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VOLUNTARY GUIDELINES FOR THE DESIGN AND EFFECTIVE IMPLEMENTATION OF ECOSYSTEM-BASED APPROACHES TO CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

Note by the Executive Secretary

1. The Executive Secretary is circulating herewith, for the information of participants in the twenty-second meeting of the Subsidiary Body on Scientific, Technical and Technological Advice, the voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction.

2. In paragraph 10 of decision XIII/4, the Conference of the Parties requested the Executive Secretary to prepare, subject to the availability of resources, in collaboration with relevant organizations, in particular the United Nations Framework Convention on Climate Change and the United Nations Office for Disaster Risk Reduction, voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction, for consideration by the Subsidiary Body on Scientific Technical and Technological Advice prior to the fourteenth meeting of the Conference of the Parties.

3. Accordingly, the draft voluntary guidelines were prepared by a consultant under the guidance of the Secretariat and of a technical reference group. A technical workshop to review the first draft of the guidelines and provide additional information to strengthen the draft was hosted by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) at their premises in Bonn from 20 to 22 November 2017. Funding for the preparation of the guidelines and the technical workshop was generously provided by the European Union and the Governments of Germany and Sweden. The draft voluntary guidelines were subsequently submitted for peer review and finalized in the light of the comments received.

4. The present information note provides an expanded version of the guidelines which are available in the annex to document CBD/SBSTTA/22/8 for consideration by the Subsidiary Body on Scientific, Technical and Technological Advice. The present document includes a primer for policymakers, a list of relevant tools, and sectoral briefs on the use of ecosystem-based approaches to climate change adaptation and disaster risk reduction.

* CBD/SBSTTA/22/1.

Voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction

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Abbreviations

CBD	Convention on Biological Diversity
CCA	Climate change adaptation
COP	Conference of the Parties
CSA	Climate-smart agriculture
CSO	Civil society organization
DRR	Disaster risk reduction
EbA	Ecosystem-based adaptation to climate change
Eco-DRR	Ecosystem-based disaster risk reduction
EC	European Commission
ES	Ecosystem services
EIA	Environmental impact assessment
EURAC	EURAC Research, European Academy of Bozen-Bolzano
FAO	Food and Agricultural Organization of the United Nations
FEBA	Friends of EbA
IIED	International Institute for Environment and Development
(I)NDC	(Intended) Nationally determined contributions
ILO	International Labour Organization
IPBES	Intergovernmental Panel on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IPLCs	Indigenous peoples and local communities
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IKI	International Climate Initiative of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB)
LDC	Least developed countries
M&E	Monitoring and evaluation
NAP	National Adaptation Plan
NbS	Nature-based solutions
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non-governmental organization
NOAA	National Oceanic and Atmospheric Administration (U.S. Department of Commerce)
PEDRR	Partnership for Environment and Disaster Risk Reduction
REDD	Reducing Emissions from Deforestation and Land Degradation
SDG	Sustainable Development Goals
SEA	Strategic environmental assessment
SREX	IPCC Special Report on Extreme Events (IPCC 2012)
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UN Environment/UNEP	United Nations Environment Programme
UNEP-WCMC	UN Environment World Conservation Monitoring Centre
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNISDR	United Nations International Strategy for Disaster Reduction
WWF	World Wide Fund For Nature

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The Secretariat of the Convention on Biological Diversity would like to acknowledge the financial assistance from the European Union and the Government of Sweden towards the preparation of the voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction.

The Secretariat acknowledges the guidance and feedback provided by experts at an informal meeting convened in collaboration with BirdLife International and UN Environment World Conservation Monitoring Centre for developing a framework for the guidelines, held in July 2017 in Cambridge, UK.

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The Secretariat also wishes to thank the following countries, organizations and universities that kindly provided comments on an initial draft of this report: Australia, Canada, Ethiopia, European Union, Germany, India, Japan, Madagascar, Mexico, Slovakia, South Africa, Sweden, Togo and United Kingdom, United Nations Environment Programme–World Conservation Monitoring Centre, United Nations University, International Labour Organization, Global Forest Coalition, Northern Cape Provincial Government–South Africa, International Union for Conservation of Nature, World Wide Fund for Nature, International Institute for Environment and Development, Network of Regional Governments for Sustainable Development, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), SwedBio at the Stockholm Resilience Centre, Wetlands International, International Petroleum Industry Environmental Conservation Association, BirdLife International, Conservation International, Mediterranean Marine Protected Areas Network, University of Nairobi, and Colorado State University.

The Voluntary Guidelines were prepared by Veronica Lo (consultant for the Secretariat) under guidance of the Secretariat and with support of GIZ and experts and reviewers mentioned above. The Voluntary Guidelines were reviewed and edited by David Cooper, Sakhile Koketso, and Lisa Janishevski of the CBD Secretariat. The Secretariat coordinated the preparation of the sectoral briefs in Section C, and gratefully acknowledges the organizations that led their preparation: The Food and Agriculture Organization of the United Nations, the International Labour Organization, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the International Union for Conservation of Nature, and the World Wide Fund for Nature.

Preface

People and nature are facing unprecedented climate change, altering the ecosystems that provide life-sustaining services and well-being. Extreme weather and climate events such as floods, drought, and heat waves are also changing in frequency, intensity and timing, causing mortality, damage to infrastructure and settlements.[1] Responding to these changes are some of the greatest challenges that nations, especially the least developed countries and small island developing states, are currently facing.

Biodiversity underpins the ecosystem processes and functions that provide critical services.[2] The loss of biodiversity, due to many drivers including climate change, alters ecosystem functioning across temporal and spatial scales, reducing ecological integrity and the corresponding capacity to provide ecosystem services.[3] In recent years, "ecosystem-based adaptation" (EbA) and "ecosystem-based disaster risk reduction" (Eco-DRR) have gained increasing attention in risk management. These approaches emphasize the importance of biodiversity and ecosystems in effective overall climate change adaptation (CCA) and disaster risk reduction (DRR) measures.

EbA and Eco-DRR build on other practices such as ecosystem conservation and restoration which seek to increase the resilience of ecosystems for the benefit of people. EbA and Eco-DRR have gained traction because they provide multiple benefits for people, ecosystems and biodiversity, enable planning for CCA and DRR on longer time scales, can be cost-effective compared to standard engineered infrastructure, and emphasize community participation and the use of traditional and local knowledge systems.[4] Due to their participatory nature and cross-sectoral approaches to adaptation and disaster risk reduction, EbA and Eco-DRR can achieve multiple policy objectives, including local, regional and national strategies for climate change, disaster risk reduction, and sustainable development, among others.

EbA and Eco-DRR are cross-cutting approaches for achieving numerous agreements and have strong policy support in the international policy arena. In implementing EbA and Eco-DRR, countries can work towards the achievement of several of the Aichi Biodiversity Targets and implementing the Strategic Plan for Biodiversity 2011-2020 adopted under the Convention on Biological Diversity. Other major agreements such as the Paris Agreement, the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction have called for enhancing the resilience of ecosystems and societies to the impacts of climate change and reducing disaster risks. Increasingly, countries are integrating ecosystem-based approaches into national plans and strategies to reduce the risk of impacts and hazards (climate and non-climate related). Examples of mainstreaming EbA and Eco-DRR have been synthesized in CBD Technical Series No. 85.[5] However, there remains a gap between policy development and implementation. The objective of these guidelines is to support and enable the design and implementation of EbA and Eco-DRR strategies as part of an overall climate change

[1] IPCC 2012; IPCC 2014
[2] Cardinale et al. 2012
[3] Perrings et al. 2010, Isbell et al. 2017
[4] Hale et al. 2009, Jones et al. 2012, Munang et al. 2013
[5] Lo 2016

adaptation or DRR strategy, on multiple scales - short, medium and long-term, and local, sub-national and national.

Mandate

The CBD Conference of the Parties (COP), in its decision XIII/4, requested the Executive Secretary to prepare, subject to the availability of resources, in collaboration with relevant organizations, in particular the United Nations Framework Convention on Climate Change and the United Nations Office for Disaster Risk Reduction, voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction, for consideration by the Subsidiary Body on Scientific Technical and Technological Advice prior to the fourteenth meeting of the Conference of the Parties.

These guidelines build on a synthesis report on experiences with ecosystem-based approaches to climate change adaptation and disaster risk reduction (CBD Technical Series No. 85)[6] developed pursuant to decision XII/20. The report identifies lessons learned as well as gaps and challenges with the implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction.

Framework for the guidelines

The guidelines are organized into three main components (Figure 1):

Section A: Primer for Policy-Makers

Section A provides high-level policy guidance for focal points to the CBD, UNFCCC, UNCCD and UNISDR, policy makers within governments at all levels, and other relevant agencies and organizations, including the private sector, researchers, donors, and advocates of EbA/Eco-DRR (such as within NGOs, CSOs, governments, etc.). Section A highlights the advantages of EbA/Eco-DRR, including how they promote multiple benefits, and demonstrates how they can be integrated into adaptation and DRR strategies and development frameworks. This information can be used to encourage key decision-makers to implement EbA and Eco-DRR across different sectors and in policies and strategies addressing climate change, disaster risk reduction and sustainable development. Policy-makers and influencers are also encouraged to make use of the mainstreaming section in Section B and Section C: Outreach into sectors.

Section B: Guidelines for Practitioners

Section B provides guidelines for practitioners/implementers on operationalizing EbA and Eco-DRR at the programme and project level. Section B outlines:

- Principles of EbA and Eco-DRR, which are key considerations throughout the process of designing and implementing EbA and Eco-DRR;[7]
- Safeguards to prevent maladaptation, ensure that rights are respected, and prevent harm to, or enhance, biodiversity and ecosystem services;

[6] Lo 2016

[7] These principles are in alignment with the Ecosystem Approach developed under the CBD https://www.cbd.int/ecosystem/

- A flexible and iterative framework outlining key stages in planning and implementing adaptation and DRR with a focus on EbA and Eco-DRR; and
- Toolboxes which provide examples of existing tools and guidance for each stage. These lists of tools are not exhaustive; users of these guidelines are encouraged to consult more comprehensive databases of tools, such as the 'Inventory of tools and methodologies relevant for EbA practitioners'.[8]

Section C: Outreach into Sectors

This section provides briefs to support advocacy by EbA and Eco-DRR practitioners for the integration of EbA and Eco-DRR into sectoral policies and plans.

Audience

The main audience for these guidelines are policy-makers (particularly Sections A and C) and implementers including subnational governments (regions, provinces, cities and municipalities), indigenous peoples and local communities (IPLCs), NGOs, private sectors, research institutions and funders. The guidelines can also be consulted when implementing related practices, such as community-based adaptation and public works programmes with an ecosystem focus. These guidelines may also be useful for different sectors in planning and implementing ecosystem-based solutions (Section C), and can be applied in other contexts, such as the application of ecosystem-based approaches into the development, humanitarian, aid, disaster relief, water management, construction, health and other fields.

[8] A draft inventory currently containing more than 200 tools related to EbA planning and implementation is available at https://www.iied.org/call-for-feedback-inventory-tools-support-ecosystem-based-adaptation, developed as part of the International Climate Initiative (IKI) funded global projects: Ecosystem-based adaptation (EbA): strengthening the evidence and informing policy implemented by IIED, IUCN and UNEP-WCMC with support from the project Mainstreaming EbA - Strengthening Ecosystem-based Adaptation in Planning and Decision Making Processes implemented by GIZ.

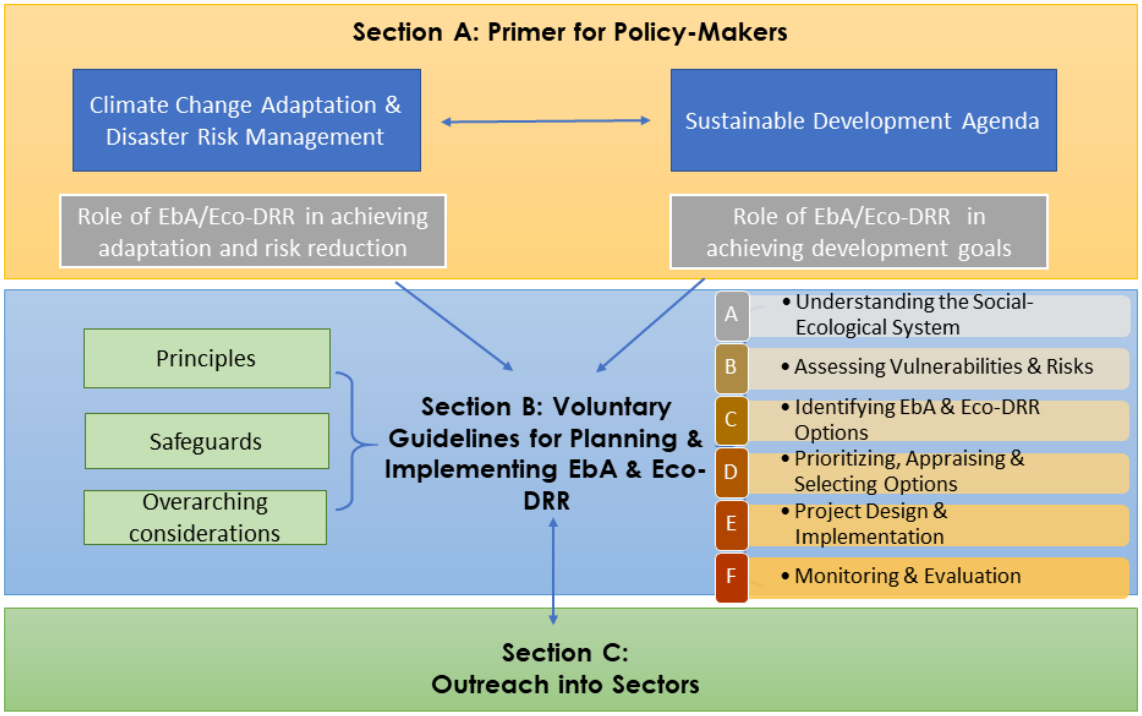


Figure 1. Framework for the Voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction

These guidelines build on the progressive work on EbA and Eco-DRR in recent years, including existing guidelines, frameworks and principles spanning the adaptation, disaster risk reduction, conservation, development and humanitarian fields. An overview of existing guidelines, on which these guidelines are based, is provided in the literature review (Annex II). The guidelines were developed in consultation with experts from governments, academia, indigenous peoples and local communities, NGO's, and inter-governmental organizations. An informal meeting with experts was convened in collaboration with BirdLife International and UN Environment World Conservation Monitoring Centre (UNEP-WCMC) for developing a framework for the guidelines (July 2017, Cambridge), and a technical workshop was conducted with country-nominated and other experts in order to review a draft version of the guidelines (November 2017, Bonn).[9] Definitions of key terms in these guidelines are based on an updated glossary in the CBD Technical Series No. 85 (Annex I).

[9] Technical workshop for review of the voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction. Convened by CBD with support from the Governments of Germany and Sweden, and the European Commission, 20-22 November, Bonn, Germany. https://www.cbd.int/meetings/CCBWS-2017-01

A. Primer for Policy Makers

A1. Key messages

- Ecosystem-based approaches to climate change adaptation (EbA) and disaster risk reduction (Eco-DRR) use biodiversity and ecosystem services to help people to adapt to the impacts of climate change and reduce disaster risk through the sustainable management, conservation and restoration of ecosystems.
- In the face of current and future climate change impacts and disaster risks, governments urgently need to implement adaptation and risk reduction measures, including EbA and Eco-DRR, as part of overall adaptation and risk reduction strategies.
- EbA and Eco-DRR:
    - Promote inclusive, participatory, and resilient approaches to risk reduction across scales;
    - Generate multiple benefits for people, nature and economies;
    - Are cross-cutting approaches that deliver on numerous agreements and have strong policy support, including within the framework of the Sustainable Development Goals, the Strategic Plan for Biodiversity 2011-2020 under the CBD, and the Paris Agreement under the UNFCCC;
    - Can be flexible, cost-effective and broadly applicable approaches for reducing the impacts of climate change and disasters.
- EbA and Eco-DRR should be integrated into relevant social, economic and environmental policies and actions, contributing to resilient and sustainable development.

A2. Introduction

All over the world, across continents and oceans, changes in climate have been impacting natural and human systems. These changes are unprecedented – they include warming of the atmosphere and ocean, diminishing snow and ice, altered hydrological cycles, sea level rise, and ocean acidification.[10] Extreme weather and climate events such as floods, drought, and heat waves are also changing in frequency, intensity and timing, causing mortality, damage to infrastructure and settlements[11] and at devastating costs - the economic cost of weather and climate disasters in the USA in 2017 was an estimated 306 billion USD.[12]

At the same time, direct and indirect drivers of change are placing further pressure on life-sustaining ecosystems and their capacity to provide a buffer from climate change impacts and disasters. These drivers include not only climate change, but also habitat change, overexploitation of natural resources, and invasive alien species.[13] Projected population increases and urbanization are increasing vulnerability and disaster risk by placing additional development pressures in zones that are most sensitive to climate change impacts, including coastal systems and low-lying areas.[14]

[10] IPCC 2013
[11] IPCC 2012
[12] NOAA 2018
[13] Millennium Ecosystem Assessment 2005
[14] IPCC 2014

Responding to these changes are some of the greatest challenges that nations, especially the least developed countries and small island developing states, are currently facing.

Policy-makers can choose from a wide range of interventions to adapt to climate change and reduce disaster risk. Such interventions can include 'soft' options such as policy frameworks, or 'hard' options such as built infrastructure. Within this spectrum, 'green' options include those based on conserving, managing or restoring ecosystems that provide services critical to reducing risks and impacts, and 'hybrid' options integrate ecosystem-based options with other approaches. Hybrid approaches could include ecological engineering, green infrastructure, grey-green options, and building with nature solutions, among others.

'Hard' or engineered approaches have been by far the most common way to reduce the risk of climate impacts and disasters. However, these approaches tend to address single hazards, risking increasing vulnerability in the long-term by not considering future climate hazards or the interaction of multiple hazards. Due to their permanent and inflexible characteristics, engineered structures can also become obsolete in the face of unpredictable climate conditions[15]. Thus, there is increasing support in the policy forum for implementing ecosystem-based or hybrid approaches as evidence of their effectiveness and their potential for generating multiple benefits is increasing.

A3. The role of biodiversity and ecosystems in adaptation to climate change and reduction of disaster risk

Ecosystems provide crucial services to society, particularly regulating and supporting services that help people adapt to the adverse effects of climate change and reduce disaster risk. For example, coral reefs and coastal vegetation can dissipate wave action and protect shorelines from erosion, peatland, marshes and floodplains provide a buffer from floods and water scarcity, and forested mountains and slopes can stabilize sediments, protecting from landslides.[16] Ecosystems can also prolong the sustainability and lifetime of built infrastructure, thus protecting investments in engineered defenses – such as restoring salt marshes adjacent to sea walls.[17]

Biodiversity underpins the ecosystem processes and functions that provide such critical services[18] (Box 1). The loss of biodiversity, due to many drivers including climate change, alters ecosystem functioning across temporal and spatial scales, reducing ecological integrity and the corresponding capacity to provide ecosystem services[19]. Thus, investing in actions to sustainably manage, conserve and restore biodiversity and ecosystems are essential for maintaining the ecosystem services critical for climate change adaptation and disaster risk reduction, reducing vulnerabilities and increasing resilience (Figure 2).[20] According to the latest assessment report of the IPCC (AR5), "successful adaptation will depend on our ability to allow and facilitate natural systems to adjust to a changing climate, thus maintaining the ecosystem services on which all life depends."[21]

[15] Royal Society Science Policy Centre 2014
[16] Hale et al. 2009, Ferrario et al. 2016, Renaud et al. 2013
[17] Temmerman et al. 2013
[18] Cardinale et al. 2012
[19] Perrings et al. 2010, Isbell et al. 2017
[20] Sumaila et al. 2017
[21] IPCC 2014

Water-related disasters (including floods, droughts and windstorms) are a key example, accounting for an estimated 90% of the most disastrous events since 1990, affecting 4.2 billion people and causing USD 1.3 trillion in damage.[22] It is thus crucial to enhance resilience of water resources and ecosystems including all types of wetlands, watersheds, basins, coastal and marine ecosystems, and drylands.

Box 1. Key terms and their linkages in the Guidelines

Biodiversity means the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (CBD Article 2).

Ecosystem means the dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (CBD Article 2).

Ecosystems are shaped by people, and all people depend on the capacity of ecosystems to deliver essential ecosystem services – thus people and ecosystems are interdependent **social-ecological systems** (Elmqvist et al. 2010).

Biodiversity underpins ecosystem functioning, and in turn, the provisioning of **ecosystem services**, including the services that contribute to enhancing resilience of the social-ecological system and reducing the risk of climate change impacts and disasters (Cardinale et al. 2012).

The latest assessment report of the IPCC (AR5) notes that "successful adaptation will depend on our ability to allow and facilitate natural systems to adjust to a changing climate, thus maintaining the ecosystem services on which all life depends" (IPCC 2014).

[22] United Nations 2015

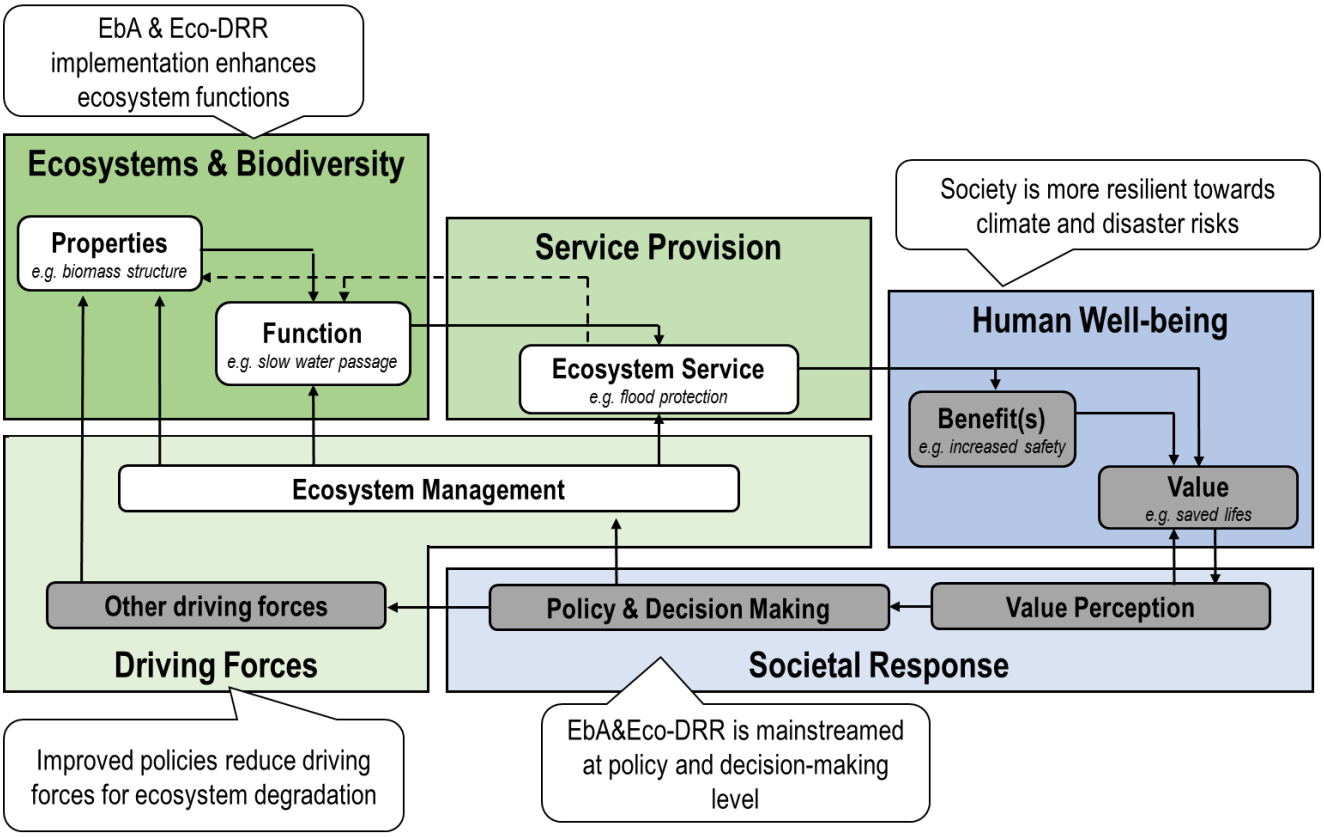


Figure 2. Linkages between policies, management, ecosystems and human well-being within a social-ecological system in the context of EbA & EcoDRR. Ecosystems provide key services for human well-being which have a high value. Societal response, especially policy and decision making shapes the way ecosystems are managed and the degree to which they can provide their services in a sustainable manner. Climate change is an important driving force that shapes current and future ecosystems and their services.[23]

[23] Figure by GIZ, adapted from van Oudenhoven et al. 2013

A4. EbA and Eco-DRR: Integral components of adaptation and risk reduction strategies

The concepts and practice of ecosystem-based adaptation (EbA) and ecosystem-based disaster risk reduction (Eco-DRR) have been developed and refined in recent years as integrative approaches to reduce the risk of climate-related and other types of hazards (Box 2). These approaches emphasize the importance of biodiversity and ecosystems in reducing risk, and build on other practices such as conservation and ecosystem restoration which seek to increase the resilience of ecosystems for the benefit of people.

Box 2. What are EbA and Eco-DRR?

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. EbA 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." (SCBD 2009)

Ecosystem-based disaster risk reduction (Eco-DRR) is "sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim of achieving sustainable and resilient development." (Estrella and Saalismaa 2013)

EbA and Eco-DRR are conceptually similar, sharing common underlying principles of sustainable management, conservation and restoration of ecosystems to increase the resilience of social-ecological systems, and both emphasize participatory approaches (Figure 3). However, EbA largely addresses climate-related hazards, although there are examples of EbA interventions such as implementing protection forests that stabilize the soil to prevent landslides (which can be climate and non-climate-related). EbA also aims to address slow-onset climate change impacts, such as changing precipitation patterns, rising mean temperatures, and sea level rise, which has not been a traditional focus of DRR. In contrast, Eco-DRR addresses hazard events that are not necessarily linked to climate change or climate variability.[24] Including both non-climate (e.g. earthquakes, tsunamis), and climate-related (e.g. hurricanes, heat waves) hazards. In practice, EbA and Eco-DRR are difficult to distinguish,[25] and so such approaches are referred to together in these guidelines as EbA and Eco-DRR.

[24] Renaud et al., 2013
[25] Doswald and Estrella 2015

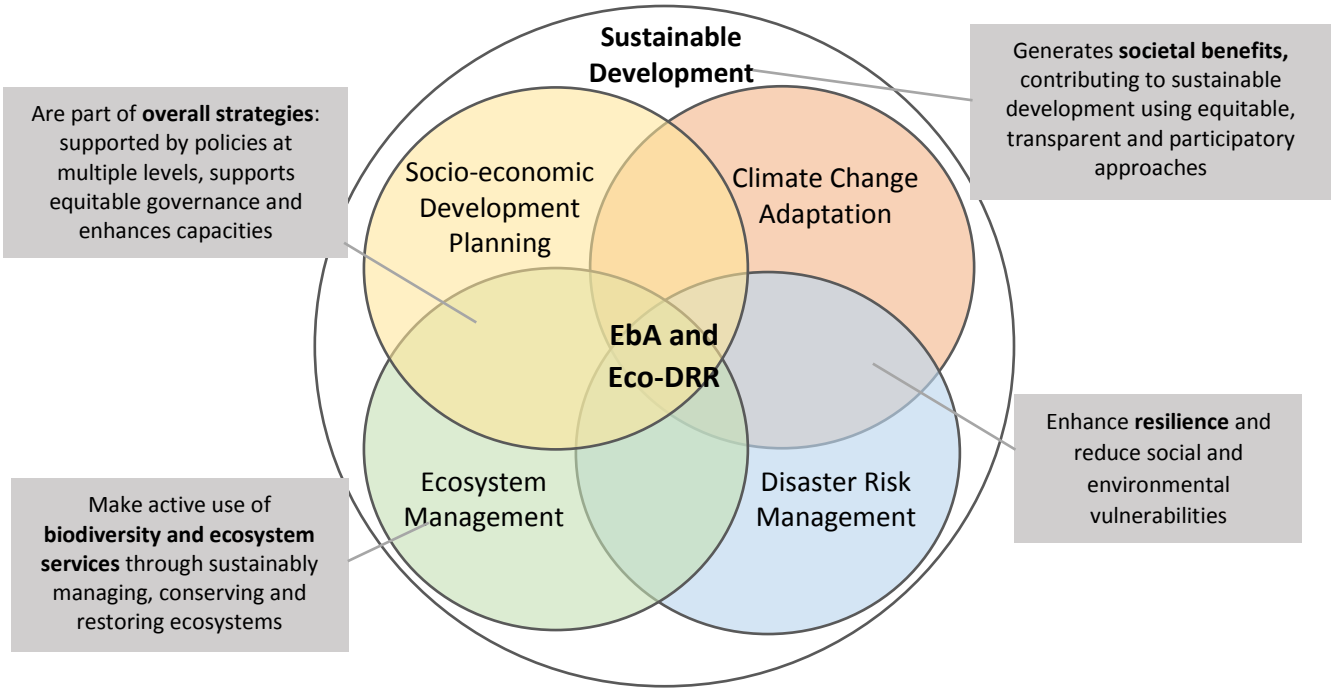


Figure 3. Conceptual diagram of EbA and Eco-DRR: Ecosystem-based approaches to adaptation and disaster risk reduction (EbA and Eco-DRR) use ecosystems and biodiversity to integrate climate change adaptation, disaster risk management, ecosystem management and socio-economic development planning. The main elements of EbA and Eco-DRR are shown in the grey boxes[26]

Case studies and literature have demonstrated that ecosystem-based approaches can be flexible, cost-effective and broadly applicable approaches for reducing the impacts of climate change.[27] Examples of EbA and Eco-DRR include restoration of floodplains for flood protection and water storage; greening of cities to counter the heat island effect; crop diversification with indigenous varieties that are resistant to climate change; creating protected areas to enhance ecosystem resilience and provisioning of essential ecosystem services such as erosion control, beach stabilization and water retention; sustainable management of grasslands and rangelands to enhance pastoral livelihoods and increase resilience to climate-induced drought and flooding; or training activities to enhance knowledge of utilizing ecosystems to adapt to the impacts of climate change.

EbA and Eco-DRR draw from, and share similarities with, other fields of practice that promote the sustainable management, conservation and restoration of biodiversity and ecosystems to adapt to change.[28] For example, conservation practices, such as protected areas or ecological restoration, aim to maintain or enhance biodiversity and ecosystem functioning. EbA and Eco-DRR specifically aim to reduce current and future impacts of climate change and disaster risk, based on the ongoing identification or assessment of risks and vulnerabilities of a social-ecological system that includes both people and ecosystems. Although traditional conservation practices have a different main

[26] Adapted from Midgley et al. 2012, DEA and SANBI 2017, and Sudmeier et al. 2013
[27] Munang et al. 2013
[28] Kabisch et al. 2016

objective from EbA and Eco-DRR, they are an important complement to, and an important means to achieve, adaptation and disaster risk reduction efforts.

Other approaches related to EbA and Eco-DRR include community-based adaptation, climate-smart agriculture, natural water retention measures, and building with nature solutions. EbA and Eco-DRR can also be considered under the wider umbrella concept of nature-based solutions as ecosystem approaches which specifically address the issues of climate change adaptation and disaster risk reduction[29,30]. In practice, EbA and Eco-DRR have included many approaches that are considered nature-based solutions, including ecological restoration, integrated coastal zone management, integrated water resources management, green infrastructure, and protected areas management. The above-mentioned approaches are complementary and focus on developing holistic, integrated ways to enhance the resilience of social-ecological systems, reduce disaster risk, and/or help people adapt to change through using ecosystems and biodiversity in a sustainable manner. They often place emphasis on participatory processes and community engagement, which are crucial to improving community resilience, enhancing adaptive capacity, and ensuring local benefits are realized.

[29] Nature-based Solutions (NbS) are actions to protect, sustainably manage and restore natural or modifed 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 (IUCN)

[30] Cohen-Shacham et al. 2016

A5. The policy context for EbA and Eco-DRR

EbA and Eco-DRR are recognized as instruments for promoting synergistic implementation of the Rio Conventions – the Convention on Biological Diversity (CBD), UN Convention to Combat Desertification (UNCCD), and the UN Framework Convention on Climate Change (UNFCCC) (Box 3).

