United Nations

FCCC/SBSTA/2017/3

Framework Convention on Climate Change

Distr.: General
27 March 2017

Original: English

Subsidiary Body for Scientific and Technological Advice
Forty-sixth session
Bonn, 8–18 May 2017

Item 3 of the provisional agenda
Nairobi work programme on impacts, vulnerability and adaptation to climate change

Adaptation planning, implementation and evaluation addressing ecosystems and areas such as water resources

Synthesis report by the secretariat

Summary

Healthy ecosystems play an essential role in increasing the resilience of people to climate change. Climate change, however, can damage the ability of ecosystems to provide life-supporting services and to protect society from climate-related stressors. Adaptation to climate change therefore needs to strengthen the resilience of both communities and ecosystems. Ecosystem-based adaptation (EbA) – the use of biodiversity and ecosystem services to adapt to the adverse effects of climate change – provides such adaptation solutions. EbA initiatives also contribute to climate change mitigation by reducing net emissions from ecosystem degradation and by enhancing carbon sequestration.

Countries should consider EbA in their approach to adaptation, including in national adaptation plans. EbA has demonstrated potential to increase social and ecological resilience to climate change and adaptive capacity in the long term and in an economically viable way. The evidence of the effectiveness and economic viability of EbA, although largely anecdotal and project-derived, is promising. Quality data and tools are essential for determining the economic viability of EbA measures. Institutional arrangements, finance and capacity-building also play a critical role in ensuring the effectiveness of EbA.

This synthesis report was prepared under the Nairobi work programme on impacts, vulnerability and adaptation to climate change in collaboration with members of Friends of EbA. Information in 45 submissions served as primary inputs.

GE.17-04859(E)

1704859

Contents

I. Introduction

1. **Healthy ecosystems play an essential role in helping people to adapt and increase resilience to climate change by: providing water, food, fuel and fibre; promoting soil formation and nutrient cycling; and providing recreational and spiritual services**. In this context, resilience is defined as the capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential functions, identity and structure, while also maintaining the capacity for adaptation, learning and transformation.[1]

2. This document provides a synthesis of information on: lessons learned and good practices in relation to adaptation planning processes that address ecosystems and interrelated areas such as water resources; lessons learned and good practices in monitoring and evaluating the implementation of ecosystem-based adaptation (EbA); and tools for assessing the benefits of mitigation and adaptation towards enhancing resilience and reducing emissions that EbA provides. This document will be considered by the Subsidiary Body for Scientific and Technological Advice (SBSTA) at its forty-sixth session.[2]

3. This document was prepared in collaboration with Nairobi work programme on impacts, vulnerability and adaptation to climate change (NWP) partner organizations, in particular members of Friends of EbA (FEBA).[3] It is based on the information contained in 45 submissions[4] from Parties, NWP partner organizations and other relevant organizations.

4. **The remainder of chapter I** provides relevant definitions. **Chapter II** provides the mandate and role of the NWP and an overview of the submissions. A synthesis of the findings is provided in **chapter III**, followed by conclusions (key messages) in **chapter IV**.

A. Ecosystems and ecosystem-based adaptation: relevant definitions and roles in enhancing resilience and reducing emissions

5. **Climate change affects ecosystem functions, their ability to regulate water flows and cycle nutrients, and the essential foundation that they provide for peoples' well-being and livelihoods.** Ecosystems are already being affected by observed changes in climate and are proving vulnerable to heatwaves, droughts, floods, cyclones and wildfires.[5]

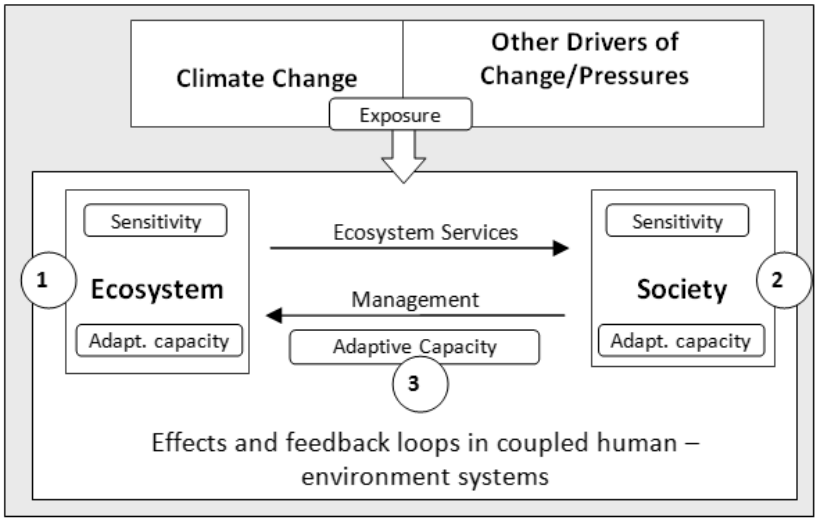
6. **In many instances, one impact of climate change can damage the functioning of an ecosystem, compromising that ecosystem's ability to protect society from a range of climate-related stressors.** This can be seen in the effects of climate change on the role that natural ecosystems play in buffering against extreme weather events, which is especially important as these events become more frequent and more intense with climate change.[6] For example, a coral reef structure weakened by ocean warming and acidification will be less effective at dissipating offshore wave energy and minimizing storm surges than one

[1] See http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgII_spm_en.pdf, page 5.
[2] As mandated in document FCCC/SBSTA/2016/2, paragraph 15(c).
[3] FEBA is an informal network of over 30 organizations with an interest in promoting collaboration and knowledge-sharing on EbA through joint events and initiatives, as well as the development of position papers and technical documents on EbA. See https://www.iucn.org/theme/ecosystem-management/our-work/ecosystem-based-adaptation-and-climate-change/feba-%E2%80%93-friends-eba.
[4] Submitted to the secretariat as at 18 June 2015.
[5] http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-TS_FINAL.pdf.
[6] http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0158094.

which is in a healthy condition. Impacts of climate change often compound existing direct human pressures on ecosystems, such as damage to reefs from dynamite fishing, further compromising their ability to play their natural buffering role.

7. Figure 1 shows a close link between the health of ecosystems and the adaptive capacities of people within coupled human–environment systems.

Figure 1
Effects and feedback loops in coupled human–environment systems



Source: Adapted from Locatelli B, Kanninen M, Brockhaus M, Colfer CJP, Murdiyarso D and Santoso H. 2008. *Facing an uncertain future: how forests and people can adapt to climate change*. Bogor: Center for International Forestry Research. Available at http://www.cifor.org/online-library/browse/view-publication/publication/2600.html.

Note: Healthy ecosystems have the capacity (see section 1) to accommodate pressures, to maintain resilience and to continue to provide ecosystem services important for the adaptive capacities of human societies (see section 2). The adaptive capacity of the human–environment system (see section 3) is reduced when demand for ecosystem services exceeds supply owing to climate change and other drivers.

8. It is crucial to design adaptation options that strengthen the overall resilience of both communities and ecosystems to climate change. EbA provides such adaptation solutions. **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**.[7] Examples of EbA measures include restoring coastal ecosystems to protect communities from storm surges, incorporating shade trees on coffee farms to stabilize production in dry, variable climates, and restoring forests in headwaters and riparian zones to regulate water supplies and protect human settlements from flooding.[8]

9. **EbA aims to reduce current and future impacts of climate change and is based on the identification or assessment of the vulnerabilities of a social-ecological system**

[7] Convention on Biological Diversity. 2009. *Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change*. Montreal: Convention on Biological Diversity.

[8] Seddon N, Hou-Jones X, Pye T, Reid H, Roe D, Mountain D and Raza Rizvi A. 2016. *Ecosystem-based adaptation: a win–win formula for sustainability in a warming world?* Available at http://pubs.iied.org/pdfs/17364IIED.pdf.

that includes both people and ecosystems.[9] It supports the stability and resilience of ecosystems as a whole and their connectivity and multiple roles in landscapes and seascapes. **EbA initiatives also contribute to climate change mitigation** by reducing net emissions from ecosystem degradation and by enhancing carbon sequestration.[10]

B. Interrelationships between ecosystems and other areas such as water resources

10. **All ecosystems, from near-pristine forests to highly modified and managed agricultural or urban systems, play an essential role in influencing and maintaining the hydrological cycle.** The conservation and restoration of ecosystems helps to manage water resources, including for mitigating flooding and drought, reducing vulnerability to erosion and storm damage, providing sustainable clean supplies of water, supporting food production and regulating global and local climatic processes. Well-functioning watersheds and wetlands provide water storage and clean water and manage flood flows, among other benefits.[11]

11. Ecosystems, water resources, food production through agriculture, and human settlements are thus interrelated areas.

II. Overview

A. Mandate and role of the Nairobi work programme in advancing action through knowledge

12. In response to the mandate,[12] the secretariat carried out a mapping exercise to identify relevant experts and expert institutions, and invited them, Parties and NWP partner organizations to share relevant experience and expertise through submissions. The secretariat established a partnership with relevant experts (in this case, members of FEBA) to prepare this synthesis report in collaboration with them. A joint side event with NWP partners is planned at SBSTA 46 to disseminate the key findings and foster dialogue among Parties, experts and relevant organizations on collaborative actions to address countries' needs (see figure 2).

13. SBSTA 46 will be invited to consider this synthesis report and to decide on any relevant recommendations, including in the elaboration of further activities under the NWP.

