UNEP

CBD

Convention on Biological Diversity

Distr.
GENERAL

UNEP/CBD/SBSTTA/20/INF/1
1 April 2016

ENGLISH ONLY

SUBSIDIARY BODY ON SCIENTIFIC,
TECHNICAL AND TECHNOLOGICAL ADVICE
Twentieth meeting
Montreal, Canada, 25-30 April 2016
Item 8 of the provisional agenda*

GUIDANCE ON ENHANCING POSITIVE AND MINIMIZING NEGATIVE IMPACTS ON BIODIVERSITY OF CLIMATE CHANGE ADAPTATION ACTIVITIES

Note by the Executive Secretary

INTRODUCTION

1. The need to urgently address climate change to limit its negative impacts on humans and ecosystems is now widely recognized. While efforts and activities to adapt to the effects of climate change could have large positive impacts on biodiversity, they could also have negative impacts if they are not appropriately designed and implemented. Guidance and tools are available to maximize the positive and minimize the negative impacts of response activities on biodiversity.

2. In paragraph 8 of decision X/33, the Conference of the Parties invited Parties and other Governments, according to national circumstances and priorities, as well as relevant organizations and processes, to consider the guidance listed under subparagraphs (a) to (z) on ways to conserve, sustainably use and restore biodiversity and ecosystem services while contributing to climate change mitigation and adaptation. Paragraph 8 (u) invites Parties and other Governments, as well as relevant organizations, to increase positive and reduce negative impacts of climate change mitigation and adaptation measures on biodiversity inter alia, based on results from strategic environmental assessments (SEAs)[1] and environmental impact assessments (EIAs) that facilitate the consideration of all available climate change mitigation and adaptation options.

3. In decision XII/20, paragraph 7 (d), the Conference of the Parties requested the Executive Secretary to develop, further to paragraph 8 (u) of decision X/33, guidance on enhancing the positive and minimizing the negative impacts on biodiversity of climate change adaptation activities in cooperation with the Joint Liaison Group of the Rio Conventions.

4. Since paragraph 8 (u) of decision X/33 refers to both mitigation and adaptation measures and because both types of measures are often interlinked, and since many of the same principles for enhancing their positive and minimizing their negative impacts can be applied, the present document also discusses mitigation activities in addition to adaptation activities, where appropriate.

* UNEP/CBD/SBSTTA/20/1/Rev.1.

[1] Decision VIII/28 (Voluntary guidelines on biodiversity-inclusive impact assessment).

5. The guidance provided in paragraph 8 of decision X/33 is based on the work of the second Ad Hoc Technical Expert Group (AHTEG) on Biodiversity and Climate Change.[2] The second AHTEG on Biodiversity and Climate Change was convened in 2008 in response to paragraph 12 (b) of decision IX/16 B. It was established to provide biodiversity-related information through the provision of scientific and technical advice and assessment on the integration of the conservation and sustainable use of biodiversity into climate change mitigation and adaptation activities. The mandate of the group included the identification of potential biodiversity-related impacts and benefits of adaptation activities, especially in the regions identified as being particularly vulnerable under the Nairobi work programme of the United Nations Framework Convention on Climate Change (developing countries, especially least developed countries and small island developing States).

6. Prior to the work of the second AHTEG, information on enhancing positive and minimizing negative impacts of mitigation and adaptation activities was also generated by the first AHTEG on Biodiversity and Climate Change, and presented in 2003 in CBD Technical Series No. 10,[3] and in 2006 in CBD Technical Series No. 25.[4]

7. The present document provides guidance on enhancing the positive and minimizing the negative impacts on biodiversity of climate change mitigation and adaptation activities as per decision XII/20 paragraph 7 (d), based on recent literature, case studies and experiences, and building on the information provided by the first and second AHTEGs on biodiversity and climate change.

8. Section I presents the main principles which can contribute to enhancing positive and reducing negative impacts of climate change adaptation activities on biodiversity. Section II provides further guidance for enhancing positive and minimizing negative impacts of climate change adaptation activities, with some specific examples for different sectors and ecosystems. As decision XII/20 requests guidance related to adaptation activities, and because guidance related to mitigation activities has been addressed in a number of other reports prepared by the Secretariat, this report focuses mainly on adaptation activities. However, given the interrelationships between adaptation and ecosystem-based approaches for mitigation, section III provides some examples of tools to enhance the benefits and reduce the negative impacts of mitigation on biodiversity, with references to other reports where additional information can be found.

I. PRINCIPLES FOR INCREASING POSITIVE AND REDUCING NEGATIVE IMPACTS OF CLIMATE CHANGE ADAPTATION ACTIVITIES

9. Experiences in the design and implementation of climate change response activities have yielded a number of principles which can contribute to enhancing their positive and reducing negative impacts on biodiversity. Table 1 summarizes these main principles.

Table 1. Principles for increasing positive and reduce negative impacts of climate change response activities on biodiversity

1. Application of the ecosystem approach	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. It is based on the application of appropriate scientific methodologies focused on levels of biological organization which encompass

[2] Secretariat of the 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, Technical Series No. 41, 126 pages. https://www.cbd.int/doc/publications/cbd-ts-41-en.pdf.