Box 3. EbA and Eco-DRR – Achieving synergies in implementing the Rio Conventions

EbA and Eco-DRR are cross-cutting approaches to achieving implementation of the Rio Conventions. Rio+20's Action on Adaptation Plan describing it as a planning tool for realising synergy between the Rio Conventions.

- **The Strategic Plan for Biodiversity 2011-2020** and the **Aichi Biodiversity Targets**, under the Convention on Biological Diversity (CBD), aim to halt the loss of biodiversity to ensure ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life and contributing to human wellbeing and poverty eradication. EbA and Eco-DRR are particularly relevant to **Target 15,** which aims, by 2020, to enhance ecosystem resilience and the contribution of biodiversity to carbon stocks, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification. EbA is encouraged in decisions X/33, XII/20 and XIII/4, of the Conference of the Parties to the Convention on Biological Diversity and are also referred to in other recent decisions, XI/15, XI/19, XI/21. **National Biodiversity Strategies and Action Plans** (NBSAPs) are important entry points for prioritizing EbA and Eco-DRR.
- The **10-year Strategic Plan and Framework** (2008-2018) of the United Nations Convention to Combat Desertification (UNCCD) seeks to reverse and prevent land degradation and desertification, and specifically recognizes the important services provided by ecosystems, especially in dryland ecosystems, for drought mitigation and the prevention of desertification. By adopting the **Land Degradation Neutrality** (LDN) target, Parties have agreed that the amount of healthy and productive land should stay stable starting in 2030, enhancing land resilience to climate change and halting biodiversity loss linked to ecosystem degradation.
- The **Cancun Adaptation Framework** under the UN Framework Convention on Climate Change (UNFCCC), aims to enhance action on adaptation, reducing vulnerability and building resilience in developing country Parties. **National Adaptation Plans** (NAPs) aim to reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience; and integrate climate change adaptation into policies, programmes and activities within all relevant sectors and at different levels **(Intended) Nationally Determined Contributions** ((I)NDCs) set out high-level objectives and a vision for addressing adaptation goals. The NAP process is a key tool for coherent implementation of an (I)NDC adaptation component (see Box 5).
- **The Paris Agreement** recognises protecting the integrity of ecosystems and biodiversity for both climate change mitigation and adaptation actions. It specifically lays out principles of adaptation that takes ecosystems into consideration. It also calls for integrating adaptation into relevant environmental policies and actions, where appropriate, as well as for building resilience of ecosystems through sustainable management of natural resources, taking into account the imperatives of a just transition of the workforce.

Support for EbA and Eco-DRR has been embedded in other major agreements and promoted in the international policy arena. Other major agreements are highlighted below, and summarized in more detail in Annex II.

- Several of **the Sustainable Development Goals** (SDGs) adopted by the UN General Assembly explicitly address sustainable ecosystem management, including SDG 13 on urgent action to combat climate change and its impacts and SDG 11 to make cities and human settlement inclusive, safe, resilient and sustainable, in addition to SDGs 1 (end poverty), 2 (end hunger), 3 (ensure healthy lives and well-being), 6 (access to water and sanitation), 14 (conserve oceans), and 15 (sustainably manage forests and halt biodiversity loss) (see Figure 4 and Annex II for other relevant SDGs). The SDGs also promote sustained, inclusive and sustainable economic growth through full and productive employment.
- The **Sendai Framework for Disaster Risk Reduction** (SFDRR) 2015-2030, building on the Hyogo Framework for Action 2005-2015, outlines seven global targets to be achieved over the next 15 years, prioritizing "ecosystem-based approaches…to build resilience and reduce disaster risk". The role of ecosystems will need to be taken into account in disaster risk assessments (Priority Action 1), strengthening risk governance (Priority Action 2) and investments in disaster resilience (Priority Action 3). The SFDRR also calls for greater collaboration between institutions and stakeholders from other sectors, and calls for ecosystem-based approaches to be implemented in transboundary cooperation for shared resources, such as within river basins and shared coastlines.
- One of the **Ten Essentials for Making Cities Resilient,** building on the Sendai Framework, is to safeguard natural buffers to enhance the protective functions offered by natural ecosystems. It is encouraged to consider natural buffers in the rural hinterland of the city and the wider region, and to build regional resilience through trans-boundary cooperation with other municipalities (Essential #5).
- The **IPCC Special Report on Extreme Events** (SREX) recommends investing in ecosystems, sustainable land management and ecosystem restoration and management).
- **UN General Assembly resolutions** (RES/70/195, RES/71/219, and RES/72/220) highlight the importance of sustainable land management for sand and dust storms which are among the emerging concerns of the global community.
- The **Fifth Assessment Report of the IPCC** (AR5) notes that "successful adaptation will depend on our ability to allow and facilitate natural systems to adjust to a changing climate, thus maintaining the ecosystem services on which all life depends."
- **The Ramsar Convention** Resolution XII.13 on Wetlands and Disaster Risk Reduction encourages Parties to integrate wetland-based disaster risk management and climate change adaptation into development policies and planning at all levels of government, including integration in vulnerability analysis, poverty reduction strategies and natural resource management plans and sectors, and in multi-sector policies and plans
- Eco-DRR has also been endorsed in the outcomes of **regional DRR platforms** of Asia, Africa, Latin America and Arab states, and of the European Ministerial meeting on DRR.
- The **World Humanitarian Summit** commits the UN Member countries to core responsibilities of humanitarian aid and disaster risk preparedness, including building community resilience.

- The **New Urban Agenda** adopted at the UN Conference on Housing and Sustainable Urban Development (Habitat III) contains three transformative commitments: leaving no one behind and fighting against poverty; urban prosperity and opportunities for all; and ecological and resilient cities and human settlements
- The **Cancun High-Level Communiqué** adopted at the fifth session of the **Global Platform for Disaster Risk Reduction 2017** emphasizes the close nexus between climate change and water-related hazards and disasters and highlights Integrated Water Resources Management (IWRM) as an effective instrument for enhancing resilience and serving both DRR and CCA goals, in addition to investments in resilient infrastructure, including green infrastructure and housing. All countries, provinces and cities are urged to make integrated flood and drought management central to their planning and management processes.
- **The Guidelines for a Just Transition towards environmentally sustainable economies and societies for all** recommends supporting public works and employment programmes, including initiatives linking poverty eradication and ecosystem protection, as well as those for workers affected by the transitioning to environmentally sustainable economies, including climate change, who have been laid off due to structural or technological change[31]
- Local investments for climate change adaptation highlights the importance of using employment intensive approaches, focusing on inclusive local practices for environmental sustainability and the impact that altering the quality and productivity of natural resources and ecosystems will have on biological diversity and environmental degradation.

A7. Multiple benefits from EbA and Eco-DRR implementation

EbA, Eco-DRR and related approaches generate additional environmental, economic, and social benefits beyond adaptation and disaster risk reduction. They are often referred to as low-regrets or no-regrets options as they can generate benefits regardless of uncertainties in climate projections. For example, mangrove restoration can stabilize sediments and protect coastlines, and through increasing habitat for fish and other species, support livelihoods through employment creation programmes, and contribute to carbon storage. EbA and Eco-DRR also enhances biodiversity conservation, among other multiple benefits. In disaster risk management, the post-disaster reconstruction period offers an opportunity to "build back better." In other words, such occasions provide new opportunities to conserve and restore biodiversity to strengthen the resilience of ecosystems and people as well as decrease vulnerability to disasters. As biodiversity underpins the services provided by ecosystems, investing in approaches that enhance biodiversity is like broadening a risk reduction investment portfolio to provide long-term returns for the future. Assessing multiple benefits of nature-based solutions can be challenging due to the considerations of benefits/costs across socio-cultural, socio-economic, environment, biodiversity, ecosystem, and climate elements, but is an area of active research.[32]

Several examples of how EbA and Eco-DRR in landscapes and seascapes can address the Aichi Biodiversity Targets under the Convention for Biological Diversity and the Sustainable Development Goals are shown in Figure 4.

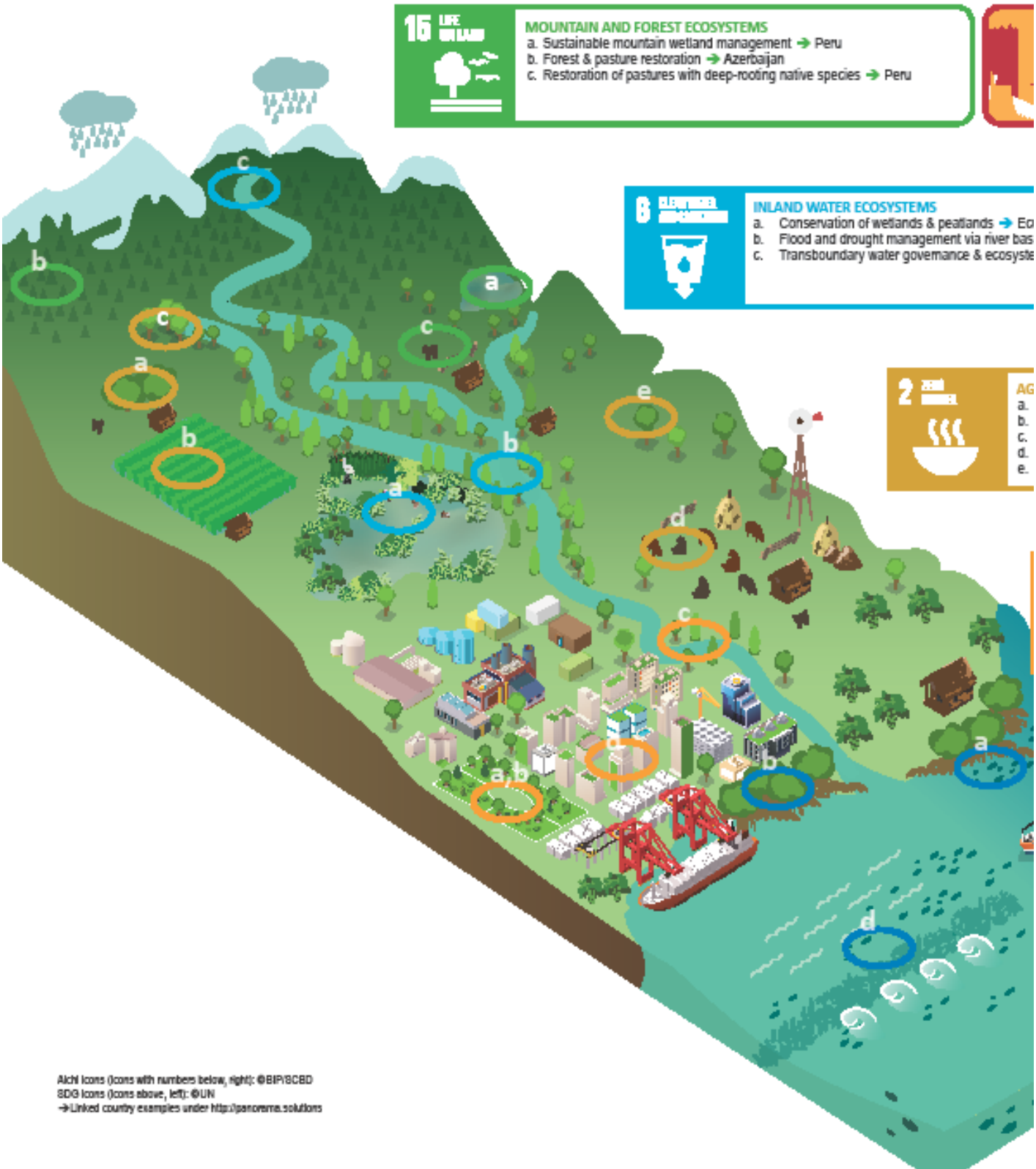
[31] ILO 2015
[32] Raymond et al. 2017

In economic terms, the benefits of EbA and Eco-DRR have been demonstrated in several case studies:[33]

- In comparison to the economic loss caused by loss of ecosystem services, the cost-benefit ratio of return on investment of appropriate restoration of ecosystems may be as high as 3 to 75, depending on the ecosystem context and the measures taken.[34]
- Mangrove rehabilitation at the village level is generating significantly higher wealth benefits from risk reduction and natural resource utilization (2.3 million USD over 20 years) compared to dyke construction (only 0.5 million USD), according to a case study in Vietnam.[35]
- A cost-benefit analysis indicates a significant higher revenue (a net present value of 841,902 USD over 20 years) under an EbA scenario, including the low impact grassland management in a community with wild llamas, compared to a business as usual scenario (a net present value of 486,571 USD over 20 years) with intensive domestic cattle management (UNEP-IUCN-UNDP Mountain EbA Programme in Peru).[36]
- Early investment in climate resilience has been found to be more cost-effective than post-disaster relief. For example, a case study found that Barbados could cost-effectively avoid more than 30% of expected losses by implementing risk mitigation initiatives such as beach nourishment.
- In hybrid solutions, EbA and Eco-DRR can complement more expensive infrastructure investments and prolong the lifetime of engineered flood protection measures.[37]

[33] Examples from www.AdaptationCommunity.net and http://panorama.solutions
[34] United Nations 2015
[35] Köhler and Michaelowa 2013
[36] Rossing et al. 2015
[37] Munang et al. 2013, Temmerman et al. 2013

Ecosystem-based Adaptation & D
addressing the Sustainable Development Goals



Aichi Icons (Icons with numbers below, right): ©BIP/SCBD
SDG Icons (Icons above, left): ©UN
→Linked country examples under http://panorama.solutions

Disaster Risk Reduction Solutions
ls and CBD Aichi targets in a Land- and Seascape

Ecosystem	SDG	Aichi	Hazards	Measures	Co
					
The Aichi goals 4, 7, 11, 13, 14, 15 and SDG 13 apply to all ecosystems					
Mountain and forest			• Drought • Soil erosion • Erratic rainfall	• Sustainable mountain wetland management	•
				• Forest & pasture restoration	•
				• Restoration of pastures with deep-rooting native species (Peru	•
Inland water			• Erratic rainfall • Flood • Drought	• Conservation of wetlands & peatlands	•
				• River basin restoration	•
				• Transboundary water governance & ecosystem restoration	•
Agricultural and dryland			• Erratic rainfall • Temperature increase • Shift of seasons • Drought	• Ecosystem restoration and agroforestry	•
				• Intercropping of adapted species	•
				• Using trees to adapt to changing dry seasons	•
				• Sustainable livestock management & pasture restoration	•
				• Drought resilience by sustainable dryland management	•
Urban			• Extreme heat • Temperature increase • Floods • Erratic rainfall	• Green aereation corridors for cities	•
				• Storm water management by green spaces	•
				• River restoration in urban areas	•
				• Green facades for buildings	•
Marine and coasts		 	• Storm surges • Cyclones • Sea level rise • Salinisation • Temperature increase	• Mangrove restoration and coastal protection	•
				• Coastal realignment	•
				• Sustainable fishing & mangrove rehabilitation	•
				• Coral reef restoration	•

	Country examples	Impacts
	• Peru	• Improved water regulation • Erosion prevention • Improved water storage capacity
	• Azerbaijan	
	• Peru	
	• Ecuador / UK	• Improved water storage capacity • Flood risk reduction • Improved water provision
	• Thailand	
	• Guatemala & Mexico	
	• India / Burundi	• Improved water storage capacity • Adaptation to higher temperatures • Adaptation to shifting seasons • Improved water provision
	• Sweden	
	• Pakistan	
	• South Africa	
	• Sudan	
	• Germany	• Heat wave buffering • Adaptation to higher temperatures • Flood risk reduction • Improved water regulation
s	• Sweden	
	• Germany	
	• Austria	
	• Indonesia / Grenada / Ecuador / Colombia	• Storm & cyclone risk reduction • Flood risk reduction • Improved water quality • Adaptation to higher temperatures
	• UK	
	• Mexico	
	• Vanuatu	

Figure 4. Examples of EbA and Eco-DRR in a landscape/seascape that help achieve adaptation and risk reduction goals under the CBD Aichi Biodiversity Targets and SDGs. (Graphics by GIZ, with examples from the PANORAMA database https://panorama.solutions/en/portal/ecosystem-based-adaptation.)

Beyond direct economic benefits, there are broader benefits of effective EbA and Eco-DRR, such as avoided costs of using artificial systems instead of ecosystem services, land or service value increases, local income enhancement, livelihood diversification, improved access to markets, improved food security and health, sustainable water provisioning, reduction of conflicts over resources, improved social cohesiveness, and knowledge enhancement. These are often broader than the direct financial benefits shown by cost-benefit calculations or other valuation techniques, and while difficult to quantify in monetary terms, they provide invaluable benefits to society. Other examples of multiple benefits of EbA and Eco-DRR include:

- Providing adaptation and DRR solutions that deliver on multiple commitments by supporting national development and adaptation goals such as coastal protection, conservation of natural resources, sustainable development and social well-being.[38]
- Contributing to employment and income security – a national priority in many countries, by twinning the objectives of employment creation with environmental protection through public works programmes which already have an aim of climate change adaptationCCA and DRR.
- Contributing to climate change mitigation targets via: i) conservation or restoration of forests and coastal vegetation,[39] and rewetting of drained peatlands to reduce CO2 emissions., which enhance carbon sequestration and ii) reduction of deforestation and land degradation including peatland drainage, which aids in limiting further greenhouse gas emissions.[40]
- Improving the quality of life and mental and physical health of people, for example, through providing urban green spaces which also provide relief from heat.[41]
- Engaging people and communities, helping to build trust and responsibility while maintaining livelihoods and providing potential business opportunities.
- Addressing underlying key drivers of climate and disaster risk, generating more robust solutions for coping with future challenges and uncertainty due to climate change.

[38] WWF 2013
[39] Duarte et al. 2013
[40] Busch et al. 2015
[41] Kabisch et al. 2016

Box 4. The role of EbA and Eco-DRR in creating green jobs

As adaptation is inherently local, much depends on the capacity of communities to respond to climate change, which has far-reaching consequences in terms of participation, planning, information flow and fund allocation. Infrastructure investments and public employment programmes can be a catalyst for creating additional jobs, providing income security and building very much needed public assets and services (ILO 2015). Catalysing this opportunity, EbA and Eco-DRR provide several entry points to support local job creation:

- The involvement of local communities can support and contribute to the development of practical measures to protect, maintain and strengthen existing local infrastructure or building new infrastructure that can withstand the effects of climate change.
- Building climate resilience is also a way of contributing to a just transition by using public works and employment programmes as a vehicle to link poverty eradication to ecosystem protection.
- Infrastructure will need to be built to higher standards and improved designs will be needed to better withstand the local impacts of climate change, thus providing opportunities for job creation in the infrastructure sector

Through greening infrastructure and natural resource management, in addition to the sustainable management, conservation and restoration of ecosystems, the public works sector can be sensitized to the risks of environmental degradation and disaster risk, and use employment schemes to build capacity for adaptation and risk reduction.

A8. Planning and Implementing EbA & Eco-DRR

EbA, Eco-DRR and related practices span a spectrum of naturalness, from natural to semi-natural or hybrid, covering a wide range of natural to artificial ecosystems. For example, protected areas designed to reduce socio-economic vulnerability to climate change and disaster risk through enhancing the resilience of ecosystems are on the natural end of the spectrum, while green spaces, green roofs and walls in cities reduce the risk of heat shocks, or rainwater storage to alleviate water shortages can be considered hybrid or semi-natural options. EbA and Eco-DRR activities encapsulate the following characteristics:[42]

(a) Enhance resilience and reduce social and environmental vulnerabilities to current and future climate change impacts and disaster risk, contributing to incremental and transformative adaptation and disaster risk reduction;

(b) Generate societal benefits, contributing to sustainable and resilient development using equitable, transparent and participatory approaches;

(c) Make active use of biodiversity and ecosystem services through sustainably managing, conserving and restoring ecosystems;

(d) Be part of overall strategies for adaptation and risk reduction that are supported by policies at multiple levels, and encourage equitable governance while enhancing capacity.

Key principles and safeguards and a flexible and iterative framework are detailed in Section B. This framework integrates other related guidelines and processes, including the adaptation

[42] FEBA 2017, DEA and SANBI 2017

process under the UNFCCC, and is composed of key steps (see summary in Table 1 and detail in Section B).

Table 1. Framework for planning and implementing EbA and Eco-DRR.

	Step	Purpose
Overarching Considerations: Integrating knowledge of IPLCs; Mainstreaming; Raising awareness and building capacity	A. Understanding the Social-Ecological System (SES)	Identify key features of the target SES, including biodiversity and ecosystem services, and their inter-linkages with people
	B. Assessing Vulnerabilities & Risks	Identify the main climate change and disaster risks and impacts on the SES
	C. Identifying EbA & Eco-DRR Options	Identify potential options within an overall adaptation/risk reduction strategy
	D. Prioritizing, Appraising and Selecting options	Develop criteria for prioritizing and appraising options, including consideration of scale and monetary- and non-monetary benefits
	E. Project Design & Implementation	Design and implement selected options, ensuring ongoing stakeholder engagement, capacity-building, mainstreaming and monitoring
	F. Monitoring & Evaluation	Improve implementation by providing information for adaptive management and encourage continual learning to help inform future policy and practice.

Governments urgently need to implement resilient adaptation and risk reduction measures in response to current and future climate change impacts and disaster risks. There is mounting evidence that sustainable management, conservation and restoration of ecosystems are effective solutions for these global challenges. By addressing risk across scales and through a social-ecological lens, EbA and Eco-DRR provide flexible and effective options as part of an overall strategy for adaptation and disaster risk reduction, while promoting multiple benefits for people, nature and the economy. Encouragingly, recent analyses of countries submitting (I)NDCs showed that 86% of country submissions included an adaptation component in their plans which outline goals, activities and needs for adaptation[43]. Many of these (I)NDCs include ecosystem-orientated visions for adaptation and propose a range of conservation, restoration, agroforestry and community-led approaches to achieve these visions[44] (see Box 5: How do EbA & Eco-DRR fit into the UNFCCC (I)NDCs and NAPs? for further information). These guidelines provide a framework for translating such visions and ambitions into action.

[43] World Resources Institute 2017
[44] Seddon et al. 2016

A6. Governance opportunities for EbA and Eco-DRR

Governance aspects are key considerations when planning EbA and Eco-DRR measures, as multi-level and multi-sectoral approaches are required to address holistic ecosystem management for risk reduction objectives. Key governance challenges relevant to nature-based solutions generally include:

- **Multi-level governance:** Climate change, disaster risk reduction and ecosystem governance occur within a complex web of stakeholders operating at different levels. Although climate variability occurs at different scales, the role of local and regional settings for the formulation of adaptation and risk reduction strategies is highly important.
- **Multi-sectoral governance**: The integration of adaptation and risk reduction issues in different sectors and corresponding policies is a central mechanism of governance.
- **Governing under uncertainty**: A challenge in formulating and implementing adaptation strategies is due to considerable uncertainties around the sensitivity of the climate system, regional climate impacts and the consequences for social-ecological systems. Governance arrangements should therefore be able to undertake process-oriented approaches, react flexibly to new scientific findings and develop strategic stakeholder relationships according to the needs and opportunities arising, but considering the long-term perspective of all climate-related planning.

Adapting to uncertain climate risks can provide a window of opportunity for institutional change. Since climate change and disaster risks are affecting societies, policy responses need to consider diverse contexts and socio-economic considerations beyond the relatively restricted means of national governments. Linking ecological dynamics with policies in complex, multi-jurisdictional settings with adaptive management and governance frameworks can move social-ecological systems toward greater sustainability.[45]

Integrating ecological concepts into governance frameworks requires a dialogue across multiple disciplines, including ecologists, hydrologists, climate experts, social scientists, resilience experts and legal scholars. Leveraging civil society and the private sector can considerably strengthen planning and implementation of EbA/Eco-DRR measures. A broad suite of stake- and rights holders should thus be considered in the planning phase, and windows of opportunity for joint action with government institutions on different levels should be identified and built into coherent climate change adaptation or risk reduction strategies. These plans should avoid duplication of efforts or gaps by clearly defining roles, responsibilities and mandates while respecting equity and human rights aspects.

In the context of EbA and Eco-DRR, policy integration is relevant at all levels of governance. Especially where vulnerabilities and risks are highly localized, subnational actors play a key role in effective governance and should address trade-offs between environmental and economic objectives through policy development, land use planning and permitting and licensing of infrastructure or economic activities.[46]

[45] Cosens et al. 2014
[46] Ibid

Governance principles relevant for the mainstreaming of EbA and Eco-DRR thinking relate to: inclusive decision-making, transparency, responsiveness and accountability. They are oriented towards effective, equitable and sustainable resource management and livelihood enhancement, and embrace diverse cultures and knowledge systems. In times of uncertainty, polycentric governance systems, with multiple centers of semiautonomous decision-making, can have numerous advantages such as enhanced adaptive capacity, provision of good institutional frameworks for natural resource systems, and mitigation of risks due to redundant governance actors and institutions.[47]

Good governance goes beyond the government; it includes civil society and businesses/the private sector with clear roles and mandates for action (Figure 5). A key role of the state is to create a favourable political, legal & economic environment for adaptation and risk reduction. Civil society can mobilize people's participation in policy making and governance, including via media, or interest groups such as NGOs, community organizations or indigenous peoples' associations. Academia provides scientific knowledge as the basis for policy and informed decision-making. The private sector is a key actor for the governance of EbA and Eco-DRR measures due to its flexibility of action and innovation, importance for public awareness, financial powers and potential to enhance policy implementation. Financing institutions, insurance companies, investors, producers, retailers, and sector-specific actors bring cost-benefit and efficiency thinking to the table. They can provide the financial means for innovations to emerge, or use pressure or incentives for new policies to be developed, implemented or enhanced.

[47] Carlisle and Gruby 2017

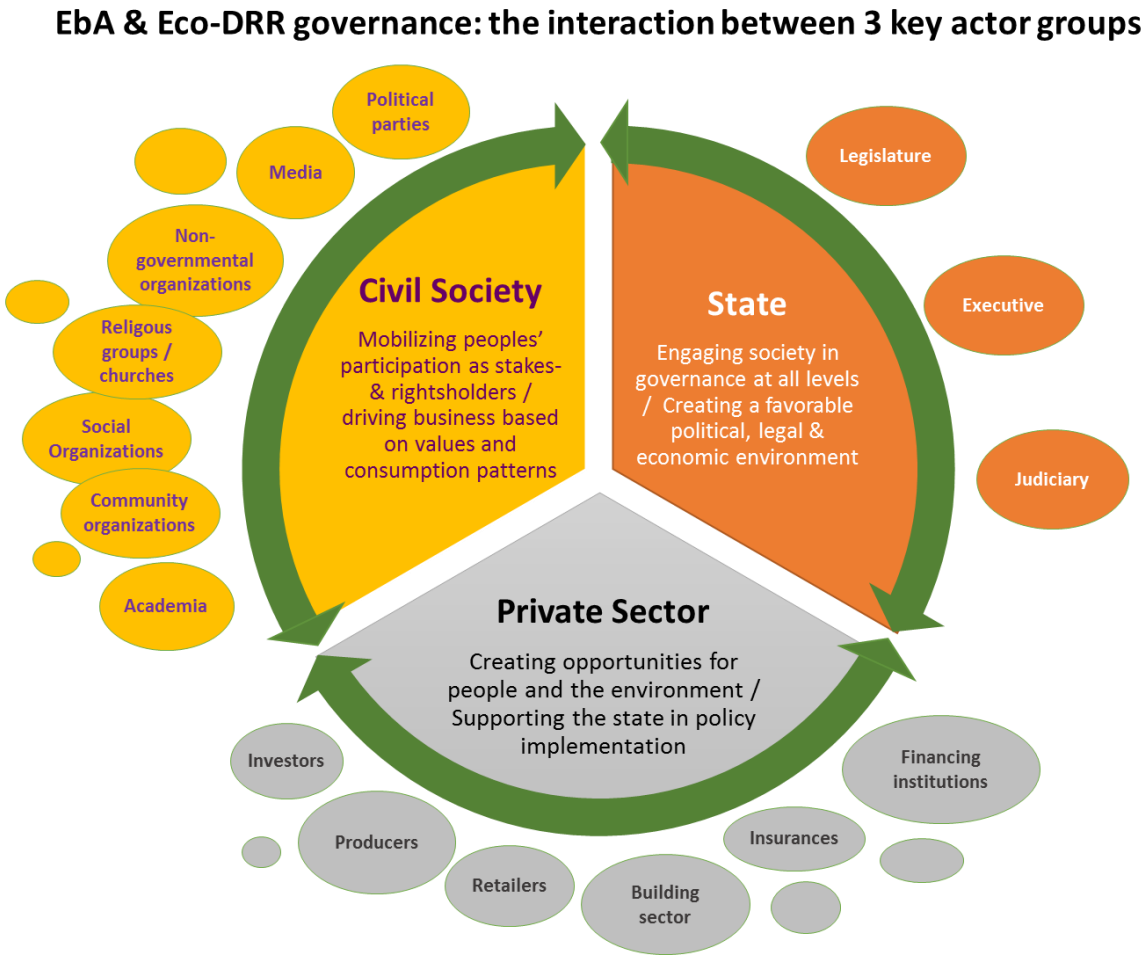


Figure 5. Interactions between the state, civil society and the private sector in governance for effective adaptation and risk reduction (graphic by GIZ)

B. Voluntary guidelines for the design and effective implementation of EbA and Eco-DRR

B1. Introduction

Ecosystem-based approaches to climate change adaptation and disaster risk reduction are holistic approaches that use biodiversity and ecosystems to manage the risks of climate-related impacts and disasters. 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. EbA 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.[48] Ecosystem-based disaster risk reduction (Eco-DRR) is the sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim of achieving sustainable and resilient development.[49]

These voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction have been prepared pursuant to paragraph 10 of decision XIII/4. The voluntary guidelines are intended to be used as a flexible framework for planning and implementing EbA and Eco-DRR.

B1.1 Overview of the voluntary guidelines

The guidelines begin with an overall introduction to the mandate and basic terminology of EbA and Eco-DRR. Section B2 presents principles and safeguards that provide standards and measures to bear in mind during all of the steps of planning and implementation presented in section B4. Section B3 presents other important overarching considerations on: integrating knowledge, technologies, practices and efforts of indigenous peoples and local communities, mainstreaming, and raising awareness and building capacity. The overarching considerations should also be kept in mind when undertaking the steps of planning and implementation in section B4. Section B4 presents a step-wise approach intended to work iteratively for EbA and Eco-DRR planning and implementation along with suggested practical actions, including, tools linked with the step wise process.

B1.2 What are ecosystem-based approaches to climate change adaptation and disaster risk reduction?

The Convention on Biological Diversity published Technical Series 85[50] which presents a synthesis report on experiences with the implementation of EbA and Eco-DRR. It provides detailed information on experiences with policy and legal frameworks, mainstreaming, integrating gender and the contribution of indigenous peoples and local communities. Additional examples of EbA and Eco-DRR activities are presented in Table 2.

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[48] Derived from CBD Technical Series 41. 2009. Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change (SCBD 2009)

[49] Estrella and Saalismaa. 2013.

[50] Lo 2016 (https://www.cbd.int/doc/publications/cbd-ts-85-en.pdf)

Table 2. Examples of EbA and Eco-DRR interventions and outcomes[51]

Hazard/climate change impact	*Ecosystem type*	*EbA or Eco-DRR intervention options*	*Outcome*
Drought Soil erosion Erratic rainfall	Mountains and forests	Sustainable mountain wetland management	Improved water regulation Erosion prevention Improved water storage capacity
		Forest and pasture restoration	
		Restoration of pastures with deep-rooting native species	
Erratic rainfall Flood Drought	Inland waters	Conservation of wetlands and peatlands	Improved water storage capacity Flood risk reduction Improved water provisioning
		River basin restoration	
		Transboundary water governance and ecosystem restoration	
Erratic rainfall Temperature increase Shift of seasons Drought	Agriculture and drylands	Ecosystem restoration and agroforestry	Improved water storage capacity Adaptation to higher temperatures Adaptation to shifting seasons Improved water provisioning
		Intercropping of adapted species	
		Using trees to adapt to changing dry seasons	
		Sustainable livestock management and pasture restoration	
		Drought resilience by sustainable dryland management	
Extreme heat Temperature increase Floods Erratic rainfall	Urban	Green aeration corridors for cities	Heat wave buffering Adaptation to higher temperatures Flood risk reduction Improved water regulation
		Storm water management by green spaces	
		River restoration in urban areas	
		Green facades for buildings	
Storm surges Cyclones Sea level rise Salinization Temperature increase	Marine and coastal	Mangrove restoration and coastal protection	Storm and cyclone risk reduction Flood risk reduction Improved water quality Adaptation to higher temperatures
		Coastal realignment	
		Sustainable fishing and mangrove rehabilitation	
		Coral reef restoration	

In order for climate change adaptation and disaster risk reduction activities to be recognized as EbA and Eco-DRR, they must encapsulate the following characteristics:

(e) Enhance resilience and reduce social and environmental vulnerabilities to current and future climate change impacts and disaster risk, contributing to incremental and transformative adaptation and disaster risk reduction;

(f) Generate societal benefits, contributing to sustainable and resilient development using equitable, transparent and participatory approaches;

(g) Make active use of biodiversity and ecosystem services through sustainably managing, conserving and restoring ecosystems;

(h) Be part of overall strategies for adaptation and risk reduction that are supported by policies at multiple levels, and encourage equitable governance while enhancing capacity.

