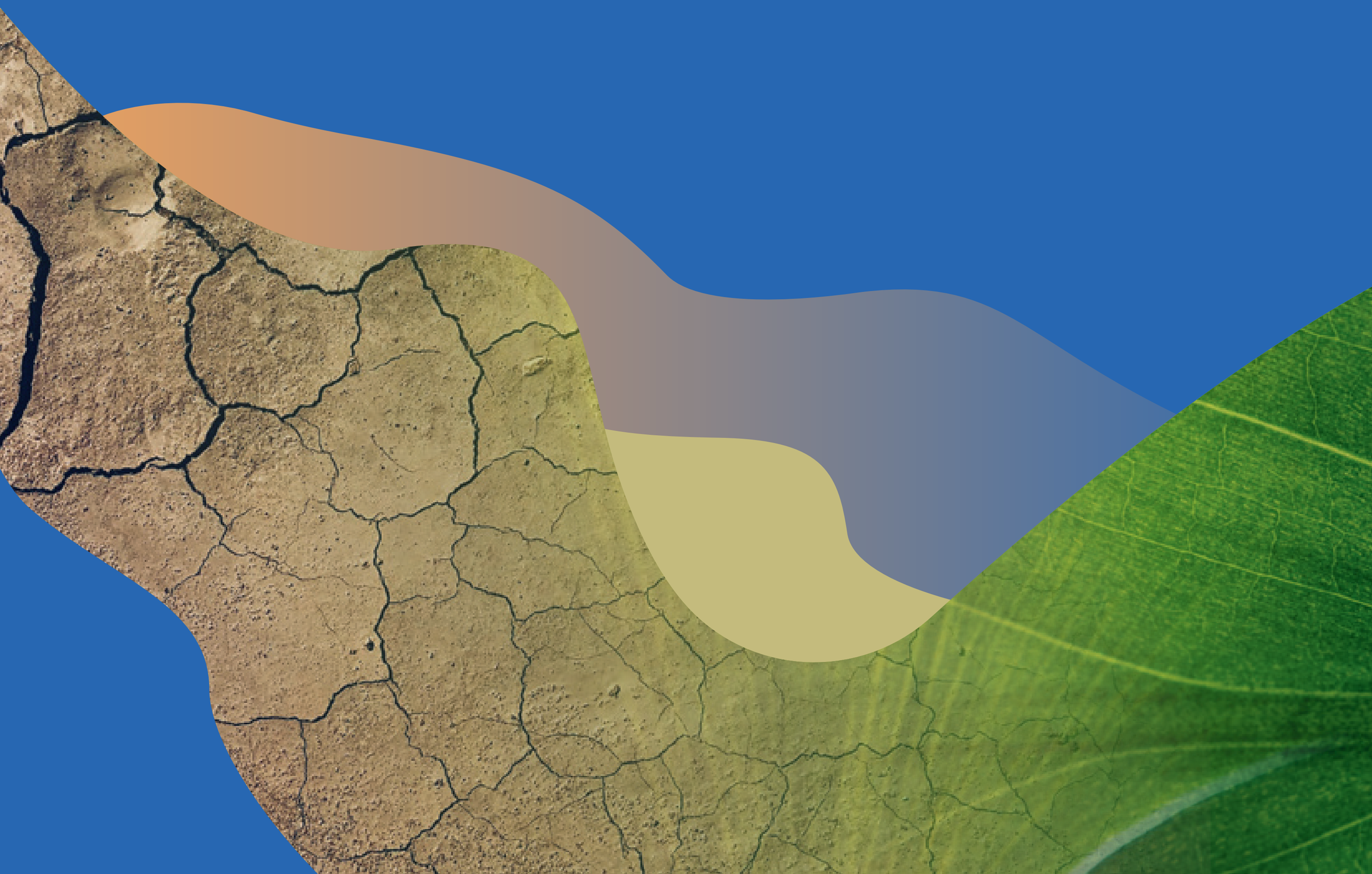
Table 6.3. **Climate change relevance to other SDGs (in addition to SDG 13)**