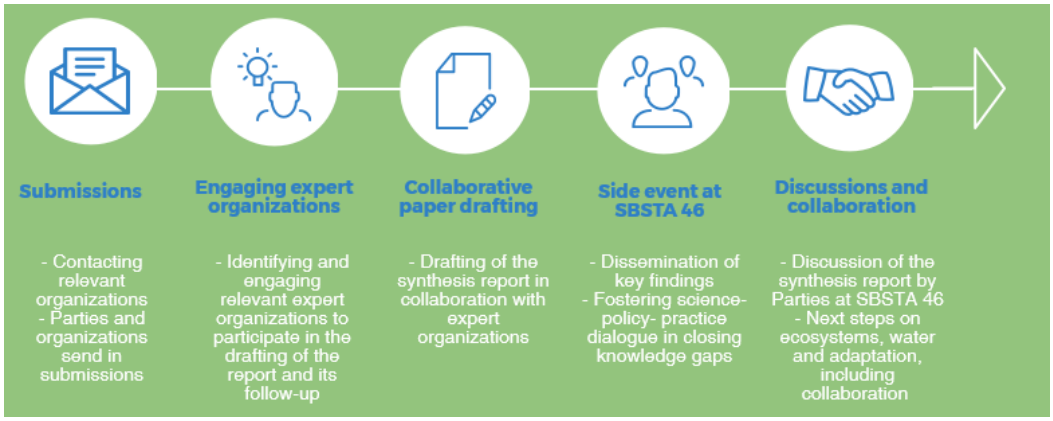
[9] WWF. *Operational Framework for Ecosystem-based Adaptation*. Available at http://awsassets.panda.org/downloads/wwf_wb_eba_project_2014_gms_ecosystem_based_adaptation_general_framework.pdf.

[10] See annex I for additional information on EbA.

[11] Secretariat of the Convention on Biological Diversity. 2013. *Natural Solutions for Water Security*. Available at https://www.cbd.int/idb/doc/2013/booklet/idb-2013-booklet-en.pdf.

[12] FCCC/SBSTA/2016/2, paragraph 15(c). See annex II for additional information on the NWP.

Figure 2
Five-step process on ecosystems and areas such as water resources under the Nairobi work programme

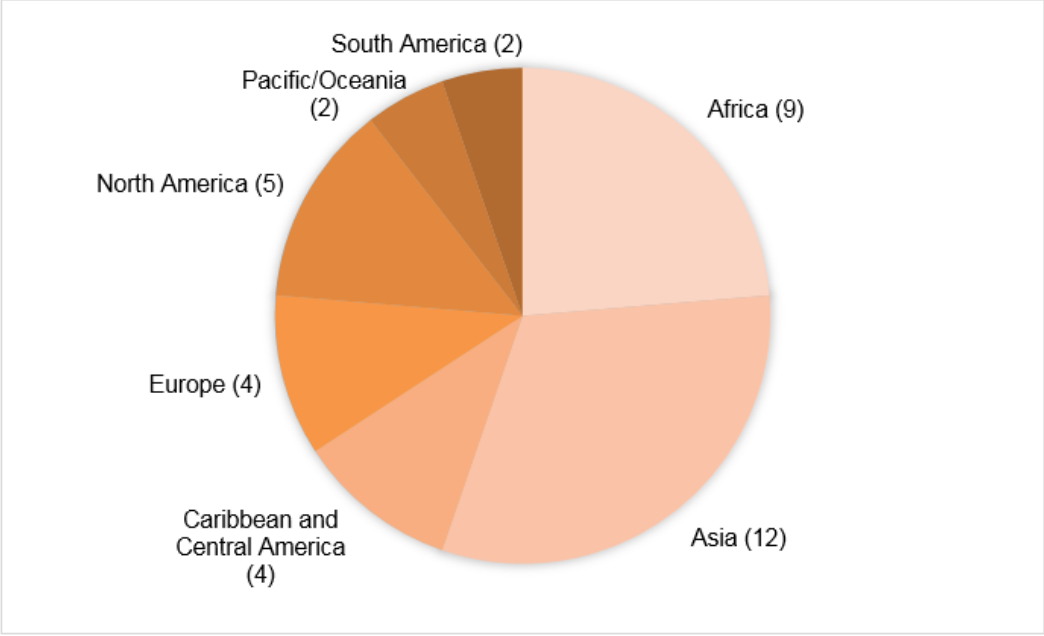


Abbreviation: SBSTA = Subsidiary Body for Scientific and Technological Advice.

B. Overview of the submissions

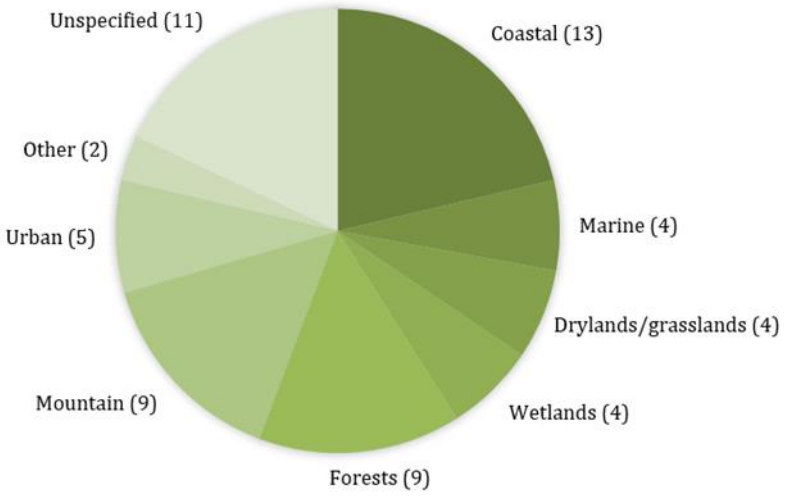
14. A total of 45 submissions[13] were contributed by Parties, NWP partner organizations and other relevant organizations (see figures 3 and 4 for an overview of distribution by regions and ecosystems, and annex III for a more detailed overview of the submissions).

Figure 3
Distribution of the submissions by regional focus



[13] Received as at 18 June 2015. Each submission was assigned a code, which is used to refer to that submission in the footnotes to this document. The list of submission codes with the corresponding submitting entity and submission file title can be found in the table in annex III.

Figure 4
Distribution of the submissions by ecosystem type



III. Synthesis of experience, opportunities and challenges in addressing ecosystems and areas such as water resources in adaptation planning and implementation

15. This chapter summarizes ongoing efforts, good practices and lessons learned, challenges and opportunities with regard to adaptation planning processes addressing ecosystems and areas such as water resources (chapter III.A) and the monitoring and evaluation (M&E) of EbA implementation (chapter III.B). Chapter III.C provides an overview of tools for assessing the benefits of EbA towards resilience and emission reduction.

A. Adaptation planning processes that address ecosystems and areas such as water resources

1. Good practices and lessons learned

16. **Co-constructing an information and knowledge base from indigenous, local and scientific sources helps to foster robust and locally appropriate solutions to build the resilience of natural and societal systems.** The Mountain EbA flagship project[14] benefited from the perspectives and expertise of local community members, national park management authorities and academics, which led to improved pastureland management, increased recognition by communities of the importance of natural resources and the definition of priority areas for action by authorities.

17. **Participatory decision-making that is decentralized to the lowest accountable level and is iterative, inclusive and adaptive facilitates the integration of EbA into national development strategies.** For the Building with Nature project of Wetlands International in Indonesia, one of the key factors for success was close collaboration with

[14] MP01.

government partners and other players at different policy levels. The project involves participatory policy analysis concerning where and how to embed measures in national and subnational policies and budgets (e.g. (spatial) development plans, master plans, coastal zonation plans, mangrove strategies, greenbelt and forest legislation, nationally determined contributions, national adaptation plans (NAPs), the Sendai Framework for Disaster Risk Reduction and the Sustainable Development Goals).

18. **The inclusion of women and of vulnerable and marginalized communities in adaptation planning has proven effective in increasing both communities' and ecosystems' resilience to climate change, given that such groups often directly depend on ecosystems for their livelihoods.** The Women's Environment & Development Organization's[15] example of gender-responsive EbA using local knowledge to transform dew and fog into potable water for 400 people in the Ait Baamrane community of Morocco reduces water collection time for women and therefore improves girls' attendance at school.

19. **Undertaking vulnerability and impact assessments that are participatory helps the long-term planning and integration of EbA at multiple levels.** The Mountain EbA[16] Programme conducted vulnerability and impact assessments, which gave communities and government stakeholders in Nepal, Peru and Uganda the necessary knowledge to validate or redesign early 'no regrets' measures[17,] as evidence-based EbA measures. This also enabled the adoption of a landscape-scale approach and long-term planning of EbA measures. It was successful in embedding EbA approaches in government planning at various levels, ensuring sustainability of actions in target landscapes and supporting their replication and scale-up in other parts of the pilot countries.

20. **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. Such approaches can create win-win solutions for the environment, society and the economy**. ICLEI - Local Governments for Sustainability[18] has promoted measures, such as blue and green infrastructure, that address multiple climate risks while restoring biodiversity and improving quality of life for residents. The Wetlands International Building with Nature public–private partnership aims to promote sustainable EbA coastal engineering approaches that make use of the natural protection provided by ecosystems like mangroves and salt marsh habitats. An integrated and interdisciplinary approach to urban biodiversity conservation and restoration of ecosystems has been implemented in Singapore by adopting both biological and engineering approaches to address multiple climate stressors such as temperature and sea level rise and increased water-induced hazards.[19]

21. **Countries should consider EbA measures as part of an overall approach to adaptation.** The Boticário Group Foundation for Nature Protection's submission reported that in Brazil early experience showed grey-green approaches to be cost-effective and yield co-benefits, and it provided a number of recommendations on the inclusion of EbA in

[15] WEDO01.

[16] IUCN02, UNDP01 and UNEP02.

[17] United Nations Development Programme. 2015. *Making the Case for Ecosystem-based Adaptation: The Global Mountain EbA Programme in Nepal, Peru and Uganda*. New York. 'No regrets' measures, a term used in the Mountain EbA Programme, means autonomous measures taken by communities that do not worsen vulnerabilities to climate change or that increase adaptive capacities, as well as measures that will always have a positive impact on livelihoods and ecosystems, regardless of how the climate changes.