[51] Examples provided by GIZ from the PANORAMA database http://panorama.solutions/en

B2. Principles and Safeguards for EbA and Eco-DRR

The voluntary guidelines are underpinned by principles and safeguards that were developed by reviewing existing literature and guidelines on EbA and Eco-DRR[52] and complement other principles and guidelines[53] adopted under the Convention or under other bodies. The safeguards are social and environmental measures to avoid unintended consequences of EbA and Eco-DRR to people, ecosystems and biodiversity; they also facilitate transparency in throughout all stages of planning and implementation, and promote the realization of benefits.

Key principles and safeguards underpin these guidelines for EbA and Eco-DRR planning and implementation. The principles serve as high-level standards for guiding the planning and implementing process. The social and environmental safeguards are measures to avoid unintended consequences of EbA and Eco-DRR to people, ecosystems and biodiversity; they also facilitate transparency in throughout all stages of planning and implementation, and promote the realization of benefits.

Principles

The principles serve as standards for guiding the planning and implementing process. They integrate elements of EbA and Eco-DRR practice and serve as high-level standards to guide planning and implementation. The principles are clustered into themes: building resilience and enhancing adaptive capacity, inclusivity and equity, consideration of multiple scales, and effectiveness and efficiency. Section B4 provides suggested steps, methodologies and associated tools to implement actions on EbA and Eco-DRR according to the principles and safeguards.

[52] Including "Guidance on Enhancing Positive and Minimizing Negative Impacts on Biodiversity of Climate Change Adaptation Activities" (UNEP/CBD/SBSTTA/20/INF/1).

[53] See Ecosystem restoration: short term action plan (decision XIII/5); the United Nations Declaration on the Rights of Indigenous Peoples; and Principles, Guidelines and Other Tools Developed under the Convention, available at https://www.cbd.int/guidelines/.

Principles for building resilience and enhancing adaptive capacity through EbA and Eco-DRR	
1	Consider a full range of ecosystem-based approaches to enhance resilience of socio-ecological systems as a part of overall adaptation and disaster risk reduction strategies.
2	Use disaster response as an opportunity to build back better for enhancing adaptive capacity and resilience[54] and integrate climate-resilient ecosystem considerations throughout all stages of disaster management.
3	Take the precautionary approach[55] in planning and implementing EbA and Eco-DRR interventions.
Principles for ensuring inclusivity and equity in planning and implementation	
4	Prioritize and target EbA and Eco-DRR interventions to prevent and avoid the disproportionate impacts of climate change and disaster risk on vulnerable groups, indigenous peoples and local communities, and ecosystems.
Principles for achieving EbA and Eco-DRR on multiple scales	
5	Design EbA and Eco-DRR interventions at the appropriate scales, recognizing that some EbA and Eco-DRR benefits are only apparent at larger temporal and spatial scales.
6	Ensure that EbA and Eco-DRR are sectorally cross-cutting and involve collaboration, coordination, and co-operation of stakeholders and rights holders.
Principles for EbA and Eco-DRR effectiveness and efficiency	
7	Ensure that EbA and Eco-DRR interventions are evidenced-based and integrate indigenous and local knowledge where available, and are supported by the best available science, research, data, practical experience, and diverse knowledge systems.
8	Incorporate mechanisms that facilitate adaptive management and active learning into EbA and Eco-DRR, including continuous monitoring and evaluation at all stages of planning and implementation.
9	Identify and assess limitations and minimize potential trade-offs of EbA and Eco-DRR interventions.
10	Maximize synergies in achieving multiple benefits, including for biodiversity, conservation, sustainable development, gender equality, adaptation, and risk reduction.

[54] The use of the recovery, rehabilitation and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating DRR measures into the restoration of physical infrastructure and societal systems, and into the revitalization of livelihoods, economies and the environment. (UNISDR 2017)

[55] The precautionary approach is stated in the preamble of the Convention on Biological Diversity: "Where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat."

Safeguards

Safeguards for effective planning and implementation of EbA and Eco-DRR	
Applying environmental impact assessments and robust monitoring and evaluation	1. EbA and Eco-DRR should be subject, as appropriate, to environmental impact assessments (EIA) including social and cultural assessments (referring to the Akwé: Kon guidelines) at the earliest stage of project design, and subject to robust monitoring and evaluation systems.
Prevention of transfer of risks and impacts	2. EbA and Eco-DRR should not result in adverse impacts on biodiversity or people, nor result in the displacement of risks or impacts from one area or group to another.
Prevention of harm to biodiversity, ecosystems and ecosystem services	3. EbA and Eco-DRR, including disaster response, recovery and reconstruction measures, should not result in the degradation of natural habitat, loss of biodiversity or the introduction of invasive species, nor create or exacerbate vulnerabilities to future disasters. 4. EbA and Eco-DRR promote and enhance biodiversity and ecosystem services, including through rehabilitation/restoration and conservation measures as part of post-disaster needs assessment and recovery and reconstruction plans.
Sustainable resource use	5. EbA and Eco-DRR should not result in unsustainable resource use nor enhance the drivers of climate change and disaster risks, and should strive to maximize international and national standards for maximising energy efficiency and minimize material resource use.
Promotion of full, effective and inclusive participation	6. EbA and Eco-DRR ensure full and effective participation of indigenous peoples and local communities, women, minorities and the most vulnerable, including the provisioning of adequate opportunities for informed involvement.
Fair and equitable access to benefits	7. EbA and Eco-DRR promote fair and equitable access to benefits and do not exacerbate existing inequities, particularly with respect to marginalised or vulnerable groups. EbA and Eco-DRR interventions should meet national labour standards, protecting participants against exploitative practices, discrimination and work that is hazardous to well-being.
Transparent governance and access to information	8. EbA and Eco-DRR promote transparent governance by supporting rights to access to information, providing all stakeholders and rights holders, particularly indigenous peoples and local communities, with information in a timely manner, and supporting the further collection and dissemination of knowledge.
Respecting human rights including rights of indigenous peoples and local communities	9. EbA and Eco-DRR measures respect human rights, including rights of indigenous peoples and local communities, women and men, and including access to and use of physical and cultural heritage.

B3. Overarching considerations for EbA & Eco-DRR design and implementation

When undertaking the step-wise process for planning and implementing EbA and Eco-DRR provided in section 4, there are three main overarching considerations to keep in mind at each step: integrating knowledge, technologies, practices and efforts of indigenous peoples and local communities; mainstreaming of EbA and Eco-DRR; and raising awareness and building capacity. Taking these actions into account can enhance uptake of EbA and Eco-DRR approaches, and improve effectiveness and efficiencies, enabling more and better outcomes from the interventions.

B3.3. Integrating knowledge, technologies, practices and efforts of indigenous peoples and local communities

Indigenous peoples and local communities have managed variability, uncertainty and change through multigenerational histories of interaction with the environment. Traditional knowledge and coping strategies can thus form an important basis for climate change and disaster risk reduction responses, complementing established evidence, and bridging gaps in information. Indigenous, traditional and local knowledge systems – and forms of analysis and documentation, such as community mapping – can play a significant role in identifying and monitoring climatic, weather and biodiversity changes and impending natural hazards, similarly to early warning systems. Ecosystem-based approaches can also serve to bring back abandoned practices, such as traditional agricultural practices in Burkina Faso and Senegal[56]. Integrating the knowledge of indigenous peoples and local communities also involves an appreciation of their *cosmovisión*,[57] and an acknowledgement of their role as knowledge holders and rights holders. Ways to incorporate indigenous and traditional knowledge and practices in EbA and Eco-DRR planning and implementation throughout all stages of planning and implementation include the following:

Key actions

a) Discover and document linkages between local, indigenous and traditional knowledge and practices and the goals and objectives of climate change adaptation and disaster risk reduction;
b) Consult multi-stakeholder working groups to facilitate knowledge-sharing across sectors on the role of ecosystems in adaptation and disaster risk reduction;
c) Put in place effective participatory and transparent mechanisms to seek the best available evidence;
d) Integrate traditional knowledge into assessments after obtaining free prior and informed consent.

[56]Monty 2017

[57] A worldview that has evolved over time that integrates physical and spiritual aspects (adapted from the Indigenous Peoples' Restoration Network).

Table 3. Toolbox for integrating knowledge, technologies, practices and efforts of indigenous peoples and local communities

Tool/Organization	Description
Traditional Knowledge and Climate Science Toolkit (UNU)	Provides articles, videos and various other resources that will assist indigenous peoples, local communities, policymakers and other stakeholders in accessing research on climate change adaptation and mitigation http://collections.unu.edu/view/UNU:1500
Weathering Uncertainty: Traditional Knowledge for Climate Change Assessment and Adaptation (UNESCO and UNU)	Provides an overview of the literature relating to the contribution of traditional/indigenous knowledge to our understanding of global climate change: observations, impacts and opportunities for adaptation http://unesdoc.unesco.org/images/0021/002166/216613e.pdf
Examples of the application of traditional knowledge to adaptation (IPCC Fifth Assessment Report, Chapter 15)	Summary of approaches and strategies for applying local knowledge to climate change adaptation across different sectors http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap15_FINAL.pdf
Indigenous people and climate change: from victims to change agents through decent work (ILO)	Report demonstrating how indigenous peoples are essential to the success of policies and measures directed towards mitigating and adapting to climate change, especially their sustainable economic model and traditional knowledge http://www.ilo.org/global/topics/indigenous-tribal/WCMS_551189/lang--en/index.htm
Handbook for ILO Tripartite Constituents (ILO)	Outlines requirements regarding consultations in accordance with the Indigenous and Tribal Peoples Convention, 1989 http://www.ilo.org/wcmsp5/groups/public/@ed_norm/@normes/documents/publication/wcms_205225.pdf
Indigenous and traditional knowledge and practices for adaptation: overview, available tools, good practices and lessons learned (UNFCCC)	Highlights the best practices, lessons learned and available tools for the use of indigenous and traditional knowledge and practices (ITKP) for adaptation https://unfccc.int/files/adaptation/application/pdf/4_synopsis_itkp.pdf

B3.4. Mainstreaming EbA and Eco-DRR

Mainstreaming EbA and Eco-DRR is the integration of ecosystem-based approaches into climate- and disaster-sensitive planning and decision-making processes at all levels. Mainstreaming may start with integrating ecosystem considerations into adaptation and disaster risk reduction objectives, strategies, policies, measures or operations so that they become part of national and regional development policies, processes and budgets at all levels and stages. Mainstreaming enhances the effectiveness, efficiency, and longevity of EbA and Eco-DRR initiatives by embedding their principles into local, municipal and national policies, planning, assessments, financing, training, and awareness campaigns, among other policy tools. The overall goal is enhanced support and implementation of EbA and Eco-DRR where it proves effective.

Mainstreaming occurs continuously throughout EbA and Eco-DRR planning and implementation. The process begins (as outlined in Step A in section B4) with the achievement of a broad understanding of the political and institutional set-up of the target system, which enables the

identification of potential entry points for mainstreaming. Other key components of mainstreaming include enhancing sectoral outreach, raising awareness, and capacity-building.

When mainstreaming EbA and eco-DRR, it is important to align with national and subnational development frameworks and mainstream into relevant plans, policies and practice at multiple scales, including with international frameworks and conventions, such as the Sustainable Development Goals and the Strategic Plan for Biodiversity 2011-2020 (Figure 6). Mainstreaming helps to enhance long-term sustainability and possibilities for funding (Box 6). It is also important to incorporate a disaster and climate risk reduction lens when implementing environmental impact assessments and strategic environmental assessments to prevent unintended impacts that may exacerbate risk and to promote EbA and Eco-DRR measures.

Key Actions

a) Underscore the value of healthy ecosystems in adaptation and disaster risk reduction policies and frameworks, supporting the maintenance of functioning and provisioning of essential services under current and future climate change scenarios.
b) Assess existing national adaptation and disaster risk reduction policies, plans and investments, in addition to broader (non-adaptation- and DRR-related) environmental, land use and development policies and plans to identify entry points for promoting Eco-DRR/CCA implementation. These include, but are not limited to:
    a. National Biodiversity Strategies and Action Plans (NBSAPs)
    b. National Adaptation Plans (NAPs) and linkages to Nationally Determined Contributions (NDCs) and national legislation (see Box 5)
    c. National Plans for Land Degradation Neutrality
    d. Disaster risk management plans, including national drought strategies
    e. Land-use planning, including urban planning
    f. Agricultural, fisheries, water, infrastructure, and other sectors (see Section C)
    g. Development policies
    h. Budget plans
c) Align EbA and Eco-DRR with national and sub-national development frameworks and mainstream into relevant plans, policies and practice at multiple scales to enhance long-term sustainability and possibilities for funding (Figure 7).
d) Align with international frameworks and conventions, such as the SDGs, CBD Strategic Plan for Biodiversity, and others, and incorporate EbA/Eco-DRR measures into reporting schemes.
e) Improve convergence in the design and implementation of EbA and Eco-DRR into existing programmes of work (including adaptation, environment, development, humanitarian), including climate-proofing existing interventions.
f) Incorporate a disaster and climate risk reduction lens when implementing Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs) to prevent unintended environmental impacts that may exacerbate risk and to promote EbA and Eco-DRR measures.
g) Invest in risk-informed development by protecting existing healthy natural/green infrastructure from new development (e.g. water-infrastructure or coastal) and by creating boundary conditions for the design of such large-scale developments.

h) Create entry points for ecosystem-based solutions in ministerial guidelines for tenders by developing boundary conditions, including considering green or hybrid solutions before grey when more effective.
i) Create incentive structures for the promotion of eco-friendly infrastructure development and incentives for private sector to include EbA/Eco-DRR (e.g. tax reduction); and
j) Screen national tax systems and public funding to avoid/eliminate perverse incentives, ecosystem degradation, or maladaptation.
k) Review technical standards, e.g. procurement documents, guidance and M&E project cycle needs to allow flexibility of ecosystem solutions.

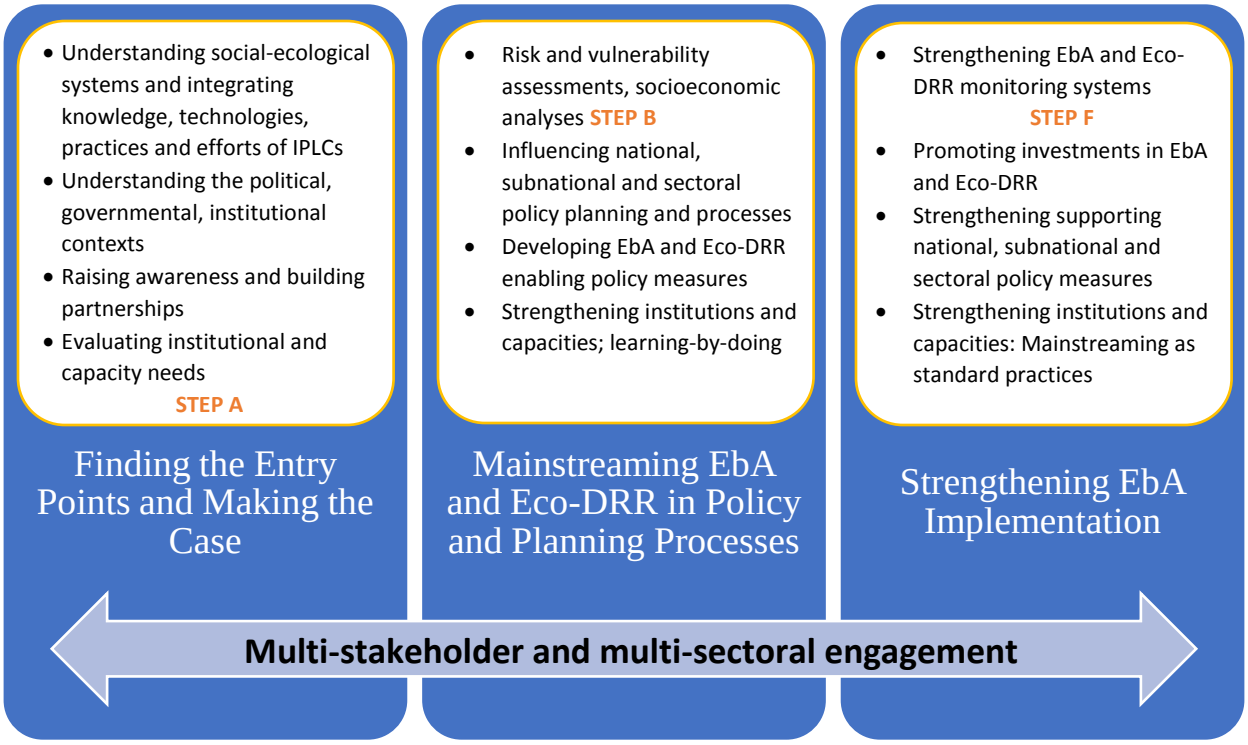

Figure 6. Example framework for mainstreaming EbA and Eco-DRR in development planning[58]

[58] Adapted from WWF 2013 and UNDP-UNEP 2011

Box 5: How do EbA & Eco-DRR fit into the UNFCCC (I)NDCs and NAPs?

(Intended) Nationally Determined Contributions ((I)NDCs) set out high-level objectives and a vision for addressing adaptation goals. 86 % of countries who submitted (I)NDCs include an adaptation component in their plans which outline goals, activities and needs for adaptation (World Resources Institute 2017). Another analysis of (I)NDCs revealed that, although only 23 countries mention EbA explicitly, many more have ecosystem-orientated visions for adaptation and propose a range of conservation, restoration, agroforestry and community-led approaches to achieve these visions (Seddon et al. 2016). The most commonly cited needs for adaptation among sectors are in the water, agriculture and human health sectors (Mogelgaard and McGray 2015).

National Adaptation Plans (NAPs) aim to reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience; and integrate climate change adaptation into policies, programmes and activities within all relevant sectors and at different levels. The main elements in developing a NAP are laying the groundwork and addressing gaps, preparatory elements including identifying and appraising adaptation options, implementation strategies; and reporting, monitoring and review. The NAP process is a key tool for coherent implementation of an (I)NDC adaptation component (GIZ 2016b). Entry-points for integrating EbA and Eco-DRR include:

- An ecosystem and risk reduction lens should be applied to the NAP process. For example, in assessing vulnerabilities and risk, using a landscape or systems approach will help to identify ecosystems that provide critical climate regulation services. EbA is explicitly listed as one of several approaches in the NAP Technical Guidelines for conducting vulnerability and risk assessments, which can aid in prioritizing measures such as conservation or restoration actions to maintain ecosystem health and functioning.
- In reviewing and appraising adaptation options, it is recommended to consider economic, ecosystem and social costs and benefits. Using appraisal methods that consider costs and benefits in the short and long-term and within appropriate geographical scales can aid in making the case for ecosystem-based approaches.
- In implementing adaptation activities, the NAP process also notes that implementation approaches could include a resilience approach, through climate-proofing development or ecosystem-based approaches. The NAP planning process is iterative and adaptive, and can involve the use of several different approaches in each of its main elements (see NAP Technical Guidelines, Least Developed Countries Expert Group 2012).

A key aspect of mainstreaming is finding appropriate entry points for integrating EbA and Eco-DRR into concrete but also often complex policy and planning frameworks and decision-making processes. Entry points can be dynamic, depending on three key aspects:

a) The awareness of stakeholders about an existing problem, challenge or risk;
b) Available solutions, proposals, tools and knowledge;
c) Political will to act, mandates and roles.

If all three aspects come together in favourable ways, there is a "momentum" for policy change. In cases of disaster, there is generally openness towards stakeholders' needs, innovative tools and approaches, joint searches for best available solutions, and a willingness to invest and (re)build better. These are important opportunities to include EbA or Eco-DRR aspects. Entry points may occur

at all levels of government, and can imply different levels of governance, or collaboration with the private sector.

In general, entry points for mainstreaming may be found in:

a) The development or revision of policies and plans, e.g. development or sectoral plans, nationally determined contributions, national adaptation plans, national biodiversity strategies and action plans, strategic environmental assessments, land-use plans;
b) Command and control instruments, e.g. climate change and environmental laws, standards, and environmental impact assessments;
c) Economic and fiscal instruments, e.g. investment programmes, funds, taxes, fees (see Box 6 for more detail);
d) Educational and awareness-raising measures, e.g. environmental education, extension programmes, technical careers and university curricula;
e) Voluntary measures, e.g. environmental agreements with private landowners, or the definition of standards.

As emphasized throughout the EbA and Eco-DRR planning and implementation process, reaching out to sectors is key to raising awareness of and integrating EbA and Eco-DRR into sectoral plans and national-level planning, and encouraging cross-sectoral collaboration for joint implementation. A key action in this respect is to consider integrating EbA and Eco-DRR in sectoral development plans at local, national and regional scales, such as in land use and water management, in both rural and urban contexts. Briefs for supporting EBA and Eco-DRR practitioners to undertake outreach into sectors are available in Section C.

Box 6. Opportunities for mainstreaming EbA and Eco-DRR into funding priorities

EbA and Eco-DRR contribute to multiple objectives, including development, disaster risk, adaptation, mitigation, food and water security, and to ensure risk-informed investments. The cross-sectoral and transdisciplinary approaches of EbA and Eco-DRR, and the potential realization of multiple benefits offer several opportunities to attract/enhance funding.

- Encourage new financial incentives for investments in sustainable ecosystem management that emphasize ecosystems as part of adaptation and disaster risk planning. Examples include developing incentive programmes for farmers to implement practices that contribute to maintaining resilient ecosystems, such as agroforestry and conservation tillage.
- Unlock new investments for EbA and Eco-DRR through the climate-proofing of existing investment portfolios.
- Work with the private sector (including insurance, tourism, agriculture and water sectors) to harness their expertise, resources and networks. This helps in encouraging and scaling up investments in EbA and Eco-DRR, and identifying public-private partnerships.
- Engage government regulatory bodies to support and endorse private sector investments in natural infrastructure and EbA and Eco-DRR.
- Identify partnerships with industry associations that can aid in the identification of climate risks, impacts and adaptation strategies. Examples include the development of climate risk assessment tools for use by private sector investors and insurance companies, adoption of hydro-meteorological and climate information services, and working with developers to improve land-use planning, including such EbA and Eco-DRR activities as ecosystem restoration.
- Create national-level incentive structures for EbA/Eco-DRR, especially for private landowners and companies.

The mainstreaming of EbA and Eco-DRR into funding priorities should ensure that initiatives adhere to the EbA and Eco-DRR principles and safeguards with clear intentions to achieve enhanced social-ecological resilience to climate change impacts and disasters.

A simple framework for mainstreaming EbA and Eco-DRR into development and sectoral plans involves identifying entry points for mainstreaming EbA and Eco-DRR within key development and sectoral strategies by: embedding ecosystem-based approaches into existing instruments and methods tools, selecting appropriate indicators for monitoring and evaluation, and ensuring successful impact by developing a theory of change to reach mainstreaming goals (Figure 7).

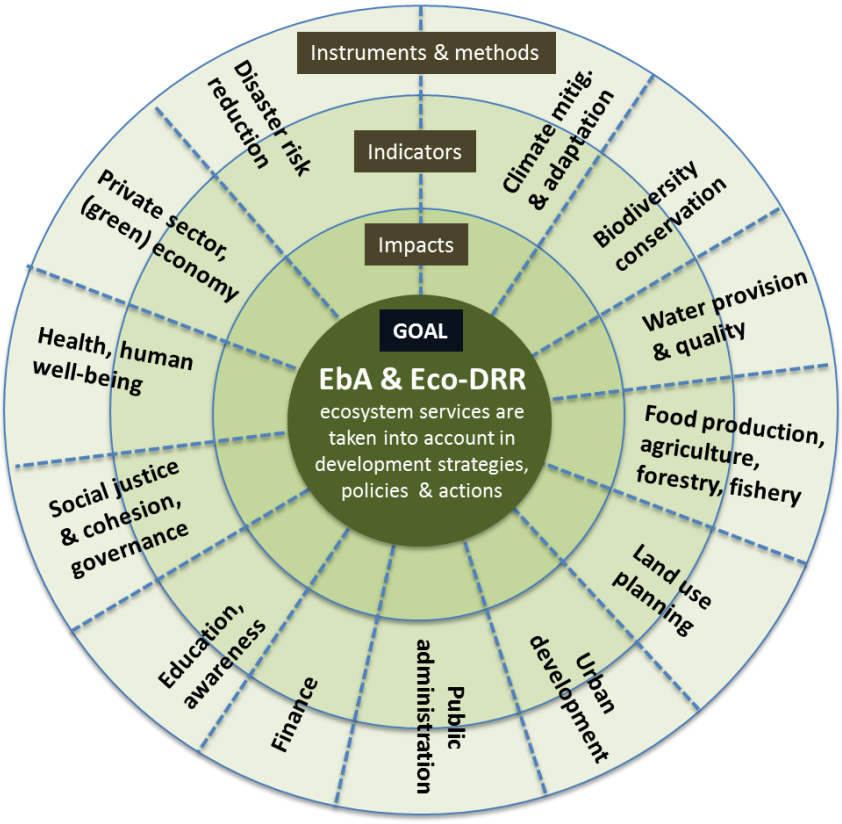

Figure 7. Entry points for mainstreaming EbA and Eco-DRR within key development and sectoral strategies Effective adaptation and risk reduction is achieved by mainstreaming ecosystem-based approaches into existing instruments and methods, selecting appropriate indicators for monitoring and evaluation, and ensuring successful impact[59]

B3.5. Raising awareness and building capacity

Communicating the multiple benefits of EbA and Eco-DRR across sectors, communities of practice, and disciplines is crucial to enhancing uptake and sustainability of initiatives, in addition to opening avenues for funding. National and international policy agreements provide an opportunity to bridge the gap between different communities of practice. Interlinkages between ecosystem management, climate change and disaster risk reduction are all reflected in various targets under the Sustainable Development Goals, the Sendai Framework for Disaster Risk Reduction, the Paris Agreement on Climate Change, decisions of the Parties to the Rio conventions, and resolutions of Parties to the Ramsar Convention (Annex II).[60]

[59] Figure by GIZ

[60] See also *CBD Technical Series No. 85* (Lo 2016), annexes II and III.

Key Actions

a) Identify targets of international frameworks, ratified in national law, that link to and promote EbA and Eco-DRR;
b) Conduct a baseline assessment of existing skills/capacity of policy makers to identify capacity and address uptake gaps and needs;
c) Conduct a baseline assessment on institutional capacities and existing coordination mechanisms to identify needs for sustainably mainstreaming and implementing EbA and Eco-DRR;
d) Consider the different information and communication needs of different stakeholder groups to develop effective outreach;
e) Build a common knowledge base and seek to identify a common language among stakeholders to support their cooperation;
f) Support active engagement of environmental managers in national platforms for the adoption and implementation of EbA and Eco-DRR strategies and plans aimed at strengthening economic, social, health and environmental resilience;
g) Identify EbA and Eco-DRR champions, high-level decision makers and institutions that can help in advocacy;
h) Systematically document the economic, social and environmental costs and benefits of EbA and Eco-DRR measures as compared with 'grey' or 'hard' infrastructure measures; and
i) Join networks to share information on experiences, barriers, opportunities, lessons learned, and best practices, including:
    - PEDRR (Partnership for Environment and Disaster Risk Reduction), a global alliance of UN agencies, NGOs and specialist institutes, a global thematic platform of the International Strategy for Disaster Reduction (ISDR) that seeks to promote and scale-up implementation of ecosystem-based disaster risk reduction and ensure it is mainstreamed in development planning at global, national and local levels, in line with the Sendai Framework for Disaster Risk Reduction.
    - Friends of EbA, an informal network of organizations with an interest in promoting collaboration and knowledge sharing on through joint events and initiatives, and the development of position papers and technical documents on EbA[61]
    - PANORAMA – Solutions for a Healthy Planet, a partnership initiative to document and promote examples of inspiring, replicable solutions across a range of conservation and sustainable development topics, enabling cross-sectoral learning and inspiration.[62]
    - BES-Net (Biodiversity and Ecosystem Services Network)[63], a capacity building "network of networks" that promotes dialogue among science, policy and practice for more effective management of biodiversity and ecosystems
    - Ecoshape: the foundation that carries out the public-private Building with Nature innovation programme. Within Ecoshape contractors, engineering companies,

[61] https://www.iucn.org/theme/ecosystem-management/our-work/ecosystem-based-adaptation-and-climate-change/friends-eba-feba
[62] http://www.panorama.solutions/en/explorer/grid/1042
[63] http://www.besnet.world/

research institutions, governments and NGOs work together to develop and spread knowledge about Building with Nature[64]

- Ecosystem Services Partnership's Thematic Working Group on Ecosystem Services and Disaster Risk Reduction[65]
- IUCN Thematic Groups, including on eco-disaster risk reduction and ecosystem-based mitigation and adaptation[66]
- CAP-Net (UNDP), network for capacity development in sustainable water management, partnership of autonomous international, regional and national institutions.

Table 4. Toolbox for mainstreaming adaptation and DRR and raising awareness

Tool/Organization	Description
Using NDCs and NAPs to Advance Climate-Resilient Development: Framework for linking NAPs and NDCs	Guidelines on streamlining and leveraging Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs) to improve adaptation planning and action. (IISD) http://napglobalnetwork.org/2016/11/using-ndcs-naps-advance-climate-resilient-development/
NAP Align: Aligning NAP processes to development and budget planning	Provides practical recommendations on how to integrate adaptation to climate change into a country's planning and budgeting system (GIZ) (English and French) http://www.adaptationcommunity.net/?wpfb_dl=235
Opportunities and options for enhancing adaptation actions and supporting their implementation: reducing vulnerability and mainstreaming adaptation (UNFCCC)	Outlines opportunities and options for reducing vulnerability and mainstreaming climate change adaptation, including through the process to formulate and implement national adaptation plans, including a section on opportunities for financing and implementing EbA/Eco-DRR https://unfccc.int/files/adaptation/groups_committees/adaptation_committee/application/pdf/tp_adaptation_2016.pdf
Mainstreaming Ecosystem-based Adaptation into development planning (GIZ)	A practice-oriented training course developed by GIZ (2016), which contains four several flexible modules and complementary sessions to guide addressing the main steps of the EbA mainstreaming cycle and includes a session on Eco-DRR(also relevant to Eco-DRR) (English and Spanish)[67]
Biodiversity Mainstreaming Toolbox for land-use planning and development (ICLEI)	Tools developed to aid the wise use of natural resources and sustainable development, and to help mainstream biodiversity objectives into land-use planning and development decision-making http://biodiversityadvisor.sanbi.org/wp-content/uploads/2015/02/Biodiversity-Mainstreaming-Toolbox_Senior-Managers-Summary.pdf
Mainstreaming Environment and Climate for Poverty Reduction and Sustainable Development: The Interactive Handbook to	This handbook draws on successful experiences from countries around the world in effectively mainstreaming poverty-environment issues into development agendas http://www.unpei.org/about-the-interactive-handbook

[64] www.ecoshape.org

[65] https://www.es-partnership.org/community/workings-groups/thematic-working-groups/twg-12-es-and-disaster-risk-reduction/

[66] https://www.iucn.org/commissions/commission-ecosystem-management/our-work/cems-thematic-groups

[67] For more information on the mainstreaming training course (available by request), please see http://www.adaptationcommunity.net/trainings/training-course-mainstreaming-ecosystem-based-adaptation-development-planning-updated-2016/

Tool/Organization	Description
Strengthen Planning and Budgeting Processes (UNDP)	
Integrated Strategic Environmental Assessment in Sri Lanka (UNEP and UNDP)	Provides guidance on undertaking Integrated Strategic Environmental Assessments that includes considerations for enhancing resilience. http://www.unep.org/disastersandconflicts/Introduction/DisasterRiskReduction/Capacitydevelopmentandtechnicalassistance/ISEAinSriLanka/tabid/105928/Default.aspx
CBD Technical Series No. 85	Contains several examples of mainstreaming EbA and Eco-DRR into national plans, strategies and targets (Lo 2016)
Helping nature help us (IUCN)	Provides information on harmonizing Eco-DRR with biodiversity conservation and the regional lessons including case studies in the document would be useful information for mainstreaming Eco-DRR into biodiversity conservation. https://portals.iucn.org/library/sites/library/files/documents/2016-070.pdf
Entry points for mainstreaming EbA (GIZ)	Experiences from practitioners on how to successfully integrate EbA and Eco-DRR in national and subnational processes and harness synergies http://www.adaptationcommunity.net/wp-content/uploads/2018/01/giz2017-en-learning-brief-entry-points-eba-low-res.pdf

B4. Stepwise approach to design and implementation of effective EbA and Eco-DRR

In developing a conceptual framework for these guidelines, various climate change adaptation and disaster risk reduction processes were considered, in addition to broader problem-solving approaches such as the landscape and systems approach frameworks. The main approaches and processes considered are briefly reviewed in Table 5 as they form the basis of the framework developed for these guidelines. These guidelines employ a broad perspective on all ecosystems and include considerations for mainstreaming EbA and Eco-DRR. The guidelines integrate these approaches within a series of iterative steps (Figure 8). The process is intended to be flexible and adaptable to the needs of a project, programme or country, region, or landscape/seascape. The principles and safeguards for EbA and Eco-DRR are central to the planning and implementation process, and the overarching considerations are provided to improve effectiveness and efficiencies. Steps are linked to a toolbox providing a non-exhaustive selection of further guidance and tools. Stakeholder engagement, mainstreaming, awareness-raising and capacity-building, and integrating the knowledge of indigenous peoples and local communities should be conducted throughout the process.