SDG		EXAMPLES OF CLIMATE CHANGE IMPACTS THAT MAY BE ADDRESSED BY EBA MEASURES
2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	Temperature effects on crop production and yield;
		Rainfall patterns changed, affecting rain-fed agriculture;
		Increasing intensity of rainfall causes. soil erosion and loss of fertility;
		Pests and diseases affecting crop production;
		Crop prices may rise, making food less affordable and resulting in a greater share of the household budget going toward food. Unable to pay school fees, parents may withdraw children from school. Crime may spike when youth have more free time.
3	Good health and well-being	Increased heatwaves especially impacting outdoor workers, the elderly and the poor;
		Increased extreme weather events causing floods and loss of life and assets;
		Increased drought incidence leading to malnutrition and skin diseases;
		Warm and wetter conditions favouring water-borne disease vectors, such as mosquitoes.
6	Clean water and sanitation	Incidence of drought frequency and severity in some countries reducing access to clean water;
		Reduced groundwater recharge, especially in paved-over areas;
		Polluted floodwaters due to overflowing sewerage systems during intense rainfall;
		Increased temperature affecting wastewater treatment systems.
9	Industry, innovation and infrastructure	Increasing rainfall and intense flash floods damaging roads, bridges and other infrastructure;
		Heatwaves buckling rail lines, melting asphalt and damaging runways;
		Sea level rise and storm surges inundating coastal infrastructure;
		Increased severity of typhoons damaging power lines, phone towers, and other vital infrastructure.
11	Sustainable cities and communities	Heatwaves exacerbating urban heat island problems;
		Increasing flood incidence affecting informal slum settlements on river banks and in flood-plains;
		Reduced groundwater recharge causing urban subsidence.
14	Life below water	Increasing seawater temperature and ocean acidification damaging coral reefs;
		Marine fauna moving to cooler fishing grounds away from major fishing nations;
		Increasing freshwater inflow from melting glaciers and ice caps changing ocean currents that affect weather patterns.
15	Life on land	Drought frequency increasing and damaging forests and contributing to wildfires;
		Loss of biodiversity as flora and fauna struggle to adapt to changing climate conditions;
		Major impacts to all forms of agricultural production.
17	Partnerships for the goals	Massive increases in climate finance for mitigation and adaptation will reduce funding availability for other SDGs;
		Climate adaptation funding needed in developed countries will reduce the availability of official development assistance.

Photo: © UNEP

CHAPTER

7 Conclusions and recommendations



7.1. Conclusions

EbA focuses on reducing vulnerability and building resilience to the impacts of climate change through the use of biodiversity and ecosystem services.

Chapter 1 illustrated the essential alignment between EbA and NDCs, as at least 104 NDCs have acknowledged that ecosystems and biodiversity are vulnerable to climate change, and 76 countries pointed to conservation of ecosystems as an important motivation for adaptation planning. Unfortunately, even where the importance of EbA is recognized in NDCs, clear and measurable targets that can track progress and local community involvement in designing and implementing adaptation activities tend to be absent. The NDC revisions currently taking place will allow for greater alignment with NAPs and for incorporating quantifiable EbA targets and increased local participation in NDCs.

Chapter 2 focuses on ensuring a sufficient explanation of the value provided by ecosystems, ecosystem services and EbA is available and detailed. An important conclusion in chapter 2 is that ecosystems and ecosystem services are also under threat from climate change, so EbA must accommodate and adjust responses to a constantly changing adaptation setting. Careful monitoring of those changes and practicing adaptive management become important considerations and point to the need for regular updating and revision of NAPs and implementation arrangements. For example, if the temperature tolerance of species used in revegetation programmes is exceeded, then rehabilitation of degraded landscapes may fail. Little is known about which species are “climate adapted”, so more research and local knowledge compilation is needed in this area.

The overwhelming rationale for adopting EbA in all NAPs is because well-designed and implemented EbA approaches generate multiple co-benefits in addition to protection from climate change impacts, including improved biodiversity protection, enhanced water and food security, alternative livelihood opportunities, community health, and disaster risk reduction. If all these benefits are calculated, then EbA becomes a benefit multiplier and an essential community asset, adding to social and natural capital.

Regardless of whether the EbA measures are first inserted into the NAP or directly into other policies, plans and programmes, a systematic approach to selection and prioritizing of adaptation options is crucial. Chapter 3 lays out a comprehensive approach to the tools available including (i) economic, least cost, cost-effectiveness, or cost-benefit analysis; (ii) multi-criteria analysis; (iii) qualitative matrices; (iv) scenarios; and (v) barrier analysis. Combinations of these tools are also possible.

Chapters 3–5 add an EbA perspective to the NAP Technical Guidelines of LEG and cover the four elements of those guidelines (albeit merging Element A and B into a combined “formulation” stage). The key steps for integrating EbA into the NAP process are shown in table 7.1.

While inclusion of EbA in NAPs is critically important, the EbA measures identified and prioritized in the NAP process need to go far beyond NAPs alone. Chapter 6 outlines how EbA can be mainstreamed into national development planning, local climate action plans, sector plans and aligned with MEA action plans, as well as SDG implementation plans.