[18] ICLEI01.

[19] UCCRN01.

NAPs in Brazil (e.g. the EbA concept, economic or cost–benefit evaluation, creating economic incentives, research and monitoring).[20]

22. **Existing national adaptation planning processes provide opportunities for integrating EbA into sectoral strategies and national development plans.** For example, the Convention on Biological Diversity (CBD) reported that NAPs and national biodiversity strategies and action plans can be effective instruments for mainstreaming EbA and disaster risk reduction into development plans and processes and into sectoral policies.[21] As part of the Mountain EbA Programme,[22, 23] technical guidance and policy review inputs were provided for integrating EbA into, for example, the Forest Policy of Nepal, the intended nationally determined contribution of Peru and the National Climate Change Strategy of Uganda.[24]

23. **Appropriate coordination with stakeholders, including through networks and platforms, helps to scale up and scale out adaptation.** The EbA South project, a flagship initiative for South–South cooperation on climate change and a joint initiative of UN Environment and China, aims to share some of China's experience and know-how in ecosystem monitoring, ecological restoration and climate change adaptation as part of South–South learning.[25]

24. **Building local institutional capacity is an important success factor for maintaining the sustainability of EbA at the local level and for inspiring replication at the national level.** In Grenada, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) supported the establishment of the Northern Telescope Mangrove Management Board to build local institutional capacity, ensure project ownership by the community and facilitate the project's future replication at the national level by joining hands with government officials in the project's management.

25. **Trade-offs and synergies between economic, social and environmental objectives and how to manage these through 'no-regrets' actions need to be considered during the design and implementation of adaptation actions.** WISE-UP to Climate of the International Union for Conservation of Nature (IUCN) aims to show the application of optimal portfolios of built and natural infrastructure using discussion with river basin decision makers to identify and agree upon trade-offs.[26] The International Fund for Agricultural Development is developing the Fostering Sustainability and Resilience for Food Security Integrated Approach Program in 12 countries in sub-Saharan Africa to promote the sustainable management and resilience of ecosystems and their different services (land, water, biodiversity and forests) as a means to address food insecurity, alleviate poverty and empower women and men. It also addresses various barriers (policy, institutional and knowledge) to emphasize a shift towards safeguarding the natural capital that underpins its sustainability and resilience for food security in the long term.

26. **Appropriate legal frameworks and laws support implementation.** The national Delta Programme in the Netherlands[27] incorporates all administrative levels in safeguarding

[20] BOT01. See also The Boticário Group Foundation for Nature Protection and ICLEI - Local Governments for Sustainability. 2015. *Ecosystem-based Adaptation: opportunities for public policies in climate change*.

[21] CBD01 and https://www.cbd.int/doc/publications/cbd-ts-85-en.pdf.

[22] UNEP02.

[23] UNDP01.

[24] See the table on policy and planning levels and opportunities for change in support of EbA in UNDP01 for further examples of mainstreaming at the national and subnational scales.

[25] UNEP01.

[26] IUCN03.

[27] https://www.government.nl/topics/delta-programme.

the country against flooding and ensuring continued availability of freshwater resources. The programme is the joint responsibility of all involved ministries, with a coordinating role for the Ministry of Infrastructure and the Environment. The legal agreements for the Delta Programme have been laid down in the Delta Act on Water Safety and Freshwater Supply.

27. **Various forms of knowledge resources and technical support (e.g. capacity-building, training, guidelines and online tools) exist and can support the planning and implementation of EbA and other adaptation actions addressing ecosystems.**[28] The European Union's Climate-ADAPT portal contains material and case studies on EbA.[29] The EbA South project's global-level technical support includes workshops, an online platform to exchange experience, and knowledge products on transboundary adaptation in relation to water and EbA.[30] The GIZ global project on mainstreaming EbA compiles cases of field-proven and replicable solutions, methods, best practices and lessons learned from EbA and interrelated areas on the online platform PANORAMA – Solutions for a Healthy Planet.[31]

28. **Payment for ecosystem services could help garner local buy-in for EbA**. In Uganda, a payment for ecosystem services scheme worked by paying farm households for bundled ecosystem services including watershed and carbon sequestration services, thus incentivizing the adoption of EbA.[32]

2. Challenges and opportunities

29. **Gaps in scientific information, particularly on baseline conditions and local-level projections, provide a challenge for adaptation planning and implementation.** Saudi Arabia identified a number of knowledge gaps with regard to desertification at the country level, such as on soil carbon sequestration, the interaction between climate change and desertification and the effects on ecosystem functions and services within arid and semi-arid regions.[33] The Urban Climate Change Research Network identified the need for city-level weather forecasts and climate change projections.[34] The Food and Agriculture Organization of the United Nations (FAO) identified the need to increase the availability of free and timely remote sensing data and to systematically apply technologies. Openforis Collect Earth, for example, could be a relevant resource for land and water resource assessments.[35]

30. **Challenges in collecting relevant data hinder the 'effective' monitoring of EbA interventions.** The United Nations Environment Programme (UNEP) reported that challenges[36] in collecting data could be related to: (1) limited experience in EbA monitoring; (2) limited understanding of data collection methodologies; (3) delays in compiling rigorous monitoring and data collection plans with clear allocation of responsibilities and budget; (4) lack of coordination between the local institutions in charge of developing long-term research programmes and the national teams responsible for implementation on the ground; (5) intervention sites' limited accessibility; and (6) general

[28] For example, AGWA01, APN01, BOT01, CANADA01, EU01, GIZ01, IUCN01, 02, 03 and 04, MEXICO01, MP01, NCCARF01, OPCC01, UNDP01 and UNEP01 and 02.
[29] EU01.
[30] UNECE01.
[31] GIZ01, PANORAMA (www.panorama.solutions) and AdaptationCommunity.net (www.adaptationcommunity.net).
[32] UNDP01.
[33] SAUDIARABIA01.
[34] UCCRN01.
[35] FAO01.
[36] UNEP01.

administrative constraints.[37] Some activities are under way, such as the IUCN Inventory for Central America and Chiapas (Mesoamerican region) on adaptation and EbA cases, which allows the monitoring of the number and topics of the adaptation projects and their emphasis on EbA at the regional level.[38]

31. **The time required to implement EbA and evaluate the results and benefits of EbA is often unaligned with the national political cycle and the duration of the project or programme.** It is essential to systematically integrate EbA into long-term policy frameworks at the national and subnational levels owing to the timescales that ecosystems require to recover from degradation and to respond to restoration efforts. Mainstreaming EbA may require institutional changes, the implementation of which is likely to go beyond the funding cycle of typical adaptation projects. For example, South Africa, in its fifth national report to the CBD,[39] identified that the mainstreaming of EbA requires institutional changes that may take 7 to 10 years.

32. **Stakeholders' awareness and understanding of EbA remains a challenge.** The WISE-UP to Climate project[40] identified that the recognition as well as the subsequent implementation of natural infrastructure approaches are complex. It identified that understanding adaptation is about better understanding not only the natural environment but crucially also how people interact with, value and manage nature at all levels. The project has created a new concept to improve the understanding and interpretation of the term 'ecosystem services' (visualized through an infographic and developed in a journal article).

33. **Using appropriate formats and languages as well as effective and audience-specific modalities of communication is crucial to be able to inform stakeholders of the opportunities, benefits and limitations of EbA.** The Mountain EbA Programme has demonstrated the importance of presenting the multiple benefits of EbA to government planners and policymakers so as to increase interest in implementing EbA measures.

34. **Capacity-building is required to support the implementation of adaptation and EbA.** The Asia-Pacific Network for Global Change Research identified that increasing awareness and capacity-building is an important aspect for environmental conservation.[41] It was found that grey literature and material are more useful to local stakeholders than journal publications, which are too technical, generally inaccessible or expensive to come by. Mentoring of students and non-governmental organization activists ensures that, after training, the critical aspects of the project are continued.

35. **Accessing finance for EbA and a lack of (public and private) financial instruments curtail the successful implementation of EbA.** FAO identified difficulty in accessing financing that supports both assessments of EbA opportunities, including valuing and accounting for natural resources, and payments for environmental services.[42] The Boticário Group identified that, in Brazil, funding EbA strategies could be a challenge, while projects based on conventional engineering are more easily approved by funders.[43] Conversely, the United Nations Development Programme noted that cost–benefit analysis can be a powerful means of unlocking the scaling up of public sector finance for EbA. This was seen in Peru, where the Mountain EbA Programme used the results of cost–benefit analysis of EbA measures in high-altitude Andes pastures to successfully make the case to

[37] UNEP01.
[38] IUCN04.
[39] CBD01.
[40] IUCN03 and AGWA01.
[41] APN01.
[42] FAO01.
[43] BOT01.

include such measures in the National System for Public Investment through the approval of new Policy Guidelines for Public Investment in Biodiversity and Ecosystem Services 2015–2021.[44]

B. Monitoring and evaluating the implementation of Ecosystem-based Adaptation

1. What is monitoring and evaluation in the context of ecosystem-based adaptation?

36. These questions can help to determine the effectiveness of any particular EbA initiative:[45]

(a) Did the initiative allow communities to maintain or improve their adaptive capacity or resilience, and reduce their vulnerability in the face of climate change, while enhancing co-benefits that promote well-being?

(b) Did the initiative restore, maintain or enhance the capacity of ecosystems to continue to provide services for local communities, and allow ecosystems to withstand both current and future (anticipated) climate change impacts and other stressors?