Table 5. Main frameworks considered for the development of the EbA and Eco-DRR Guidelines

CCA: Climate change adaptation, DRR: Disaster risk reduction

Framework	Issue	Scale	Key Features
National Adaptation Plans (NAPs) under the UNFCCC	CCA	National	Main framework under the UNFCCC for adaptation planning on a national level. Key stages of (i) assessments of impacts, vulnerability and risk; (ii) adaptation planning; (iii) implementation of adaptation actions; and (iv) monitoring and evaluation. Strengthening of technical and institutional capacity, learning and sharing of good practices and experiences, and adaptive management, are integral to each stage.[68]
Operational Framework for EbA (WWF)	CCA	Sub-national	Begins with a vulnerability assessment of social-ecological systems. Other steps include the identification and prioritization of EbA responses, implementation and monitoring, and mainstreaming EbA in national and local climate change planning.[69]
Adaptation mainstreaming cycle (GIZ)	CCA	National/ sub-national	Focuses on maintaining functionality of ecosystems, and begins with using a climate and ecosystem lens to define the problem (e.g. lack of water), and identifying the system of interest (e.g. a watershed, sector or policy).[70]
Disaster risk management cycle	DRR	National/ sub-national	Key stages of risk assessment (including risk identification, analysis and evaluation), risk prevention (through planning and policy), preparedness (early warning, emergency planning and education), and, following a disaster, response and recovery (rescue, recovery and rehabilitation, risk transfer). [71]
Eco-DRR cycle	DRR	National/ sub-national	Integrate ecosystem considerations into the traditional disaster risk management cycle. With improved development planning, on-going risk reduction and sustainable development, hazard events may be prevented from becoming disasters. Eco-DRR should be considered throughout early post-disaster recovery, reconstruction, risk and vulnerability assessments, and on-going disaster prevention through sustainable development.[72]
Ecosystems protecting infrastructure & communities (EPIC) (IUCN)	CCA/DRR	Sub-national	Promotes the use of EbA to protect communities from disasters and climate change impacts. Step-by-step guidance is proposed for implementing EbA and Eco-DRR, based on existing EbA guidelines.[73]
Landscape Approach	Multiple	Multiple	Encourages problem and solution analysis by considering landscapes and systems and integrating different spatial and temporal scales as an iterative process. Emphasizes the importance of conducting an initial landscape assessment and continuous involvement of stakeholders.[74]

[68] UNFCCC 2016
[69] WWF 2013
[70] GIZ 2016a
[71] European Environment Agency 2016
[72] Sudmeier-Rieux 2013
[73] Monty et al. 2017
[74] CARE Netherlands and Wetland International 2017

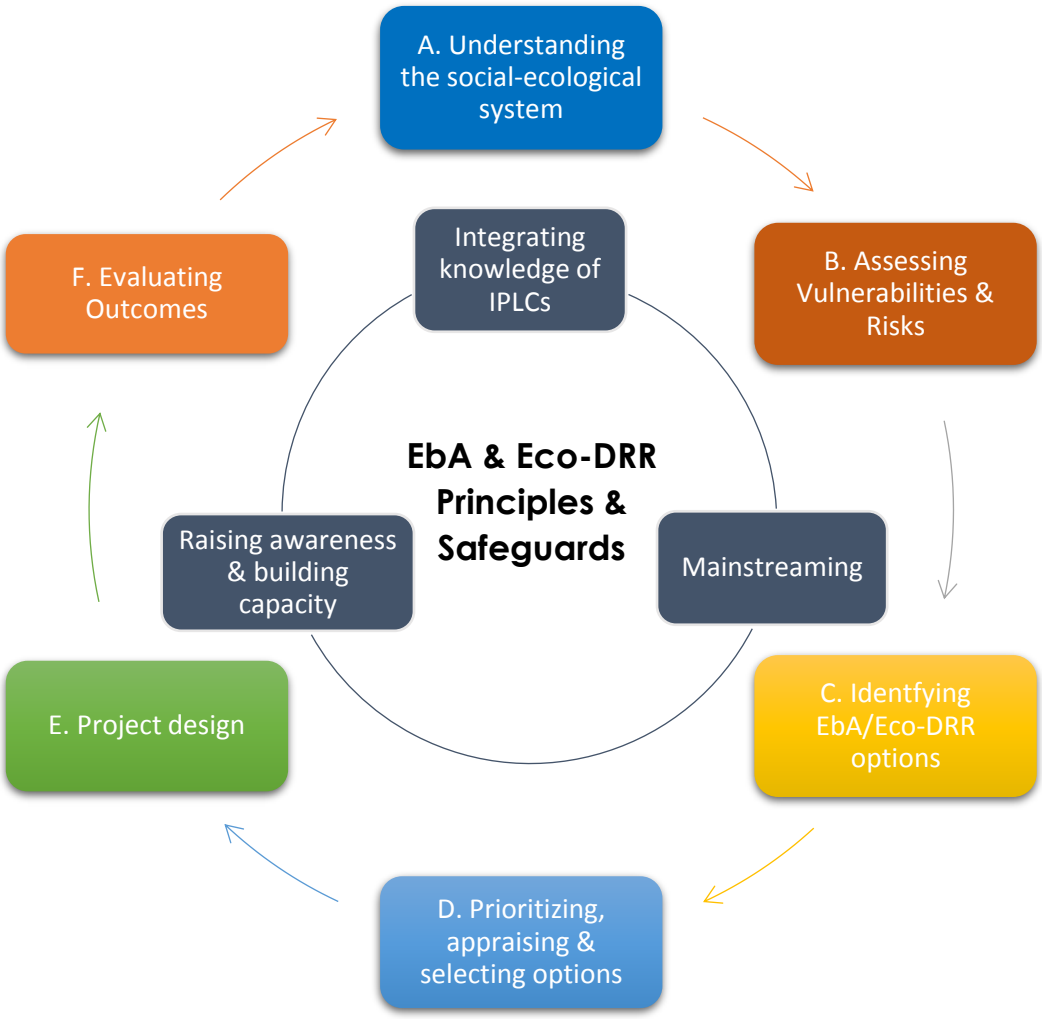

Figure 8. Iterative process for planning and implementing EbA and Eco-DRR as part of overall climate change adaptation and disaster risk reduction strategies. The process is centred on the principles and safeguards presented in these guidelines. The outer circle outlines discrete steps to take, and the inner circle outlines overarching considerations throughout the process.

Step A: Understanding the social-ecological system

Purpose

This exploratory step is aimed at enhancing the understanding of the social-ecological system targeted for adaptation and disaster risk management interventions. This includes identifying key features of the ecosystem/landscape, including biodiversity and ecosystem services, and interlinkages with people. Step A enables addressing root causes of risk in coping with current and future climate change impacts. Additionally, it generates baseline information to ensure that EbA/Eco-DRR measures reconcile conservation and development needs and do not harm biodiversity, cultural diversity or ecosystem services or the people and livelihoods that depend on such services, in line with the principles and safeguards. Moreover, Step A includes in-depth

stakeholder analysis and multi-stakeholder and participatory processes that feed into subsequent steps, and, therefore, more detailed actions are presented to undertake these analyses (Box 7).

Outcomes

a) A defined social-ecological system of interest (biodiversity, ecosystems and services, socio-economic characteristics and dependencies);
b) Defined stakeholders and rights holders; and
c) Defined political and institutional entry points for EbA/Eco-DRR within the system.

Key Actions

a) Undertake an organizational self-assessment to understand strengths, weaknesses, capacity (including technical, financial) and opportunities for partnership. Based on this, a multi-disciplinary team (including but not limited to indigenous peoples and local communities (IPLCs), experts, representatives from relevant sectors, different government bodies) is organized for planning and implementing EbA and Eco-DRR;
b) Identify and define the social-ecological system of interest (for example, a watershed, sector or policy);
c) Conduct analyses and consultations, making use of the multidisciplinary team, in order to understand the drivers of risk, capacities and assets of communities, societies and economies, and the wider social and natural environment;
d) Analyse the problem, determining its scope (geographical and temporal) by defining the boundaries of the system and set goals and objectives for adaptation and disaster risk reduction without harm to biodiversity or ecosystem services. The spatial scale for risk management should be broad enough to address the root causes of risk and to deliver multiple functions to stakeholders with different interests, and sufficiently small to make implementation feasible[75];
e) Identify and map key provisioning, regulating, supporting and cultural services in the system that contribute to resilience. As 90 per cent of disasters are water-related, including drought or floods[76], understanding the hydrology of the landscape is crucial for scoping and designing EbA/Eco-DRR interventions;
f) Determine initial entry points for EbA and Eco-DRR interventions;
g) Screen relevant entry points for EbA and Eco-DRR particularly in a policy, planning or budgeting cycle at different scales and levels where considerations of climate change risk and adaptation could be incorporated;
h) Map out the institutional responsibilities for intersections of development, conservation, disaster risk reduction and climate change adaptation, including relevant sectors;
i) Conduct an in-depth stakeholder analysis (Box 7);

[75] Care Nederland and Wetlands International 2017
[76] United Nations 2015

Box 7. Stakeholder and rights-holder analysis and establishment of participatory mechanisms

An assessment of the system or landscape helps to analyse the problem, define the boundaries for climate change adaptation and disaster risk reduction interventions, and screen for entry points for EbA and Eco-DRR. This information should feed into an in-depth stakeholder analysis before engaging stakeholders throughout the adaptation/DRR process, and also iteratively benefits from information from stakeholders. Prior and informed engagement of stakeholders and rights holders will increase ownership and likely success of any adaptation/DRR intervention. In-depth stakeholder analyses and development of multi-stakeholder processes and participatory mechanisms are key to meeting principles on equity and inclusivity and related safeguards. The Akwé: Kon Voluntary Guidelines (https://www.cbd.int/traditional/guidelines.shtml) outline procedural considerations for the conduct of cultural, environmental and social impact assessments, which are widely applicable to EbA and Eco-DRR.

Key Actions

- Identify indigenous peoples and local communities, stakeholders and rights holders likely to be affected by EbA and Eco-DRR interventions, and identify people, organizations and sectors that have influence over planning and implementation, using transparent participatory processes.
- Ensure full and effective participation of all relevant stakeholders and rights holders, including the poor, women, youth and the elderly, ensuring they have the capacity and sufficient human, technical, financial and legal resources to do so (in line with the safeguards).
- Engage with civil society organizations and/or community-based organizations to enable their effective participation.
- Where appropriate, identify and protect the ownership and access rights to areas for the use of biological resources.

Table 6. Step A Toolbox: Understanding the social-ecological system/landscape and stakeholder analysis and engagement

Tool/Organization	Description
The Toolkit for Ecosystem Service Site-based Assessment (TESSA)	Piloted in protected areas, TESSA guides non-specialists through methods for identifying which ecosystem services may be important at a site, and for evaluating the magnitude of benefits that people obtain from them currently, compared with those expected under alternative land-use. http://www.birdlife.org/datazone/info/estoolkit
Integrated Valuation of Environmental Services and Tradeoffs (InVEST)	InVEST is a suite of software models used to map and value the goods and services from nature that sustain and fulfil human life. This tool enables decision makers to assess quantified trade-offs associated with alternative management choices and to identify areas where investment in natural capital can enhance human development and conservation. http://www.naturalcapitalproject.org/InVEST.html
Exploring Nature-Based Solutions: The role of green infrastructure in mitigating the impacts of weather- and climate change-related natural hazards	This report proposes a simple, practical methodology for screening (rather than assessing) ecosystem services in areas where green infrastructure may contribute to reducing current (or future) weather- and climate-related natural hazards. The hazards addressed include landslides, avalanches, floods, soil erosion, storm surges and carbon stabilization by ecosystems. Several case studies at the European level

Tool/Organization	Description
	outline the screening process and also summarize recent estimates of the economic value of green infrastructure. http://www.eea.europa.eu/publications/exploring-nature-based-solutions-2014
Stocktaking for National Adaptation Planning (SNAP) Tool (GIZ)	Helps assess a country's current national adaptation planning capacities and in identifying strategic goals for NAP that feed into the preparation of a country-specific NAP Roadmap. The publication 'Stocktaking for National Adaptation Planning – Assessing Capacity for Implementing NDCs' highlights results from applying SNAP in various geographical terrains on national and subnational scales. http://www.adaptationcommunity.net/?wpfb_dl=362
CliF Reflect Tool to (GIZ)	This tool supports planners and policy-makers in reflecting on the current level of capacities within a country to mobilize and effectively manage climate finance. http://www.adaptationcommunity.net/ndc_adaption_toolbox/clif-reflect/
Tool for Assessing Adaptation in Nationally Determined Contributions ((I)NDCs) (TAAN)	TAAN allows users to compare several (I)NDCs' adaptation components, access a singular country's (I)NDC adaptation factsheet and visualize statistics of adaptation-related content mentioned in the (I)NDCs. The tool is a means of improving a comprehensive understanding of the adaptation-related content in the (I)NDCs. http://www.adaptationcommunity.net/nap-ndc/tool-assessing-adaptation-ndcs-taan/
Multi-stakeholder management: Tools for Stakeholder Analysis (GTZ, 2007)	10 building blocks for designing participatory systems of cooperation. Sector Project: Mainstreaming Participation. Report series: Promoting participatory development in German development cooperation. Eschborn: GTZ. https://www.fsnnetwork.org/sites/default/files/en-svmp-instrumente-akteuersanalyse.pdf
Gender Analysis	Tool to help analyze gender roles, activities, assets, needs and available opportunities for men and women. E.g., CARE Rapid Gender Analysis Toolkit http://gender.care2share.wikispaces.net/CARE+Rapid+Gender+Analysis+Toolkit
Tools to support EbA (in development) (UNEP-WCMC and IIED)	Inventory of available tools to support EbA planning and implementation. https://www.iied.org/call-for-feedback-inventory-tools-support-ecosystem-based-adaptation
Gender and Vulnerable Groups and National Adaptation Plan Processes / NDCs – Guidance (GIZ 2017)	A guidance synthesizing and presenting information and tools for the integration of gender and vulnerable groups' considerations into adaptation planning. http://www.adaptationcommunity.net/ndc_adaption_toolbox/gender-vulnerable-groups-gvg-national-adaptation-plan-nap-processes-ndcs-guidance/
Guide on Designing and Facilitating Multi-Stakeholder-Partnerships	The guide links the underlying rationale for multi-stakeholder partnerships, with a clear four phase process model and set of core principles. (Centre of Development Innovation (CDI), of Wageningen University) http://www.mspguide.org/msp-guide

Step B: Assessing vulnerabilities & risks

Purpose

Vulnerability and risk assessments are undertaken to identify the main climate change and disaster risks and impacts on the social-ecological system of interest; for example, taking stock of biodiversity and ecosystem service information to identify any species or ecosystems that are particularly vulnerable to the negative impacts of climate change. The assessments are then used to identify, appraise and select targeted adaptation and disaster risk reduction interventions in planning and design. Risk and vulnerability assessments also aid in allocating resources to where they are most needed, and establishing baselines for monitoring the success of interventions.[77]

Vulnerability describes the degree to which a natural or social system is susceptible to, and unable to cope with, adverse effects of climate change.[78] Vulnerability, exposure and hazards together determine the risks of climate-related impacts (Figure 9). The overarching framework of the Intergovernmental Panel on Climate Change since the fifth assessment report is managing current and future climate risks principally through adaptation, but also through disaster risk reduction, resilience and sustainable development informed by an understanding of the risk. Thus, the concept of risk reduction is central to adapting to current and future climate risks and disasters. While they have different definitions and underlying assumptions, both risk and vulnerability assessments follow a similar logic.[79]

[77] GIZ and EURAC 2017
[78] IPCC 2007
[79] GIZ and EURAC 2017

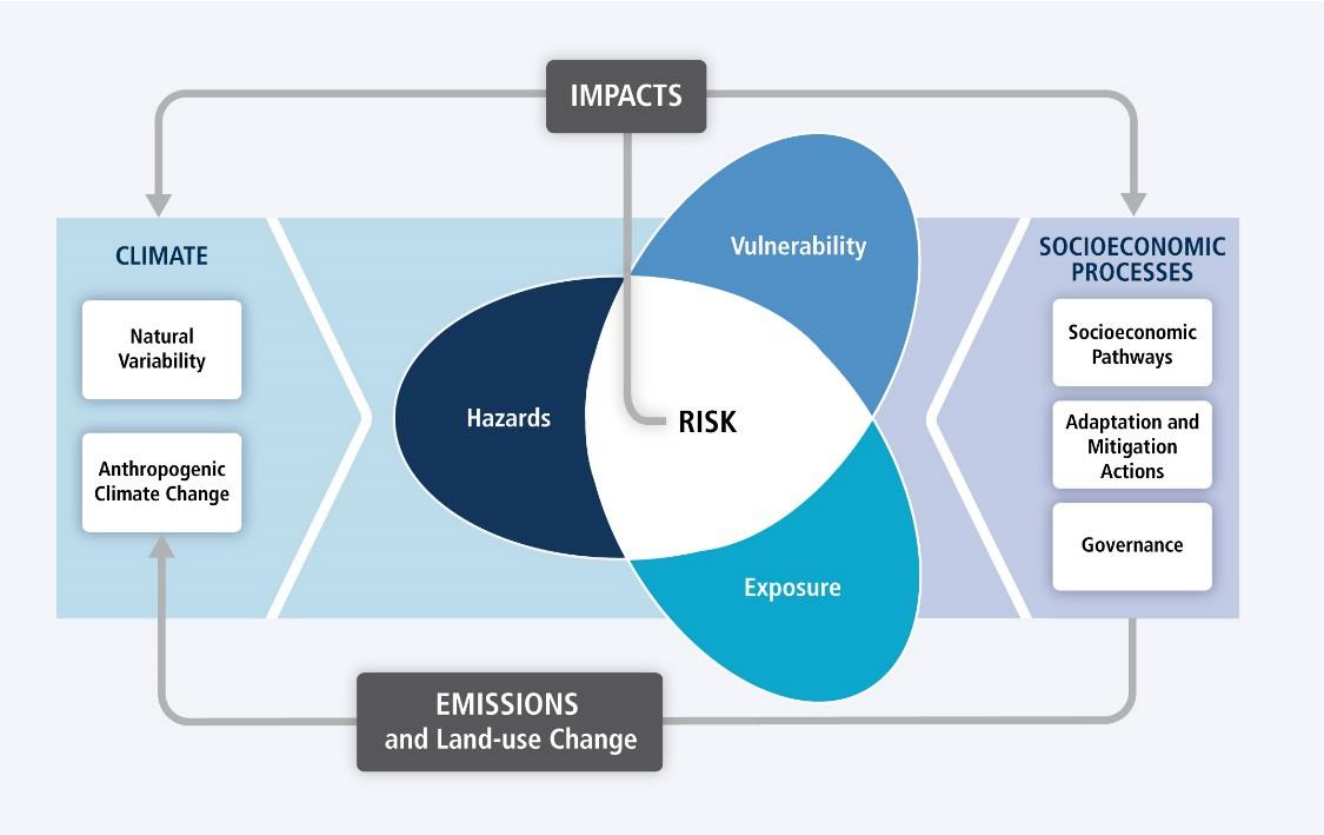

Figure 9. Illustration of the core concepts of the contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Risk of climate-related impacts results from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability and exposure of human and natural systems. Changes in both the climate system (left) and socioeconomic processes including adaptation and mitigation (right) are drivers of hazards, exposure and vulnerability[80]

Disaster risk assessments focus on hazards, exposure and vulnerabilities as core elements to understanding disaster risk. Risk assessments can include risk identification (finding, recognizing and describing risk), risk analysis (estimation of the probability of its occurrence and the severity of the potential impacts) and risk evaluation (comparing the level of risk with risk criteria to determine whether the risk and/or its magnitude is tolerable).[81] Risk assessments consider both climate and non-climate factors that generate a climate or disaster risk, and consider linkages to environmental conditions and natural resource management.[82]

The advantage of an integrated risk and vulnerability assessment approach, as opposed to assessing only vulnerability, is that it addresses the large proportion of impacts that are triggered by both climate and non-climate related hazardous events, and that it integrates both climate change adaptation and disaster risk reduction approaches.[83] A relatively new practice is moving from single

[80] IPCC 2014
[81] European Environment Agency 2017
[82] Doswald and Estrella 2015
[83] GIZ and EURAC 2017

hazard approaches to multi-hazard/multi-risk assessments. This approach can account for regions or classes of objects exposed to multiple hazards (e.g. storms and floods), and cascading effects, in which one hazard triggers another[84].

Key considerations and general activities for undertaking risk and vulnerability assessments are discussed below Tools and examples and more detailed stepwise guidance are provided in the Step B Toolbox: Conducting risk and vulnerability assessments (

Table **7**).

Outcomes

a) A risk and vulnerability profile in current and future climate scenarios of the social-ecological system covering hazards, exposure, and vulnerabilities (including sensitivities and adaptive capacities);
b) Main drivers of risks and underlying causes.

Key Actions

a) Develop or make use of frameworks and concepts that recognize the linkages between people and ecosystems as integrated social-ecological systems rather than viewing adaptation and risk reduction only through a human lens;
b) Assess past and current climate and non-climate risks to the social-ecological system with flexible criteria that address the linkages between human and environmental systems:
    i. Consult previous assessments of climate change impacts on biodiversity and ecosystem services; for example, national impact and vulnerability assessments prepared for UNFCCC, or vulnerability assessments from forest, agriculture, fisheries or other relevant sectors;
    ii. Conduct socio-economic and ecological field surveys to identify vulnerabilities in both communities and ecosystems (including ecosystems that provide critical services for climate change adaptation or DRR) (see supplementary information for further detail[85];
    iii. Assess future risks based on climate change projections or scenarios that are at the appropriate scale and downscaled to the local level where appropriate;
c) Integrate quantitative approaches (based on scientific models) and qualitative approaches, which are grounded in expert judgement and traditional and local knowledge. For example, use participatory rural appraisals to understand local perceptions and past experiences;[86]
d) Develop comprehensive spatial planning that explicitly defines and incorporates hazard and risk maps.

[84] European Environment Agency 2017
[85] Ibid
[86] WWF 2013

Box 8: Identifying the most vulnerable groups, communities & ecosystems

People who are socially, economically, culturally, politically, institutionally, or marginalized in other ways are especially vulnerable to climate change, and also vulnerable to some adaptation and mitigation responses (IPCC 2014). Their vulnerability may be a result of several factors, such as socioeconomic disparity, exposure, or discrimination due to gender, class, ethnicity, age, or disability (IPCC 2014).

Identifying the vulnerable groups and communities who are disproportionately affected by the impacts of climate change and disaster risks is essential to targeting adaptation and risk reduction measures effectively and equitably (CARE 2011). This should include indigenous peoples and local communities, and historically or politically marginalized groups such as women, youth, the elderly, the rural poor, and the disabled. Additionally, it is important to assess the ecological integrity of ecosystems, and the key ecological features that are both more impacted or transformed by climate change, and how this affects the capacity to provide critical ecosystem services. The use of disaggregated geospatial data is critical for identifying the most vulnerable groups, communities and ecosystems. In addition, important steps include:

- Conducting gender analyses to determine gender considerations influencing vulnerability to climate change and disaster risk;
- Using geospatial data on poverty and disaster risk to target and prioritize regions for adaptation and disaster risk reduction;
- Consulting the IUCN Red List of Ecosystems Categories and Criteria or the Climate Change Vulnerability Index for Ecosystems and Habitats for assessing the status of ecosystems at local, national, regional and global levels. Assessments determine whether an ecosystem is vulnerable, endangered, or critically endangered;
- Bringing the academic community to the process by promoting consultations with universities, research centres, and researchers; and
- Identifying vulnerable communities, groups and ecosystems on an ongoing basis and in a participatory and inclusive manner to ensure EbA and Eco-DRR interventions are appropriately targeted to the people and ecosystems most in need,

Table 7. Step B Toolbox: Assessing vulnerabilities and risks

Tool/Organization	Description
Risk/Vulnerability Assessments	
Vulnerability Sourcebook (GIZ)	The Vulnerability Sourcebook offers a conceptual framework and step-by-step guidelines for standardised assessments of vulnerability to climate change http://www.adaptationcommunity.net/?wpfb_dl=203
Risk Supplement to the Vulnerability Sourcebook & Climate Risk Assessment for EbA - A guidebook for policy makers and practitioners (GIZ)	The risk supplement is a practical guidance on how to apply the Vulnerability Sourcebook's approach using the IPCC AR5 risk concept. The guidebook applies a standardised approach to climate risk assessments in the context of EbA-planning by following the modular sourcebook and risk supplement methodology and using an illustrative application example. http://www.adaptationcommunity.net/vulnerability-assessment/vulnerability-sourcebook/
Operational Framework for EbA (WWF)	Step-by-step guidance for implementing EbA including a chapter on the first step of conducting risk and vulnerability assessments

Tool/Organization	Description
	http://awsassets.panda.org/downloads/wwf_wb_eba_project_2014_gms_ecosystem_based_adaptation_general_framework.pdf
Adaptation Wizard (UK)	Risk and systems' vulnerability framework for adaptation developed in the UK http://www.ukcip.org.uk/wizard/
Scenario Planning for Climate Change Adaptation: A Guidance for Resource Managers	Step-by-step guide to using scenarios to plan for climate change adaptation at a local or regional scale, helping to develop resource management approaches that take future possible climate change impacts and other important uncertainties into account. http://scc.ca.gov/files/2013/04/Scenario-Planning.pdf
Risk Assessment and Mapping for Disaster Management (European Commission)	Multi-hazard and multi-risk perspective approach taking into account regions or classes of objects exposed to multiple hazards (e.g. storms and floods), and considers 'cascading effects' https://ec.europa.eu/echo/files/about/COMM_PDF_SEC_2010_1626_F_staff_working_document_en.pdf
World Overview of Conservation Approaches and Technologies (WOCAT)	Database of practices and technologies, including some based on indigenous and traditional knowledge https://www.wocat.net/projects-and-countries
Integrating Landscape Dimensions in Disaster Risk Reduction: A Cluster Planning Approach (Partners for Resilience)	Description of a cluster planning approach for disaster risk reduction planning, building on the understanding of the relationship between landscape-scale drivers of disaster risk and community vulnerability and capacity https://link.springer.com/chapter/10.1007%2F978-3-319-43633-3_12.
Guidance on Integrating Ecosystem Considerations into Climate Change Vulnerability and Impact Assessment (VIA) to Inform Ecosystem-based Adaptation (UNEP-WCMC)	Provides information and advice on how to integrate consideration of ecosystems and their services into a climate change vulnerability and impact assessment. http://www.adaptation-undp.org/resources/training-tools/guidance-integrating-ecosystem-considerations-climate-change-vulnerability
Risk and Vulnerability Assessment Methodology Development Project (RiVAMP) in Jamaica	This training manual for quantifying the role of ecosystems in DRR and climate change adaptation, based on a pilot project implemented in Jamaica from 2009-2010. http://www.grid.unep.ch/products/3_Reports/RiVAMP_Training_2012.pdf
Local/Community-level tools	
Climate Vulnerability and Capacity Analysis Handbook (CARE)	Handbook assessing hazard impacts on each of the five categories of livelihood resources and provides a framework for community-based adaptation. http://www.careclimatechange.org/index.php?option=com_content&view=article&id=25&Itemid=30
CEDRA - Climate change and Environmental Degradation Risk and Adaptation assessment (Tearfund)	Analyses risks posed by climate change and environmental degradation and supports NGOs in understanding communities' experiences of environmental change http://tilz.tearfund.org/en/themes/environment_and_climate/cedra/
CRiSTAL - Community-based Risk Screening Tool – Adaptation and Livelihoods (IISD, Stockholm Environment Institute and IUCN)	Tool to help project planners and managers integrate climate change adaptation and risk reduction into community-level projects. https://www.iisd.org/cristaltool/
Tools considering vulnerable groups, communities and ecosystems	

Tool/Organization	Description
Red List of Ecosystems (IUCN)	Tool to evaluate the status of the ecosystems as well as a repeatable method to measure drivers and trends that contribute to ecosystem risks. Helpful to ensure long term functioning of ecosystems. https://www.iucn.org/theme/ecosystem-management/our-work/red-list-ecosystems
Climate Resilience Evaluation for Adaptation Through Empowerment (CREATE) –Integrated Vulnerability and Capacity Assessment Method	Tool to integrate existing methods such as CRiSTAL, CARE's CVCA, etc. and provides a broad framework together with general guidelines and suggestions, allowing people to assess and analyse their vulnerability and capacity, identify adaptation options and begin the planning process. https://cmsdata.iucn.org/downloads/create_factsheet_final.pdf
Database on the application of gender-sensitive approaches and tools (UNFCCC)	Case studies on the application of gender-sensitive approaches and tools for understanding and assessing impacts, vulnerability and adaptation to climate change as inputs for the technical paper mandated in paragraph 17 of FCCC/SBSTA/2013/3. http://www4.unfccc.int/sites/nwp/pages/Search.aspx
Gender-sensitive Climate Vulnerability and Capacity Analysis (GVCA): Practitioners Guide (Care)	Provides a framework for analysing vulnerability and capacity to adapt to climate change and build resilience to disasters at the community level, with a particular focus on social and in particular gender dynamics, based on experiences of using the approach in Mozambique. http://careclimatechange.org/wp-content/uploads/2016/02/GCVCA_Practitioners-Guide-FINAL-July-2014.pdf
Making Disaster Risk Gender-Sensitive: Policy & Practical Guidelines (UNISDR, UNDP and IUCN)	Increases understanding of gender concerns and needs in DRR; develop capacity to address gender issues, contains gender mainstreaming policy guidelines including gender-sensitive risk assessments, early warning systems, and gender-sensitive indicators to monitor mainstreaming progress.

Step C: Identifying EbA and Eco-DRR options

Purpose

Having defined the boundaries of the social-ecological system/landscape and identified initial entry points for EbA and Eco-DRR, as well as vulnerabilities and risks (Step A), potential options are identified by the multi-stakeholder group within an overall strategy of adaptation and disaster risk reduction. A list of relevant tools linked to this step is provided in the Step C Toolbox: Identifying EbA and Eco-DRR Strategies (Table 8).