[3] Secretariat of the Convention on Biological Diversity (2003). *Interlinkages between biological diversity and climate change. Advice on the integration of biodiversity considerations into the implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol*. Montreal, SCBD, 154p. (CBD Technical Series No. 10). https://www.cbd.int/doc/publications/cbd-ts-10.pdf.

[4] Secretariat of the Convention on Biological Diversity (2006*). Guidance for Promoting Synergy Among Activities Addressing Biological Diversity, Desertification, Land Degradation and Climate Change*. Montreal, Technical Series No. 25, iv + 43 pages. https://www.cbd.int/doc/publications/cbd-ts-25.pdf.

	the essential processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of ecosystems. The ecosystem approach is described by 12 interrelated guiding principles which facilitate decision-making in CBD decision V/6.[5]
2. Consideration of traditional knowledge and full involvement of indigenous peoples and local communities and other stakeholders	Traditional knowledge can complement science and bridge 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. Indigenous peoples and local communities have long 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 response activities. Key issues for indigenous peoples and local communities to take into account in the planning and implementation of climate change response activities include: (a) Recognition of rights and generation of opportunities; (b) Awareness-raising, capacity-building and dialogue; (c) Governance and equity; (d) Policy and legislation; (e) Gender. All relevant stakeholders should be involved in the decision-making process. This requires robust management institutions that facilitate knowledge transfer (e.g., lessons learned, best practices) among communities, economic sectors, and the general public to ensure informed decision-making. Appropriate training and capacity development need to be ensured.
3. Building on a scientifically credible knowledge base	The best available science should inform the following: (a) Status of biodiversity and its vulnerability; (b) Predicted changes in climate, variability and extremes, and potential impacts; (c) Vulnerability of adaptation options and their adaptive capacity.
4. Consideration of ecosystem-based approaches versus technological / engineered solutions	Adaptation solutions include “hard” or “grey” engineered solutions, such as the construction of sea walls, and “green” approaches, which focus on ecosystems and ecosystem services to help people adapt to impacts of climate change.[6] Hard solutions are often promoted due to the delivery of immediate benefits and the perceived feeling of security, such as building a sea wall, dike, or installing irrigation systems. However, as learned from past disaster risk reduction efforts, engineering solutions can be costly to maintain, require large

[5] CBD decision V/6: https://www.cbd.int/decision/cop/default.shtml?id=7148.

[6] Synthesis report on experiences with ecosystem-based approaches to climate change adaptation and disaster risk reduction (UNEP/CBD/SBSTTA/20/INF/2) https://www.cbd.int/doc/meetings/sbstta/sbstta-20/information/sbstta-20-inf-02-en.pdf.

	capital investments, and may even result in maladaptation in the long run by disrupting ecological processes. The potential for natural ecosystems to provide physical protection from climate change hazards should be assessed and considered. The social, environmental and economic costs and benefits of maintaining these ecosystem services should be compared to those of other kinds of adaptation activities. Ecosystem-based approaches to adaptation, which integrate the sustainable use of biodiversity and ecosystem services into an overall adaptation strategy, can be cost-effective and generate social, economic and cultural co-benefits and contribute to the conservation of biodiversity.
5. Application of strategic environmental assessments (SEAs) and environmental impact assessments (EIAs)	Environmental impact assessments and strategic environmental assessments can be integrated into the design of climate change adaptation projects and policies to assist planners, decision makers and all stakeholders to identify and mitigate potentially harmful environmental and social impacts and enhance the likelihood of positive benefits such as carbon storage, biodiversity conservation and improved livelihoods. SEAs and EIAs should be applied to all the options being considered.
6. Inclusion of the value of biodiversity and ecosystem services in decision-making	Valuation techniques can quantify costs and benefits, opportunities and challenges, and thus can improve decision-making with regard to climate change related activities. A range of valuation techniques for biodiversity and ecosystem services exists. One of the most common methods of appraising adaptation options is cost-benefit analysis. Other methodologies include cost-effectiveness analysis, robust decision-making and real options analysis, each with differing approaches, levels of uncertainties, and level of effort needed in conducting the analyses.
7. Allowing for monitoring and evaluation, and adaptive management	Monitoring and evaluation is particularly important because of the high degree of uncertainty in projections about future impacts on which adaptation decisions are based. Monitoring practices should be designed to: • Verify that the intended objectives of adaptation activities are achieved; • Address uncertainty regarding the timing and magnitude of climate change impacts; • Avoid maladaptation; • Indicators should be matched to the intended objectives and outcomes of the adaptation activities; • Indicators should be well defined, practical and measurable so that they provide timely and relevant information; • The specific choice of indicators is flexible and should be tailored to the situation being evaluated.

10. It is important to note that most of the above principles could also be applied to increase positive and reduce negative impacts of climate change mitigation activities.

II. ENHANCING POSITIVE AND MINIMIZING NEGATIVE IMPACTS OF CLIMATE CHANGE ADAPTATION ACTIVITIES ON BIODIVERSITY

11. Activities to adapt to the adverse impacts of climate change can have positive or negative effects on biodiversity, but tools are available to increase the positive and decrease the negative effects.