37. Adaptive management is integral to M&E, particularly for EbA, enabling a flexible approach in the face of uncertainty of future climate impacts. Adaptive management enables the incorporation of relevant information as it becomes available (for example on emerging local changes due to climate change) and maintains flexibility and diversity in approaches.[46]

2. Good practices and lessons learned in monitoring and evaluation

38. This section discusses good practices and lessons learned in monitoring and evaluating the implementation of EbA actions under the following categories (see annex IV for an overview of M&E tools):[47]

(a) **Risk and vulnerability assessment**, which examines climate risks and predicts future vulnerabilities through vulnerability assessments and provision of a baseline against which future adaptation can be monitored and evaluated;

(b) **Policy/project/programme evaluations**, which aim mainly at evaluating the outputs and outcomes of adaptation measures. M&E tools and frameworks under this category identify which approaches to adaptation are effective in achieving agreed policy/project/programme objectives and in helping understand some of the enabling factors for success.

39. With regard to **risk and vulnerability assessment**, the following key lessons have emerged:

(a) **Even if ecosystems are well managed and healthy now, they are vulnerable to climate change in the future, and therefore consideration of both current and future climate risks is an essential component of EbA.**[48] The RiVAMP (Risk and Vulnerability Assessment Methodology Development Programme) methodology

[44] UNDP01.
[45] Adapted from http://pubs.iied.org/pdfs/G04045.pdf.
[46] https://www.cbd.int/doc/publications/cbd-ts-85-en.pdf.
[47] See Adaptation Committee document AC/2016/16, available at http://unfccc.int/files/adaptation/groups_committees/adaptation_committee/application/pdf/ac10_5b_m_and_e_.pdf.
[48] CBD01.

integrates ecosystems and climate change factors into the analysis of disaster risk and vulnerabilities. Employing both scientific assessment and community consultations, the tool helps to evaluate, for example, coastal erosion for different sea level scenarios due to climate change;[49]

(b) **Monitoring at adequate scales is important in order to effectively inform the appropriate governance level.** CBD identified that, while local assessments are valuable for EbA implementation, regional-scale assessments are better suited for larger ecosystem processes and to better inform regional and national planning.[50] The FAO transboundary agroecosystem management project for the Kagera River Basin indicated that, for sustainable land management, M&E should be carried out at a scale similar to that of the management for which it will be used, and should be done over a number of years. This would increase the possibility of observing any impacts and taking into account high natural variability in hydrological processes;

(c) **Co-construction of local, traditional and scientific knowledge through inclusive, participatory processes helps to create robust and mutually acceptable M&E for EbA.** FAO identified that combining scientific monitoring of complex interactions with participatory monitoring leads to a better understanding of land and water resources management. Local communities can provide good expertise in monitoring, while, in many cases, innovative arrangements will have to be put in place that incorporate local expertise supported by relevant local and regional governments and institutions. Where possible, knowledge from academia, practitioners and communities should be combined for effective monitoring and provide the resource management platform needed to face climate change threats;[51]

(d) **The application of modern and affordable remote sensing technology allows the set-up of user-friendly M&E and communication products.** GIZ provided an example of the application of a monitoring tool that combines traditional approaches such as hydrological and morphological data to evaluate the effectiveness of measures with drone technology. The project created maps and 3D models to demonstrate water problems and discuss possible solutions. This contributed to a better understanding among decision makers of the set-up of an adaptation strategy at river basin level.[52]

40. With regard to **policy/project/programme evaluations**, the following key lessons have emerged:

(a) **A number of frameworks are being developed to monitor and evaluate the implementation of EbA.** The EbA South project has developed an M&E framework that assesses interventions by measuring vulnerability changes, awareness changes and percentage survivorship of plantations. A vulnerability index is developed to indicate the extent to which households at the project sites are susceptible to sustaining damage from climate change. Indicators of vulnerability are defined around the three components of vulnerability (i.e. exposure, sensitivity and adaptive capacity) but tailored to the context of each site, covering both the biophysical conditions of the regions and the socioeconomic conditions of the local communities;[53]

[49] http://www.grid.unep.ch/webadmin_scripts/functions/factsheets_pdf.php?project_dataid=2C19705.
[50] CBD01.
[51] FAO. 2013. *Climate change guidelines for forest managers*. FAO Forestry Paper No. 172. Available at http://www.fao.org/3/i3383e.pdf.
[52] GIZ01.
[53] UNEP01.

(b) **The consideration of trade-offs[54] should be present throughout the risk assessment, scenario planning and adaptive management approaches for EbA implementation.** In addition to monitoring the short-term provision of services, the long-term evolution of slowly changing variables should also be monitored. Policies can then be developed to take into account trade-offs at multiple spatial and temporal scales, and to minimize the effects of ecosystem service trade-offs. Tools such as InVEST (Integrated Valuation of Environmental Services and Trade-offs) can assist decision makers in identifying potential trade-offs in the provisioning of ecosystem services under different scenarios;[55]

(c) **Long-term data sets are necessary for monitoring and evaluating the implementation of EbA, as socioeconomic and ecological benefits span a decade or longer after implementation.** Long-term data sets, for example those created with community participation through the use of mobile phone applications, can be used to inform adaptive management during project interventions as well as investments beyond the life of the project. Long-term project data sets need to be housed in national research institutions, and monitoring systems should be embedded in national plans and budgets;[56]

(d) **In order to fully capture the benefits of EbA as well as other co-benefits, M&E should be undertaken beyond project implementation.** EbA options could also include a 'theory of change' to state the links between activities, outputs, outcomes and the project goal.[57] Several submissions stressed the importance of the necessary long-term nature of monitoring, beyond the implementation phase;[58]

(e) **Indicators are crucial to measuring the progress and benefits of EbA.** The Organisation for Economic Co-operation and Development highlighted that, subject to project design and context, a combination of quantitative, qualitative and binary indicators should generally be used to fully capture all relevant aspects of EbA. The European Union's submission highlighted that, in order to effectively capture both context and changes brought about by implementation, planners can: use a vulnerability lens to prioritize actions; focus on monitoring changing exposure in the project time frame; and plan indicators and monitoring systems with an eye to longer-run potential impacts (sensitivity, adaptive capacity and development).[59] FAO continues to develop sustainable forest management indicators (mostly focusing on socioeconomic and governance aspects), and to strengthen their use in planning, decision-making, monitoring and reporting across scales, such as via the online platform openforis.[60] For sustainable land management, FAO highlighted the importance of establishing baseline conditions and using land change indicators to monitor and evaluate what is changing, the processes of change and the sustainability of beneficial changes. Conservation International reported that many EbA projects measure project outputs (e.g. hectares of wetlands rehabilitated) but not actual

[54] Trade-offs arise when an activity protects one group of people at the expense of another, or favours a particular ecosystem service over another (see CBD01).

[55] https://www.cbd.int/doc/publications/cbd-ts-85-en.pdf.

[56] IFAD01, MP01, OECD01, UNDP01, UNEHS01 and UNEP01.

[57] McKinnon MC and Hole DG. 2015. Exploring program theory to enhance monitoring and evaluation in ecosystem-based adaptation projects. *In*: D Bours, C McGinn and P Pringle (eds.). Monitoring and Evaluation of Climate Change Adaptation: A Review of the Landscape. *New Directions for Evaluation*. 147: pp.49–60. Brief description available at http://unfccc.int/files/adaptation/groups_committees/adaptation_committee/application/msexcel/ac10_5b_inventory_m_and_e.xls.

[58] MEXICO01, CI01, EU01, OECD01, MP01, UNDP01 and UNEP02.

[59] EU01.

[60] FAO01.

adaptation outcomes. To find indicators for relevant EbA outcomes, Conservation International reviewed 60 projects. A list of indicators will be finalized in 2017;[61]

(f) **M&E guides and frameworks improve M&E effectiveness by providing structured methods for local staff and stakeholders.** Under the Climate Resilient Communities and Protected Areas project in the Gambia and Senegal, a M&E guide was developed for protected area managers, staff and community associations. It focused on monitoring adaptation interventions developed by communities and brought together simple methodologies to carry out regular climatic, socioeconomic and environmental monitoring. It also proposes resource-efficient and practical data-gathering techniques to fit the users' limited technical and financial capacities.[62] In Zanzibar, the Scalable Resilience Initiative developed a field M&E system to track and evaluate specific activity outcomes as well as the overall objective of community adaptive capacity. Data are collected in the mobile FieldVIEW database using tablets by field staff. A standardized method of manual data collection was developed and a data officer oversees the process of unification of uploads with the rest of the database. Thus, field data can be compared.[63]

3. Challenges and opportunities

41. EbA has demonstrated the potential to increase both social and ecological resilience to climate change and adaptive capacity in the long term in an economically viable way. **But, strong empirical evidence for the effectiveness, economic viability, etc. of EbA is evolving and still in the formative stages.** However, there is plenty of anecdotal[64] and project-specific evidence, mostly from ex-ante and midterm assessments. There is hence growing demand from scientists and practitioners for robust quantitative data or consistently collated qualitative data on the ecological, social and economic effectiveness of EbA projects relative to hard infrastructure or other alternatives.[65, 66] Use of relevant indicators for ex-post evaluation of M&E is critical to establish strong empirical evidence for the effectiveness of EbA.

42. **There is also a need to provide access to available tools and/or to develop tools to analyse the cost-effectiveness of nature-based solutions to dealing with the changing climate.** This can be done by carrying out cost–benefit analysis, cost-effectiveness analysis or multi-criteria analysis of projects, and total economic valuation of ecosystem goods and services. Economic valuation of ecosystem services should be part of the initial assessment during the planning phase of EbA projects. Long-term assessments are also required, to compare the benefits received over time, so that they can be used to assist in decision-making processes.