Outcome

- A list of available strategies and options to reduce the exposure and sensitivity of social-ecological systems to climate hazards and enhance adaptive capacity

Key Actions

a) Identifying existing coping strategies and responses to climate change and disaster risks, and analysing viability for future climate impacts and risks;
b) Refine the initial entry points identified for EbA/Eco-DRR. Some criteria for choosing and prioritizing entry points can include:
    i. High probability of effectiveness from previous experiences in a similar social-ecological setting;
    ii. Strong support from stakeholders;
c) In collaboration with multi-stakeholder groups, inclusive of stakeholders, rights holders and experts, formulate appropriate strategies within an overall adaptation strategy to address the risks and vulnerabilities identified in Step B;
d) Assess specific problems and priorities of the vulnerable groups, sectors, and ecosystems;
e) Ensure that EbA and Eco-DRR are planned at local, community and household levels and also landscape or catchment level, as appropriate;
f) Identify the EbA and Eco-DRR strategies that meet the objectives defined in Step A, and that adhere to its main elements;
g) Consider the qualification criteria and standards for EbA.[87]

[87] FEBA 2017

Table 8. Step C Toolbox: Identifying EbA and Eco-DRR Strategies

Tool/Organization	Description
Ecosystems Restoration Opportunity Mapping for DRR and CCA (UNEP/GRID-Geneva and UNEP/PCDMB)	New methodology and global interactive tool for mapping areas where ecosystems can reduce disaster risk, crossing human exposure to natural hazards with presence/absence of ecosystems, which enables the prioritization of areas where ecosystems should be protected and/or restored http://www.grid.unep.ch/index.php?option=com_content&view=article&id=47&Itemid=253&lang=en&project_id=235CE705
PANORAMA – Solutions for a healthy planet (GIZ, IUCN, UN Environment, GRID Arendal, Rare)	An interactive platform and database of specific, applied examples of successful NBS, EbA and Eco-DRR processes or approaches structured according to regions, ecosystems, specific thematic areas, governance and hazards addressed. The practical examples (solutions) are consisting of specific success factors (building blocks). Useful for identifying practical EbA & Eco-DRR examples that address different targets (Aichi, Sendai Framework, SDGs, NDC). http://panorama.solutions/en/explorer/grid/1042"
Selection of nature-based solutions: Good practices in the Basque Autonomous Community (Spain)	Inventory of nature-based projects implemented in the Autonomous Community of the Basque Country (BAC). This selection showcases representative practices for further dissemination s examples for future policies. They are organised into three sections - rivers, coasts and cities - dedicated to iconic measures in each of the provinces of the Basque Country. http://growgreenproject.eu/wp-content/uploads/2018/05/NBS-Climate-Adaptation-Basque-Country.pdf
Addressing Slow-Onset Events (UNFCCC)	Database that maps 151 organizations working on slow onset events - rising temperatures, desertification, loss of biodiversity, land and forest degradation, glacial retreat and related impacts, ocean acidification, sea level rise and salinization, and the scope of their current efforts. http://www4.unfccc.int/sites/NWP/Pages/soe.aspx
Options for ecosystem-based adaptation in coastal environments: A guide for environmental managers and planners and decision-support tool (UNEP)	Supports environmental decision-makers in choosing, implementing, monitoring, evaluating and, over time, adaptively managing coastal EBA. Online guide, website and decision-support tool available at https://www.unep-wcmc.org/news/coastal-eba
Database on ecosystem-based approaches to Adaptation (UNFCCC)	An initiative under the Nairobi work programme to provide examples of ecosystem-based approaches to adaptation http://www4.unfccc.int/sites/NWP/Pages/soe.aspx
EU Natural Water Retention Measures (NWRM) catalogue	Contains sector-specific NWRMs which encourage the retention of water within a catchment, thus enhancing its natural functioning. It contains a comprehensive but non-prescriptive range of measures. http://nwrm.eu/measures-catalogue
Implementing nature-based-flood protection: Principles and implementation guidance (World Bank)	Presents five principles and implementation guidance for planning, such as evaluation, design, and implementation of nature-based solutions for flood risk management as an alternative to or complementary to conventional engineering measures http://documents.worldbank.org/curated/en/739421509427698706/Implementing-nature-based-flood-protection-principles-and-implementation-guidance
Local investments for climate change adaptation: Green jobs through green works - A guide	Provides options for types of adaptation activities that use employment intensive approaches, focusing on inclusive local practices for environmental sustainability

Tool/Organization	Description
for identifying, designing and implementing interventions in support of climate change adaptation at the local level (ILO)	http://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/documents/publication/wcms_172716.pdf
Greening the Grey: a framework for integrated green grey infrastructure (IGGI)	Highlights innovations from academia and practice designed to green grey infrastructure assets such as bridges, street furniture and coastal engineering structures that need to remain primarily grey for their essential function http://eprints.gla.ac.uk/150672/
Greater working with natural processes in flood and coastal erosion risk management (Environment Agency, UK)	Explains what natural processes are in flood and coastal risk management and provides practitioners with a high quality basis for achieving greater working with natural processes http://webarchive.nationalarchives.gov.uk/20130903132727/http://www.environment-agency.gov.uk/research/planning/136425.aspx
River restoration and biodiversity (Crew, Scotland)	Describes the importance of rivers for nature conservation, summarises the damage that river habitats have sustained over many decades, and discusses ways in which repairing damage and restoring river habitats can bring benefits both to wildlife and to human society http://www.crew.ac.uk/publication/river-restoration

Step D: Prioritizing, appraising and selecting EbA and Eco-DRR options

Purpose

In this step, the EbA and Eco-DRR options identified in Step C are prioritized, appraised and selected to achieve the goals set out in Step A, as part of an overall adaptation and disaster risk reduction strategy for the system of interest.

Given the importance of evaluating trade-offs and limitations, more detailed actions are provided (Box 9). Associated tools are available in the Step D Toolbox: Prioritizing, appraising and selecting adaptation and DRR options and identifying trade-offs. Methods for appraising the value of EbA and Eco-DRR activities are detailed in Table 9. Information on ways to increase scientific and technical knowledge of EbA and Eco-DRR approaches are also elaborated below in Box 10.

Outcomes

a) List of prioritized options based on selected criteria; and
b) Selection of final options for implementation.

Key Actions

a) Using participatory approaches (Step A), identify the criteria/indicators to be used to prioritize and appraise the adaptation and disaster risk reduction options identified in Step C. For example, multi-criteria or cost-effectiveness analyses can be used to evaluate adaptation options (see Table 9 for appraisal methodologies);
b) Ensure that trade-offs and limitations of options are part of the appraisal process (Box 9), and include consideration of green or hybrid solutions before grey when more effective;
c) Consider multiple values and benefits, including non-monetary, to capture the full value of different adaptation and risk reduction options;
d) Assign weights to the proposed criteria, and use the criteria to rank the adaptation and disaster risk reduction options;
e) Prioritize and short-list adaptation strategies based on the agreed-upon criteria;
f) Make use of the multi-stakeholder group and consult other rights holders to identify the best options and develop a business case;
g) Analyze the costs, benefits, impacts and trade-offs of different risk management scenarios, and the costs of inaction, to capture gains or losses in ecosystem services provisioning that have an impact on adaptation and disaster risk reduction and resilience (e.g. consideration for wetlands);
h) Consider the sustainable use of local ecosystems, services, and/or materials in EbA/Eco-DRR options that could bring additional local benefits and reduce carbon emissions from transport, rather than outsourced labour and materials;
i) In appraising options, consider costs and benefits of adaptation interventions over the long term, as the time period in economic comparison of various options is important, and consider including both upfront capital and longer-term maintenance costs. For example,

engineered structures such as dykes can be relatively inexpensive at the investment level but require high maintenance costs, whereas ecosystem-based approaches such as wetland restoration may be less expensive in the long-term;

j) Assess the strength of proposed EbA and Eco-DRR measures by examining how they adhere to the principles and safeguards, considering qualification criteria and standards;

k) Before design and implementation of selected projects (Step E), conduct environmental impact assessments (EIA) of the recommended options, ensuring that (i) any possible social and environmental impacts have been clearly identified and assessed; (ii) appropriate measures have been taken to avoid, and if not possible, mitigate risks; and (iii) the measures taken to avoid/mitigate risks are themselves monitored and reported throughout project lifecycles. The EIA should incorporate a summary of recommendations from past, ongoing and planned projects and programs within the relevant geographic jurisdiction.

Table 9. Methods for appraising the value of EbA and Eco-DRR activities[88]

(CBA = cost-benefit analysis, NPV=net present value)

Methodology	Brief Description	Advantages	Disadvantages
Multi-criteria analysis (MCA)	Part or wholly qualitative-based approach, which provides a 'ranking' of initiatives based on monetary and non-monetary criteria	Allows appraisal to be conducted in the absence of/ limited amount of quantitative data	Limited to relative assessments of alternative policy options Outputs are appraisal-specific – i.e. cannot be generalised more widely
Cost-effectiveness analysis (CEA)	Quantitative approach which identifies the policy option providing a specific output/benefit at the lowest cost	Useful when a specific output/objective is needed to be met Can be used when comprehensive quantitative cost data is available for monetising costs but not benefits	Not applicable when a single initiative is being appraised, or when considering multiple initiatives providing different levels of the required benefit Implicitly ignores potentially significant co-benefits
Scenario-based cost-benefit analysis (SBCBA)	Quantitative approach which assesses costs and benefits (in monetary form) across different scenarios/states of the world	Accounts for uncertainty surrounding flood risk without being computationally or data intensive Provides numeric outputs, allowing for cardinal comparisons between initiatives Easily understood for non-technical audiences. Allows for the application of risk-based rules	Potentially difficult to gain consensus on the appropriate scenarios to use Risk of not capturing the extent of uncertainty surrounding climate change, especially under 'deep uncertainty'
Robust decision making (RDM)	Quantitative approach which assesses the proposed initiatives across all plausible states of the world, and identifies the initiative most robust across these	Captures deep uncertainty – leaves 'no stone unturned' Provides numeric outputs Provides a clear picture of which initiatives are optimal in different states of the world	Can be computationally and data intensive Potentially difficult to interpret for non-expert audiences Value function for deriving costs and benefits needs to be well calibrated Ranges of plausible parameter values need to be known
Real options analysis (ROA)	Extension of CBA which estimates the 'option value' associated with each initiative i.e. the option to delay or adjust in the future. Calculates the NPV of each initiative given the particular actions that could be taken given different states of the world being realised, and the probabilities of these occurring	Accounts for learning about the nature or extent of flood risk going forward. – captures the value in delaying or adjusting a particular initiative. Useful when comparing large irreversible options with smaller-scale flexible options	Can be computationally or data intensive – requires the assignment of probabilities to scenarios at various future time periods

[88] Excerpted from Frontier Economics 2013

Box 9. Evaluating trade-offs and limitations

Part of the process of prioritizing, appraising and selecting adaptation/DRR options involves the identification and evaluation of potential trade-offs. Trade-offs may arise when an activity protects one group of people at the expense of another, or favours a particular ecosystem service over another. Some trade-offs are the result of deliberate decisions; others occur without knowledge or awareness. For example, the implementation of adaptation actions upstream may have effects on downstream communities, and at different times. Ecosystems are subject to climate change, and, therefore, EbA, Eco-DRR and other practices that use ecosystem-based approaches should be designed to be robust in the face of current and projected impacts of climate change. Trade-offs and limitations should be considered and integrated within overall adaptation and disaster risk reduction planning and aligned with national policies and strategies. They should also be implemented alongside other measures of risk reduction, including avoidance of high-risk zones, improved building codes, early warning and evacuation procedures. A trade-off analysis across scales and considering multiple benefits can help to place EbA and Eco-DRR options on equal footing alongside other options.

Key actions

- Develop indicators of short- and long-term changes across various spatial scales to detect potential trade-offs and limitations of EbA and Eco-DRR (see Step F for more detail);
- Use geospatial data and models (such as those available in InVEST (https://www.naturalcapitalproject.org/invest) to understand how changes in ecosystem structure and function as a result of adaptation or DRR interventions will affect ecosystem services across a land- or seascape;
- Consider the full range of infrastructure options from "green" to "hybrid" to "hard" and their compatibility, recognizing that different combinations are needed in different situations;
- Ensure that EbA and Eco-DRR are informed by the best available science and indigenous and traditional knowledge to fully account for possible trade-offs and limitations;
- Ensure the integration of EbA and Eco-DRR into overall adaptation or disaster risk reduction strategies, in recognition of potential limitations of ecosystem-based approaches;
- Consider and minimize trade-offs or unintended consequences of EbA and Eco-DRR throughout all stages of planning and implementation, including accounting for uncertainties in climate projections and for different scenarios.

Box 10. Increasing scientific and technical knowledge of EbA and Eco-DRR approaches

The transdisciplinary, multi-sectoral approaches of EbA and Eco-DRR provide new avenues for research and opportunities for enhancing the evidence base. To set the stage for this, linkages between IPLCs, the scientific community, experts and practitioners can be made by planning and implementation through consultations, knowledge platforms, learning networks, communities of practice, and knowledge co-generation. Areas that could benefit from collaborative research regarding EbA and Eco-DRR include:

- Exploring new modeling approaches to understand the linkages between adaptation, disaster risks, and social-ecological systems, and linkages between biodiversity and climate change at different scales;
- Developing comparative assessment procedures of EbA and Eco-DRR vs. traditional hard or grey infrastructure;
- Developing and testing indicators of EbA and Eco-DRR efficacy in the context of social-ecological resilience;
- Understanding the limits and thresholds of EbA and Eco-DRR;
- Understanding the full scope of multiple benefits from implementing EbA and Eco-DRR, and means to upscale them;
- Enhancing the efficacy of participatory processes.

Additionally, The Paris Agreement (Article 8) outlines several areas of cooperation and facilitation to enhance understanding, action and support for adaptation, including adapting to slow onset events, events that may involve irreversible and permanent loss and damage, comprehensive risk assessment and resilience of communities, livelihoods and ecosystems.

Table 10. Step D Toolbox: Prioritizing, appraising and selecting adaptation and DRR options and identifying trade-offs

Tool/Organization	Description
Valuing the Benefits, Costs and Impacts of Ecosystem-based Adaptation Measures: A sourcebook of methods for decision-making	Resource to guide the design, delivery and use of EbA valuation studies to inform and influence decision-making, including 40 case studies on EbA-relevant valuations that have been implemented globally, over recent years. (GIZ 2017) http://www.adaptationcommunity.net/download/sec_guides/EbA-Valuations-Sb_2017-Dec_en_online_1-0.pdf
Supporting decision-making for effective adaptation (National Climate Change Adaptation Facility, Australia)	Policy brief exploring the support of decision-making for adaptation, through provision of frameworks, knowledge and criteria for performance evaluation and comparisons (Decision Support Tools) https://www.nccarf.edu.au/sites/default/files/attached_files_publications/DECISION_070313_A4.pdf
Integrated Valuation of Environmental Services and Tradeoffs (InVEST)	InVEST enables decision-makers to assess quantified trade-offs associated with alternative management choices, with models to account for both service supply (e.g., living habitats as buffers for storm waves) and the location and activities of people who benefit from services (e.g., location of people and infrastructure potentially affected by coastal storms). http://www.naturalcapitalproject.org/InVEST.html

Tool/Organization	Description
Restoration of the sponge function in wetland soils as a measure for integrated river basin management in the Rhine catchment (Wetlands International)	Report on a recent study on the costs and benefits of restoration of the sponge function in wetland soils in the middle mountains of the Rhine basin for flood and drought risk reduction https://europe.wetlands.org/publications/sponge-restoration/
ROAM (Restoration Opportunities Assessment Methodology) (IUCN)	Restoration and assessment methodology for land use trade-offs at landscape scale https://www.iucn.org/theme/forests/our-work/forest-landscape-restoration/restoration-opportunities-assessment-methodology-roam
OpeNESS	Decision-making tool on Natural Capital and Ecosystem Services www.openness-project.eu
Voluntary guidelines for responsible governance over the tenure of land, forestry and fisheries (FAO)	Provides a forward-looking framework for countries to enhance tenure security and user and access rights over land and natural resources used in agriculture, forestry and fisheries sectors, and provides guidance on how to ensure principles such as transparency, equity, civic engagement, accountability, effectiveness, efficiency and sustainability can be upheld in land administration, management and policy formulation. http://www.fao.org/docrep/016/i2801e/i2801e.pdf
Cost and Benefits of Ecosystem Based Adaptation: The Case of the Philippines (IUCN)	Highlights case studies using 1) Cost-Benefit Analysis (CBA); 2) Cost-Effective Analysis; and 3) Multi-criteria Analysis for EbA decision-making https://www.iucn.org/sites/dev/files/content/documents/philippines_cba_study_final_version.pdf
Making the economic case for Ecosystem-based Adaptation: Learning Brief (UNDP)	Description of application of cost-benefit analyses to EbA and lessons learned based on the the Global Mountain EbA Programme in Nepal, Peru and Uganda http://www.adaptation-undp.org/sites/default/files/downloads/undp_mt_eba_learning_brief_3_final_web_vs_05.01.16.pdf

Step E: Project design and implementation

Purpose

In this step, the interventions selected in Step D are designed and implemented according to the principles and safeguards. Throughout the design and implementation, it is important to continually revisit the principles and safeguards and ensure ongoing stakeholder engagement, capacity-building, mainstreaming and monitoring (Figure 8). Given the added importance of transboundary and cross-sectoral cooperation, coordination and policies, more detailed actions are provided (Box 11). Associated tools are provided in the Step E toolbox: Project design and implementation.

Outcome

- A project design and implementation plan (including a finance strategy, capacity development strategy, defined actions for institutional and technical support measures)

Key Actions

(a) Consider the EbA and Eco-DRR elements, principles and safeguards throughout design and implementation (See Step B);
(b) Consider the qualification criteria and standards for EbA;[89]
(c) Design interventions at the appropriate scale to address the goals set out in Step A;
(d) Engage relevant experts, and strengthen linkages between the scientific community and project executors to ensure optimal and appropriate use of ecosystems for adaptation and DRR;
(e) Select appropriate tools, and if needed, plan for the development of new methodologies;
(f) Determine technical and financing requirements and develop a budget accordingly;
(g) Establish a workplan, including timelines of activities, milestones to achieve, multi-stakeholder consultations needed, and allocation of tasks and responsibilities;
(h) Develop strategies to mitigate identified risks and trade-offs and enhance synergies (see Step D);
(i) Establish linkages between the project and national, subnational, and/or local development plans, strategies, and policies;
(j) Consider principles for building resilience in social-ecological systems (see Box 12).

[89] FEBA 2017

Box 11. Transboundary and cross-sectoral cooperation, coordination and policies

Climate change impacts and disaster risks extend beyond political boundaries; therefore, an integrated landscape or systems approach aids in problem-solving across sectors and boundaries. Transboundary cooperation can enable the sharing of costs and benefits and prevent potentially negative impacts of measures taken unilaterally. Transboundary cooperation can also provide opportunities for socioeconomic development and managing issues at appropriate ecosystem scales.

EbA and Eco-DRR interventions increasingly call for cooperation with other sectors, including agriculture, water, urban development and infrastructure.

Transboundary and cross-sectoral considerations can be integrated into EbA and Eco-DRR by:

- Integrating the different scales of critical ecosystem functioning needed for adaptation and disaster risk reduction in EbA and Eco-DRR;
- Greater coherence between regional/transboundary EbA and Eco-DRR-strategies and policies contributes to improved effectiveness of actions;
- Learning from well-established cross-sectoral planning mechanisms, such as integrated water resources management (IWRM), integrated coastal zone management (ICZM) and land-use planning, to strengthen cross-sectoral cooperation and enhance uptake of EbA and Eco-DRR into relevant sectoral frameworks (also applicable to mainstreaming EbA and Eco-DRR);
- Setting up a commission or task group with transboundary partners and sector; representatives to develop a joint vision, goals and objectives for EbA and Eco-DRR;
- Developing a common understanding of vulnerabilities at the transboundary scale and for different sectors through the use of common models and scenarios and agreed-on methodologies and sources of information; and
- Adopting an iterative monitoring and evaluation process (see Step F) to ensure that transboundary and cross-sectoral EbA and Eco-DRR strategies continue to meet national adaptation and disaster risk reduction targets and maximize the potential for multiple benefits.

Box 12. Applying resilience thinking in EbA and Eco-DRR design

A resilience approach to sustainability focuses on building capacity to deal with unexpected change – such as the impacts of climate change and the risk of disaster. Applying a resilience lens to designing EbA and Eco-DRR interventions involves managing interactions between people and nature as social-ecological systems to ensure continued and resilient provisioning of essential ecosystem services that provide adaptation and disaster risk functions. There are seven key principles in applying resilience thinking, distilled from a comprehensive review of social and ecological factors that enhance resilience the of social-ecological systems and the ecosystem services they provide (Stockholm Resilience Centre 2014):

1. Maintain diversity and redundancy, for example, by maintaining biological and ecological diversity. Redundancy is the presence of multiple components that can perform the same function, and can provide 'insurance' within a system by allowing some components to compensate for the loss or failure of others.
2. Manage connectivity (the structure and strength with which resources, species or actors disperse, migrate or interact across patches, habitats or social domains in a social-ecological system), e.g. by enhancing landscape connectivity to support biodiversity and ecosystem services that contribute to adaptation and risk reduction.
3. Manage slowly changing variables and feedbacks (two-way 'connectors' between variables that can either reinforce (positive feedback) or dampen (negative feedback) change.
4. Foster complex adaptive systems thinking by adopting a systems framework approach (Step A)
5. Encourage learning such as by exploring different and effective modalities for communications.
6. Broaden participation, such as by dedicating resources to enable effective participation.
7. Promote polycentric governance systems, including through multi-institutional cooperation across scales and cultures.

Table 11. Step E Toolbox: Project design and implementation

Tool/Organization	Description
Implementing nature-based flood protection: Principles and implementation guidance (World Bank)	Guidelines including principles and implementation steps for ecosystem-based flood protection. http://documents.worldbank.org/curated/en/739421509427698706/Implementing-nature-based-flood-protection-principles-and-implementation-guidance
Water in drylands: Adapting to scarcity through integrated management (IUCN)	Guidelines for integrated water resources and management in drylands ecosystems https://portals.iucn.org/library/de/46239
Protected Areas as tools for disaster risk reduction: a handbook for practitioners (IUCN)	Guidelines on using protected areas as effective buffers to prevent natural hazards from becoming disasters https://www.iucn.org/content/protected-areas-tools-disaster-risk-reduction-handbook-practitioners
Safe Havens: Protected Areas for Disaster Risk Reduction and Climate Change Adaptation (IUCN)	18 case studies to demonstrate how protected areas can be better managed for disaster risk reduction and climate change adaptation https://www.iucn.org/sites/dev/files/2014-038.pdf
Restoring River Continuity: methods and challenges (Wetlands International – European Association and the	Webinars explaining methods and challenges of river restoration with a specific focus on improving river connectivity https://europe.wetlands.org/event/rivers/

Tool/Organization	Description
Italian Center for River Restoration)	
Climate Change Adaptation for World Heritage Sites: A Practical Guide (UNESCO)	Guidelines and framework for assessing risk to World Heritage sites and features of contribute to their Outstanding Universal Value (OUV) and identifying and selecting options for adaptation and DRR.http://whc.unesco.org/en/series/
Building with Nature and hybrid approaches (Ecoshape)	Guidelines on how to introduce and integrate Building with Nature principles into water infrastructure development. https://www.ecoshape.org/en/design-guidelines/ and https://publicwiki.deltares.nl /display/BWN1/Guideline
Mainstreaming Climate-Smart Agriculture into a Broader Landscape Approach (FAO)	Guidance on understanding the different options that are available for planning, policies and investments and the practices that are suitable for making different agricultural sectors, landscapes and food systems more climate-smart http://www.fao.org/3/a-i3325e.pdf
CBD Decision XIII/5: Ecosystem restoration: short-term action plan	Principles and key activities for short-term action plans on ecosystem restoration https://www.cbd.int/doc/decisions/cop-13/cop-13-dec-05-en.pdf
Gender, Climate Change and Community-Based Adaptation (UNDP)	Guidebook for designing and implementing gender-sensitive community-based adaptation programmes and projects. http://www.undp.org/content/undp/en/home/librarypage/environment-energy/climate_change/gender/gender-climate-change-and-community-based-adaptation-guidebook-.html
Pacific Gender and Climate Change Toolkit: Tools for Practitioners	Toolkit designed to support climate change practitioners working in national governments, non-governmental organisations, regional and international organisations, integrate gender into all aspects of policy, programming and project work. https://www.pacificclimatechange.net/sites/default/files/documents/Pacific_gender_toolkit_full_version.pdf
Making Ecosystem-based Adaptation Effective: A Framework for Defining Qualification Criteria and Quality Standards (FEBA)	Practical assessment framework for designing, implementing and monitoring EbA measures by proposing a set of elements, qualification criteria and quality standards and example indicators. EN: http://www.adaptationcommunity.net/download/ecosystem-based_adaptation/technical_paper/FEBA_EbA_Qualification_and_Quality_Criteria_EN.pdf SP: http://www.adaptationcommunity.net/download/ecosystem-based_adaptation/technical_paper/FEBA_EbA_Qualification_and_Quality_Criteria_ES.pdf FR: http://www.adaptationcommunity.net/wp-content/uploads/2017/07/FEBA_EbA_Qualification_and_Quality_Criteria_FR.pdf
EbA Finance Guidebook (GIZ)	Provides practical information on potential funding sources for EbA measures from public and private actors by a collection of country examples. http://www.adaptationcommunity.net
Exploring nature-based solutions: The role of green infrastructure in mitigating the impacts of weather- and climate change-related natural hazards (European Environment Agency)	Report focusing on extreme events and natural hazards at the European scale that are projected to increase due to climate change, such as landslides, avalanches, floods and storm surges. In addition, the report also touches upon the green infrastructure and ecosystem services contributing to global climate regulation. The analysis is carried out using spatially explicit data centred on the physical capacity of ecosystems to deliver services that can mitigate natural hazard risks.

Tool/Organization	Description
	https://www.eea.europa.eu/publications/exploring-nature-based-solutions-2014
AdaptationCommunity.net	On-line platform for sharing information on applying approaches, methods and tools that facilitate the planning and implementation of adaptation action. www.adaptationCommunity.net
A Community of Practice for EbA on YouTube (adaptationcommunity.net)	A YouTube channel providing regular information from practitioners, experts, planners and decision makers on EbA related topics, such as broadcasted webinars https://www.youtube.com/channel/UCb_x4rPctuGmFOLjHdSIN8Q
Ecosystem-based disaster risk reduction in Japan	Introduces the basic concepts of Eco-DRR and important points for the design and implementation of EbA/Eco-DRR projects http://www.env.go.jp/nature/biodic/eco-drr/pamph04.pdf
Green infrastructure Guide for water management (UNEP)	http://web.unep.org/ecosystems/resources/publications/greeninfrastructure-guide-water-management

Step F: Monitoring and Evaluation of EbA and Eco-DRR

Purpose

Monitoring and evaluation (M&E) of EbA and Eco-DRR actions are critical for assessing progress and effectiveness of interventions. Monitoring enables adaptive management and is ideally carried out throughout the lifetime of the intervention. Evaluation assesses an ongoing or completed project, programme or policy, its design, implementation and results. M&E can encourage continual learning to help inform future policy and practice.

There is a movement towards integrating approaches for M&E from both adaptation and disaster risk reduction fields. A myriad of approaches and frameworks have been developed, including logical frameworks and results-based management. Key actions and considerations related to M&E are outlined below.[90] Tools associated with this step are available in the Step E Toolbox: Monitoring and evaluation of EbA and Eco-DRR.

Outcome

- A monitoring and evaluation framework that is realistic, operative and iterative, including a protocol for data collection and evaluation, and information generated on outcomes and impacts of interventions

Key Actions

(a) Set up an M&E framework, establishing its objectives, audience (who uses the information from an M&E assessment), data collection, mode of dissemination of information, and available technical and financial capacity;

[90] Several of the key actions and considerations are based on the M&E Learning Brief (in development), to be published in 2018 by Deutsche Gesellschaft für Internationale Zusammenarbeit.

(b) Develop a results/outcomes framework within the M&E framework that details the expected effects of the EbA/Eco-DRR intervention, including short- and medium-term outcomes and long-term results;
(c) Develop indicators at the appropriate temporal and spatial scales to monitor the quantity and quality of change:
    (i) Ensure that monitoring and evaluation include indicators[91] formulated to the SMART criteria, which are specific, measurable, achievable and attributable, relevant and realistic, time-bound, timely, trackable and targeted and/or the ADAPT principles (Adaptive, Dynamic, Active, Participatory, Thorough);
    (ii) Ensure that indicators are vulnerability and risk-oriented and focused, and that they are able to measure high risks versus low risks and how EbA/Eco-DRR interventions reduce risk over time. It is important to define "risk layers" and to prioritize which risks should be measured using indicators;
    (iii) Use targets and indicators under the Sustainable Development Goals, Aichi Biodiversity Targets and other relevant frameworks to track progress in sustainable ecosystem management and biodiversity enhancement, which also deliver towards strengthening resilience to climate change impacts and disasters;
    (iv) Align indicators with existing M&E frameworks where possible;
(d) Determine baselines for assessing effectiveness;
(e) Use appropriate participatory and inclusive tools for monitoring and evaluation of EbA and Eco-DRR, ensuring the engagement of local communities, stakeholders and rights holders. Ensure the relevant experts are engaged, such as specialists on ecosystems/species status, and ecosystem function;
(f) Test EbA/Eco-DRR related indicators for local relevance.

[91] More information on indicators is available through the CBD website (https://www.cbd.int/indicators/default.shtml) and in the IPCC Fifth Assessment Report (see https://www.ipcc.ch/report/ar5/)

Table 12. Step F Toolbox: Monitoring and Evaluation

Tool/Organization	Description
Monitoring and evaluating ecosystem-based adaptation (EbA) – A guidebook (GIZ)	Step-by-step practical guidance on the development and implementation of an M&E system for EbA on multiple scales. The guidebook enables EbA projects operating at a local and community level to connect with EbA policies and programmes generated at regional and national levels and demonstrates the benefits of EbA and how effective M&E can strengthen the case for its inclusion in strategies for responding to the impacts of climate change. https://www.adaptationcommunity.net/publications/
Monitoring and Evaluation Learning Brief: How to measure successes of ecosystem-base adaptation (GIZ)	Experiences from practitioners on how to set up M&E systems and indicators for monitoring and evaluating adaptation results and linking EbA-specific M&E to other monitoring and reporting systems. http://www.adaptationcommunity.net/wp-content/uploads/2018/01/giz2017-en-learning-brief-measuring-success-eba-low-res.pdf
Climate Change Policy Brief: Adaptation metrics and the Paris Agreement (GIZ)	Policy brief examining the feasibility and practicability of a set of common global adaptation indicators and their use in context of the Paris Agreement, looking at the different purposes of applying adaptation metrics and provides recommendations for their targeted use http://www.adaptationcommunity.net/wp-content/uploads/2017/11/giz2017-en-policy-brief-adaptation-metrics.pdf
AdaptMe: Adaptation Monitoring and Evaluation Toolkit (European Climate Adaptation Platform)	Enables users to think through some of the factors that can make an evaluation of adaptation activities inherently challenging, and guide the design of a robust evaluation http://www.ukcip.org.uk/wp-content/PDFs/UKCIP-AdaptME.pdf
Summary of tools for monitoring and evaluating adaptation activities (DEA and SANBI)	Table of tools and approaches for conducting monitoring and evaluation of adaptation activities, including compatibilities with EbA https://www.sanbi.org/wp-content/uploads/2018/03/final-guidelines-ecosystem-based-adaptation-eba-south-africa.pdf
Toolkit for the Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes (UNU, Biodiversity International, UNDP, IGES)	Provides practical guidance for making use of Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes in the field, for engaging local communities in adaptive management of the landscapes and seascapes in which they live http://collections.unu.edu/eserv/UNU:5435/Toolkit_for_the_Indicators_of_Resilience.pdf
Integrating ecosystems in resilience practice: Criteria for Ecosystem-Smart Disaster Risk Reduction and Climate Change Adaptation (Wetlands International)	Introduces a set of criteria and steps to develop an 'ecosystem-smart' approach in the design, implementation and evaluation of risk reduction programmes, and guidance on the required capacities, partnerships, institutional set-up and planning needs https://www.wetlands.org/publications/integrating-ecosystems-in-resilience-practice-criteria-for-ecosystem-smart-disaster-risk-reduction-and-climate-change-adaptation/

C. Outreach into Sectors

The participants in the workshop to review the draft of the Voluntary Guidelines (held 20-22 November in Bonn) expressed a need for practical briefs to support EbA and Eco-DRR practitioners to more efficiently and effectively advocate for ecosystem-based approaches within sectors. Accordingly, the CBD Secretariat coordinated a group of experts from agencies[92] who volunteered their time and expertise to lead the development and authorship of sectoral briefs on: (1) development planning and public finance; (2) spatial planning; (3) agriculture; (4) humanitarian; (5) infrastructure; (6) forestry; and (7) water. Drafts of these sectoral briefs were provided to a wide range of experts across FEBA and PEDRR networks for their comments and inputs.

The briefs offer information and advice on how sectors are impacted by climate change and how ecosystem based approaches can provide solutions, including practical examples, actions needed, and relevant resources.

These sectoral briefs are self-contained with their own list of references and figures, apart from the entirety of this document to facilitate their use as outreach papers.

I. Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for development planning and public finance[93]

A. How are development planning and finance affected by climate and disaster risks?

Climate change and natural disasters pose serious, wide-ranging risks to the development targets of governments covering economies, societies and ecosystems. A recent study by OECD (2015) indicates a projected global gross domestic product (GDP) loss of 2-10% until 2100 under a projected temperature rise of 4°C. The ILO estimates that by 2030 a 1.5°C increase would lead to a loss of 2% of work hours globally. This is equivalent to about 75 million full time jobs (ILO 2018). By 2050, the combination of land degradation and climate change is predicted to reduce global crop yields by an average of 10%, and by up to 50% in some regions (IPBES 2018).

Effective development policies and financing strategies are needed to reduce risks, combined with instruments and tools to help retain, share or transfer financial losses if extreme events occur. In addition, national and sector-based strategies and policies, especially in vulnerable sectors such as agriculture, need to be developed to ensure climate change and natural disaster resilience to safeguard the investment (FAO 2017a).

[92] The Food and Agriculture Organization of the United Nations, The International Labour Organization, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the International Union for Conservation of Nature, and the World Wide Fund for Nature,

[93] The development and authorship of the sectoral brief "Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for development planning and public finance" was led by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

B. Why ecosystem-based approaches should be strengthened

Ecosystems, stretching over land- and seascapes, provide the foundation for sustainable development pathways of societies and economies. Livelihoods of at least three billion people depend directly on marine biodiversity (SCBD 2009), 1.2 billion jobs directly depend on natural resources and ecosystem services (ILO 2018) and 5-8% of current global crop production worldwide is directly attributable to pollination (IPBES 2016).

Ecosystem-based solutions, either as stand-alone measures or in combination with built infrastructure, have often been proven as being more cost-effective in delivering key facilities and services than grey measures on their own. Despite their importance, ecosystems continue to be degraded and depleted. The value of services that ecosystems provide to humanity tend to be poorly understood and articulated, and as a result, it is frequently overlooked when formulating policies and planning investment projects. Very often, both the benefits associated with conserving and sustainably using ecosystems and the costs attached to their degradation and loss are under-estimated. As a result, sectoral developmental policies, institutions and markets incentivize overexploitation of ecosystems for short-term gains.

Figure 1: Interdependency between economy, society and the biosphere illustrated by the sustainable development goals (Carl Folke et al, Stockholm Resilience Center, 2017)

Ecosystem-based approaches to climate change adaptation and disaster risk reduction provide various solutions to development challenges dealing with climate and disaster risks. They support a holistic and cross-sectoral thinking that takes the interactions and interdependence of people, economy and nature into account.

There is a wide recognition that the SDGs are interconnected and that their implementation can only take place in an integrated manner, addressing social, economic and environmental concerns equally. This approach represents a mind shift from previous development and financing policies, which focused primarily on socio-economic development without integrating the importance of ecosystems and the services they provide to the public.

A systematic integration of ecosystem-based approaches into development planning and public finance policies holds various advantages that cover the following:

- **Multiple benefits:** Besides risk reduction for public investments, ecosystem-based approaches provide a multitude of benefits to society and economy at low cost, including provision of decent jobs and natural resources (food, fibers, medicine), water regulation, climate change mitigation by carbon sequestration recreation, provision of habitats for species

- **Cost-effectiveness:** As natural buffers, ecosystems are often less expensive to maintain and could be more effective than physical engineering structures. Depending on local conditions and climate projections, hybrid grey-green infrastructure solutions may work best in terms of public health, social cohesion, urban biodiversity and mitigation, creating win-win solutions for the environment, society and the economy (NWP, 2017).
- **Social inclusion, participation and productive employment:** Especially rural poor and marginalized groups of societies directly depend on ecosystems and their services for sustaining their livelihoods. Ecosystem-based approaches helps them to actively participate in ecosystem management and livelihood improvement since they require local ownership, knowledge and resources, including labor force. This increases productive employment ('green jobs' that contribute to preserve or restore the environment) and income generation, sustainability and independence from external financial and technical 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 social development frameworks.
- **Addressing various development goals:** The 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.
- **Leveraging international support:** Ecosystem-based approaches provide additional entry points for international policy and financial support ranging from global climate and biodiversity funds (e.g. GCF, GEF) to green development strategies, poverty reduction strategies, environmental compliance systems etc. Integrating ecosystem-based approaches into planning and finance policies often raises international recognition and reputation of a country as a 'front runner' for sustainable development.

C. Typical ecosystem based approaches & technologies include the following:

Approach/technology examples (including weblinks on EbA/Eco-DRR examples at the PANORAMA Solutions platform)[94]	**Environmental benefit**	**Risk reduction benefit**	**Socio-economic benefit**
Reforestation of slopes in upper watersheds - through native tree species that stabilize soils and store water. Species should be resistant to current and future risks such as pests, extreme weather events, cyclones etc.	Erosion prevention, fertility maintenance, carbon sequestration, fresh water provision, climate regulation, habitat for species	Buffering of cyclones, land-slide prevention, flood prevention	Social protection, job creation, productivity maintenance, income generation

[94] PANORAMA Solutions for a healthy planet platform (www.panorama.solutions)

Agroforestry - as an integrated approach to the production of trees and of non-tree crops or animals on the same piece of land. Agro-forestry can improve the resilience of agricultural production to current climate variability as well as long-term climate change through the use of trees for intensification, diversification and buffering of farming systems	Climate regulation, food provision, habitats for species, pollination, carbon sequestration	Buffering of extreme temperatures, precipitation droughts, storm surges	Economic diversification, job creation, productivity increase
Renaturation of flood plains - consists of measures to (re-) create natural retention areas for flood water e.g. by the restoration of old river arms, flood retention areas, restoration of river forests, etc.	Erosion prevention, water provision and regulation, habitats for species	Flood protection	Cost reduction (avoided damage, maintenance), job creation, recreation
Coastal habitat conservation/restoration - such as mangroves, salt marshes, seagrass meadows or coral reefs aims to provide a natural buffer against coastal erosion and inundation.	Erosion prevention, carbon sequestration, habitat for (commercial) species, water purification, nutrient cycling	Buffering of cyclones and storm surges	Economic diversification, job creation, productivity increase, social protection (of livelihoods), provision of raw material and food

(Source: GIZ, 2018)

D. Existing opportunities & required action

Several entry points for strengthening ecosystem-based approaches for climate change adaptation and disaster risk reduction within development planning and public finance include the following:

Entry points	**Examples**
Policies	Economic development and public investment policies, fiscal policies, policy alignment strategies, Guidelines for a Just Transition towards environmentally sustainable economies and societies for all (2015), UN Agenda 2030 and sustainable development goals (SDGs), UN Rio Conventions including the UFCCC Paris agreement (NDC, NAP), UNCCD, CBD, UNISDR
Planning instruments	Long-term and medium-term development plans at national and subnational level and budgeting, compliance systems for higher political commitments (e.g. SDGs)
Command and control instruments	Public expenditure and investment laws, standards and safeguards

Economic and fiscal instruments	Public investment programmes, debt funding, funds, taxes (e.g. carbon tax), fees, environmental fiscal reforms and transfer mechanisms, subsidies as incentive systems, insurance systems, payment for ecosystem services,
Institutions	Inter-ministerial task forces, committees, chambers of commerce, mobilization of civil society etc.

Further action will be needed in the following areas:

- Assess the interdependencies between economic activities, productive employment and ecosystems and design policy mechanisms that ensure that ecosystems continue delivering services and generating decent jobs.
- Analyze current and potential risks for development planning and public investment caused by climate change and natural disasters at the appropriate scale such as land-/seascape, administrative entity (e.g. district) and local scale (community).
- Identify short-, medium- and long-term actions to address current and future risks including ecosystem-based, hybrid and engineering based solutions as well as social options
- Compile evidences and convincing arguments - including facts and figures, that cover quantitative and qualitative information - for the effectiveness and efficiency of measures in reducing risks.
- Assess the potential role of ecosystems for productive employment creation and income generation.
- Identify key development and financing policies and funding streams where ecosystem-based approaches need to be strengthened and assess how they can be combined to insure sustainability. This includes multilateral funds, national budgets, private investments.
- Identify key actors from government, civil society and private sector to become allies during the integration of actions into public investments and to form partnerships for development.
- Support a mind shift from environment *versus* development towards a paradigm of environmental conservation and sustainable use *for* development -as being a necessary and enabling condition.
- Use ecosystem service valuation methods at the appropriate scale to analyze benefits, costs and impacts of ecosystem services across different sectors. This analysis will serve to inform policy-makers about the impacts of decisions and to allow the weighing of different options. It should also cover the 'cost of inaction' under a business as usual scenario.
- Promote the revision of legal frameworks to strengthen ecosystem-based approaches.
- Promote inclusive planning strategies through social dialogue.

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II. Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for spatial planning in land- and seascapes[95]

A. How is land and marine spatial planning affected by climate and disaster risks?

Climate change as well as natural disasters pose serious, wide-ranging challenges to the development targets of governments for national economies, societies and ecosystems. Immediate hazards such as floods, heat waves, droughts and cyclones but also slowly increasing hazards such as increasing

[95] The development and authorship of the sectoral brief "Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for spatial planning in land- and seascapes" was led by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

temperatures, glacier retreat and sea level rise pose significant challenges for societies and their use of land-based and marine resources. The manifest themselves at local, land- and seascape level.

There are multiple factors contributing to risk, that vary spatially, requiring place-based, context-specific, approaches to risk reduction and adaptation planning. For example, flood risk to a city might be increased by deforestation and soil erosion in the upper watershed, while storm damage within a coastal village might be exacerbated by degraded mangroves, coral reefs or seagrass beds. Other factors might affect the coastline, such as unsustainable groundwater extraction causing land subsidence, river canalization causing disturbance of sedimentation in rivers, built infrastructure along the coastline disturbing sediment settlement in front of the coastline, etc. Therefore land-based and marine spatial planning - including a multitude of actors, sectors and interests - is key for setting up climate change adaptation and risk reduction strategies.

B. Why ecosystem-based approaches should be strengthened

Ecosystems, stretching over land- and seascapes and the services they provide, are the foundation for sustainable development pathways of societies and economies. Ecosystem-based approaches to climate change adaptation and disaster risk reduction support holistic and cross-sectoral thinking that takes the interactions and interdependency of people, economy and nature into account.

Integrated management and restoration of ecosystems at the level of land- and seascapes can greatly enhance the overall benefits that ecosystems provide to society, as significant increases in one ecosystem service can often be achieved at limited cost to another. For example, the conservation and sustainable management of forests of an upper watershed does not only provide local services such as water storage and erosion prevention, but landscape services such as water provision and flood risk reduction to downstream land use systems. To ensure sustainability in the long term, it is crucial to use ecosystems in a way that avoids degradation, considers current and future vulnerabilities and maintains resilience. (FEBA, 2016).

Concepts such as ecosystem-based adaptation (EbA) and disaster risk reduction (Eco-DRR) are landscape approaches – i.e. framework to integrate policy and practice for multiple land uses, within a given area – where decisions (policies, planning, and implementation) need to be based on spatial information. A landscape approach is an interdisciplinary, cross-sectoral and holistic approach to help overcome barriers by sector and contribute to effective climate change adaptation by connecting all stakeholders involved, starting with the communities at risk in the landscape (Sayer, et al 2013).

Within landscapes, there are several spatial relationships between different ecosystems where a service such as reduction of a risk is produced and where the benefit becomes apparent.

A systematic integration of ecosystem-based approaches into spatial planning holds various advantages that cover the following:

- **Multiple benefits:** Besides risk reduction, ecosystem-based approaches provide a multitude of benefits to society and economy at low cost, including provision of natural resources (food, fibers, medicine), water regulation, climate change mitigation by carbon sequestration, recreation and provision of habitats for species.
- **Cost-effectiveness:** As natural buffers, ecosystems are often less expensive to maintain and could be more effective than physical engineering structures. Depending on local conditions and climate projections, hybrid grey-green infrastructure solutions that combine ecological

infrastructure (e.g. forests, wetlands) with built infrastructure (e.g. dams, water retention ponds) may work best in terms of public health, social cohesion, urban 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; ecosystem-based or hybrid approaches, combining grey and green infrastructure can be adapted and managed more easily to fulfil their functions for society.
- **Social inclusion, participation and employment:** Especially rural poor and marginalized groups of societies directly depend on ecosystems and their services for sustaining their livelihoods. Ecosystem-based approaches help them to participate in ecosystem management and livelihood improvement since they require local ownership, knowledge and resources, including labor force. Participatory spatial planning will enable 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 based and marine resources.

C. Typical ecosystem based approaches & technologies at landscape/seascape level include the following:

Approach/technology examples (including weblinks on EbA/Eco-DRR examples at the PANORAMA Solutions platform[96]	**Environmental benefit**	**Risk reduction benefit**	**Socio-economic benefit**
Reforestation of slopes in upper watersheds - through native tree species that stabilize soils and store water. Species should be resistant to current and future risks such as pests, extreme weather events, cyclones etc.	Erosion prevention, fertility maintenance, carbon sequestration, fresh water provision, climate regulation, habitat for species	Buffering of cyclones, land-slide prevention, flood prevention	Social protection, productivity maintenance, income generation, job creation
Renaturation of flood plains - consists of measures to (re-) create natural retention areas for flood water e.g. by the restoration of old river arms, flood retention areas, restoration of river forests, etc.	Erosion prevention, water provision and regulation, habitats for species	Flood protection	Cost reduction (avoided damage, maintenance), recreation, income generation, job creation
Coastal habitat conservation/restoration - such as mangroves, salt marshes, seagrass meadows or	Erosion prevention, carbon sequestration,	Buffering of cyclones and	Economic diversification, productivity

[96] PANORAMA Solutions for a healthy planet platform (www.panorama.solutions)

coral reefs aims to provide a natural buffer against coastal erosion and inundation.	habitat for (commercial) species, water purification, nutrient cycling	storm surges, sea level rise	increase, social protection (of livelihoods), job creation, provision of raw material and food

(Source: GIZ, 2018)

D. Existing opportunities & required action

Entry points as opportunities for strengthening ecosystem-based approaches for climate change adaptation and disaster risk reduction within spatial planning include the following:

Entry points	Examples
Policies	UN Agenda 2030 and sustainable development goals (SDGs), UNFCCC Paris agreement (NDC, NAP), UNCCD (land degradation neutrality), CBD, UNISDR, Bonn Challenge on Forest Landscape Restoration
Planning instruments	"ridge-to-reef" or source-to-sea approaches, territorial planning and landscape approaches, long-term and medium-term land, coastal and marine development plans at national and subnational level, risk maps, land use maps and cadastral systems, land use conflict resolution mechanisms, participatory land use, coastal and marine spatial planning approaches (e.g. the concept of "Blue Planning in Practice"
Command and control instruments	Land use and zoning laws, standards and safeguards, management certification schemes, strategic environmental assessments, environmental impact analysis
Economic and fiscal instruments	Public investment programmes, funds (e.g. land degradation neutrality fund), taxes, fees, fiscal transfer mechanisms and subsidies as incentive systems for spatial planning
Institutions	Inter-ministerial task forces and management committees, river basin committees, land use planning, forest user and water user associations etc.
Technology	High resolution spatial data and information (satellite based, drones, etc.) that is often openly available, geographical information systems (e.g. open source) and related planning and decision support tools (e.g. Marxan, InVEST, SeaSketch)

Further action will be needed in the following areas:

- Assess the current and potential challenges (and risks) for land use, coastal and marine spatial planning caused by climate change and natural disasters in addition to other man-made risks by using a combination of available geographical information systems and spatial data climate and disaster risk information.
- Identify short-, medium- and long-term actions to address these risks including ecosystem-based, hybrid and engineering-based solutions as well as social options.

- Identify key actors from government, civil society and private sector to become allies in adapted spatial planning and establish suitable formats for ongoing exchange, negotiation and joint planning between these actors and sectors.
- Strengthen the role of non-state actors and local ownership (e.g. local civil society, research, private sector) in spatial planning.
- Further align land cover and spatial use maps across different sectors such as agriculture, forestry, mining, urban planning, nature conservation, shipping, industrial and artisanal fisheries (i.e., national spatial data infrastructure).

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III. Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for the agriculture sector[97]

A. How is agriculture affected by climate and disaster risks?

Agricultural production depends on well-functioning ecosystems and the services they provide such as the provision of healthy and fertile soils, water, pollination, climate regulation as well as buffering from extreme events and other shocks. The agriculture sector often bears a disproportionate share of disaster impacts, many of which are borne directly by smallholders and the poor in both urban and rural areas (FAO 2018a). The workers whose livelihoods depend on agriculture and landscape related sectors such as tourism are particularly affected (ILO, 2017a).

Changing weather patterns and increasing frequency of natural hazards such as prolonged droughts, storms, heatwaves, and torrential rain are affecting agricultural productivity and income from crops, livestock and fish; this significantly affects agricultural investments, incomes, food production and food security now and in the future. Therefore, climate change is considered a significant "hunger-risk multiplier". The vulnerability of the populations concerned may also mean forced migration and social fragility (ILO, 2017a).

Of all the natural hazards, floods, droughts and storm surges and tides affect the agriculture sectors the most showing the severe impact of climate-related disasters. In developing countries, during 2003–2013, loss and damage caused by natural hazards in the agricultural sectors totaled nearly USD 80 billion (FAO 2015). It has been estimated that over 20 percent of all damage and loss caused by natural disasters, and 80 percent for drought was absorbed by agriculture (FAO, 2018a). Other natural hazards such as diseases and infestations and wildfires also have a considerable effect on agricultural production (FAO, 2018a).

Disasters can have both direct and indirect negative impacts on the natural resources and ecosystems that sustain agriculture. These include, among others, surface and groundwater depletion and contamination, increased soil erosion, damage to native forests, mangroves, wetlands and salinization of soils. Furthermore, the displacement of affected people in the aftermath of disasters could indirectly lead to increased pressure on natural resources (e.g. exploitation of forest and water resources) in the areas surrounding displacement camps (FAO, 2018a).

[97] The development and authorship of the sectoral brief "Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for spatial planning in land- and seascapes" was led by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Food and Agriculture Organization of the United Nations (FAO).

The effects of climate change on agricultural production and livelihoods are expected to intensify over time, regions particularly affected include Sub-Saharan Africa and South-east Asia (FAO, 2016a). It is estimated that the population living in poverty could increase by between 35 and 122 million by 2030 due to climate change, largely due to negative effects on household agricultural incomes from agricultural (FAO, 2016a). Climate change will also have disproportionately impact the most vulnerable including unprotected workers and farmers that lack access to services and natural resources such as land (ILO, 2017).

B. Why ecosystem-based approaches should be strengthened

Ecosystem-based approaches are an effective solution to build resilience of agricultural production systems as well on the ecosystems on which they depend. As well as reducing the impacts of extreme events and adapting to climate change other co-benefits can be achieved such as improving the sustainability of food production, increasing the availability of natural resources (water and soil nutrients) and reducing the need for external inputs. Ecosystem-based approaches can therefore play a significant role in the needed major shift from current unsustainable production systems to long-term sustainable system that can meet the future population's dietary and food security requirements (FAO 2014). Many past policies and strategies have often led to unsustainable and/or even counter-productive goals (Munang, 2014). On the other hand, EbA and Eco-DRR look at the economic, ecological and social dimensions of agro-ecosystems and systematically integrate information on climate and disaster risks into planning and decision-making within landscapes, governance and management systems. Such approaches have been integrated into FAO's common vision for sustainable food and agriculture (FAO, 2014) including concepts such as climate smart agriculture (FAO, 2010 and FAO, 2018b) and agroecology (FAO, 2018c and FAO, 2018d).

Agricultural practitioners are often the major custodians and managers of land and waterscapes and one of the major users of ecosystem services. Through capacity building and provision of services and incentives, these stakeholders can apply EbA and Eco-DRR interventions both at the territorial and farm level. For example, interlinked natural hazards of floods and droughts can be addressed through interventions, which capture water within the landscape through soil and watershed interventions (FAO, 2018e). By reducing risks and building resilience at farm and territorial levels, EbA and Eco-DRR help to minimize losses and maintain or even increase agricultural productivity. In addition, other co-benefits can be promoted, such as carbon sequestration, habitats for species and pollinators and biodiversity protection. It has been estimated that a shift to more agriculture sustainable practices, including traditional knowledge from indigenous people, has the potential to create over 200 million more full-time jobs by 2050, with growth coming from more labour-intensive green farming practices, management and preservation of ecosystems, research and development, and training of rural populations in the use of green technologies (ILO, 2017a and 2017b).

C. Examples of typical ecosystem based approaches, technologies and techniques within the agricultural sector and at the territorial level include the following:

Approach/technology examples (including weblinks on EbA/Eco-DRR examples at the PANORAMA Solutions platform[98] and FAO examples	**Environmental benefit**	**Risk reduction benefit**	**Socio-economic benefit**
Crop diversification: through the introduction of additional cultivated species and climate resilient varieties it is aimed at enhancing plant productivity, quality, health and nutritional value and build resilience to pests, diseases and climate change	Erosion prevention, soil fertility maintenance	Buffering of extreme temperatures, precipitation droughts, floods, storm surges	Economic diversification, productivity and increased income, food security
Sustainable livestock production and pasture restoration: with locally adapted breeds, optimization of grazing density and grazing rotation.	Erosion prevention, maintenance of biodiversity	Buffering of potential losses due to extreme events	Productivity and income stability; maintenance of productive assets
Agroforestry: as an integrated approach to the production of trees and of non-tree crops or animals on the same piece of land. Agro-forestry can improve the resilience of agricultural production to current climate variability as well as long-term climate change through the use of trees for intensification, diversification and buffering of farming systems	Climate regulation, food provision, habitats for species, pollination, carbon sequestration	Buffering of extreme temperatures, precipitation, droughts, storm surges	Economic diversification, productivity increase
Assisted Natural Regeneration (ANR): land restoration method that can convert degraded lands into more productive area, by retention of naturally regenerating seedlings (Monty, 2017)	Soil productivity, crop protection	Droughts, salinity	Enhanced productivity, limited resources required
Soil management: Soil cover/mulching, zero tillage, as used in agroecology, CSA, conservation agriculture.	Reduced loss/use of natural resources (water), improve soil fertility and biodiversity	Reduced water requirement, improved resilience to floods and droughts	Increased production/ income, job creation
Territorial and landscape interventions (sustainable land and water management): water retention/regulation at landscape and field level. Can include contour ploughing, protection of water catchments, and flood plains, trenches for water retention, shade and water capture trees, etc.	Improved water quality and availability, reduced soil erosion. Increased biodiversity and ecosystem functioning.	Reduce variability of agricultural production, reduce incidence and severity of floods, droughts and landslides.	Stable production and increased food security, job creation

(Source: FAO 2010, FAO, 2017a, FAO 2017b, GIZ, 2018 and www.panorama.solutions)

D. Existing opportunities & required action

Several entry points for strengthening ecosystem-based approaches for climate change adaptation and disaster risk reduction within the agriculture sector do exist already and include the following:

Entry points	Examples
Policies	Food security policies, economic development policies, UN Agenda 2030 and sustainable development goals (SDGs), UNFCCC Paris agreement (NDC), NAPs and NAMAs, UNFCCC Koronivia Joint Work on Agriculture (KJWA), UNCCD Land Degradation Neutrality Target Setting Programme, CBD, UNISDR, Guidelines for a Just transition towards environmentally sustainable economies and societies for all.
Planning instruments	Development plans, agricultural production plans, sector plans, watershed management plans, land use plans, climate change strategies including National Adaptation Plans (NAPs) and Nationally Appropriate Mitigation Action (NAMAs), FAO climate smart agriculture (CSA) framework, Skills development strategies
Command and control instruments	Agrarian laws, standards, environmental laws and impact assessments, mandatory certification schemes
Economic and fiscal instruments	Agricultural investment programmes, funds, taxes, fees and subsidies as incentive systems, payments for environmental services (PES)
Informative measures	Formal education, such as agricultural schools and non-formal extension programmes, demonstration sites, farmer to farmer exchanges, IT agricultural solutions, etc.
Voluntary measures	Voluntary environmental agreements, standards and certification schemes e.g. fairtrade and "green" certification schemes.
Institutions	Task forces, committees, associations, unions, cooperatives, regional government agricultural and environmental advisory bodies, international and national food producing companies, extension services.
Management types	Public, collaborative and private management of farmland and pastures, integrated water resource management (IWRM) approaches, micro-watershed management for improving irrigation, CSA approaches.

Ecosystem-based approaches in agriculture can support implementation of the Nationally Determined Contributions as agriculture sectors (crops, livestock, forestry, fisheries and aquaculture) feature prominently in meeting national mitigation and adaptation goals (FAO, 2016b). Among the 131 countries that include priority areas for adaptation and/or adaptation actions related to the agriculture sectors, 97 percent refer to crops and livestock, 88 percent refer to forests, and 64 percent refer to fisheries and aquaculture (FAO, 2016b). Furthermore, countries refer to the ecosystem approach for managing the natural systems that support the agriculture sectors. Many countries in their NDCs already advocate an ecosystem approach focusing on restoring degraded ecosystems and/or often including specific measures like landscape/watershed and fire management (FAO, 2016b).

National Adaptation Plans (NAPs) are an instrument for achieving countries' NDCs as well as disaster risk reduction and sustainable development objectives. Within a NAP, EbA could form a policy or

planning objective as well as a means for implementing adaptation practices in agriculture. EbA can be mainstreamed throughout the recommended stages for the formulation and implementation of a NAP. Like a NAP roadmap, it can be integrated into these stages of the planning processes at the sector and national levels (Nyman, 2018). The NAP process also offers an entry point to mainstreaming agriculture sector priorities – including EbA practices – into national development plans and budgets, national climate change strategies, and other planning instruments (FAO, 2017c). Considering that EbA has also co-benefits such interventions may also be relevant in achieving Nationally Appropriate Mitigation Action (NAMAs) (FAO, 2016c).

Further action will be needed in the following areas:

- Assess the dependency of agricultural value chains on ecosystem services and how agricultural activities affect the provision of ecosystem services.
- Assess the current and potential risks for agricultural value chains - from production to consumption - caused by current and future hazards and the role that natural and artificial ecosystems can play to mitigate risks.
- Assess the vulnerability to climate change impacts in terms of sensitivity, exposure to risks and adaptive capacity.
- Assess the capacity and skills needed to manage, implement and monitor ecosystems-based practices.
- Identify short-, medium- and long-term actions to address these risks based on existing local and traditional/indigenous knowledge and scientific knowledge/developments.
- Develop methodologies for integrated CCA/DRR interventions and the assessments of cost benefits of using different interventions (including eco DRR) in specific contexts.
- Ensure improved coordination of government sectors (e.g. Ministries of Agriculture and Environment, Public Works), policy and legislation to create the needed enabling environment for the adoption of EbA/Eco-DRR measures.
- Identify leaders and key actors from government (planning and sector ministries), civil society (associations, foundations, community organizations, media and academia) and private sector (including food producing companies, cooperatives and retailers as well as investors) to become allies/partners during the planning and implementation of measures.
- Strengthen local governance and management structures by improving technical and institutional capacities of land use organizations (farmers, pastoralists, fishers).
- Identify key opportunities to mainstream ecosystem adaptation priorities into development plans at local, regional, and national scales.
- Optimize the tools for creating an effective enabling environment for the adoption of appropriate EbA/Eco-DRR measures by farmers and other practitioners, including the effective use of incentive and taxation schemes.
- Further assess the potential for integrating the risk reduction potential of ecosystems into agricultural insurance products.

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IV. Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for the humanitarian sector[99]

A. How is the humanitarian sector affected by climate and disaster risks?

Millions of people every year worldwide need humanitarian assistance because of disasters caused by natural hazards. The frequency and magnitude of extreme events is increasing under climate change, threatening decades of development efforts and survival. By exacerbating competition over natural resources, environmental degradation, water scarcity and food insecurity, among many other factors, climate change is also a primary amplifier of ongoing humanitarian crises.

Between 2008 and 2015, around 27 million people were displaced annually by natural hazards and climate related disasters, and this trend is rising (IDMC, 2015). Healthy ecosystems and ecosystem services can play a vital role in disaster risk reduction (DDR) and climate change mitigation and adaptation as well as in building resilience to changing conditions. Farm incomes would increase by 30% if farmers could effectively mitigate risks linked to climate change (FAO, 2016).

Over the past decade, ecosystem-based and bio-engineering approaches have emerged as an alternative to grey infrastructure or engineered approaches. Ecosystem-based approaches focus on the sustainable management, conservation and restoration of ecosystems and their services, to strengthen the resilience of species, people and communities in facing disasters and climate change respectively (UN Environment, 2015).

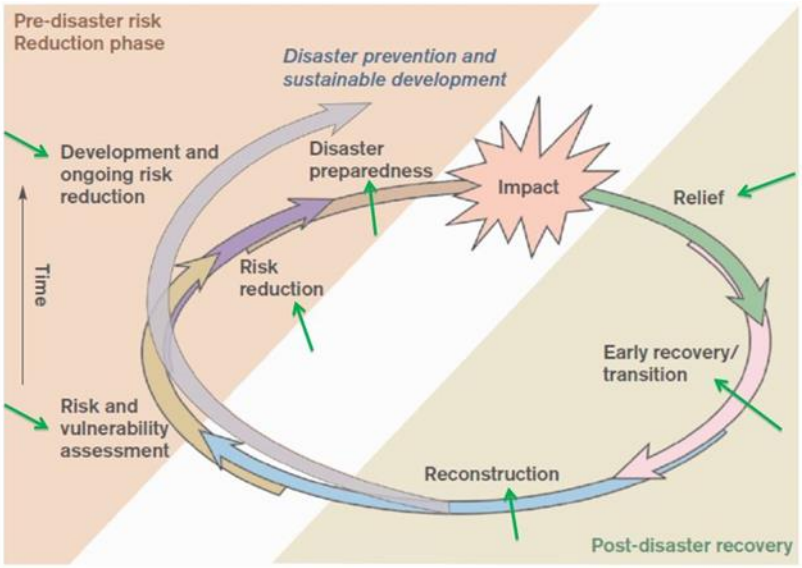

Figure 1. Entry points for Eco-DRR within the Disaster Management Cycle. Adapted from RICS, 2009.

Cross-sectoral collaboration including multiple stakeholders is crucial for further mainstreaming and scaling-up on Ecosystem-based DRR (Eco-DRR) and Adaptation (EbA). Recent global policy developments provide important

[99] The development and authorship of the sectoral brief "Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for the humanitarian sector" was led by the International Union for Conservation of Nature.

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 climate change adaptation, as highlighted in the Sendai Framework for Disaster Risk Reduction, the Paris Agreement, the Agenda for Humanity and, the 2030 Agenda for Sustainable Development. In line with a New Way of Working, these approaches can also support bridging the development, conservation and humanitarian worlds.

Current efforts are being made in the relief, early recovery, and reconstruction steps but it is necessary to highlight the need for proactive action in disaster preparedness, risk reduction and risk and vulnerability assessment (Figure 1).

B. Why ecosystem-based approaches should be strengthened

EbA and Eco-DRR approaches can help understand disaster risk and climate change adaptation by identifying their root drivers through multi-stakeholders and multi-sectoral dialogues. Exploring opportunities for strengthening coordination between environmental, development and humanitarian sectors helps to engage with different to find solutions for alleviating pressures on the humanitarian sector.

Healthy ecosystems can contribute to reducing risks, including for cascading effects, and assist in delivering humanitarian aid before and after disaster. The need to conduct detailed environmental assessments to identify the status of ecosystems facilitates the collaboration of scientists and local communities when developing locally adapted EbA and Eco-DRR plans and strategies. Such activities could promote job creation in disaster prone areas, local ownership and encourage environmental information and data sharing, including traditional and indigenous knowledge. Such would, for example, be the case of post-disaster emergency employment interventions that could contribute to building resilience in the reconstruction, contributing to EbA and Eco-DRR. In addition, both approaches help to develop locally adapted and cost-effective solutions by promoting local innovations through integrated social and ecological vulnerability as well as capacity assessments (Monty, 2017).

Fostering these approaches within a sustainable development framework goes beyond response or recovery from impacts, leading to longer-term resilience. EbA and Eco-DRR entails several aspects, from prevention to increase community, ecosystem and institutional resilience of ecosystem, strengthen public policy on Eco-DRR, enhance preparedness and *build back better*.

C. What does the sector have to do?

Climate change and ecosystem conservation/restoration are crucial for climate change adaptation and disaster risk reduction, although, advocacy, fund raising and joint efforts remain necessary to address the negative impacts of climate change and disasters. Main challenges can be identified in linking humanitarian assistance to development activities, to increase the understanding of EbA and Eco-DRR by collecting specific data and strengthening capacities of partners to integrate EbA and Eco-DRR into their strategies, plans and projects. Indeed, capacity building, and training on Eco-DRR and EbA to support their integration in humanitarian assistance and ensure cooperation could be a major challenge. Gathering evidence of the benefits of investing in Eco-DRR and EbA as opposed to the costs of inaction or of hard engineering alternatives could help overcome some of these challenges.