12. Adaptation activities can threaten biodiversity either directly—through the destruction of habitats, for example, building sea walls, thus affecting coastal ecosystems—or indirectly, through the introduction of new species or changed management practices, for example, mariculture or aquaculture. For example, the draining of coastal wetlands may be adopted as an adaptation strategy to expand agricultural production and ensure food security; however, such an activity could reduce breeding and feeding grounds for fish and other marine biodiversity, thereby increasing the vulnerability of marine ecosystems and associated livelihoods such as fisheries, and may become increasing costly in the face of sea level rise.

A. Key considerations for maximizing positive and minimizing negative impacts on biodiversity

13. The first AHTEG on Biodiversity and Climate Change analysed a number of adaptation activities and provided, in table 1 of Technical Series No. 25,[7] an indicative list of adaptation activities and their potential impacts on, and risks to, biodiversity, and possible adaptive management actions. The second AHTEG further reviewed the potential impacts of a range of adaptation activities on biodiversity and presented options for maximizing positive effects and minimizing negative effects (annex III to Technical Series No. 41).

14. In reviewing these activities, key considerations for maximizing positive effects of adaptation activities on biodiversity can be identified, including:

(a) Involvement of the community/stakeholders;

(b) Use of a landscape planning approach;[8]

(c) Use of native/endemic species;

(d) Understanding of the principles of ecosystem functions, biodiversity relationships and thresholds;

(e) Taking into account the maintenance and restoration of resilience to sustain the delivery of ecosystem goods and services. Biological factors which confer resilience include genetic heterogeneity, regenerative populations, multiple successional states, and habitat connectivity across environmental gradients;

(f) Education and training;

(g) Provision of positive incentive measures and alternative income generating sources.

15. Key considerations for minimizing negative effects of mitigation activities on biodiversity include:

(a) Use of the precautionary principle;

(b) Taking into account particular local/site conditions;

(c) Assessing the potential invasiveness risk of the introduced species;

(d) Monitoring and evaluation.

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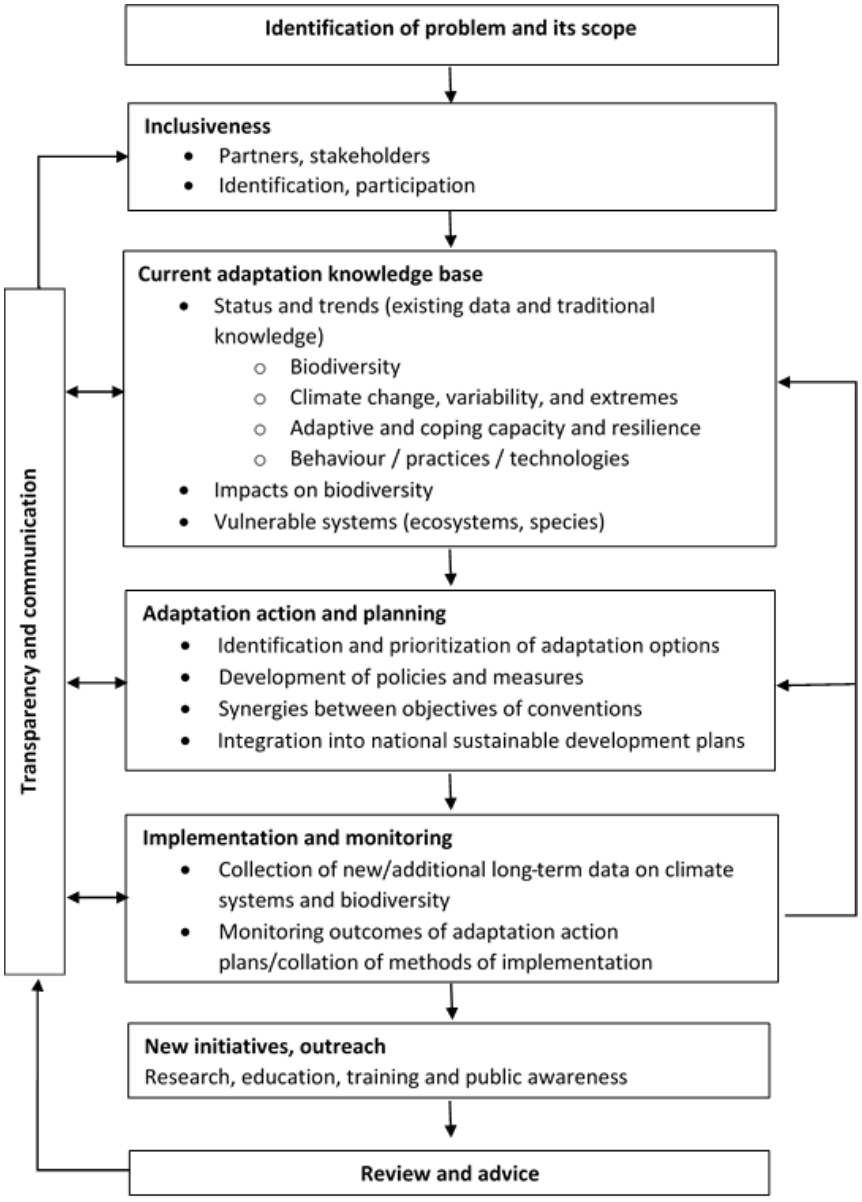
[7] Secretariat of the Convention on Biological Diversity (2006). *Guidance for Promoting Synergy Among Activities Addressing Biological Diversity, Desertification, Land Degradation and Climate Change*. Montreal, Technical Series No. 25, iv + 43 pages. https://www.cbd.int/doc/publications/cbd-ts-25.pdf.