43. **Capacity-building is needed to raise awareness and enable access to existing EbA tools for planners, managers and decision makers.** Despite the existing number of tools for EbA planning and assessment, the integration of ecosystem considerations into adaptation planning is often a challenge. This suggests a lack of access to tools or lack of awareness of their existence. An example of an existing support tool is the EbA Learning

[61] CI01.
[62] UNEP02.
[63] CFI01.
[64] CBD01.
[65] Doswald N, Munroe R, Roe D, Giuliani A, Castelli I, Stephens J, Möller I, Spencer T, Vira B and Reid H. 2014. Effectiveness of ecosystem-based approaches for adaptation: review of the evidence-base. *Climate and Development*. 6(2): pp.185–201.
[66] Travers A, Elrick C, Kay R and Vestergaar O. 2012. *Ecosystem-based adaptation guidance: moving from principles to practice*. UNEP Working Document.

Framework developed by IUCN for use across its secretariat, membership and commissions.[67]

44. **Improved M&E methods are needed**, particularly methods with some level of standardization, if appropriate, which will enable comparison between EbA approaches.[68]

45. **Lack of means of implementation (institutional arrangements/governance, finance and capacity-building) affects M&E at all stages, including data collection, monitoring protocols and reporting.** Standardized methods of M&E would assist in the comparison of EbA approaches. In the development of the FieldVIEW mobile M&E system, one challenge that slowed down the process was training staff in the use of tablets, and embedding the system into daily use continues to be challenging.[69] The European Union's submission called for bilateral and multilateral agencies funding adaptation programmes, including EbA, to devote more resources to long-term (over 15 years) monitoring. The short and medium time frame associated with funding might not be compatible with EbA owing to the timescales that ecosystems require to recover from degradation and to respond to restoration efforts.[70]

C. Tools for assessing the benefits that ecosystem-based adaptation provides towards enhancing resilience and reducing emissions

1. Overview of tools

46. Research methodologies, frameworks and quantitative and qualitative tools are needed to assess the 'effectiveness' of EbA and to communicate the results to decision makers as well as to all public and private stakeholders and beneficiaries of EbA actions.

47. The challenges in assessing the effectiveness of EbA seem to result primarily from a lack of understanding of the following: [71]

(a) How, and over what temporal and geographical scales, the natural environment buffers human communities against the effects of climate change (so-called 'adaptation services');

(b) How different ecosystem services and EbA measures might trade off against one another;

(c) How climate hazards interact with other stressors (e.g. land-use change) to influence ecosystem services and determine tipping points beyond which ecosystem functions fail and cannot recover.

48. This section provides an overview of assessment tools (including those currently in the pilot phase of implementation) and, where relevant, discusses those tools in addressing the issues referred to in paragraph 47 above.[72] The majority of the tools identified in the submissions focus on ex-ante and midterm assessments.

[67] https://www.iucn.org/sites/dev/files/content/documents/iucn_eba_learning_framework.pdf.
[68] CBD01.
[69] CFI01.
[70] Renaud FG., Sudmeier-Rieux K, Estrella M, Nehren U (Eds.). 2016. *Ecosystem-based disaster risk reduction and adaptation in practice*. Springer International Publishing.
[71] Adapted from http://pubs.iied.org/pdfs/G04045.pdf.
[72] Owing to limited availability of information on relevant tools in the submissions, this section includes additional examples, with inputs from FEBA.

49. UNEP noted that the majority of available EbA tools address the early stages of planning (79 per cent), assessment (78 per cent) and design (51 per cent).[73] Furthermore, only 5 of the 170 tools and methodologies covered in the EbA evidence-based project address both mitigation and adaptation, and tools tend not to be specific to one ecosystem.[74]

50. It is also relevant here to note that traditional adaptation tools for vulnerability assessments, planning processes and M&E are useful in the context of EbA as they are or can be adapted for EbA.

2. Tools for assessing the benefits of ecosystem-based adaptation

51. **Planning tools exist that are relevant to understanding how different adaptation options might generate trade-offs.** The Mountain Partnership and FAO are engaged in the development of biodiversity monitoring tools for REDD-plus[75] in Papua New Guinea at the national scale. The combined carbon-biodiversity inventory will enable decision-making to better understand trade-offs between reducing emissions and protecting biodiversity. The project has led to: the design of a methodology to assess forest biodiversity at the national scale as part of the National Forest Inventory; field-tests of all biodiversity protocols; and training the Forest Authority staff in the implementation of the biodiversity survey. One challenge is the lack of standardized protocols and techniques for the integration of biodiversity issues into REDD-plus activities in tropical forests at the national scale. This is due to the lack of consensus on what to monitor and the lack of a single reliable metric of biodiversity.[76]

52. **Tools are being developed and tested to evaluate the costs and benefits of EbA activities.** One example is the InVEST suite of modelling tools, which maps, quantifies and estimates the value of ecosystem services, helping decision makers to evaluate the economic and spatial impacts of development and climate change. InVEST combines spatial and biophysical models with economic techniques (e.g. avoided damage cost or market valuation) to value ecosystem services, improving upon traditional cost–benefit analysis methods by addressing variation in the distribution of costs and benefits across an area.[77] InVEST has been piloted in several countries, including Belize, where it was used to develop a national integrated coastal zone management plan.[78]

53. **There are tools to assess social, environmental and ecological benefits during the design of EbA interventions.** In Mexico, efforts are being made to inform decision-making by assessing and quantifying the adaptation benefits (ecological and social resilience) of a water reserves programme. The programme explores trade-offs in engineering and ecological performance metrics across different possible management actions under uncertain future hydrological and climate conditions. Its five-step iterative process includes defining system performance criteria, building a system model, conducting a vulnerability analysis, evaluating options and identifying a preferred decision (and

[73] UNEP02.
[74] UNEP02.
[75] In decision 1/CP.16, paragraph 70, the Conference of the Parties encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities: reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks.
[76] MP01.
[77] Rosenthal A, Arkema K, Verutes G, Bood N, Cantor D, Fish M, Griffin R and Panuncio M. 2013. *Identification and Valuation of Adaptation Options in Coastal-Marine Ecosystems: Test case from Placencia, Belize*. The Natural Capital Project, Stanford University, World Wildlife Fund.
[78] CBD01 and https://www.cbd.int/doc/publications/cbd-ts-85-en.pdf.

redefining management options/criteria if necessary). The project is currently in the scenario testing and vulnerability analysis phase.[79]

54. **There are ex-post methodologies, mainly in formative stages, to assess the effectiveness of EbA.** The International Institute for Environment and Development, together with the UNEP World Conservation Monitoring Centre and IUCN, is deploying a research methodology to test the effectiveness of EbA. The research will cover 15 EbA projects from 12 countries in the developing world.[80] The questions are aimed at collecting evidence of the effectiveness of EbA, determining the obstacles to its implementation and influencing policy (i.e. effectiveness for societies and ecosystems, financial and economic incentives, and policy and institutional issues).[81]

55. **There are tools that can be used to assess the benefits and/or co-benefits that EbA provides in terms of greenhouse gas emission reduction:**

(a) The Ex-Ante Carbon balance Tool (EX-ACT) developed by FAO is an appraisal system of the impacts that agriculture and forestry efforts have on the carbon balance. It is a land-based accounting system, estimating emissions or sinks of carbon dioxide as well as emissions per unit of land. It can be applied to a wide range of projects (e.g. climate change mitigation, sustainable land management, watershed development, production intensification, food security, livestock, forest management or land-use change).[82] Other useful tools for assessing the benefits of EbA interventions in reducing emissions would include tools developed in other contexts for monitoring and reporting on carbon sequestration. For example, country-level work to protect, maintain and restore coastal ecosystems for their adaptation benefits also has mitigation benefits, which can be assessed using the methodology developed by the Blue Carbon Initiative;[83]

(b) The Ecologic Institute and Environmental Change Institute of Oxford University Centre for the Environment conducted an assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe. The objective of the valuation study was to gain a better understanding of the role and potential of ecosystem-based approaches in climate change adaptation and mitigation in Europe. Project managers were asked to provide evidence of the financial and opportunity costs as well as of the ecological and socioeconomic benefits of their respective ecosystem-based projects so as to contribute to a cost–benefit analysis;[84]

(c) The Ecosystem-based Adaptation in Watersheds (ECOSWat) tool[85] measures EbA co-benefits of carbon emissions and absorption (carbon sequestration), water use and water production. The ECOSWat project developed a tool for the rapid assessment of the ecological impact of measures. This tool is based on photosynthesis as the core ecological activity. The input data consist of only four parameters: carbon emissions and absorption (carbon sequestration), water use and water production. The benefit of this tool is twofold: it is easy to understand and only widely available and accepted data are fed into the tool. The outcome shows whether and how the EbA measure is influencing the carbon (absorption–emissions) and water (production–use) balance.

[79] AGWA01.
[80] www.iied.org/ecosystem-based-adaptation.
[81] http://pubs.iied.org/pdfs/G04045.pdf.
[82] FAO01.
[83] http://thebluecarboninitiative.org/new-manual-for-measuring-assessing-and-analyzing-coastal-blue-carbon/.
[84] http://ec.europa.eu/environment/nature/climatechange/pdf/EbA_EBM_CC_FinalReport.pdf.
[85] GIZ01.