7.2. Recommendations

RECOMMENDATION 1

Use an ecosystem lens: There are definite advantages to integrating EbA into NAPs, although EbA is not appropriate to every situation. Nevertheless, it is always worthwhile to examine possible adaptation options through an ecosystem lens, which means identifying the ecosystem context of the vulnerable communities that need to be protected from climate change impacts, assessing the ecosystem services that are affected by those impacts, and considering whether a nature-based response would provide the desired level of protection.

RECOMMENDATION 2

Have the right expertise and voices involved at all stages of the NAP process to help for a full conceptualization of the impacts and risks of climate change and the range of adaptation solutions possible, bearing in mind that different actors may be needed at each of the three stages.

RECOMMENDATION 3

Combine indigenous and scientific knowledge: For generations, indigenous communities have used many EbA measures as coping mechanisms. Consultation with village elders and other indigenous leaders can often identify knowledge about ecosystem structures and functions that have evaded modern scientific enquiry.

RECOMMENDATION 4

Identify and value co-benefits: One of the main attractions of EbA compared to infrastructure options is that EbA usually provides multiple co-benefits, such as biodiversity protection. While some of these co-benefits may be difficult to quantify regarding the additional economic value they provide, they may sway the

Table 7.1. **Key steps in integrating EbA into the NAP process**

FORMULATION STAGE	IMPLEMENTATION STAGE	REVIEW STAGE
• Conduct a climate risk assessment and stock-take; • Identify available information and gaps; • Identify entry points for EbA; • Conduct stakeholder mapping; • Capacity assessment; • Identify adaptation options, including "grey" and "green" options; • Compare EbA options with infrastructure options where appropriate (and with grey-green hybrids); • Conduct cost and benefit assessments; • Prioritize adaptation options for the most vulnerable communities; and • Solicit feedback on the prioritization and proposed implementation arrangements.	• Where climate funding is directly available, implement EbA priorities (especially low-hanging fruit) identified in the NAP; • Identify entry points for EbA measures prioritized in the NAP to be implemented through other plans and programmes; • Conduct additional capacity needs assessment of those officials and contractors responsible for implementation, followed by appropriate training; • Mobilize additional domestic and international funding, and promote private sector investments in EbA; and • Progressively implement all the EbA measures included in the NAP, as funding allowws.	• Establish clear responsibilities in monitoring EbA approaches and facilitating the effective coordination among actors; • Devise a comprehensive set of indicators and metrics for documenting progress in EbA and assessing the effectiveness of EbA options; • Assess the extent to which EbA options have been effectively integrated and implemented as part of the NAP implementation plan and other relevant national, sectoral and subnational adaptation and development plans; • Strengthen capacities in topics such as formulating monitoring systems, methods, and techniques for collecting, storing, analysing and interpreting data; • Progressively update NAPs and integrate new information; and • Learn from experience in implementing EbA and report the results, while updating and revising the NAP so that it becomes a living document.

decision towards EbA, even where the economic rates of return are less favourable than for infrastructure options. Conversely, many EbA measures are also "no-regrets" interventions, as they will deliver multiple benefits no matter how quickly the climate changes.

RECOMMENDATION 5

Empower public participation at all stages: While it is common practice to insist on public participation at the formulation stage, the public is often less involved at the implementation and review stages. Many EbA measures require ongoing maintenance to maintain their adaptation effectiveness. Public understanding and buy-in to provide voluntary inputs and/or day labour for such maintenance will help to avoid eventual maladaptation. Similarly, at the review stage, local observers can monitor and report on changes in the ecosystem that suggest the need for an adaptive management response.

RECOMMENDATION 6

Devise appropriate metrics and indicators: Setting quantitative targets and establishing a firm baseline are essential for results-based adaptive management. Ecosystem-related targets may already be established at the national level e.g., in National Biodiversity Strategies and Action Plans. A detailed MERL plan that allows for the complexities of EbA should be developed at the formulation stage and be part of the NAP documentation.

RECOMMENDATION 7

Use the review stage as input to NAP updates: Using the concept of adaptive management, MERL results should be relatively frequent and allow the NAP to become a "living" document. The lessons learned from EbA will be more nuanced and require more careful investigation than from infrastructural adaptation. Consider using an expert committee to examine the MERL results and propose any adjustment in the EbA approach to make it more effective.