[8] Report on how to improve sustainable use of biodiversity in a landscape perspective. https://www.cbd.int/doc/meetings/sbstta/sbstta-15/official/sbstta-15-13-en.pdf.

B. Framework for the integration of biodiversity into climate change adaptation

16. A framework to assist countries in the integration of biodiversity into climate change adaptation was presented in Technical Series No. 41[9] (figure reproduced in figure 1 below). The framework follows a risk management approach and includes iterative steps including the identification of the problem, ensuring and seeking participation from multiple partners, assessing the knowledge base, and preparing and implementing adaptation action plans. These stages are followed by monitoring the outcomes of the plan and when needed supplementing and strengthening the information/knowledge base and research activities. Communication and transparency are important throughout the process.

Figure 1. Framework for adaptation integrating biodiversity concerns



[9] Secretariat of the 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, Technical Series No. 41, 126 pages. https://www.cbd.int/doc/publications/cbd-ts-41-en.pdf.

C. Synergies through the design, review and implementation of National Adaptation Plans and national biodiversity strategies and action plans

17. Strengthening synergies between the conservation and sustainable use of biodiversity and climate change adaptation at the national level through design, review and implementation of National Adaptation Plans (NAPs) and national biodiversity strategies and action plans (NBSAPs) is key to ensuring that adaptation activities achieve maximum benefits and do not have negative impacts on biodiversity.

18. On the one hand, in planning for the conservation and sustainable use of biodiversity, NBSAPs promote the maintenance and enhancement of the protective function, resilience and adaptive capacity of ecosystems, thereby contributing to climate change adaptation. On the other hand, the integration of biodiversity into NAPs will ensure that the selected activities will not negatively impact biodiversity. It will also ensure that, where relevant, cost-effective and sustainable adaptation strategies will make full use of biodiversity and ecosystem services. More information is presented in a document prepared by the Secretariat to assist national focal points of the Convention on Biological Diversity and their climate change counterparts in strengthening synergies between the conservation and sustainable use of biodiversity and climate change adaptation at the national level through NAP and NBSAP design, review and implementation (UNEP/CBD/COP/12/INF/29).[10]

D. Ecosystem-based approaches for adaptation

19. Ecosystem-based adaptation (EbA) is described in decision X/33 as the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change. In the same decision, the Conference of the Parties invited Parties to implement ecosystem-based approaches for adaptation.

20. EbA is gaining traction worldwide, with more case studies and literature demonstrating that EbA can be a flexible, cost-effective and broadly applicable approach for reducing the impacts of climate change, with multiple benefits, including biodiversity conservation, poverty reduction, sustainable development, climate change mitigation, and disaster risk management.

21. Like other adaptation activities, ecosystem-based adaptation is not without complexity, uncertainty, and risk. A synthesis report on experiences with ecosystem-based approaches to climate change adaptation and disaster risk reduction, prepared for the twentieth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (UNEP/CBD/SBSTTA/20/INF/2) in response to decision XII/20, provides information and tools for maximizing co-benefits of ecosystem-based approaches for adaption, including with regard to assessing vulnerability, integrating EbA into planning and policy, implementation, monitoring and evaluation.

E. Ecosystem restoration

22. Ecosystem restoration is considered an important activity for climate change adaptation and mitigation since it involves activities that increase ecosystem resilience and enhance the ability of ecosystems to provide ecosystem services. Various decisions of the Conference of the Parties acknowledge the contribution of ecosystem restoration for climate change adaptation and mitigation (XII/19, XII/20, XI/16, and X/33).

23. For example, coastal wetland restoration can provide protection against sea level rise and extreme weather events, while also providing increased fishery opportunities, and carbon sequestration. Similarly, the restoration of forests can help stabilize land slopes and regulate water flows during floods.

[10] Promoting Synergies in Addressing Biodiversity and Climate Change Adaptation Issues: Linking National Adaptation Plans and National Biodiversity Strategies and Action Plans (UNEP/CBD/COP/12/INF/29). https://www.cbd.int/doc/meetings/cop/cop-12/information/cop-12-inf-29-en.pdf.

24. Restoration activities should be carefully designed and implemented to ensure that they do not have negative impacts on biodiversity. For example, the introduction of new species into an ecosystem could have negative impacts on native biodiversity.