EbA and Eco-DRR can be part of long-term efforts associated with development assistance, as they lay the basis to bridge the humanitarian and development gap. When it comes to humanitarian action which covers recovery and reconstruction practices, however, the environment often continues to be considered only as an afterthought (JEU, 2014). Nowadays, DRR and preparedness have a direct link to humanitarian aid, but it is still necessary to mainstream the ecosystem component into this to promote both EbA and Eco-DRR. Currently, a high percentage of funding is provided to carry out specific DRR activities in the short term, while it would be more effective to invest in ecosystem-based initiatives with a long-term view.

Better coordination between humanitarian and environmental actors combined with a reinforced consideration of environment and climate knowledge in humanitarian assistance can ensure the continuity of response activities into a more resilient reconstruction phase. Data-sharing will facilitate synergies across sectors and underpin a strengthened humanitarian-environmental approach. Environmental and humanitarian actors should work together to ensure that the environment is duly considered when planning for humanitarian action, creating the basis for longer-term recovery and resilience efforts.

D. Typical ecosystem based approaches & technologies include the following:

Approach / technology examples	Description
Land restoration (Ethiopia) – Wetlands International	Wetlands International in collaboration with humanitarian partners, including the Netherlands Red Cross worked on large-scale tree planting to mitigate erosion and retain water by establishing a roadmap for improving land and water health, and enhancing awareness through capacity building. More information at: https://goo.gl/u4WLHm
Water sanitation (Peru) - UNEP	Project Agua Limpa: restoring the health of water supplies while boosting biodiversity by restoring forests and rehabilitating river banks and riverside vegetation in river basin. More information at: https://goo.gl/C5N6FR
Disaster Risk Knowledge (Tajikistan) - European Civil protection and Humanitarian Aid operations	Villagers in Tajikistan put disaster risk knowledge in practice through training session on ecological awareness to reduce risk and protect communities from landslides and avalanches. Activity: tree plantation to reduce avalanches. More information at: https://goo.gl/Y4XsbV
Population preparedness through mangrove reforestation (Philippines) - HEKS/EPER	Mangrove reforestation and fruit tree planting along with training events for DRR committees and community members led to improved understanding of local hazards, early warning systems and better community preparation thus ensuring long term sustainability and the resilience of livelihoods to future disasters. More information at: https://goo.gl/UAeBom
Resilient Coastal Cities - USAID	The goal is to enhance local collaboration and problem solving to support effective climate change adaptation. To do this, community assessment approaches are tailored to community resilience needs at a city-wide perspective so that stakeholders can absorb and contextualize community-scale needs. More information at: https://goo.gl/Y9WDf5

Green works and Climate Change Adaptation - ILO	ILO in collaboration with national governments, employers and workers promotes sustainable local reconstruction and recovery in times of conflict and crisis, seeking to bridge immediate crisis recovery to long-term development work. It aims to create jobs by restoring and protecting the productive capacity of lands to create livelihood and income security for the most vulnerable. More information at: https://goo.gl/MDeE5c

E. Advantages and challenges of mainstreaming Eco-DRR and EbA approaches

According to priority 1 of the Sendai Framework, "*policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions …hazard characteristics and the environment*" (UNISDR, 2015). To achieve cross-sectoral implementation of policies and practice, local and indigenous knowledge and practices should be combined with scientific knowledge mainstreaming the ecosystem component thus ensuring EbA and Eco-DRR implementation.

A cross-sectoral approach, coupled with high investment and involvement of crucial sectors, e.g. policy and decision makers, informed by the best scientific and local knowledge ensures increasing inter-institutional collaboration and community capacity building. This combination helps to improve human well-being, strengthen resilience and enhance preparedness. Ecosystem-based approaches within climate change adaptation and DRR are useful not only for their capacity to reduce and buffer against impacts of hazards, but also for associated social, economic and cultural benefits.

Despite the advantages, there remain many challenges particularly in the enhancement of existing partnerships and the creation of new ones along with an increase of funds allocated to EbA and Eco-DRR projects.

Further action will be needed in the following areas:

- Enlarge the Humanitarian-Environmental cooperation, integrating also the Development sector.
- Map environmental information, data and assessments at different levels with focus on preparedness, disaster-wide data, national level coordination and direct programming implementation.
- Ecosystems risks are directly related to social vulnerability and success of Nature-based Solutions in general, and particularly of EbA and Eco-DRR approaches. Therefore, ecosystem risk assessments (e.g. IUCN RLE methodology) should be conducted as a key baseline for monitoring ecosystem health and identifying key threats and mechanisms driving to biodiversity loss.
- During post-disaster phases, environmental assessments tools should be framed according to the range of users, aims and functionalities within community consultation and engagement; these should also be realistic in terms of humanitarian response timelines and lack of environmental expertise in many humanitarian organizations.
- Increase the overall quality and accountability of humanitarian action by assessing environmental risk more accurately.
- Quantify benefits of EbA and Eco-DRR approaches to demonstrate the value provided by ecosystem services; both approaches are still both very underfunded, despite the evidence

that every preparedness dollar has an impact in the long term therefore the humanitarian sector should work to strengthen this.

- Broadening the engagement of the donor community, come with a new concept with a long-term vision which directly benefits the affected communities.
- Cope with the lack of institutionalization of environment due to constant rotating personnel;
- Work to develop ways to better integrate environmental considerations into the humanitarian programme cycle approach.

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World Overview of Conservation Approaches and Technologies (WOCAT), see more at https://www.wocat.net/en/. The overall goal of the WOCAT Network is to unite knowledge management and decision-support efforts, to enable scaling up of Sustainable Land Management among all stakeholders.

The Climate, Environment and Disaster Risk Reduction Integration Guidance (CEDRIG) is a practical and user friendly tool developed by the Swiss Agency for Development and Cooperation (SDC), see more at https://www.cedrig.org/

V. Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for the infrastructure sector[100]

A. How physical and natural infrastructure is affected by climate change and disaster risks

Industrialization, use of fossil fuels, and poor consideration for the environment (e.g. deforestation, unsustainable farming) have contributed to climate change, intensifying the frequency and strengths of natural disasters around the world. Extreme weather patterns are causing intensified storms and flooding and at the same time in other regions, droughts and desertification are becoming the norm. Natural disasters "destroy jobs, oblige people to move and slow down economic activity through the destruction of capital stock, delivery and transport systems and other infrastructure. Although rebuilding capital stock following a disaster may stimulate GDP, the short- and long-term economic consequences of disasters are negative, particularly for developing and smaller economies (Felbermayr and Gröschl, 2014). Infrastructure is a key area that can help meet both climate change mitigation in reducing emissions and adaptation objectives through building disaster resilience.

Climate change can impact all kinds of infrastructure, assets and services. It can:

- lead to damage on transport systems;
- impede access to schools and health services, markets, and job opportunities;
- destroy buildings, storage and necessary community infrastructure and assets which are needed for the functioning of a society and contributing to productivity and GDP;
- damage ecosystems, farm lands, waste management and sewage systems, irrigation canals, dams and dykes which can affect health and productivity of lands;
- affect food and water supply; and,
- ultimately lead to climate displacement and / or death.

OECD estimates that some USD 6.3 trillion are needed to meet global infrastructure requirements and that only USD 0.6 trillion additional investments are needed to make the investment climate-neutral (OECD, 2017). The ILO's World Economic Social Outlook highlights that although 1.2 billion jobs depend on environmental services, 23 million working-life-years have already been lost to disasters since 2000, and that 24 million jobs will be created resulting from a 2 degrees C trajectory, of which 6 million jobs could be created by embracing the circular economy (ILO, 2017).

B. Why ecosystem-based approaches should be strengthened

Infrastructure development does not have to be capital intensive. It can be labour-based, which by its nature is more environmentally friendly, and appropriate choices of technology can also be environmentally friendly, while creating sustainable livelihoods and additional jobs. In 2011, the ILO coined the term "Green Works" to refer to "infrastructure and related work that have direct environmental benefits is or in response to a specific environmental context including changes in

[100] The development and authorship of the sectoral brief "Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for the infrastructure sector" was led by the International Labour Organization with contributions from the International Union for Conservation of Nature.

climate and extreme weather events". Different techniques appropriate to labour based approaches can be used, for example on road construction, including cold techniques with bitumen emulsion, which avoid heating the aggregates, and can reduce the environmental impacts and decrease occupational hazards (ILO, 2013). Green Infrastructure (GI) encourages infrastructure investments by relying on services produced by ecosystems, for example, using natural infrastructure for flood protection, water purification and storage, and by reducing runoffs. For example, techniques such as "permeable pavement combined with other GI is an effective measure to avoid storm water run-off. It can be up to 25% cheaper than traditional pavement when all construction and drainage costs are included. GI is an especially effective method also for retaining storm water that also generates a wide range of economic and social benefits beyond improved water quality." (EC, 2014). GI in urban landscapes can tackle simultaneously warming effects of climate change combined with those of the urban heat island (Knight, 2016). Within this landscape, GI can directly have multiple benefits in several sectors such as health, water, planning or agriculture. GI through labour-based approaches have benefits in reducing noise, air and water pollution, in addition to decreasing ecological casualties, while bringing significant benefits to biodiversity, environmental rehabilitation and increasing biodiversity.

The role of indigenous and local communities to increase climate resilience of infrastructure

Climate change and risk of disaster endanger the livelihoods of people globally, but especially rural and local communities who are the most vulnerable and have contributed the least to the changing climate. Groups such as children, elderly, and persons with disabilities; women and indigenous peoples face socio-economic vulnerabilities and exclusion. They are also subjected to a greater risk from the impacts that invariably affect them in every aspect of socio-economic life. Indigenous peoples for instance, who are often located in remote areas, already lack access to quality, reliable, sustainable and resilient infrastructure necessary for their economic development and well-being. Climate change threatens both built and natural infrastructure that is critical for subsistence activities among such communities (ILO, 2016). Moreover, the damages caused by natural disasters on infrastructure and assets, the decrease in the availability of productive lands and unfair practices are also leading to more conflict and fragility in some countries.

Empowering affected communities - especially poor, rural or urban ones, as well as indigenous and tribal peoples -to adapt to the changing climate is necessary to reduce future impacts on their livelihoods and living conditions. Many countries lack social protection that leave the poorest even more vulnerable to climate shocks. Governments and donor agencies can assist in providing policies and strategies that will support adaptation. Nevertheless, the burden remains on indigenous peoples and local communities and organizations that have the least capacity, to respond to and recover from a disaster. On the other hand, indigenous peoples' traditional knowledge can play a vital role in building resilience by building community infrastructure and assets with local material, for which adequate capacity and inclusive design as well as decision making processes are critical (ILO, 2017).

There are two key points to consider: firstly, the poor are both most affected and tend to lack a voice and representation. The capacity of these communities to assess their own situation and to make the necessary effort to improve it is often grossly underestimated. The second point is that climate change adaptation is not the same as disaster relief. Trying to reduce the adverse impacts of natural hazards and climate change is necessary. It needs to be an integral part of national policies and strategies. Moreover, because adaptation is inherently local, much depends on the capacity of

communities to respond to climate change. This has far-reaching consequences in terms of participation, planning, information flow and fund allocation.

The two components have impact at both the national and local levels. It remains necessary to strengthen local and national institutions. Communities need to improve their understanding and reinforce their awareness for continued environmental and biodiversity protection, and effective response to climate change thus enhancing the protection of natural capital. This also entails ensuring strong mechanisms for consultation and participation of communities in planning, decision making and implementing such strategies. GI contribute to global sustainable development while building resilience in natural capital to reduce disaster risks and adapt to climate change (Figure 1).

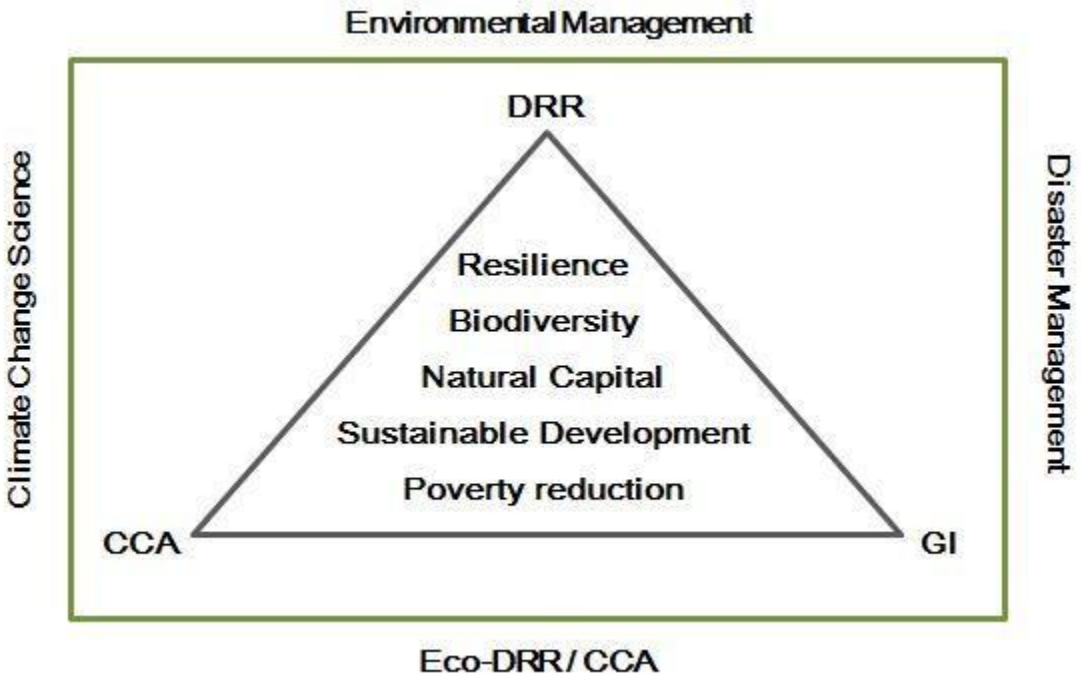

Figure 1. Inter-relations between Disaster Risk Reduction, Climate Change Adaptation and Green Infrastructures have both direct and indirect impacts on resilience, biodiversity conservation, Natural Capital, long term sustainable development and reduction of poverty (Adapted from Belle, 2017).

However, inadequate resources and poor governance often result in poor provision of public and community infrastructure, assets and services. Those services that would help to manage and cope by building climate resilience through water and soil conservations schemes, but also by supporting productive means of livelihoods through better irrigation and transportation systems, often receive limited attention in many of the countries of the region. At the same time, indigenous peoples' traditional knowledge often does not receive adequate focus as a means for building climate resilience at the local level.

Box 1. Community engagement and employment opportunities in restoring forest in Indonesia

Forest covers 60% of the Indonesia's land area, making it the third largest area of tropical rainforest in the world. Indonesia has set ambitious targets for reducing carbon emissions through deforestation and conserving forests as part of their commitments to the Paris Agreement. Indonesia has also aimed at maximizing the development impact and employment growth of adaption measures by building on community empowerment.

In 1995, the Mega Rice Project in Central Kalimantan resulted in over one million hectares of peat swamp drained for conversion to rice growing agriculture. After the peat was drained and canals built, it was found that the soil conditions were not suitable for intensive agriculture. Much of the peat land was either abandoned, turned into palm oil plantations or used by indigenous people for smallholder agricultural purposes. The degraded land burnt frequently, leading to trans boundary haze, high levels of greenhouse gas emissions and increased livelihood vulnerability.

Successful efforts to restore and conserve the area began in 2007. One of the key principles that contributed to successful socio-economic development was community empowerment and the participation in the design and implementation of activities. One such effort is the *Green Livelihood Access for Central Kalimantan's Inclusive Environmental Response to Climate Change (GLACIER)*, implemented in 2012-13. The project included the assessment of canal blocking, fire prevention, and agro forestry, and investments in environmental infrastructure. This led to the creation of some 4,993 work days and planting rubber, fruit and native forest trees over 166.9ha of land, with some 1600 metres of fire breaks. Rural access was enhanced through the construction of swampy crossings, motorbike trails and bridges, generating 4,743 work days. The project also contributed to green value chain development with some 25 fish ponds built, a series of trainings on entrepreneurship, rubber tapping and fish farming and the improvement of skills and knowledge of both rubber farmers and fishermen on production techniques while linking them to potential markets. The project created temporary jobs for community members and the infrastructure investments have improved the communities' access to livelihoods, public facilities, such as schools and community health clinics, as well as markets outside the villages. These outputs have helped overcome the many challenges to sustainable development in Central Kalimantan, including illegal logging, fire management, drainage of peat land, sustainable cultivation, plantation expansion, encroachment on protected and conservation areas and illegal mining.

The GLACIER project offered a sustainable strategy for GI investments that support climate change adaptation through community driven participatory decision-making that also maximized employment opportunities. By the end of the project, communities were self-reporting forest crimes to the project and sharing their genuine concerns about sustainable forest management.

Source: ILO (2013a)

How ecosystem-based /natural approaches can contribute to increased resilience

According to the IUCN publication "Nature-based Solutions to address global societal challenges" both green (GI) and natural infrastructures (NI) fall within Nature-based Solutions (NbS) infrastructure-related approaches (Cohen-Sacham, 2016). An NI approach could be seen to be restoring structure, function and composition of ecosystems to deliver ecosystem services, whereas a GI approach would enhance these aspects of ecosystems, to deliver these services. In both GI and NI approaches, hybrid solutions are commonly used, mixing hard infrastructure with ecosystem-based infrastructure. A GI could be applied at the urban and landscape scale while NI only landscape.

Green Works resonates well with the ecosystem-based approaches, especially when replacing or complementing "Grey Infrastructure" with GI, especially where it is easily possible, for example

through water and soil conservation schemes, flood and coastal defence, water treatment, tourism and recreational infrastructure. In all cases, the employment potential of these activities which contributes to natural resource management, and in most cases natural resource regeneration and protection, can be very high and can be designed in such a way that they are also inclusive of the communities that live and are dependent of these natural resources, offering an economic, social and environmentally responsible and sustainable way of responding to climate change.

The economic argument needs to be made on the benefits of EbA and Eco-DRR, which not only contributes to environmental protection, but can very well provide livelihood and incomes to the very same people that are at potential risk from its degradation. In some countries, the use of labour-based appropriate technologies with an optimized mix of equipment and employment-intensive approaches has proven that assets can be built in such a way that local communities are increasing their income potential, while using local materials and technologies, creating multipliers in the local economy. Furthermore, innovations based on local traditional knowledge can not only enhance resilience, but also provide opportunities to build enterprises and cooperatives, while also furthering decent green jobs, which in turn can play a vital role in empowering indigenous women and men. For instance, they can contribute to knowledge on sustainable agricultural practices, based on the sound management of the local biodiversity, adapted crop management and harvesting methods, storage, water resources and soil fertility preservation or improvement. But as mentioned earlier, their meaningful participation in inclusive design, decision making, implementation, monitoring of the impacts in using traditional and local technologies is an essential first step (ILO, 2017).

Box 2. Water Management and Sanitation for Dispersed Rural and Indigenous Communities

A water and sanitation project in Paraguay in 2015 was implemented to empower rural and indigenous populations from the Boqueron department to manage their own water resources and thus improve the quality of, and access to, public water and sanitation services.

During the project implementation besides creating direct and indirect jobs, two key elements were raised: i) how lo link traditional practices and local knowledge constructing appropriate facilities for water consumption and storage; and ii) awareness raising on the inherent role of women as traditional custodians of water as valuable resource for human life and the transit to acquire health and managerial skills for water provision systems as service operators and freeing their time from fetching water (unpaid care work).

The programme led to a drastic reduction in poverty due to greater access to water, participation of women, investment at the local level, and training of community guards. There was an increase in the number of organized communities implementing their projects through community contracting, in which 350 entrepreneurs were involved. In addition, a self-community identification of empirical technicians for the works was established.

Source: ILO (2011)

Large labour-based infrastructure programmes, in addition to protecting ecosystems, also has the potential to sensitize a large number of workers on the risks of environmental degradation and disaster risk, to also build their capacity to withstand climate change in a more sustainable manner. The involvement of indigenous peoples and local communities can support and contribute to the development of practical measures to protect, maintain and strengthen existing local infrastructure or building new climate resilient infrastructure. Moreover, gender responsive interventions can reduce the additional vulnerabilities faced by women, and can provide an opportunity for their enhanced participation in labour markets as well as access to decent jobs, better incomes and decision making processes.

Box 3. Green Works and Eco-DRR in Haiti

Haiti remains a fragile state, where most of the population live in a precarious and vulnerable situation. Haiti was ranked 163 (out of 186) in the 2015 Human Development Index. Extreme poverty and food insecurity are prevalent: 79% of the population live on less than USD 2 (purchasing power parity) a day, while 55% live in extreme poverty. Unemployment and under-employment are severe challenges. Recurring cyclones and hurricanes, with increasing threats from climate change and the intensity and frequency of natural disasters, will compound not only the environmental impacts, but also the social impacts, increasing vulnerabilities. Haiti is considered the most vulnerable of the Caribbean Islands, with indicators of vulnerability to cyclones of 12.9 out of a scale of 13.

In 2004, Hurricane Jeanne made landfall in Haiti and ripped through the shores of Gonaives causing heavy mudslides, killing more than 3,000 people in the country and leaving thousands more homeless. As a response, the affected population participated to restore the extremely fragile and weakened environment around the city in a programme managed by the ILO. In collaboration with EU, IOM, MINUSTAH, UNDP, NGO CHF/ US Aid and WFP, ILO worked closely with the Government of Haiti within the framework of an employment-intensive Green Works programme in Gonaives. This programme focused on creating jobs, protection of the environment through water and soil conservation, and building institutional capacity of local and community actors through the 12 federations that were created and that still exist to this day, focusing on the six micro-watersheds a source for 324,043 inhabitants. 9,000 individuals, of which some 75% were youth, directly benefited from the programme through labour-intensive activities (e.g. afforestation, anti-erosive ditches and gully erosion control measures, reinforcing bridges, river training of La Quinte river, among others).

14 years later this approach was found sustainable, with local communities still planting vetiver in a sustainable manner to prevent soil erosion and most of the federations still running showing that local capacities were increased. Communities were better sensitized about the risks of environmental degradation.

The Haitian example shows that employment-intensive schemes in watershed management, water and soil conservation, irrigation schemes and flood protection have proven to strengthen climate resilience while creating decent income and productive jobs.

Source: ILO (2004)

Infrastructure has and will continue to play a major role in local adaptation to climate change and investing in local infrastructure can help the very same communities to adapt and build their resilience. At the same time, these investments will continue to generate income and create jobs, and if done in a climate smart way, will also be able to reduce future climate change impacts. They will also contribute to a just transition (ILO, 2015) by using public works and employment programmes as a vehicle to link poverty eradication to ecosystem protection[101]. Equally, infrastructure will need to be built to higher standards and improved designs will be needed to better withstand the local impacts of climate change. In the infrastructure sector, one of the ways to ensure more environment-friendly job creation is to emphasize the potential of labour-based, employment-generating schemes.

A local and natural resource-based approach to infrastructure development can be a major contribution to more inclusive approaches, creating jobs and income, and assisting communities adapt to climate change. The use of local resources and eco-based technologies will not only make a

[101] Guidelines for a Just Transition towards environmentally sustainable economies and societies for all, ILO 2015.

positive contribution towards the environment, but will also create lasting multipliers in the local economy.

C. Typical ecosystem based approaches & technologies include the following:

Approach/technology examples	Socio-economic benefit	Environmental benefit	Risk reduction benefit	Employment opportunities
Irrigation and water and land resource management – control the variability and intensity of water and improve the quality of existing land (including building on traditional and local knowledge systems) e.g. encourage urban farms, solar powered drip irrigation systems	Productivity increase, More arable land, Food and water security, Income security through labour-based approaches	Erosion prevention, fertility preservation	Buffering of extreme temperatures, precipitation droughts, storm surges	Water purification and regulation such as improvement of riparian vegetation, wetland restoration, sustainable agriculture, land management
Reforestation or agroforestry - as an integrated approach to the production of trees and of non-tree crops or animals on the same piece of land. Agro-forestry can improve the resilience of agricultural production systems to current climate variability as well as long-term climate change using trees for intensification, diversification and buffering of farming systems (including building on traditional and local knowledge systems)	Economic diversification, productivity increase, Income security through labour-based approaches	Micro-climate regulation, provide habitats for species to promote biodiversity conservation, pollination, carbon sequestration, soil erosion reduction and fertility restoration	Erosion prevention, Buffering of extreme temperatures, precipitation droughts, storm surges	Ecosystem restoration, tree nurseries, tree planting and trimming
Flood control through strengthened coastal defences, ensure controlled runoff from road works and lift dykes and bunds (including building on traditional and local knowledge systems)	Income security through labour-based approaches	Manage the variability and frequency of water availability	Manage the loss of life, destruction of crops and infrastructure and decrease health problems caused by contaminated water.	Mangrove restoration, river training
Rural transport infrastructure (including green bridges, eco-ducts, wildlife passages, etc.)	Increased agricultural productivity and production, better access and integration to value-chains, local development, Income security through labour-based approaches	Can include features and designs to specifically to assist species movement which can result from compensation measures to recreate a physical connection which has been lost or compromised as a result of grey infrastructure	Manage accessibility, decrease in productivity, decrease in access to basic services also leading to health risks	Ecological corridors (hedgerows, wildlife strips) stepping stones, riparian river vegetation, green bridges, etc.

		construction (e.g. a motorway)		
Restoration of wetlands and floodplains	Income from recreation and tourism, Provision of navigable waterways	Support ecosystems, Water quality improvement, flood protection	Life support and cultural inheritance	Wetland restoration, alternative sources of income

A local resource-based approach to infrastructure development can be a major contribution to more inclusive approaches, creating jobs and income, and assisting communities adapt to climate change. The use of local resources and eco-based, traditional and local knowledge and technologies, including those of indigenous and local communities, will not only make a positive contribution towards the environment, but will also create lasting multipliers in the local economy.

D. Further action will be needed in the following areas:

- Call on knowledge providers, standards setters, and training institutions to support governments and other project proponents by sharing data, knowledge, tools, approaches, and other mechanisms for increasing the sustainability of infrastructure development, and building the capacity of stakeholders to effectively use the tools and approaches.
- Seek for a more strategic, proactive, systems-level approaches to infrastructure planning that ensure nature based solutions are carefully considered and integrated across different sectors, in close connection to the SDGs.
- Mainstreaming green infrastructures into national adaptation plans (NAP) and put them into practice to meet both climate change mitigation and adaptation objectives by reducing infrastructure emissions and building resilience.

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VI. Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for the forestry sector[102]

A. How is the forestry sector affected by climate and disaster risks?

There is no commonly agreed definition of the "forestry sector". Ideally, the sector should be defined to include all economic activities that mostly depend on the production of goods and services from forests. This would include commercial activities that are dependent on the production of wood fibre (i.e. production of industrial round-wood, wood-fuel and charcoal; sawn wood and wood based

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panels; pulp and paper; and wooden furniture). It would also include activities such as the commercial production and processing of non-wood forest products and the subsistence use of forest products. It could even include economic activities related to production of forest services (although it would be difficult to determine exactly which activities are dependent on forest services) (FAO, 2016).

We depend on forests for our survival, from the air we breathe to the wood we use. Forests offer watershed protection, prevent soil erosion, and mitigate climate change. Forests further provide shelter, water, and food and fuel security for people. Forests are home to 80% of the world's terrestrial biodiversity, and they also form the source of livelihoods for many different human settlements, including 70 million indigenous people. Forestry represents 5% of the employment that relies on ecosystem services (ILO, 2018).

All these activities are directly or indirectly at risk due to a rapidly changing climate. Forest ecological integrity, a common indicator to assess its composition, structure and functionality, can be impacted by climate-related events, in multiple ways, according to the IPCC fifth assessment report (AR5):

- "Within this century, magnitudes and rates of climate change represent high risk of abrupt and irreversible regional - scale change in the composition, structure, and function of terrestrial ecosystems" (IPCC, 2013).
- In addition, "increased tree mortality and associated forest dieback is projected to occur in many regions over the 21st century, due to increased temperatures and drought" (IPCC, 2013).
- "Forest dieback poses risks for carbon storage, biodiversity, wood production, water quality, amenity, and economic activity" (IPCC, 2013), and has effects on non-timber forest products and tourism.

Variations in climate conditions and extreme events can alter the dynamics of plant diseases, reproduction rates, population distribution of species with commercial value, ecological interactions between species, trophic relationships and resilience of ecosystems (Dunlop & Brown, 2008) as well as frequency and severity of forest fires. These influences occur at the same time as effects of direct human intervention such as land-use change or establishment of tree plantations. Scenarios of transformation will cause changes in productivity and new challenges, and will require new solutions from the forestry sector.

Ecosystem services provided by forests provide important economic value. However, their value and contributions to human well-being and economic activity are not captured by GDP or market exchanges. In Costa Rica, for example, the forestry sector contributes 0.1 per cent of GDP, as usually calculated from monetary transactions, but its contribution rises to 2.0 per cent when associated ecosystem services are considered. This is due to forests' contribution to agriculture and hydroelectric production (through water flow regulation), tourism (through aesthetic and cultural values) and the pharmaceutical sector (through biodiversity preservation) (ILO, 2018).

B. Why ecosystem-based approaches should be strengthened

Forests and climate are intrinsically linked: forest degradation is a source of greenhouse gas emissions that cause climate change; in contrast, sustainable management of forests is a mitigation and adaptation measure against this problem (WWF, 2018). Sustainable forest management "can increase the resilience of communities by providing fundamental economic, social and

environmental services such food, wood energy, shelter, fodder and fiber, as well as income and employment and the conservation of biodiversity" (FAO, 2016).

Around 70 million indigenous and tribal peoples are dependent on forests to meet their livelihood needs. While they face challenges from the impacts of climate change, their traditional knowledge and sustainable relationship with natural resources is fundamental for reducing emissions from deforestation and combating forest degradation (ILO, 2017).

In the context of disaster risk reduction, forests increase resilience within hydrologic and soil systems, configure natural barriers to retain storms and winds, provide stability to prevent future landslides, configure micro-climates against heat waves and reduce risks of other events. Forest management is therefore a key component of an integrated landscape, territorial and watershed approach that can ensure resilience to shocks but also bring other social, economic and environmental co-benefits (FAO 2017a).

Different management strategies are employed by foresters to aim for achieving a climate-resilient tree species composition. Due to the long rotation times, foresters are usually well-practiced at planning for the long-term, however not all strategies (e.g. introduction of exotic species, GMOs) are necessarily beneficial for ecosystem resilience and there is a high risk of maladaptation. Undertaking and accessing relevant research and implementing adaptive management are essential components of management planning.

C. Typical ecosystem based approaches, technologies and techniques within the forestry sector include the following:

Approach/technology examples	**Environmental benefit**	**Risk reduction benefit**	**Socio-economic benefit**
Forest conservation and management: strategies to manage ecosystems and increase forest integrity: Including new protected areas, management of strategic areas for carbon capture, increase governance of forest and planning of connectivity.	Population conservation, erosion prevention, ecological integrity.	Buffering of extreme temperatures and precipitation, flood risk reduction, storm risk reduction,	Income generation, job creation, provision of non-timber forest products
Sustainable Forest Management according with the study of opportunities, climatic threats and risks, futures scenarios of use of the land, local or regional priorities and markets.	Population conservation, ecological integrity	Buffering of extreme, temperatures and precipitation, flood risk reduction, storm risk reduction,	Income generation job creation, provision of wood, fuel and fiber
Forest landscape/ecological restoration: recovery, rehabilitation *and/or* restoration of degraded forests.	Population conservation, increase of ecological integrity, erosion prevention, carbon sequestration, climate regulation,	Buffering of extreme, temperatures and precipitation, flood risk	Income generation, job creation provision of wood, fuel and fiber

	recreation, fresh water provision, habitats for species	reduction, storm risk reduction,	

Source: (Lhumeau & Cordero 2012, WWF 2018)

D. Existing opportunities & required action

Entry points for strengthening ecosystem-based approaches for climate change adaptation and disaster risk reduction within the forestry sector include the following:

Entry points	Examples
Policies	Forest sector policy, UNFF, Bonn Challenge and Forest Landscape Restoration Pledges, REDD+ Strategies, National Adaptation Strategies, NDCs,
Planning instruments	Long- and medium-term forest sector plans, sustainable forest management strategies, skills development strategies, landscape-level planning
Command and control instruments	Forest certification and safeguards, forest law enforcement, governance and trade (FLEGT)
Economic and fiscal instruments	Timber taxes, payments for ecosystem services
Informative measures	Forest extension
Voluntary measures	Voluntary certification schemes (e.g. FSC)
Institutions	Ministries of Agriculture and Forestry, Forest industry, Forest user associations
Management types	Sustainable forest management, collaborative and participatory forest management.