56. **Some assessment tools are relevant to understanding how climate hazards interact with other stressors (i.e. interaction of social, economic and ecological systems).** The GIZ project[86] on strategic mainstreaming of EbA in Viet Nam has developed a structured approach to designing and implementing multiscalar vulnerability assessments of complex systems for EbA. The Vulnerability Assessment for Socio-Ecological Systems approach recognizes that social, economic and ecological systems are inextricably linked, providing practical guidance on identifying all relevant factors affecting the coupled systems when conducting a vulnerability assessment. It has been successfully tested in two provinces Quang Binh and Ha Tinh. The approach is due for implementation in the national adaptation strategy in the near future. **However, these tools might not be fully suitable to determining tipping points beyond which ecosystem function fails and cannot recover.**

57. **A number of tools are being used to determine economic benefits of EbA and of hybrid green-grey approaches during the planning and implementation phase.** The Assessing Direct Use Values of Ecosystem Services in Arid Areas project in Isiolo County, Kenya, explored the value per m^3 water provided as an ecosystem service as a basis for cost–benefit analysis and EbA. Estimates were made in USD disaggregated per sector (i.e. domestic use, livestock, irrigated agriculture and tourism).[87] In the Mountain EbA Programme, cost–benefit analysis was used to make the economic case for EbA as it is a widely accepted methodology as a project appraisal tool, especially in ministries of finance and planning. GIZ supported the Government of Thailand in making the economic case for ecosystem-based flood risk reduction and water security by comparing green (wetland sediment trap) against grey infrastructure (sediment trap and dredging).[88]

58. **Several tools also focus on cyclic learning, course-correction and knowledge-sharing on EbA.** The GIZ-supported global project on mainstreaming EbA is in the process of preparing a sourcebook for comparing and evaluating the benefits of EbA measures against grey infrastructure measures. The sourcebook is based on a review of more than 75 guidance and case studies on primarily the valuation of EbA benefits, ecosystem services in the context of adaptation and adaptation benefits generated by grey infrastructure. Most case studies (15) have been extracted from the ValuES platform, a comprehensive source of information regarding the valuation of ecosystem services.[89]

59. **Research and support are needed to generate and disseminate the information required to refine and develop tools.** For example, the United Nations Development Programme identified that cost–benefit analysis has proven to be a useful tool for conceptualizing and assessing the multiple benefits of EbA, but cited that lack of data can undermine the evaluation of EbA benefits. This is compounded by the mismatch between the time needed to assess benefits and decision-making timelines.[90] FAO reported in relation to EX-ACT that it is challenging to provide a tool that is easy to use, cost-effective and adaptable over time, but at the same time capable of covering the wide range of projects relevant to the agriculture, forestry and other land-use sector.[91]

[86] GIZ01.
[87] KENYA01.
[88] GIZ01.
[89] http://www.aboutvalues.net/.
[90] UNDP01.
[91] FAO01.

IV. Conclusions

60. Healthy ecosystems help people to adapt to climate change through the delivery of a wide variety of services, including the provision of water, food, fuel and fibre; soil formation and nutrient cycling; and recreational and spiritual services. Healthy ecosystems thus play an essential role in increasing the resilience of communities to climate change.

61. Climate change, however, affects ecosystems' functions, their ability to regulate water flows and cycle nutrients, and the many services that they provide to society. Sometimes climate change can damage the functioning of an ecosystem, compromising the ecosystem's ability to protect society from another climate change impact.

62. It is crucial to design adaptation options that strengthen the overall resilience of both communities and ecosystems to climate change. EbA employs integrated approaches, based on vulnerability assessments, for enhancing the adaptive capacities of both humans and ecosystems. 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 (both current and future or anticipated).

63. Current and future climate risks are both essential components of EbA during risk/vulnerability assessment: even well managed and healthy ecosystems are vulnerable to climate change.

64. EbA initiatives also contribute to climate change mitigation by reducing net emissions from ecosystem degradation and by enhancing carbon sequestration. Understanding potential synergies between mitigation and adaptation can help to minimize future climate change impacts in the context of a holistic approach to sustainable development.

65. As natural buffers, ecosystems are often less expensive to maintain and could be more effective than physical engineering structures, such as dykes. However, 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.

66. Countries should consider EbA measures as part of an overall approach to adaptation, including in their NAPs and nationally determined contributions. NAPs and national biodiversity strategies and action plans can be effective instruments for integrating EbA into development plans and processes and into sectoral policies. The key messages in paragraphs 67–72 below should be considered relative to effectively mainstreaming EbA into adaptation and development plans and processes at the national level.

67. EbA has demonstrated the potential to increase both social and ecological resilience to climate change and adaptive capacity in the long term in an economically viable way. The accumulation of strong empirical evidence for the effectiveness and economic viability of EbA is still in the early stages. However, there is plenty of anecdotal and project-specific evidence, mostly from ex-ante and midterm assessments.

68. Adaptive management is integral to M&E, particularly for EbA, enabling a flexible approach to responding to the uncertainty of future climate impacts. Adaptive management enables the incorporation of relevant information as it becomes available (for example on emerging local changes due to climate change) and maintains flexibility and diversity in approaches.

69. With regard to research and data provision, long-term data sets are necessary for monitoring and evaluating the outcomes of EbA, and at appropriate scales, as socioeconomic and ecological benefits span a decade or longer after implementation.

Research is also needed to generate and disseminate the information required to refine and develop tools. More robust quantitative data or consistently collated qualitative data on the ecological, social and economic benefits of EbA projects relative to hard infrastructure or other alternatives need to be collected to better determine under which conditions EbA effectively contributes to resilience and is economically viable.

70. Trade-offs and synergies (i.e. between different ecosystems or between economic, social and environmental objectives) and unintended consequences need to be considered during the design and implementation of EbA. In addition to monitoring the short-term provision of services, the long-term evolution of those services under slowly changing conditions should also be monitored. Policies can then be developed to address trade-offs at multiple spatial and temporal scales.

71. In order to make the economic case for EbA, it is important to fully capture the benefits of EbA as well as other co-benefits in the long run, and therefore M&E should be undertaken beyond project implementation. Although some tools to assess the cost-effectiveness of nature-based solutions to dealing with the changing climate currently exist, these tools might not sufficiently address the effectiveness of EbA in relation to enhancing overall resilience.

72. The lack or inadequacy of institutional arrangements/governance structures and/or mechanisms, finance and capacity-building affects all stages of EbA projects. For example, capacity-building is needed to raise awareness and enable access to existing EbA tools for planners, managers and decision makers. Accessing finance for EbA and a lack of (public and private) financial instruments curtail the successful implementation of EbA. The short and medium time frame associated with funding (e.g. through development assistance) might not be compatible with EbA, tangible protective benefits of which often require more distant time horizons.

Annex I

Background information on ecosystem-based adaptation

[English only]

1. **Ecosystem-based adaptation (EbA) is a people-centred process that**:

(a) Improves the adaptive capacities of people through the use of biodiversity and ecosystem services and by addressing the needs of people, especially those who directly depend on or use natural resources and who are particularly vulnerable to climate change impacts;

(b) Addresses current and future climate change and climate variability, which is based on assessments of climatic vulnerability, impacts, hazards or risks to people, and the adaptation benefits derived from ecosystem services;

(c) Restores, maintains and improves ecosystems, landscapes and seascapes and is in line with the ecosystem approach.[1] It is applied at a scale that addresses the challenge of, and integrates the trade-offs resulting from, climate change. It supports the stability and resilience of ecosystems as a whole and their connectivity and multiple roles in landscapes and seascapes;

(d) Is part of an overall adaptation strategy that operates at one or more levels (national, regional, landscape, local or sectoral), which can involve supporting sectoral adaptation and multisectoral approaches at multiple geographical scales;

(e) Enhances governance of natural resources with respect to the use of biodiversity and ecosystem services by following a community-centred, participatory and gender-sensitive approach that embraces transparency, empowerment, accountability, non-discrimination and active, meaningful and free participation at the local level.[2]

2. **The core principles**[3] **of EbA** consist in:

(a) Promoting the resilience of both ecosystems and societies;

(b) Promoting multisectoral approaches;

(c) Operating at multiple geographical scales;

(d) Integrating flexible management structures that enable adaptive management;

(e) Minimizing trade-offs and maximizing benefits with development and conservation goals to avoid unintended negative social and environmental impacts;

(f) Being based on best available science and local knowledge, and fostering knowledge generation and diffusion;

[1] The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.

[2] Friends of EbA Policy Paper (2017, unpublished), drafted by the Gesellschaft für Internationale Zusammenarbeit, the International Union for Conservation of Nature and the International Institute for Environment and Development. *Criteria and categories for successful Ecosystem-based Adaptation – setting up a framework for qualification and quality criteria*.

[3] Andrade A et al. 2011. *Principles and Guidelines for Integrating Ecosystem-based Approaches to Adaptation in Project and Policy Design*. Available at https://portals.iucn.org/library/sites/library/files/documents/2011-064-Rev.pdf.

(g) Being participatory, transparent, accountable and culturally appropriate and actively embracing equity and gender issues.

3. **The benefits of EbA in terms of enhancing resilience** include:

(a) Providing adaptation and disaster risk reduction solutions that are consistent with national development and adaptation goals (e.g. protection against storm surges, sea level rise and coastal inundation; prevention of landslides, securing water supply and regulation and conserving agricultural species' genetic diversity);

(b) Complementing more expensive infrastructure investments, such as prolonging the lifetime of engineered flood protection measures;[4]

(c) Conserving biodiversity (e.g. conservation of ecosystems, habitat, species and genetic diversity) and therewith ecosystem-dependent livelihoods;

(d) Engaging people and communities, helping to build trust and responsibility, while maintaining livelihoods and providing potential business opportunities,[5] strengthening local ownership by using local capacities and resources, hence providing sociocultural and economic benefits (e.g. generation of income for local communities, opportunities for recreation, protection of indigenous peoples and local communities, diversification of food products, and environmental services such as bees for pollination of cultivated crops).

4. Appropriately designed EbA initiatives can also contribute to climate change mitigation by reducing net emissions from ecosystem degradation and by enhancing carbon sequestration. Emission reductions are achieved through the creation, restoration and management of ecosystems. These include:

(a) Conservation or restoration of forests, coastal vegetation or peatlands, which boost carbon sequestration;[6]

(b) Prevention of deforestation and land degradation, which aids in limiting further greenhouse gas emissions;[7]

(c) Soil conservation practices such as integrated soil fertility management, which can deliver carbon sequestration at a rapid rate.[8]

[4] Munang R, Thiaw I, Alverson K, Liu J, and Han Z. 2013. The role of ecosystem services in climate change adaptation and disaster risk reduction. *Current Opinion in Environmental Sustainability*. 5(1): 47–52; Temmerman S, Meire P, Bouma TJ and Herman PMJ. 2013. Ecosystem-based coastal defence in the face of global change. *Nature*. 504:79–83.