25. Key considerations for optimizing the benefits and minimizing negative impacts of ecosystem restoration on biodiversity, such as avoiding the afforestation of grasslands and ecosystems with naturally low tree cover, and preventing the introduction of invasive alien species, are presented in the appendix of document UNEP/CBD/SBSTTA/20/12.[11] Additional guidance and tools will be presented in information notes UNEP/CBD/SBSTTA/20/INF/35 and UNEP/CBD/SBSTTA/20/INF/36. Further guidance on ecosystem restoration is provided in decisions XII/19 and XI/16.

F. Examples in specific sectors and ecosystems

26. There are specific adaptation options for different sectors and ecosystems, which can maximize positive and minimize negative impacts on biodiversity. Examples are set out in the following paragraphs.[12]

1. Agricultural sector

27. Responses to the projected impacts of climate change in the agricultural sector could include intensification and use of systems which require greater inputs, such as irrigation and increased amounts of fertilizers and other chemicals, as well as moving agricultural production to new areas. However, such responses are likely to be maladaptive.

28. The application of agroecological approaches aimed at conserving soil moisture and nutrients, applying integrated pest management and diversifying crops and farming systems through the application of multicropping or mixed farming systems can increase long-term resilience against climate change impacts and has many co-benefits such as reducing erosion or eutrophication problems.

2. Freshwater ecosystems

29. Responses to climate change impacts on freshwater ecosystems often relate to water management including addressing flood and drought risks. Common technical approaches to flood risk include the construction of dykes and dams. Hard structures can have significant environmental impacts, such as destruction or alteration of wetlands, reducing connectivity between lakes, rivers and riparian zones, and changing sediment flows.

30. Restoration of upland watersheds and floodplain restoration are ecologically viable alternatives that deserve attention. In some cases, it may be possible to consider ecosystem-based alternatives such as watershed management to increase the storage of rainwater in wetlands and forests, and agricultural practices that improve the water storing capacities of soils, e.g., by enhancing soil structure and humus content.

3. Forestry and forests

31. Possible adaptation activities in forests with likely negative consequences for biodiversity could include increased development of plantation forests especially those with non-native species, thinning, increased use of herbicides and insecticides to combat pests, and reduced rotation length. Some of the more controversial techniques that could be used include assisted migration of regional tree species, the importation of invasive alien tree species or the use of genetically modified tree stock.

32. The available scientific evidence strongly supports the conclusion that resilience of a forest ecosystem to changing environmental conditions is determined by its biological and ecological resources,

[11] Protected areas and ecosystem restoration (UNEP/CBD/SBSTTA/20/12) https://www.cbd.int/doc/meetings/sbstta/sbstta-20/official/sbstta-20-12-en.pdf

[12] Most of these examples were taken from the Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. (Technical Series No. 41): https://www.cbd.int/doc/publications/cbd-ts-41-en.pdf.

in particular (a) the diversity of species, including micro-organisms, (b) the genetic variability within species (i.e., the diversity of genetic traits within populations of species), (c) the landscape diversity; and (d) the regional pool of species and ecosystems.[13]

33. The protection of primary forests, reducing fragmentation, and increasing landscape connectivity could form important elements of a portfolio of adaptation options that maximize biodiversity benefits.

34. The negative impacts of adaptation in managed forests can be reduced through an increased understanding of forest ecosystems and improved application of the ecosystem approach within forest management. In forests managed primarily for production, sustainable forest management is an important framework. Key elements include, among others:

(a) Maintaining genetic diversity in forests by avoiding practices that select only certain trees for harvesting;

(b) Maintaining stand and landscape structural complexity;

(c) Maintaining connectivity across forest landscapes by reducing fragmentation, recovering lost habitats (forest types), expanding protected area networks, and establishing ecological corridors;

(d) Maintaining functional diversity and eliminating the conversion of diverse natural forests to monotypic or reduced-species plantations;

(e) Reducing non-natural competition by controlling invasive species and reducing reliance on non-native tree crop species for plantation, afforestation, or reforestation projects;

(f) Developing an effectiveness monitoring plan that monitors climate conditions, and adapting planning and implementation as necessary.

35. For the design, implementation and monitoring of afforestation, reforestation and forest restoration activities, the Conference of the Parties provided the following guidance for enhancing positive impacts on biodiversity (decision X/33, paragraph 8 (p)):

(a) Converting only land of low biodiversity value or ecosystems largely composed of non-native species, and preferably degraded ones;

(b) Prioritizing, whenever feasible, local and acclimated native tree species when selecting species for planting;

(c) Avoiding invasive alien species;

(d) Preventing net reduction of carbon stocks in all organic carbon pools;

(e) Strategically locating afforestation activities within the landscape to enhance connectivity and increase the provision of ecosystem services within forest areas.[14]

36. Another important key consideration for adaptation in forest ecosystems is enabling stakeholder participation, especially among local communities, and to provide secure land tenure and forest user rights and sufficient financial incentives. In this regard, the Conference of the Parties, in decision X/33,

[13] Thompson, I., Mackey, B., McNulty, S., Mosseler, A. (2009). *Forest Resilience, Biodiversity, and Climate Change. A synthesis of the biodiversity/resilience/stability relationship in forest ecosystems*. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series No. 43, 67 pages. https://www.cbd.int/doc/publications/cbd-ts-43-en.pdf.