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Glossary

Adaptation to climate change*: actions undertaken to reduce the adverse consequences of climate change, as well as to harness any beneficial opportunities. It entails strategies, plans and actions that enable people, livelihoods and assets to resist dangerous weather events, e.g., heavy rains that may cause floods and landslides.

Adaptive capacity: the ability of nature and society to adjust to climate change, to moderate potential damage, to take advantage of opportunities, or to cope with the consequences.

Adaptive management: is an approach to the management of projects and/or natural resources that uses learning by doing, monitoring, review and synthesis for improving management over time.

Climate hazard*: the potential occurrence of a natural or human-induced climatic event, trend of physical impact that may cause loss of life, injury or other health impacts, as well as damage and loss of property, infrastructure, livelihoods, service provision and environmental resources.

Climate risk: people, with their livelihoods and assets, may be at climate risk if they do not have the capacities, resources and experience to withstand dangerous weather events (i.e., climate hazards) and are located in an area frequently hit by such events, e.g., people living in flood-prone areas may be facing increased climate risk during the rainy season.

Community-based adaptation: plans and activities based on communities' knowledge and experience, and enabling them to deal with dangerous weather events, such as floods or droughts, caused by climate variability and change and aimed at enhancing adaptive capacity.

Ecosystem*: an ecosystem is a dynamic complex of plant, animal and microorganism communities and the non-living environment interacting as a functional unit. Wetlands, forests and coral reefs are types of ecosystems. Humans are an integral part of ecosystems.

Ecosystem functioning*: the processes and interactions taking place between the components of an ecosystem. It depends on vegetation and soil structure, food web structure, key ecological interactions and species composition.

Ecosystem services (ESS): the benefits people derive from nature, including different types of ecosystems. The functioning of an ecosystem determines the supply of ecosystem services.

Ecosystem-based adaptation (EbA): the use of biodiversity and ecosystem services as part of an overall strategy to help people adapt to the adverse effects of climate change.

Enabling environment (for EbA): the institutions, laws, regulations, standards, policies, plans and programmes established by national and subnational governments to facilitate effective implementation of climate change adaptation.

Exposure: the presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected.

Green infrastructure (GI): parks, green belts, as well as natural areas immediately surrounding urban centres, such as wetlands or forests, that build climate resilience in urban ecosystems.

Green measures*: an adaptable term used to describe an array of products, technologies and practices that use natural systems, or engineered systems that mimic natural processes, to enhance overall environmental quality and provide utility services.

Grey measures*: manufactured, engineered components of a system. Also known as hard or traditional infrastructure or engineering.

Maladaptation: an adaptation action that does not succeed in reducing vulnerability but increases it instead.

Mitigation*: in the context of climate change, mitigation refers to human interventions to reduce emissions or enhance the extent of sinks for greenhouse gases. In the context of disaster risk management, it refers to the lessening or limitation of the adverse impacts of hazards and related disasters. For instance, constructing flood defences, planting trees to stabilize slopes and implementing strict land use and building construction codes.

Nature-based solutions (NbS): using ecosystems and the services they provide to address societal challenges such as climate change, food security or natural disasters.

Natural capital: the stock of renewable and non-renewable natural assets (e.g., ecosystems) that yield a flow of benefits to people (i.e., ecosystem services). The term "natural capital" is used to emphasize that it is a capital asset, like produced capital (roads and buildings) and human capital (knowledge and skills).

Resilience*: the ability of a social or ecological system to maintain basic structural and functional characteristics over time despite external pressures.

Risk: in the context of climate change, a risk is the chance of something happening that will have a negative effect on ecosystems, people or assets. The level of risk reflects the likelihood of the unwanted event, as well as the potential consequences of the unwanted event.

Scenario*: a projection of future conditions over a given timeframe. These can be used to test the effectiveness of adaptation options under different assumptions.

Sensitivity*: the degree to which a system is affected, either adversely or beneficially, by climate change, either directly or indirectly.

Socio-ecological systems*: linked systems of people and nature. The term emphasizes that humans must be seen as a part of, not apart from, nature, and that the delineation between social and ecological systems is artificial and arbitrary.

Structural and non-structural measures*: structural measures refer to the creation or reinforcement of the physical landscape, using grey or green measures. Non-structural measures do not involve physical interventions (engineering or ecological) and may involve those aiming for governance changes or for changes in community and household practices.

Vulnerability to climate change*: the degree to which a system (social, ecological or socio- ecological) is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity (IPCC 2007).

Sources: Dasgupta (2021); Intergovernmental Panel on Climate Change (2012); McLoughlin *et al*. (2020); McMullen (2019); Munroe *et al*. (2015).

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