[5] Naumann S, Anzaldua G, Berry P, Burch S, Davis M, Frelih-Larsen A, Gerdes H and Sanders M. 2011. *Assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe*. Final report to the European Commission, DG Environment. Oxford University Centre for the Environment.

[6] Duarte CM, Losada IJ, Hendriks IE, Mazarrasa I and Marbà, N. 2013. The role of coastal plant communities for climate change mitigation and adaptation. *Nature Climate Change*. 3: 961–968.

[7] Busch J, Ferretti-Gallon K, Engelmann J, Wright M, Austin KG, Stolle F, Turubanova S, Potapov PV, Margono B, Hansen MC and Baccini A. 2015. Reductions in emissions from deforestation from Indonesia's moratorium on new oil palm, timber, and logging concessions. *PNAS*. 112(5):1328–1333.

[8] See 4‰ Initiative, launched by France.

Annex II

Background information on the Nairobi work programme: knowledge to action network on adaptation

[English only]

1. The Nairobi work programme on impacts, vulnerability and adaptation to climate change (NWP) contributes to advancing adaptation action through knowledge in order to scale up adaptation at all governance levels, with a focus on developing countries. It synthesizes and disseminates information and knowledge on adaptation, facilitates science–policy–practice collaboration in closing adaptation knowledge gaps and fosters learning to boost adaptation actions, including through the adaptation knowledge portal.

2. Activities under the NWP involve close collaboration with a network of over 340 organizations working on adaptation all over the world. The NWP provides support on adaptation knowledge and stakeholder engagement to Parties as well as to the Adaptation Committee and the Least Developed Countries Expert Group, which is in line with new processes under the Paris Agreement.

3. When Parties consider the outcomes of NWP activities related to ecosystems and adaptation at the forty-sixth session of the Subsidiary Body for Scientific and Technological Advice, there could be further opportunities under the NWP for fostering science–policy–practice collaboration in order to reduce climate risks for ecosystems and to enhance overall resilience, including through ecosystem-based adaptation.

Annex III

Overview of submissions

[English only]

1. Overall description

1. A total of 45 submissions were contributed by Parties, Nairobi work programme on impacts, vulnerability and adaptation to climate change (NWP) partner organizations and other relevant organizations. The submissions comprise 7 from Parties, 1 from a group of Parties (the European Union with examples across member States) and 37 from 33 organizations.

2. Figure 3 in the document depicts the regional distribution of the focus of the submissions. Some of the submissions do not specify which region their content covers, while others cover multiple regions. This is why the total count differs from the total number of submissions. Asia is the region that is the most widely covered in the submissions (12), while South America and Pacific/Oceania are covered in the lowest number of submissions (2) after the polar region (0). Furthermore, there are six submissions focusing on the Least Developed Countries (LDCs) and three on small island developing States (SIDS).

3. Figure 4 in the document shows the number of submissions that touch upon a specific ecosystem type. Eleven submissions do not specify particular ecosystem types, while others cover multiple. This is why the total count differs from the total number of submissions. Only those submissions that specify a specific ecosystem type are included in the figure.

4. Of the 45 submissions, 11 explicitly consider national adaptation plans (NAPs), 4 the Sustainable Development Goals, 9 local/indigenous knowledge and 6 gender.

5. The secretariat assigned each submission a unique code (see the table below for the code, title and other information for each submission; and see annex IV for the tools and methods referred to in each submission). Where appropriate, this document refers to the submissions by their codes, mostly in the footnotes.

2. Overview of submissions addressing adaptation planning processes

6. Of the 45 submissions from Parties and organizations, 29 report on ongoing efforts and experience in relation to adaptation planning processes that address ecosystems or interrelated areas such as water resources.

7. Four submissions provide information on adaptation in the LDCs. Three of those submissions detail information on the Global Mountain Ecosystem-based Adaptation Programme, which provides capacity-building and participatory assessments in Nepal, Uganda and Peru.[1] The fourth submission is on "Enhancing Capacity, Knowledge and Technology Support to Build Climate Resilience of Vulnerable Developing Countries", a South–South cooperation initiative in Mauritania, Nepal and Seychelles.[2]

8. Three submissions provide information on adaptation in SIDS: Mauritius[3] and the Gesellschaft für Internationale Zusammenarbeit (GIZ) on "Restoration and community co-

[1] IUCN02, UNDP01 and UNEP02, respectively.
[2] UNEP01.
[3] MAURITIUS01.

management of mangroves" in Grenada[4] and the United Nations Environment Programme (UNEP) on "Building Capacity for Coastal Ecosystem-Based Adaptation for SIDS" in Grenada and Seychelles. The aim of the UNEP project is to strengthen the capacity of national governments to incorporate ecosystem-based adaptation (EbA) approaches into their NAPs through decision-support, capacity-building and civil society engagement.[5]

9. Four submissions consider the inclusion of local or indigenous knowledge:[6] Canada's Climate Change and Health Adaptation Program bridges the gap between traditional knowledge and science through innovative co-management in order to enhance communities' adaptive capacity; SLYCAN's submission on addressing soil salinity in the paddy fields of the Morawewa area of Tricomalee in Sri Lanka refers to indigenous knowledge as a way to ensure sustainability of action;[7] "Identification of the most effective EbA measures for the NorYauyos Cochas Landscape Reserve (NYCLR)", part of the Global Mountain EbA Programme, identifies the use of both scientific and local knowledge as good practice;[8] and GIZ's Programme on Ecosystem-based Adaptation to Climate Change in High Mountainous Regions of Central Asia used an open standards framework for vulnerability assessments combining scientific and local knowledge with capacity development.[9]

10. Three submissions consider gender issues: the Global Mountain EbA Programme approach includes awareness-raising and participation in decision-making with a view to ensuring the full and equal participation of less privileged actors such as women;[10] "Adaptation to Climate Change Impacts in Coastal Wetlands of the Gulf of Mexico" sought to engage and empower women in every stage of the project;[11] and the Women's Environment & Development Organization stresses the importance of gender-sensitive EbA planning.[12] It identifies the need for gender equality to be reflected as a guiding principle and cross-cutting element in the structure of all EbA processes.[13]

11. Six submissions relate to national adaptation planning processes: the Convention on Biological Diversity reports on lessons learned in integrating and mainstreaming EbA and eco disaster risk reduction into national biodiversity strategies and action plans, national adaptation programmes of action and NAPs;[14] Boticário Group Foundation for Nature Protection shares lessons learned on the process of including EbA in NAPs;[15] Kenya draws attention to the challenge of integrating local resilience assessment outcomes into national adaptation planning;[16] Conservation International points to the need to integrate EbA into national adaptation planning;[17] the United Nations Economic Commission for Europe shares lessons learned and good practices in transboundary planning processes related to water and EbA;[18] and UNEP reports on national-level capacity-building in Grenada and

[4] GIZ01.
[5] UNEP02.
[6] CANADA01, SLYCAN01, MP01 and WEDO01.
[7] SLYCAN01.
[8] MP01.
[9] GIZ01.
[10] IUCN01.
[11] MEXICO01.
[12] WEDO01.
[13] WEDO01.
[14] CBD01.
[15] BOT01.
[16] KENYA01.
[17] CI01.
[18] UNECE01.

Seychelles to strengthen the capacity of governments to incorporate EbA approaches into their national adaptation strategies.[19]

12. Two submissions refer to the Sustainable Development Goals: the Alliance for Global Water Adaptation and the International Union for Conservation of Nature (IUCN) report on the "nature-based solution for climate change adaptation and sustainable development" project and its focus on water and food security. The project contributes to goals 1, 2, 9 and 13, concerning poverty reduction, food security, infrastructure and climate resilience, respectively.[20]

3. Overview of submissions addressing monitoring and evaluation

13. Of the 45 submissions received, 15 report on ongoing efforts and experience in the monitoring and evaluation (M&E) of the implementation of EbA.

14. Submissions on M&E with reference to a specific ecosystem type are distributed as follows: forests (four), mountain ecosystems (four), drylands/grasslands (two), coastal (two) and marine (one). However, most submissions do not focus on one specific ecosystem type (eight). One submission covers M&E in regard to the LDCs, namely Nepal and Uganda.[21] Two submissions provide information in regard to the use of local or indigenous knowledge in M&E.[22]

15. The Organisation for Economic Co-operation and Development (OECD) analysed M&E frameworks from six bilateral cooperation agencies to examine the approaches being used for adaptation-related projects. Many of the projects analysed focused on improving the provision of ecosystem services, particularly those provided by forests and wetlands.[23] An inventory of EbA tools and methodologies currently under development by the UNEP World Conservation Monitoring Centre, the International Institute for Environment and Development, IUCN and GIZ shows that there are fewer tools for M&E and EbA mainstreaming compared with the planning and assessment stages of EbA.[24, 25]

List of submissions made by Parties and organizations

Submission code	*Party/organization*	*Submission file title*[a]
EU01	European Union, submitted by Malta	MT-01-18-EU Submission Nairobi Work Programme
CANADA01	Canada	Canada submission on NWP FINAL (English) Communication du Canada au Programme de travail de Nairobi (French)
HAITI01	Haiti	Haiti - NWP submission_Adaptation Ecosystem Based_Haiti
INDONESIA01	Indonesia	Indonesia Submission on NWP Ecosystem based Adaptation

[19] UNEP01.
[20] AGWA01 and IUCN03.
[21] UNEP02.
[22] CBD01 and FAO01.
[23] Lamhauge N, Lanzi E and Agrawala S. 2012. *Monitoring and Evaluation for Adaptation: Lessons from Development Co-operation Agencies*. OECD Environment Working Paper No. 38. Paris: OECD Publishing. Available at http://dx.doi.org/10.1787/5kg20mj6c2bw-en.
[24] https://www.iied.org/call-for-feedback-inventory-tools-support-ecosystem-based-adaptation.
[25] UNEP02.