[14] The second AHTEG on Biodiversity and Climate Change noted that afforestation activities can have positive or negative effects on biodiversity and ecosystem services depending on their design and management and the present land use. For example, afforestation activities that convert non-forested landscapes with high biodiversity values and/or valuable ecosystem services, increase threats to native biodiversity. However, afforestation activities could help to conserve biodiversity if they, for example, convert only degraded land or ecosystems largely composed of exotic species, include native tree species, consider the invasiveness of non-natives, and are strategically located within the landscape to enhance connectivity (CBD Technical Series No. 41).

paragraph 8 (q), invited Parties and other Governments to enhance the benefits for, and avoid negative impacts on, biodiversity from reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries, and other sustainable land management and biodiversity conservation and sustainable-use activities, taking into account the need to ensure the full and effective participation of indigenous and local communities in relevant policymaking and implementation processes, where appropriate; and to consider land ownership and land tenure, in accordance with national legislation.

4. Marine and coastal ecosystems

37. Many proposed strategies to adapt to climate change impacts in coastal regions consider hard infrastructure approaches (e.g., sea walls, dykes, etc.). Such structures often adversely impact natural ecosystems processes by altering tidal current flows, disrupting or disconnecting ecologically related coastal marine communities, disrupting sediment or nutrition flows, and may cause stagnation in some contexts. Such structures may also impede successful reproduction of some species (e.g., turtles).

38. Adaptation activities should make use of the ecosystem approach and address all sources of impacts (human and climatic). Adaptation measures need to address coastal protection while limiting adverse impacts on coastal biodiversity. Ecosystem-based adaptation offers potential for co-benefits in the context of building climate−resilient coastal communities.

39. Coral reefs not only provide essential services such as buffering against storm surges, stabilizing coastal areas against erosion, they also serve as nursery habitats for commercially important fish species and support livelihoods and economic activities, such as tourism and fishing. Unfortunately, they are also among the most vulnerable to climate change.

40. Aichi Biodiversity Target 10 calls for the minimizing of the multiple anthropogenic pressures on coral reefs and other vulnerable ecosystems impacted by climate change or ocean acidification, so as to maintain their integrity and functioning. The fourth edition of the *Global Biodiversity Outlook* (GBO-4) found that, based on available evidence, we have actually moved away from achieving this target, and that significantly accelerated actions are needed to reverse this trend. In order to address this need, the Conference of the Parties adopted, at its twelfth meeting, a set of priority actions to achieve Aichi Biodiversity Target 10 for coral reefs and closely associated ecosystems. By taking these actions, the resilience of coral reefs can be enhanced and co-benefits for climate change adaptation and biodiversity conservation can be achieved. The actions address, in particular:

(a) Reducing the impacts of multiple stressors, in particular those stressors that are more tractable at the regional, national and local levels;

(b) Enhancing the resilience of coral reefs and closely associated ecosystems through ecosystem-based adaptation;

(c) Maintaining sustainable livelihoods and food security in reef-dependent coastal communities and providing for viable alternative livelihoods;

(d) Increasing the capability of local and national managers to forecast and plan proactively for climate risks and associated secondary effects; and

(e) Enhancing international and regional cooperation in support of national implementation of priority actions.

41. The full list of actions is available in the annex to decision XII/23.[15]

[15] Decision XII/23: https://www.cbd.int/decision/cop/default.shtml?id=13386; also available in the booklet on priority actions to achieve Aichi Biodiversity Target 10 for coral reefs and closely associated ecosystems: https://www.cbd.int/doc/publications/cbd-aichi-target-10-en.pdf.

5. *Dry and sub-humid lands ecosystems*

42. Predicted likely impacts of climate change on dry and sub-humid lands include accelerated water decline, reduced productivity of croplands, increased habitat loss and fragmentation, and adverse impacts on human well-being through increased resource scarcity.[16]

43. One strategy to enhance the adaptive potential of the biodiversity of dry and sub-humid lands is to reduce other threats while considering both current threats and those threats that are, themselves, expected to be exacerbated by climate change.

44. One of the most commonly addressed fields of adaptation in dry and sub-humid lands is disaster management, largely because of projected impacts of climate change on the frequency and intensity of floods and drought. Adaptation activities include early warning systems, education and awareness raising, improved land and water management and the development of reservoirs. These activities have the potential to deliver positive benefits for biodiversity if such considerations are integrated into planning. For example, an early warning system that considers climate data in addition to data on ecosystem carrying capacity would have more positive benefits than a system based on climate data alone.[17]

45. Ensuring the participation of stakeholders representing different land uses has been identified as being key in dry and sub-humid lands in order to avoid conflict between, inter alia, sedentary agriculture, pastoralism, and conservation and tourism.

46. Pastoral communities typically inhabit areas characterized by scarce resources and extreme climatic conditions, making them vulnerable to climate change. However, pastoralists are also equipped to adapt to climate change, as pastoral livelihood strategies are designed to respond to such scarce and variable natural resources and climatic conditions. Pastoralism can have both positive and negative impacts on biodiversity, but globally there are a growing number of initiatives which apply incentives to either promote the most environmentally healthy practices of pastoralism or to reduce disincentives that promote harmful management practices.

47. Ensuring that the natural adaptive capacity of pastoral systems is maintained or restored through, for example, conserving indigenous livestock breeds and fodder varieties, maintaining freedom of movement, and identifying and supporting traditional coping mechanisms such as water capture and management, and market access, can be important adaptation activities.[18]

48. A compilation of experiences in the field of climate change mitigation and adaptation, soil management and pastoralism in dry and sub-humid lands prepared by the International Union for Conservation of Nature (IUCN)[19] in response to decision IX/17, paragraph 8 (c) reveals that strengthening the adaptive capacity of pastoralists and other drylands communities is associated with strengthening rights, enabling reform, managing risk and increasing resilience, which requires greater partnership between communities, governments and organizations and an appropriately regulated private sector. Strengthening adaptive capacity goes hand in hand with enhancing the economic and social well-being of pastoralists and enabling them to sustain ecosystem services.

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[16] Secretariat of the Convention on Biological Diversity, Global Mechanism of the United Nations Convention to Combat Desertification and OSLO consortium (2013). *Valuing the biodiversity of dry and sub-humid lands*. Technical Series No. 71. Secretariat of the Convention on Biological Diversity, Montreal, 94 pages. https://www.cbd.int/doc/publications/cbd-ts-071-en.pdf.

[17] In-depth review of the work on biodiversity and climate change. Addendum: Integration of climate change impacts and response activities within the programme of work on the biodiversity of dry and sub-humid lands. (UNEP/CBD/SBSTTA/14/6/Add.1). https://www.cbd.int/doc/meetings/sbstta/sbstta-14/official/sbstta-14-06-add1-en.pdf.

[18] Secretariat of the Convention on Biological Diversity. 2010. *Pastoralism, Nature Conservation and Development: A Good Practice Guide*. https://www.cbd.int/development/doc/cbd-good-practice-guide-pastoralism-booklet-web-en.pdf.

[19] Compilation of experiences in the field of climate change mitigation and adaptation, soil management and pastoralism in dry and sub-humid lands (UNEP/CBD/SBSTTA/14/INF/35): https://www.cbd.int/doc/meetings/sbstta/sbstta-14/information/sbstta-14-inf-35-en.pdf.

III. LINKAGES WITH ECOSYSTEM-BASED APPROACHES FOR CLIMATE CHANGE MITIGATION

49. Some adaptation options can affect, or contribute to, mitigation, and vice versa, in particular in the case of ecosystem-based approaches. For example, ecosystem-based adaptation can contribute to climate change mitigation by conserving carbon stocks, reducing emissions from ecosystem degradation and loss, and enhancing carbon sequestration. Therefore it may be necessary to simultaneously consider the potential positive and negative impacts of both adaptation and mitigation on biodiversity when designing and implementing climate change response activities. In addition, as noted earlier, most of the key principles to increase positive and reduce negative impacts of climate change adaptation activities apply to mitigation activities.

50. Evidence has been established to support the hypothesis that there is some degree of linkage between higher levels of species diversity and higher rates of carbon sequestration, and that higher biodiversity can increase the resilience of ecosystems and their carbon stocks to disturbance. Management methods that maintain or restore biodiversity can support the effectiveness of ecosystem-based climate change mitigation efforts.[20]

51. Ways to enhance the benefits and reduce the negative impacts of mitigation on biodiversity have been addressed in a number of other reports prepared by the Secretariat and therefore this document does not explore this issue in detail. Some examples are given below, with references to other reports where additional information can be found.

Forestry-related climate change mitigation activities

52. There is a wide range of forestry-related mitigation options that could potentially provide important biodiversity conservation benefits, including reducing emissions from deforestation and forest degradation, forest conservation, sustainable management of forests and enhancement of forest carbon stocks. The extent to which these activities deliver benefits depends on how and where they are implemented. Ways and means to reduce negative impacts on biodiversity in managed forests is discussed in section II above in the context of adaptation but the same principles of sustainable forest management can apply to mitigation activities.

53. The Secretariat has studied the linkages between forests and climate change response activities, in particular the relationship between forest resilience, biodiversity, and climate change, in CBD Technical Series No. 43,[21] and in relation to reducing emissions from deforestation and forest degradation, conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks in developing countries, in CBD Technical Series No. 59.[22] These links are also addressed in a number of CBD decisions (including decisions XI/19, X/33, and IX/5).

Other (non-forest) land use management climate change mitigation options

54. Agriculture and other land use management activities on non-forested land can also make an important contribution to climate change mitigation and biodiversity conservation. Key examples of agricultural activities that can deliver multiple benefits include conservation tillage and other means of sustainable cropland management, sustainable livestock management, agroforestry systems, reduction of drainage systems in organic agricultural soils, improved management of fertilizers, and maintenance or restoration of natural water sources and their flows including peatlands and other wetlands. The

[20] Managing ecosystems in the context of climate change mitigation: A review of current knowledge and recommendations for action (UNEP/CBD/SBSTTA/20/INF/3).

[21] Thompson, I., Mackey, B., McNulty, S., Mosseler, A. (2009). *Forest Resilience, Biodiversity, and Climate Change. A synthesis of the biodiversity/resilience/stability relationship in forest ecosystems*. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series No. 43, 67 pages. https://www.cbd.int/doc/publications/cbd-ts-43-en.pdf.

[22] Secretariat of the Convention on Biological Diversity (2011). *REDD-plus and Biodiversity*. Montreal, Technical Series No. 59. 68 pages. https://www.cbd.int/doc/publications/cbd-ts-59-en.pdf.

restoration of degraded cropland soils, for example, may increase soil carbon storage and crop yields, while contributing to the conservation of agricultural biodiversity, including soil biodiversity.

55. Another information document[23] for the twentieth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice, prepared by the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), summarizes current knowledge on the potential of non-forest ecosystems for climate change mitigation, such as peatlands, grasslands and savannahs, coastal ecosystems and agroecosystems. It also provides recommendations for maximizing synergies with climate change adaptation, disaster risk reduction, sustainable development and biodiversity conservation.

Other climate change mitigation activities

56. There is a range of other mitigation options with potential implications for biodiversity and ecosystem services.

57. A report on the contribution of Aichi Targets to land-based climate mitigation,[24] commissioned by the Secretariat of the Convention on Biological Diversity, has been prepared by the Université Paris-Sud in collaboration with a panel of international experts working on the relationships between climate mitigation and biodiversity. The report demonstrates that land-based climate mitigation strategies based on halting the conversion of natural terrestrial ecosystems and restoring degraded ecosystems could potentially make significant contributions to climate mitigation. Land-based mitigation strategies based on bioenergy, especially when coupled with carbon capture and storage (BECCS), could have benefits for biodiversity by mitigating climate change, but there are also considerable risks of negative impacts of bioenergy deployment resulting from habitat conversion and pollution. The report explores land-based mitigation that may have positive effects on biodiversity.

58. With regard to the use of biofuels, the Conference of the Parties, in decision IX/2, urged Parties to promote the positive and minimize the negative impacts of biofuel production and its use on biodiversity and the livelihoods of indigenous and local communities, and in decision X/37 requested that the CBD Secretariat examine tools and approaches as well as gaps pertaining to the sustainable production of biofuels. Such information is presented in CBD Technical Series No. 65.[25]

59. Increasing attention has been recently given to additional options to mitigate climate change, such as geoengineering. The possible impacts of geoengineering techniques on biodiversity and associated social, economic and cultural considerations, and the regulatory mechanisms for climate-related geoengineering, have been studied in detail in response to CBD decision X/33 and the findings are published in CBD Technical Series No. 66.[26] An updated report[27] has also been prepared in response to decision XI/20 based on relevant recent scientific reports such as the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

IV. CONCLUSION

60. Taking into consideration biodiversity when designing, implementing and monitoring climate change adaptation activities, as well as mitigation activities, can not only deliver multiple benefits, but also contribute to avoiding negative impacts of the activities on biodiversity and ecosystems.

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[23] Managing ecosystems in the context of climate change mitigation: A review of current knowledge and recommendations for action (UNEP/CBD/SBSTTA/20/INF/3) https://www.cbd.int/doc/meetings/sbstta/sbstta-20/information/sbstta-20-inf-03-en.pdf.

[24] The contribution of Aichi Targets to land-based climate mitigation (UNEP/CBD/SBSTTA/20/INF/29).

[25] Webb, A. and D. Coates (2012). *Biofuels and Biodiversity*. Secretariat of the Convention on Biological Diversity. Montreal, Technical Series No. 65, 69 pages. https://www.cbd.int/doc/publications/cbd-ts-65-en.pdf.

[26] Secretariat of the Convention on Biological Diversity (2012). *Geoengineering in Relation to the Convention on Biological Diversity: Technical and Regulatory Matters*, Montreal, Technical Series No. 66, 152 pages. https://www.cbd.int/doc/publications/cbd-ts-66-en.pdf.

[27] Update on climate geoengineering in relation to the Convention on Biological Diversity (UNEP/CBD/SBSTTA/19/INF/2). https://www.cbd.int/doc/meetings/sbstta/sbstta-19/information/sbstta-19-inf-02-en.pdf.

61. Good practice principles, tools and guidance are available to assist policymakers and practitioners in maximizing the positive and minimizing the negative impacts of climate change response activities on biodiversity.

62. Recognizing the role of sustainable management, conservation and restoration of ecosystems in limiting climate change impacts on biodiversity and helping people adapt to the adverse effects of climate change, ecosystem-based approaches for adaptation should be considered, promoted and integrated into adaptation strategies and plans, national action plans to combat desertification, national biodiversity strategies and action plans, poverty reduction strategies, disaster risk reduction strategies and sustainable land management strategies.

63. As more climate change response activities are being implemented globally, there is an opportunity to learn from experience and to make use of the available tools and guidance to maximize the benefits and avoid the negative impacts on biodiversity.

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