Public Employment Programmes (PEPs) can provide alternative employment with better working conditions and income for poor persons who are engaged in deforestation and over-harvesting. PEPs can direct their labour towards environmentally sound activities such as reforestation and other agro-forestry activities, instead of environmental destruction (ILO, 2018).

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VII. Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for the water sector[103]

A. How is the water sector affected by climate and disaster risks?

Climate change has the potential to impact significantly on water resources. Approximately 80% of the world's population already suffers serious threats to its water security, as measured by indicators including water availability, water demand and pollution (Vörösmarty et al ., 2010). Climate change can alter the already precarious availability of water and therefore threaten water security. The IPCC states in the 5th Assessment Report AR5 (2014) that changing climate over the past several decades can be associated with changes in key components of the hydrological cycle. Changes in precipitation (annual and seasonal patterns, intensities, and extremes) have been observed around the world. Climate change is also projected to (i) reduce renewable surface water and groundwater resources significantly in most dry subtropical regions; (ii) increase the frequency of meteorological droughts (less rainfall) and agricultural droughts (less soil moisture) in presently dry regions; (iii) increase the frequency of short hydrological droughts (less surface water and groundwater) in dry regions; and (iv) negatively impact freshwater ecosystems by changing streamflow and water quality.

These alterations can result in changes in annual and seasonal flow regimes, groundwater–surface water interactions and, therefore, affect raw water availability, which can also affect water quality and biodiversity. This will also exacerbate competition for water among different users and sectors. It is important to remember that water is the agent that delivers most of the impacts of climate change to society, for example to the energy, agriculture, industry and transport sectors.

Even though water moves through the hydrologic cycle, it is a locally variable resource, and vulnerabilities to water-related hazards such as floods and droughts differ between regions. Further, changes in the hydrologic cycle due to climate change can lead to diverse impacts and risks on people and nature, and they are conditioned by and interact with non-climatic drivers of change and water-management responses (e.g. disproportionate and inequitable water allocation to the multiple users and sectors in basins).

B. Why ecosystem-based approaches should be strengthened

[103] The development and authorship of the sectoral brief "Ecosystem-based approaches to climate change and disaster risk reduction – opportunities for the water sector" was led by the World Wide Fund for Nature.

Ecosystems, and in particular forests, wetlands and grasslands, play an important role in the global water cycle. Recognizing this role and the interactions between the two is critical to managing water resources and basins sustainably. The water sector must deal with the complex task of securing and balancing water for people, industry, food production, navigation, hydropower and the environment (and others). Yet, the dependency of human wellbeing on ecosystems has been given insufficient attention whence, historically, narrow economic pursuits have been given priority over other concerns. On top of that, there are many other stresses than climate change on freshwater resources, with water quality and availability impacted by growing demand, population growth, unsustainable consumption, wasteful practices, sea-level rise and pollution.

Water security is defined by United Nations as "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability" (UN-Water 2014). Ecosystem based approaches are a central component of a water security approach, allowing the possibility to maintain and enhance ecosystem functions, aiming to maximize and optimize the total value of the ecosystem functions by conserving and even enhancing these functions for the next generations. Concepts, like Sustainable Drainage Systems (SuDS), Natural Water Retention Measures (NWRM) are gaining importance within holistic water management strategies. Therefore, an Ecosystem-based adaptation and Eco-DRR approach within the water security agenda can help the water sector in multiple ways such as:

- Increasing water quantity and enhancing water quality: Ecosystems, such as forests and wetlands play a crucial role in water provision and regulation. They store and gradually release water during drier periods and create a favorable microclimate. This helps to reduce costs for water pumping. Buffer strips and ground cover help to prevent a siltation of creeks and rivers.
- Minimizing impacts from extreme weather events and climate variability: Inland water ecosystems including rivers and meadows have a significant risk reduction function for extreme rain and flood events by absorbing and holding excessive water.
- Enhancing the ecological integrity and functionality that sustains water regulation: A holistic management of ecosystems within a landscape, by using integrated watershed management approaches, significantly strengthens water regulation services.
- Providing sustainable development benefits: Ecosystems help to secure and to filter clean water for domestic consumption and sanitation, food production and other purposes. If well combined with build infrastructure, they strengthen zero hunger policies, sustainable communities, good health and well-being.
- Contributing to the overall climate resilience of societies both in rural and urban areas.

C. Typical ecosystem based approaches, technologies and techniques within the water sector include the following:

Approach/technology examples	Environmental benefit	Risk reduction benefit	Socio-economic benefit
Green infrastructure in urban areas and their hinterland (including the use of green roofs, porous pavements, and urban parks) can improve storm water management and reduce flood risk in cities, and can moderate the heat-island effect, as well as having co-benefits for mitigation. Many ecosystem services that are relevant to the city's resilience may be provided well outside its geographical area, and hence natural buffers in the rural hinterland of the city and wider surrounding landscape should be considered, as well as cooperation with municipalities and citizens there to establish a regional approach of land use planning to protect the buffers.	Improved microclimate, improved habitat for urban species	Flood protection, reduction of extreme weather event risks	Risk reduction for people and infrastructure, new recreation areas, Aesthetic appreciation and inspiration for culture, improved well-being (health) New opportunities for employment, innovations, public/private partnerships…
Strategic selection of the size, location, and layout of Protected Areas	Conservation of biodiversity, carbon capture and sequestration	Buffer zones, Flood protection, secured water provisioning, reduction of extreme weather event risks	Improved water provisioning, quality and security, benefits to livelihoods through sustainable use (tourism, biodiversity-derived products).
Reduction of Non-Climate Stresses, promote effective and equitable governance and Restoration of Degraded Ecosystems	Conservation of biodiversity, carbon capture and sequestration	Sustainable management of natural resources	Improved livelihoods of local communities
Landscape and Watershed Management and river basin management by including a multitude of ecosystems, land use systems and stakeholders relevant for improving water regulation and provision	Fresh water provisioning, improved water regulation, carbon sequestration, provision of habitats for species	Flood protection, drought risk reduction	Improved water provisioning and quality, for people (consumption, sanitation) and production sectors (e.g. agriculture, industries, energy production)
Restoration of wetlands, artificial wetlands - Restoring degraded, damaged, or destroyed wetlands or creating artificial wetlands reduces discharge volumes by providing retention areas, enhances biodiversity and water quality, and support livelihoods of local communities. Wetlands and other natural ''sponges'' do not, however, influence the peaks of extreme flood events once soils are completely saturated.	Fresh water provision and sanitation, improved water regulation, reduced carbon emissions (peatlands), provision of habitats for species	Flood protection, drought risk reduction, storm buffering	Improved water provision and quality, for people (consumption, sanitation) and production sectors (e.g. agriculture, fisheries, industries, energy production)

Restoration of flood plains to (re-)create natural retention areas for flood water. Also, the tendency of communities to live in riverbank areas should be reduced and land use plans may have to be revised and adapted.	Improved water regulation, erosion prevention, provision of habitats for species	Flood protection	Risk reduction for people, infrastructure and industry, Improved water provision and quality, for people (consumption, sanitation) and production sectors (e.g. agriculture, industries, energy production)

D. Existing opportunities & required action

Several entry points for strengthening ecosystem-based approaches for climate change adaptation and disaster risk reduction within the water sector do exist already and include the following:

Entry points	Examples
Policies	Water security policies, Basin, national and subnational Climate Change Adaptation policies, Disaster Risk Reduction Policies, National Climate Change Mitigation plans (as many ecosystems have ecosystem services that serve both mitigation and adaptation (e.g. mangroves, peatlands)
Planning instruments	Water sector plans, Watershed plans, runoff master plans, Development planning (e.g. engineering sector, agriculture sector), Urban planning, Forestry (peatlands and mangroves), Integrated Coastal Zone Management plans, Spatial Plans, Protected areas plans, integrated river basin plans, wetland management plans
Command and control instruments	water standards, environmental and social impact assessments, ministerial guidelines (e.g. for coastal zone management projects)
Economic and fiscal instruments	Payment for ecosystem services, ecological fiscal reform, environmental taxes, Water Funds
Informative measures	Education and extension programmes, participatory planning, Water and Nexus Dialogues
Voluntary measures	Water Stewardship
Institutions	Water regulating bodies, water providers, Ministry of Environment, Ministry of Agriculture, Ministry of Energy, Planning Ministry, Alliance for Water Stewardship, civil society networks
Management types	Landscape restoration, Integrated Water Resource Management, Integrated Coastal Zone Management, Transboundary water cooperation

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Annex I: Glossary[104]

Term	Definition/description and source
Adaptation	In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate (IPCC)
Adaptive capacity	The combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities (IPCC) Builds the capacity of people to adapt to climate change impacts through maintaining and enhancing their asset/capital sets, addressing entitlements, encouraging innovation, giving greater access to information, establishing flexible governance/decision-making, related to biodiversity and ecosystem services (IUCN)
Agroforestry	The practice of integrating trees into agriculturally productive landscapes (World Agroforestry Centre)
Biological diversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems
Building with Nature	A new approach to hydraulic engineering that uses the forces of nature to benefit environment, economy and society (Ecoshape)
Capacity	The combination of all the strengths, attributes, and resources available to an individual, community, society, or organization, which can be used to achieve established goals (IPCC)
Climate change	A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC)
Climate change adaptation	The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects *(*IPCC AR5)
Climate extreme	The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events are referred to collectively as "climate extremes." (IPCC)
Climate risk management	An integrated approach that advances climate-sensitive decision-making. It focuses on development outcomes that are dependent on climatic conditions, such as in agriculture, water resources, food security, health, the environment, urbanism and livelihoods (UNDP)
Climate-smart agriculture	CSA contributes to the achievement of sustainable development goals. It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges. It is composed of three main pillars: 1) sustainably increasing agricultural productivity and incomes; 2) adapting and building resilience to climate change; 3) reducing and/or removing greenhouse gases emissions, where possible (FAO)

[104] Updated from CBD Technical Series No. 85 (Lo 2016)

Community-based adaptation	A community-led process, based on communities' priorities, needs, knowledge and capacities, which should empower people to plan for and cope with the impacts of climate change (IIED)
Community-based natural resource and risk management	An approach that combines the sustainable management of natural resources and risks in a given area. It combines the concept of "co-management" of natural resources with community-based disaster risk reduction.
Desertification	Defined as land degradation in drylands, leading to a condition of significantly reduced fertility and water holding capacity. Desertification is a reversible condition of the earth's surface, as opposed to aridity, which is a climatic condition (UNCCD)
Disaster	A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources (UNISDR) Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery (IPCC)
Disaster risk	The likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recover (IPCC)
Disaster risk management	Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development (IPCC)
Disaster risk reduction	Denotes both a policy goal or objective, and the strategic and instrumental measures employed for anticipating future disaster risk; reducing existing exposure, hazard, or vulnerability; and improving resilience (IPCC) The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events (UNISDR 2009, p. 10-11)
Drought	A period of abnormally dry weather long enough to cause a serious hydrological imbalance. Drought is a relative term, therefore any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, shortage of precipitation during the growing season impinges on crop production or ecosystem function in general (also termed agricultural drought), and during the runoff and percolation season primarily affects water supplies (hydrological drought). A megadrought is a very lengthy and pervasive drought, lasting much longer than normal, usually a decade or more. (IPCC)
Ecosystem approach	Strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way (CBD)
Ecosystem-based adaptation	Incorporates biodiversity and ecosystem services into an overall adaptation strategy to help people to adapt to the adverse effects of climate change (CBD) Uses biodiversity and ecosystem services as part of an overall adaptation strategy to help people and communities adapt to the negative effects of climate change at local, national, regional and global levels (UNEP) Any initiative that reduces human vulnerabilities and enhances adaptive capacity in the context of existing or projected climate variability and changes through sustainable management, conservation and restoration of ecosystems. (IUCN)

Ecosystem-based disaster risk reduction	Sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim to achieve sustainable and resilient development (Estrella and Saalismaa 2013) Decision-making activities that take into consideration current and future human livelihood needs and bio-physical requirements of ecosystems, and recognize the role of ecosystems in supporting communities to prepare for, cope with and recover from disaster situations. Sustainable ecosystem management for disaster risk reduction is based on equitable stakeholder involvement in land management decisions, land-use-trade-offs and long-term goal setting. (IUCN)
Ecosystem function	The flow of energy and materials through the biotic and abiotic components of an ecosystem. It includes many processes such as biomass production, trophic transfer through plants and animals, nutrient cycling, water dynamics and heat transfer. (IPBES, adapted from http://www.ecosystemservicesseq.com.au/ecosystem-functions.html)
Ecosystem health	Ecosystem health is a metaphor used to describe the condition of an ecosystem, by analogy with human health. Note that there is no universally accepted benchmark for a healthy ecosystem. Rather, the apparent health status of an ecosystem can vary, depending upon which metrics are employed in judging it, and which societal aspirations are driving the assessment. (IPBES)
Ecosystem services	The benefits people obtain from ecosystems, which have been classified by the Millennium Ecosystem Assessment as: *Provisioning* services, such as supply of food, fibre, timber and water; *regulating* services, such as carbon sequestration, climate regulation, water regulation and filtration, and pest control; *cultural* services, such as recreational experiences, education and spiritual enrichment and *supporting* services, such as seed dispersal and soil formation; (Millennium Ecosystem Assessment 2005)
Exposure	The presence of people; livelihoods; species or ecosystems, environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected (IPCC)
Extreme weather	See "Climate extreme"
Evaluation	The systematic and objective assessment of an ongoing or completed project, programme or policy, its design, implementation and results. An evaluation should also assess the effects of any positive or negative changes in the developmental and environmental context of an EbA measure (GIZ)
Flood	The overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas that are not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods, and glacial lake outburst floods (IPCC)
Food security	Occurs when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preference for an active and healthy life (FAO). Household level food security is complex, trans-boundary and multifaceted including biophysical, socio-economic, political, demographic, gender and other dimensions. In general, three key indicators are used to measure the level of food insecurity, namely: availability, access and utilization (UNCCD)
Gender analysis	A gender analysis examines how gender relations affect different problems and proposed solutions. It involves assessing gender norms, roles and relations in order to establish a baseline with regard to gender differences and to expose where there is gender inequality.
Gender equality	Gender equality refers to equal rights, responsibilities and opportunities for women and men. Achieving gender equality means ensuring that individuals' choices, options and autonomy are not constrained because of their gender. Gender equality implies that women and men, in their differences and similarities, are equally valued and respected by the society they live in.
Gender mainstreaming	Gender mainstreaming is a globally recognized strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring, and evaluation of policies and programmes in all political, economic, and

	societal spheres. This is to ensure that women and men benefit equally from processes of development, and that inequality is not perpetuated.
Green infrastructure	Green infrastructure a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, green infrastructure is present in rural and urban settings. (European Commission)
Hazard	The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources (IPCC)
Impacts	Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as *consequences* and *outcomes*. The impacts of climate change on geophysical systems, including floods, droughts, and sea level rise, are a subset of impacts called physical impacts. (IPCC 2014)
Incremental adaptation	Refers to actions where the central aim is to maintain the essence and integrity of the existing technological, institutional, governance, and value systems, such as through adjustments to cropping systems via new varieties, changing planting times, or using more efficient irrigation.
Integrated Risk Management	Integrating Disaster Risk Reduction (DRR), Ecosystem Management and restoration (EMR) and Climate Change Adaptation (CCA) to strengthen and protect livelihoods of vulnerable communities, as applied by Partners for Resilience
Integrated water resource management	A process that promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP 2000)
Landscape	Landscapes are distinct geographical areas or properties uniquely representing the combined work of nature and of man, illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal (World Heritage Committee)
Landslide	A mass of material that has moved downhill by gravity, often assisted by water when the material is saturated. The movement of soil, rock, or debris down a slope can occur rapidly, or may involve slow, gradual failure. (IPCC)
Land use planning	Land-use planning means the systematic assessment of physical, social and economic factors in such a way as to encourage and assist land users in selecting options that increase their productivity, are sustainable and meet the needs of society. (FAO)
Least developed country	A country that exhibits the lowest indicators of socioeconomic development, with the lowest Human Development Index ratings of all countries in the world.
Low-regrets adaptation options	Low-regrets adaptation options are those actions that could potentially deliver net socioeconomic benefits to local communities and ecosystems whatever the extent of future climate change. The low-regrets approach is an important part of EbA and focuses on maximizing positive and minimizing negative aspects of nature-based adaptation strategies and options. (definition adapted from a joint UNEP-UNDP-IUCN working definition of "no-regrets" adaptation)
Maladaptation	An action or process that increases vulnerability to climate change-related hazards. Maladaptive actions and processes often include planned development policies and measures that deliver short-term gains or economic benefits but lead to exacerbated vulnerability in the medium to long-term (UNDP). Maladaptation can also include trade-offs or benefitting one group at the expense of another.
Mitigation (of climate change)	A human intervention to reduce the sources or enhance the sinks of greenhouse gases (IPCC)

Mitigation (of disaster risk and disaster)	The lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability (IPCC).
Monitoring	Systematically collecting and documenting data on specified indicators with the aim of tracking change. This enables planners and practitioners to improve adaptation efforts by adjusting processes and targets, and can be carried out during implementation throughout the lifetime of the adaptation/risk reduction intervention (UNFCCC).
Multi-criteria analysis	A structured approach used to determine overall preferences among different alternative options, where the options accomplish several objectives that may not always complement one another. In MCA, desired objectives are specified and corresponding attributes or indicators are identified. The measurement of these indicators is often based on a quantitative analysis (through scoring, ranking, and weighting) of a wide range of qualitative impact categories and criteria.
Nairobi work programme (UNFCCC)	A mechanism under the UNFCCC to facilitate and catalyse the development and dissemination of information and knowledge that would inform and support adaptation policies and practices. Its implementation has been coordinated by the SBSTA, under the guidance of the Chair of the SBSTA and with assistance from the secretariat, and with contributions from Parties and other adaptation stakeholders. Through its diverse range of modalities, the Nairobi work programme provides unique opportunities for linking relevant institutions, processes, resources and expertise outside the Convention to respond to adaptation knowledge needs arising from the implementation of the various workstreams under the Convention and identified by Parties.
National adaptation plan (UNFCCC)	Established under the Cancun Adaptation Framework, the NAP provides Parties to the UNFCCC with the means of identifying medium- and long-term adaptation needs and developing and implementing strategies and programmes to address those needs.
National biodiversity strategy and action plan (CBD)	The principal instruments for implementing the CBD at the national level (Article 6). The Convention requires countries to prepare a national biodiversity strategy and action plan (or equivalent instrument) and to ensure that this strategy is mainstreamed into the planning and activities of all those sectors whose activities can have an impact (positive and negative) on biodiversity.
National report (CBD)	National reports provide information on measures taken for the implementation of the CBD, and their effectiveness. Parties submitted their fifth national reports in response to decision X/10 of the Conference of the Parties (COP) to the CBD.
Nature-based Solutions	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. (IUCN)
Precautionary approach	The precautionary approach is Principle 15 of the Rio Declaration on Environment and Development, adopted by the United Nations Conference on Environment and Development in Rio de Janeiro (1992). It states that: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."
Preparedness	The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions (UNISDR)
Recovery	The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors (UNISDR)
Resilience	The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner,

	including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions (IPCC)
Risk	The combination of the probability of an event and its negative consequences (UNISDR). Risk is commonly expressed as a function of exposure, the conditions of vulnerability that are present, and the magnitude and frequency of a hazard event (Sudmeier-Rieux 2013).
Social-ecological system	A coupled system of humans and nature that constitutes a complex adaptive system with ecological and social components that interact dynamically through various feedbacks (Stockholm Resilience Centre)
Spatial planning	A method used to influence the future distribution of activities in space (European Commissio). Spatial planning is critical for delivering economic, social, and environmental benefits by creating more stable and predictable conditions for investment and development, by securing community benefits from development, and by promoting prudent use of land and natural resources for development (WWF).
Storm surge	The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place. (IPCC)
Sustainable land and water management	The adoption of land use systems that, through appropriate management practices, enables land users to maximize the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources. SLWM includes management of soil, water, vegetation and animal resources. It involves a holistic approach that integrates social, economic, physical and biological assets. SLWM encompass other approaches such as integrated natural resource management, integrated water resource management, eco-agriculture and sustainable forest management (SFM), and many facets of sustainable agriculture, agriculture (GEF 2011).
Synergies	Linking processes in a way that increases the effects of the sum of the joint activities beyond the sum of individual activities, and thus making efforts more effective and efficient.
Theory of Change	Process of project planning and evaluation which maps the relationship between a long-term goal of a project and the intermediate and early changes that are required to bring it about. The approach emphasizes the theory and assumptions underlying the pathway of change from the implementation of selected interventions and activities to intended outcomes. (Conservation International)
Transformational adaptation	Seeks to change the fundamental attributes of systems in response to actual or expected climate and its effects, often at a scale and ambition greater than incremental activities. It includes changes in activities, such as changing livelihoods from cropping to livestock or by migrating to take up a livelihood elsewhere, and also changes in our perceptions and paradigms about the nature of climate change, adaptation, and their relationship to other natural and human systems. (IPCC AR5)
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC AR5) The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard (UNISDR)
Women's empowerment	Women's empowerment is the process of supporting women in gaining more control over their own lives: it involves support at the personal level, such as self-esteem and awareness development, in conjunction with measures to help women challenge the broader barriers to their autonomy, such as gender-discriminatory laws and cultural practices.

Annex II: Policies related to EbA and Eco-DRR

Table A1: Policy instruments and frameworks related to EbA and Eco-DRR

Framework	Policy Instrument	Description
CBD Strategic Plan for Biodiversity	Strategic Goal B *Reduce direct pressures on biodiversity and promote sustainable use*	Target 5: Rate of loss of all natural habitats halved Target 7: Areas under agiculture, aquaculture and forestry are managed sustainably including biodiversity conservation Target 10: Multiple anthropogenic pressures on coral reefs and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized to maintain integrity and functioning
	Strategic Goal C *Improve status of biodiversity by safeguarding ecosystems, species and genetic diversity*	Target 11: Protected areas – terrestrial, inland water, coastal and marine water landscapes and seascapes Target 13: Genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained
	Strategic Goal D *Enhance the benefits to all from biodiversity and ecosystem services*	Target 14: Ecosystems that provide essential services including water and that contribute to health livelihoods and wellbeing are restored and safeguarded Target 15: Ecosystem resilience and contribution of biodiversity to carbon stocks enhanced, including restoration of degraded ecosystems, mitigation, adaptation, and desertification
Sustainable Development Goals	SDG 13 Take urgent action to combat climate change and its impacts	- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries - Integrate climate change measures into national policies, strategies and planning
	SDG 6 Ensure access to water and sanitation for all	- achieve universal and equitable access to safe and affordable drinking water for all - implement integrated water resources management at all levels, including through transboundary cooperation as appropriate - , protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
	SDG 2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture	- ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality
	SDG 1: End poverty in all its forms everywhere	- Build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters
	SDG 3: Ensure healthy lives and well-being for all at all ages	- Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks

Framework	Policy Instrument	Description
	SDG 11: Make cities inclusive, safe, resilient, and sustainable	- Substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework
	SDG 14: Conserve and sustainably use the oceans, seas and marine resources	- sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans
	SDG 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss	- Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements
Sendai Framework	Prioritizes ecosystem based approaches to build resilience and reduce disaster risk	- Priority Action 1: The role of ecosystems will need to be taken into account in disaster risk assessments - Priority Action 2: Strengthening risk governance - Priority Action 3: Strengthen investments in disaster resilience
Paris Agreement:	Parties established the 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)	Preamble: - Recognizing the importance of the conservation and enhancement, as appropriate, of sinks and reservoirs of the greenhouse gases referred to in the Convention, - Noting the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth, and noting the importance for some of the concept of "climate justice", when taking action to address climate change, Article 7, paragraph 2 - Parties recognize that adaptation is a global challenge faced by all with local, subnational, national, regional and international dimensions, and that it is a key component of and makes a contribution to the long-term global response to climate change to protect people, livelihoods and ecosystems, taking into account the urgent and immediate needs of those developing country Parties that are particularly vulnerable to the adverse effects of climate change. Article 7, paragraph 5 - Parties acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of

Framework	Policy Instrument	Description
		indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate.
CBD Decisions	X/33	The Conference of the Parties called for implementation of ecosystem-based approaches for adaptation, including sustainable management, conservation and restoration of ecosystems
	XII/20	Calls on governments and other relevant organisations to promote EbA and Eco-DRR approaches and integrate these into their respective policies and programmes on Biodiversity and Climate Change and DRR, recognizing that while biodiversity and ecosystems are vulnerable to climate change, the conservation and sustainable use of biodiversity and restoration of ecosystems can play a significant role in climate change mitigation and adaptation, combating desertification and disaster risk reduction.
UNFCCC Cancun Adaptation Framework	National Adaptation Plans (NAPs)	Enables Parties to formulate and implement national adaptation plans as a means of identifying medium- and long-term adaptation needs and developing and implementing strategies and programmes to address those needs
CBD Article 6	National Biodiversity Strategies and Action Plans (NBSAPs)	Urges Parties and other governments to use revised and updated NBSAPs as instruments for the integration of biodiversity targets into national development and poverty reduction policies and strategies, economic sectors and spatial planning processes (decision X/2). Parties were also invited to integrate ecosystem-based approaches for adaptation into relevant strategies, including adaptation strategies and plans, national action plans to combat desertification, NBSAPs, poverty reduction strategies, disaster risk reduction strategies and sustainable land management strategies (decision X/33).
UNCCD Decisions	Land degradation neutrality (LDN) target	The amount of healthy and productive land should stay stable starting in 2030. Parties also agreed to develop indicators for measuring progress in LDN and for enhancing land resilience to climate change and halting biodiversity loss linked to ecosystem degradation
Ramsar Convention Resolutions	Resolution XII.13 on Wetlands and Disaster Risk Reduction	Encourages Parties to integrate wetland-based disaster risk management and climate change adaptation into development policies and planning at all levels of government, including in vulnerability analysis, poverty reduction strategies and natural resource management plans (including land-use and water-use plans) and sectors, and in multi-sector policies and plans
	Resolution VIII.35 The Impact of natural disasters, particularly drought, on ecosystems	Encourages Parties with Ramsar sites affected by drought or other natural disasters to use the mechanisms and benefits of the Montreux Record by placing such sites that are in need of priority conservation action on the Record and, as appropriate,

Framework	Policy Instrument	Description
		seeking national and international assistance to support their conservation action.
	Draft resolution on cultural values, local communities and climate change mitigation and adaptation in wetlands	Encourages integrating wetland cultural services into all relevant national and regional policies, including in Poverty Reduction Strategies, National Climate Change Strategies, Sustainable Development Goals
	Draft resolution on the rapid assessment of wetland ecosystem services	Encourages the application of the Rapid Assessment of Wetland Ecosystem Services in order to assess ecosystem services, contribute to the description of the ecological character of Ramsar Sites, and ensure the maintenance of these services in their management processes, acknowledging that the important ecosystem services that wetlands provide have direct relevance to the achievement of the Sustainable Development Goals including those related to the reduction of natural disasters and adaptation to climate change, biodiversity and sustainable use of ecosystems.
Ramsar Convention Policy Brief	Wetlands for disaster risk reduction: Effective choices or resilient communities	- Wetlands and the benefits they provide should be considered in disaster risk assessments and their impacts should be considered across entire river basins or coastal zones rather than just political and administrative boundaries; - Development planning and land use changes should be considered when assessing disaster risk patterns and wetland degradation; and - Rapid environmental assessments conducted after a disaster should consider options for wetland restoration as a contribution to wetland recovery.

Annex III: Existing Guidelines and Principles

Table A2: Examples of existing guidelines and principles for EbA and Eco-DRR and related practices that were considered for the development of the principles and safeguards presented in this document

Guidelines	Description/Aims	Target Audience
Principles and Guidelines for Integrating Ecosystem-based Approaches to Adaptation in Project and Policy Design (Andrade et al. 2011)	Set of draft principles and guidelines to act as a foundation for planning and implementing EbA	Planners/ implementers; Financial institutions
EbA Decision Support Framework: From Principles to Practice (UNEP 2012)	Framework includes setting adaptive context, selecting adaptation options, designing for change, and adaptive implementation.	Mid-level decision-makers and planners at national / local level
Operational Guidelines on EbA (GEF 2012)	Aimed at clarifying criteria for EbA projects and at providing practical, operational advice; guidelines also complement review criteria applied to projects and programmes submitted for funding approval	EbA implementing agencies, executing agencies and project proponents seeking LDCF and SCCF funding
Operational Framework for Ecosystem-based Adaptation (WWF 2013)	Framework aims to provide robust and detailed guidance for planning, assessment and implementation of EbA measures. Vulnerability-based, begins with vulnerability assessment of social-ecological systems, then identification and prioritization of options, implementation, and mainstreaming EbA into national policies and programmes	Decision-makers involved in subnational decision making
Advancing Implementation of the Sendai Framework for Disaster Risk Reduction (2015-2030) through Ecosystem Solution (PEDRR 2016)	Highlights opportunities for implementing integrated ecosystem management and risk reduction strategies in countries and communities, and outlines a roadmap for advancing implementation of the SFDRR through Eco-DRR/CCA and reflects on the scope for promoting Eco-DRR/CCA as an integrated strategy that delivers across the 2030 Sustainable Development Agenda	Policy-makers, implementers
A Landscape Approach for Disaster Risk Reduction in 7 steps (CARE Netherlands and Wetlands International 2017)	Synthesizes the main characteristics of the landscape approach and suggests seven steps when adopting a landscape approach. Although this paper focuses specifically on disaster risk reduction to help increase community resilience, the landscape approach is applicable to other types of programming.	Policy-makers, implementers
Guidelines for EbA in South Africa (Republic of South Africa, in draft 2017)	Outlines actions for identifying, developing and implementing EbA and defines EbA cornerstones, high-level principles, criteria, and safeguards	Practitioners, funders, researchers, policy makers

Guidelines	Description/Aims	Target Audience
EbA: Question-based guidance for assessing effectiveness (Reid et al. 2017)	Describes a process, based around asking a detailed set of questions, that can be used by project managers and researchers to shape project design, assess progress, or draw conclusions effectiveness.	Project managers, researchers
Ethical Principles on Disaster Risk Reduction and People's Resilience (Prieur 2012)	European and Mediterranean Ethics Charter on resilience to major disasters, approved by the Council of Europe, with the aim to improve preparedness and deal with ethical problems concerning victims of disasters	Policy-makers
Making Ecosystem-based Adaptation Effective: A Framework for Defining Qualification Criteria and Quality Standards (FEBA technical paper developed for UNFCCC -SBSTA 46) (FEBA 2017)	Practical assessment framework for designing, implementing and monitoring EbA measures by proposing a set of elements, qualification criteria and quality standards and example indicators	Policy-makers and practioners
Implementing nature-based flood protection: Principles and implementation guidance. (World Bank 2017)	Present five principles and implementation guidance for planning, such as evaluation, design, and implementation of nature-based solutions for flood risk management as an alternative to or omplementary to conventional engineering measures.	Professionals in risk management and climate adaptation, NGOs, donors, and international organizations.
Nature-based Solutions to address global societal challenges (Cohen-Shacham et al. 2017)	Proposes a definitional framework for nature-based solutions (NbS), which includes EbA/Eco-DRR. The report includes a set of general principles for any NbS intervention and considers several potential parameters that can be used to build an operational framework, on the basis of which the efficiency, effectiveness and sustainability of NbS interventions can be systematically assessed.	Conservation and development practitioners, policy makers and researchers, as well as civil society organizations.
Ecoshape Building with Nature design guideline https://www.ecoshape.org/en/design-guidelines/	Aims to give guidance on how to introduce and integrate Building with Nature into water infrastructure developments, including the Building with Nature principles and the five general design steps that are involved.	Contractors, engineering companies, research institutions, governments and NGOs
When not every response to climate change is a good one: Identifying principles for sustainable adaptation (Eriksen et al. 2011)	Proposes normative principles to guide responses to climate change, avoid maladaptation and promote sustainable adaptation: 1. Recognize context for vulnerability, 2. Acknowledge differing values and interests, 3. Integrate local knowledge into adaptation, 4. Consider feedbacks between local and global processes	Policy-makers