KENYA01	Kenya	Kenya submission NWP_ ecosystems and water resources
MEXICO01	Mexico	Submission Mexico NWP ecosystems and water
MAURITIUS01	Mauritius	Mauritius_ Adaptation Planning Processes Addressing Ecosystems and Interrelated Areas
SAUDIARABIA01	Saudi Arabia	NWP Ecosystems submission by KSA
AGWA01	Alliance for Global Water Adaptation	Submission by AGWA
APN01	Asia-Pacific Network for Global Change Research	Seagrass – Mangrove Ecosystems: Bioshield against Biodiversity Loss and Impacts of Local and Global Change along Indo-Pacific Coasts
APN02	Asia-Pacific Network for Global Change Research	Developing Ecosystem based Adaptation Strategies for Enhancing Resilience of Rice Terrace Farming Systems against Climate Change
APN03	Asia-Pacific Network for Global Change Research	Optimising Climate Adaptation through Enhanced Community Resilience
BOT01	Boticário Group Foundation for Nature Protection	Contribution under the Nairobi work programme
CBD01	Convention on Biological Diversity	Submission by CBD
CI01	Conservation International	Ecosystem-based adaptation: lessons, good practices and tools
CI02	Conservation International	Adaptation to Climate Impacts in Water Regulation and Supply for the Area Chingaza-Sumapaz-Guerrero, Colombia
CFI01	Community Forests International	Submission by Community Forests International
CRECER01	Community Growth of Regional Employment	Submission by CRECER
FAO01	Food and Agriculture Organization of the United Nations	Submission by FAO
GIZ01	Deutsche Gesellschaft für Internationale Zusammenarbeit	Best practices on planning, implementing and monitoring & evaluating ecosystem-based adaptation to climate change
GMA01	Global Mountain Action	Submission by Global Mountain Action
ICIMOD01	International Centre for Integrated Mountain Development	Wetlands in Himalayas. Securing services for livelihoods at the time of climate change
ICLEI01	ICLEI - Local Governments for Sustainability	Submission by ICLEI
IFAD01	International Fund for Agricultural Development	IFAD submission to NWP
IUCN01	International Union for Conservation of Nature	Participatory planning as a tool for effective stakeholder engagement in addressing ecosystems challenges

IUCN02	International Union for Conservation of Nature	Ecosystem based Adaptation in Mountain Ecosystems in Nepal
IUCN03	International Union for Conservation of Nature	Water infrastructure solutions from ecosystem services underpinning climate resilient policies and programmes (WISE-UP)
IUCN04	International Union for Conservation of Nature	Submission by IUCN – several projects being implemented in Mexico and Central America: Go4EbA, RCCP, and the project: Coastal Protection for Climate Change Adaptation in Small Island States in the Caribbean
MP01	The Mountain Partnership	Submission by The Mountain Partnership
NCCARF01	National Climate Change Adaptation Research Facility	Submission by NCCARF
OECD01	Organisation for Economic Co-operation and Development	OECD submission to the UNFCCC Subsidiary Body for Scientific and Technological Advice
OPCC01	Pyrenees Climate Change Observatory	Understanding the evolution of natural hazards in the Pyrenees in face of climate change and analyzing the role of forest management
SLYCAN01	SLYCAN Trust	Submission by SLYCAN Trust as a partner of the Nairobi Work Programme under the UNFCCC on Work Related to Ecosystems, Interrelated Areas such as Water Resources & Adaptation
SPREP01	Secretariat of the Pacific Regional Environment Programme	Submission by SPREP
TMI01	The Mountain Institute	Submission by TMI
UNUEHS01	United Nations University Institute for Environment and Human Security	Submission by UNU-EHS
UCCRN01	Urban Climate Change Research Network	Climate Change and Cities. Second Assessment Report of the UCCRN
UNDP01	United Nations Development Programme	UNDP's work on ecosystems, interrelated areas such as water resources & adaptation
UNECE01	United Nations Economic Commission for Europe	Information on recent work in the area of ecosystems and water resources
UNEP01	United Nations Environment Programme	Ecosystem-based adaptation through south-south cooperation (EbA South)
UNEP02	United Nations Environment Programme	Submission on UNEP-WCMC's recent work and lessons learned in the area of ecosystems, water resources and adaptation
WI01	Wetlands International	Submission by Wetlands International
WWF01	World Wide Fund for Nature	Submission by WWF
WEDO01	Women's Environment & Development Organization	Submission by WEDO
WMO01	World Meteorological	Submission by WMO

Organization

[a] Submission title as listed on the submission portal for Parties and the web page for submissions from non-Party stakeholders to the Subsidiary Body for Scientific and Technological Advice for organizations.

Annex IV

List of indicators, guides, frameworks, methodologies and tools referred to in the submissions

[English only]

Indicator	*Description*	*Submission*	*Available at*
Household vulnerability index	A vulnerability index to indicate the extent to which households are susceptible to climate change impacts. Developed under the Ecosystem-based Adaptation (EbA) South project	UNEP01	Not available (NA)
List of indicators for EbA outcomes	Conservation International (CI) reported that many EbA projects measure project outputs (e.g. hectares of wetlands rehabilitated) but not actual adaptation outcomes. To find indicators for relevant EbA outcomes, CI reviewed 60 projects	CI01	A list of indicators will be finalized in 2017
Guide/framework	*Description*	*Submission*	*Available at*
Monitoring and evaluation guide for protected area managers, staff and community associations	Under the Climate Resilient Communities and Protected Areas project, a guide was developed for regular climatic, socioeconomic and environmental monitoring using simple techniques	UNEP02	https://www.unep-wcmc.org/system/comfy/cms/files/files/000/000/774/original/UNEP-WCMC_M_E_Guide_2016_en.pdf
Exploring nature-based solutions – The role of green infrastructure in mitigating the impacts of weather- and climate change-related natural hazards	The 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	CBD01	http://www.eea.europa.eu/publications/exploring-nature-based-solutions-2014
Quantifying the role of marine and coastal ecosystems in mitigating beach erosion	A training manual for the quantification of marine and coastal ecosystems' role in mitigating beach erosion, with a focus on disaster risk reduction and climate change adaptation. It involves the use of geographic information systems, erosion modelling, statistical analysis and local expert and community consultations	CBD01	http://www.grid.unep.ch/products/3_Reports/RiVAMP_Training_2012.pdf
National Adaptation Policy Guidelines Around River Management for	The guidelines will inform decision-making by assessing and quantifying the adaptation benefits (ecological and social resilience) of a water reserves programme using a five-step iterative process	AGWA01	NA, under development

the Mexican Government			
Vulnerability Assessment for Socio-ecological Systems	A structured approach to designing and implementing multiscalar vulnerability assessments of complex systems for EbA	GIZ01	http://www.climatechange.vn/en/wp-content/uploads/sites/2/2016/12/VA-Approach_ENG.pdf

Tool	*Description*	*Submission*	*Available at*
Openforis Collect Earth	Open source geospatial forest monitoring	FAO01	http://www.openforis.org/tools/collect-earth.html
FieldVIEW	Tablet-based database for in-the-field use by project staff to track 'overall' and 'specific' objectives	CFI01	NA, under development
EbA planning tool	Will support local-level resilience-building activities for ecosystem-dependent communities, and aims to close the gap between understanding EbA benefits and uptake by adaptation practitioners. It will build on the Community-based Risk Screening Tool – Adaptation and Livelihoods	UNEP01	NA, under development
i-Tree	Software tools that allow the quantification of ecosystem service benefits from urban trees	UCCRN01	https://www.itreetools.org
Green Values Calculator	A tool for comparing performance, costs and benefits of green infrastructure practices	UCCRN01	http://greenvalues.cnt.org/national/calculator.php
Integrated Valuation of Environmental Services and Trade-offs (InVEST)	A suite of software models for the assessment and mapping of ecosystem service values and trade-offs to support investment	CBD01	http://www.naturalcapitalproject.org/InVEST.html
EX-Ante Carbon balance Tool	An ex-ante appraisal system of the impacts that agriculture and forestry efforts have on the carbon balance. It is a land-based accounting system, estimating emissions or sinks of carbon dioxide as well as emissions per unit of land	FAO01	http://www.fao.org/fileadmin/templates/ex_act/pdf/Technical_guidelines/EX-ACT_User_Manual_Final_Draft_v01.pdf
Biodiversity monitoring tools	The Mountain Partnership and the Food and Agriculture Organization of the United Nations are engaged in the development of biodiversity monitoring tools for REDD-plus[a] in Papua New Guinea at the national scale. The combined carbon-biodiversity inventory will enable decision-making on trade-offs between reducing emissions and protecting biodiversity	MP01	NA, under development
Tool for Integrating Ecosystems into Climate Change	A tool to guide national planners and decision-makers from across the government to integrate ecosystem-based approaches throughout the adaptation planning process	CI01	http://www.conservation.org/publications/Documents/NAP-Ecosystems-Tool-FINAL-2015.pdf

Adaptation Planning. Linking Biodiversity and Ecosystems into the National Adaptation Planning Process			
Strategic Plan indicators	A series of factsheets and potential indicators to assist with national implementation of activities related to the Strategic Plan for Biodiversity 2011–2020 and Aichi Biodiversity	CBD01	http://www.cbd.int/sp/indicators/

[a] In decision 1/CP.16, paragraph 70, the Conference of the Parties encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities: reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks.