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CONVENTION ON BIOLOGICAL DIVERSITY

INTERLINKAGES BETWEEN BIOLOGICAL DIVERSITY AND CLIMATE CHANGE AND ADVICE ON THE INTEGRATION OF BIODIVERSITY CONSIDERATIONS INTO THE IMPLEMENTATION OF THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE AND ITS KYOTO PROTOCOL

Report prepared by the Ad Hoc Technical Expert Group on Biodiversity and Climate Change established under the Convention on Biological Diversity

Draft Executive Summary

The present paper was prepared by the Ad Hoc Technical Expert Group on Biodiversity and Climate Change established by the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity (CBD) in response to a request of the Conference of the Parties to the Convention[1]. The paper examines the interlinkages between climate change and biological diversity (commonly referred to as biodiversity), and more specifically the impacts of climate change on biodiversity, the potential effects of activities for the mitigation and adaptation to climate change on biodiversity, and the role of biodiversity in mitigating climate change and contributing to adaptation options for climate change. The paper also reviews the approaches and tools such as criteria and indicators, environmental impact assessment, and decision analytic frameworks, that can facilitate the application of scientific advice for the integration of biodiversity considerations into the implementation of measures that might be taken under the United Nations Framework Convention on Climate Change and its Kyoto Protocol to mitigate or adapt to climate change. The paper concludes with a review of lessons learned from country experiences on harmonization of climate-change-mitigation and adaptation activities and their biodiversity considerations. The paper extends the work in the “IPCC technical paper on climate change and biodiversity”.

Biodiversity and linkages to climate change

1. **Biological diversity includes all plants, animals, microorganisms, the ecosystems of which they are part, and the diversity within species, between species, and of ecosystems**[2]. Functional diversity, which describes the ecological functions of species or groups of species in an ecosystem, is a biodiversity descriptor that provides an alternative way of understanding the disturbances caused by human activities, including climate change, on biodiversity. No single component of biodiversity (i.e., genes, species or ecosystems) is consistently a good indicator of the overall biodiversity as these components can vary independently.

2. **Biodiversity underlies the goods and services provided by ecosystems that are crucial for human survival and well-being.** These can be classified along several lines. *Supporting services*

[1] Decision V/4, para 11.
[2] This is a contraction of the definition in the Convention on Biological Diversity.

maintain the conditions for life on Earth including, soil formation and retention, nutrient cycling, primary production; *regulating services* include regulation of air quality, climate, floods, soil erosion, water purification, waste treatment, pollination, and biological control of human, livestock and agriculture pests and diseases; *provisioning services* include providing food, fuelwood, fibre, biochemicals, natural medicines, pharmaceuticals, genetic resources, and fresh water; and *cultural services* provide non-material benefits including cultural diversity and identity, spiritual and religious values, knowledge systems, educational values, inspiration, aesthetic values, social relations, sense of place, cultural heritage, recreation, communal and symbolic values.

3. **Ecosystem goods and services have significant economic value, even if some of these goods and most of the services are not traded by the market and carry no price tags to alert society to changes in their supply or in the condition of the ecosystems that generate them**. Many ecosystem services are largely unrecognized in their global importance or in the crucial role that they play in meeting needs in particular regions. For example, to date there have been no markets that recognize the important contribution of terrestrial and oceanic ecosystems and their biodiversity in absorbing at least half of the carbon that is currently emitted to the atmosphere from human activities, thereby slowing the rate of global climate change.

4. **Biodiversity is determined by the interaction of many factors that differ spatially and temporally.** Biodiversity is determined for example, by a) the mean climate and climate variability; b) the availability of resources and overall productivity of a site; c) the disturbance regime and occurrence of perturbations of cosmic (e.g. meteorites), tectonic, climatic, biological or anthropic origin; d) the original stock of biodiversity and dispersal opportunities or barriers; e) spatial heterogeneity of habitats; f) the intensity and interdependency of biotic interactions such as competition, predation, mutualism and symbiosis; and g) the intensity and kind of sexual reproduction and genetic recombination. Biodiversity at all levels is not static, as the dynamics of natural evolutionary and ecological processes induces a background rate of change.

5. **The current levels of human impact on biodiversity are unprecedented, affecting the planet as a whole, and causing large-scale loss of biodiversity**. Current rates and magnitude of species extinction, related to human activities, far exceed normal background rates. Human activities have already resulted in loss of biodiversity and thus may have affected goods and services crucial for human well-being. The main indirect human drivers (underlying causes) include: demographic; economic; sociopolitical; scientific and technological; and cultural and religious factors. The main direct human drivers (proximate causes or pressures) include: changes in local land use and land cover (the major historical change in land use has been the global increase in lands dedicated to agriculture and grazing); species introductions or removals; external inputs (e.g., fertilizers and pesticides); harvesting; air and water pollution; and climate change. The rate and magnitude of climate change induced by increased greenhouse gases emissions has and will continue to affect biodiversity either directly or in combination with the drivers mentioned above, and might outweigh them in the future.

6. **Past changes in the global climate resulted in major shifts in species ranges and marked reorganization of biological communities, landscapes, and biomes**. The present global biota was affected by fluctuating Pleistocene (last 1.8 million years) concentrations of atmospheric carbon dioxide, temperature, and precipitation, and coped through evolutionary changes, species plasticity, range movements, and/or the ability to survive in small patches of favourable habitat (refugia). These changes, which resulted in major shifts in species ranges and marked reorganization of biological communities, landscapes, and biomes, occurred in a landscape that was not as fragmented as today, and with little or no pressures from human activities. Anthropogenic habitat fragmentation has confined many species to relatively small areas within their previous ranges, with reduced genetic variability. Warming beyond the ceiling of temperatures reached during the Pleistocene will stress ecosystems and their biodiversity far beyond the levels imposed by the global climatic change that occurred in the recent evolutionary past.

7. **For a given ecosystem, functionally diverse communities are likely to be better able to adapt to climate change and climate variability than impoverished ones.** In addition, high genetic diversity within species appears to increase their long-term persistence. It must be stressed, however, that the effect

of the nature and magnitude of genetic and species diversity on certain ecosystem processes is still poorly known. The ability of ecosystems to either resist or return to their former state following disturbance may also depend on given levels of functional diversity. This can have important implications for the design of activities aimed at mitigating and adapting to climate change. Therefore, conservation of genotypes, species and functional types, along with the reduction of habitat loss, fragmentation and degradation, may promote the long-term persistence of ecosystems and the provision of ecosystem goods and services.

Climate change and biodiversity: observed and projected impacts

8. **Changes in climate over the last few decades of the 20th century have already affected biodiversity.** The observed changes in the climate system (e.g., increased atmospheric concentrations of carbon dioxide, increased land and ocean temperatures, changes in precipitation and sea level rise), particularly the warmer regional temperatures, have affected the timing of reproduction of animals and plants and/or migration of animals, the length of the growing season, species distributions and population sizes, and the frequency of pest and disease outbreaks.

9. Projected changes in climate during the 21st century will occur faster than in at least the past 10,000 years and combined with land use change and exotic/alien species spread, are likely to limit both the capability of species to migrate and the ability of species to persist in fragmented habitats. The projected impacts due to changes in mean climate, extreme climatic events and climate variability include:

(a) **The climatic range of many species will move poleward or upward in elevation from their current locations.** Species will be affected differently by climate change; some will migrate through fragmented landscapes whilst others may not be able to do so.

(b) **Many species that are already vulnerable are likely to become extinct.** Species with limited climatic ranges and/or with limited geographical opportunities (e.g., mountain top species, species on islands, peninsulas (Cape Flora)), species with restricted habitat requirements and/or small populations are typically the most vulnerable.

(c) **Changes in the frequency, intensity, extent, and locations of climatically and non-climatically induced disturbances will affect how and at what rate the existing ecosystems will be replaced by new plant and animal assemblages**. Species in an ecosystem are unlikely to all migrate at the same rates; long-lived species will persist longer in their original habitats leading to new plant and animal assemblages. Many ecosystems will be dominated by opportunistic, ‘weedy’ species, i.e., species well adapted to dispersal and rapid establishment, especially if the frequency and intensity of disturbance is high.

(d) **Some ecosystems are particularly vulnerable to climate change**, such as coral reefs, mangroves, high mountain ecosystems, remnant native grasslands and ecosystems overlying permafrost. Some ecosystems will often be slow to show evidence of change, e.g., those dominated by long-lived species (e.g., long-lived trees), whilst others, e.g. coral reefs, will show rapid response.

10. **Net primary productivity of many species (including crop species) will increase due to the elevated concentrations of atmospheric carbon dioxide, however, there may be losses in net ecosystem and biome productivity.** The changes in the net primary productivity will result in changes in the composition and functioning of ecosystems. Losses in net ecosystem and biome productivity can occur e.g., in some forests, at least when significant ecosystem disruption occurs (e.g., loss of dominant species or a high proportion of species due to changes in the disturbances, such as wildfires, pest and disease outbreaks)

11. **The livelihood of many indigenous and local communities, in particular, will be adversely affected** if climate and land-use change lead to losses in biodiversity. These communities are directly dependent on the products and services provided by the terrestrial, coastal and marine ecosystems, which they inhabit.

12. **Changes in biodiversity at ecosystem and landscape scale, in response to climate change and other pressures (e.g., deforestation and changes in forest fires, introduction of invasive species),**

would further affect global and regional climate through changes in the uptake and release of greenhouse gases and changes in albedo and evapotranspiration. Similarly, changes in biological communities in the upper ocean could alter the uptake of carbon dioxide by the ocean or the release of precursors for cloud condensation nuclei causing either positive or negative feedbacks on climate change.

Climate change mitigation and adaptation options: links to, and impacts on, biodiversity

13. **Terrestrial and oceanic ecosystems play a significant role in the global carbon cycle and their proper management can make a significant contribution to reducing the build up of greenhouse gases in the atmosphere.** Each year about 60 gigatons[3] (Gt) of carbon (C) are taken up and released by terrestrial ecosystems and about another 90 Gt C are taken up and released by ocean systems. These natural fluxes are large compared to the approximately 6.3 Gt C currently being emitted from fossil fuels and industrial processes, and about 1.6 Gt C per year from deforestation, predominantly in the tropics. Terrestrial ecosystems appear to be storing about 3 Gt C each year and the oceans another about 1.7 Gt. The result is a net build up of 3.2 Gt of atmospheric C per year.

14. **There are significant opportunities for mitigating climate change, and for adapting to climate change, while enhancing the conservation of biodiversity.** Mitigation involves reducing the greenhouse gas emissions from energy and biological sources or enhancing the sinks of greenhouse gases. Adaptation is comprised of activities that reduce a system's (human and natural) vulnerability to climate change. Carbon mitigation and adaptation options that take into account environmental (including biodiversity), social and economic considerations, offer the greatest potential for positive synergistic impacts.

15. **The ecosystem approach of the Convention on Biological Diversity provides a flexible management framework to address climate change mitigation and adaptation activities in a broad perspective.** This holistic framework considers multiple temporal and spatial scales and can help to balance ecological, economic, and social considerations in projects, programmes, and policies related to climate change mitigation and adaptation. "Adaptive management", which allows for the re-evaluation of results through time and alterations in management strategies and regulations to achieve goals, is an integral part of the ecosystem approach.

16. **Land-use, land-use change and forestry activities can play an important role in reducing net greenhouse gas emissions to the atmosphere.** Biological mitigation of greenhouse gases through land use, land-use change and forestry (LULUCF) activities can occur by three strategies: (a) conservation of existing carbon pools, i.e., avoiding deforestation (b) sequestration by increasing the size of carbon pools, e.g., through afforestation and reforestation, and (c) substitution of fossil fuel energy by use of modern biomass. The estimated upper limit of the global potential of biological mitigation options (a and b) through afforestation, reforestation, avoided deforestation, and agriculture, grazing land, and forest management is on the order of 100 Gt C (cumulative) by the year 2050, equivalent to about 10–20% of projected fossil-fuel emissions during that period[4], although there are substantial uncertainties associated with this estimate. The largest biological potential is projected to be in subtropical and tropical regions. When LULUCF activities are used to offset emissions from fossil fuels, there is a net shift of carbon from fossil storage to more labile storage—but potentially long term—in terrestrial ecosystems.

17. **Within the context of the Kyoto Protocol, additionality, leakage, permanence, and uncertainties, are important concepts for carbon storage in relation with the implementation of mitigation activities.** A project credited under the Clean Development Mechanism is additional only if it would not have occurred without the stimulus of the Mechanism and if it removes more greenhouse gases from the atmosphere than would have occurred without the project. Leakage refers to the situation where activities related to carbon sequestration or conservation of existing carbon pools triggers an activity in another location, which leads in turn, to carbon emissions. Permanence refers to the longevity and stability of soil and vegetation carbon pools, given that they will undergo various management regimes

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[3] 1 gigaton equals 10^9 tons

[4] The emission of carbon from the combustion of fossil fuels is projected to increase from the current level of 6.3Gt C per year to between 10 and 25 Gt C per year.

and be subjected to an array of natural disturbances. Uncertainties result from lack of information or disagreement about what is known or even knowable.

18. **Afforestation[5] and reforestation[6] can have positive, neutral, or negative impacts on biodiversity depending on the ecosystem being replaced, management options applied, and the spatial and temporal scales.** The value of a planted forest to biodiversity will depend to a large degree on what was previously on the site and also on the landscape context in which it occurs. The reforestation of degraded lands will often produce the greatest benefits to biodiversity but can also provide the greatest challenges to forest management. Afforestation and reforestation activities that pay attention to species selection and site location, can promote the return, survival, and expansion of native plant and animal populations. In contrast, clearing native forests and replacing them with a monoculture forest of exotics would clearly have a negative effect on biodiversity.

19. **Short rotation plantations will not sequester and maintain carbon as much as long rotation plantations in which vegetation and soil carbon is allowed to accumulate.** Loss of soil carbon occurs for several years following harvesting and replanting due to the exposure of soil, increased leaching and runoff and reduced inputs from litter. Short rotation forests, with their simpler structure, foster lower species richness than longer lived forests. However, products from short rotation plantations may alleviate the pressure to harvest or deforest longer-lived or primary forests.

20. **Plantations of native tree species will usually support more biodiversity than exotic species and plantations of mixed tree species will usually support more biodiversity than monocultures, but plantations of exotic species can contribute to biodiversity conservation when appropriately situated in the landscape.** Tree plantations may be designed to allow for the colonization and establishment of diverse under-storey plant communities by providing shade and by ameliorating microclimates. Specific sites may make better candidates for implementing such activities than others, based on past and present uses, and the local or regional importance of their associated biodiversity, and proximity to other forests across a landscape. Involvement of local and indigenous communities in the design and the benefits to be achieved from a plantation may contribute to local support for a project and hence contribute to its longevity. Plantations may contribute to the dispersal capability of some species among habitat patches on a formerly fragmented landscape. Even plantations of a single species can confer some benefits to local biodiversity, especially if they incorporate features such as allowing canopy gaps, retaining some dead wood components, and providing landscape connectivity.

21. **Slowing deforestation and forest degradation can provide substantial biodiversity benefits in addition to mitigating greenhouse gas emissions and preserving ecological services.** In temperate regions, deforestation mainly occurred, when it did, several decades to centuries ago. In recent decades, deforestation has been most prevalent in the tropics. Since the remaining primary tropical forests are estimated to contain 50–70 percent of all terrestrial plant and animal species, they are of great importance in the conservation of biodiversity. Tropical deforestation and degradation of all types of forests remain major causes of global biodiversity loss. Any project that slows deforestation or forest degradation will help to conserve biodiversity. Projects in threatened/vulnerable forests that are unusually species-rich, globally rare, or unique to that region can provide the greatest immediate biodiversity benefits. Projects that protect forests from land conversion or degradation in key watersheds have potential to substantially slow soil erosion, protect water resources, and conserve biodiversity.

22. **Forest protection through avoided deforestation may have either positive or negative social impacts**. The possible conflicts between the protection of forested ecosystems and ancillary negative effects, restrictions on the activities of local populations, reduced income, and/or reduced products from these forests, can be minimized by appropriate stand and landscape management, as well as using environmental and social assessments.

23. **Most of the world's forests are managed, hence improved management can enhance carbon uptake or minimize carbon losses and conserve biodiversity.** Humans manage most forests for

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[5] Afforestation requires planting trees on land that has not contained a forest for over 50 years

[6] Reforestation requires planting trees on land that was not forested in 1990

conservation purposes and to produce goods and services. Forest ecosystems are extremely varied and the positive or negative impact of any forest management operation will differ according to soil, climate, and site history, including disturbance regimes (such as fire). Because forests are enormous repositories of terrestrial biodiversity at all levels of organization (genetic, species, population, and ecosystem), improved management activities have the potential to positively affect biodiversity. Forestry practices that enhance biodiversity in managed stands and have a positive influence on carbon retention within forests include: increasing rotation length, low intensity harvesting, leaving woody debris, post-harvest silviculture to restore the local forest types, paying attention to landscape structure, and harvesting that emulates natural disturbance regimes. Management that maintains natural fire regime will usually maintain biodiversity and carbon storage.

24. **Agroforestry systems have substantial potential to sequester carbon and can reduce soil erosion, moderate climate extremes on crops, improve water quality, and provide goods and services to local people.** Agroforestry incorporates trees and shrubs into agricultural lands to achieve conservation and economic goals, while keeping the land in production agriculture. The potential to sequester carbon globally is very high due to the extensive agricultural land base in many countries. Agroforestry can greatly increase biodiversity, especially in landscapes dominated by annual crops or on lands that have been degraded. Agroforestry plantings can be used to functionally link forest fragments and other critical habitat as part of a broad landscape management strategy.

25. **There are a large number of agricultural management activities (e.g., conservation tillage, erosion control practices, and irrigation) that will sequester carbon in soils, and which may have positive or negative effects on biodiversity, depending on the practice and the context in which they are applied.** Conservation tillage denotes a wide range of tillage practices, including chisel-plow, ridge-till, strip-till, mulch-till, and no-till that can allow for the accumulation of soil organic carbon and provide beneficial conditions for soil fauna. The use of erosion control practices, which include water conservation structures, vegetative strips used as filters for riparian zone management, and agroforestry shelterbelts for wind erosion control can reduce the displacement of soil organic carbon and provide opportunities to increase biodiversity. The use of irrigation can increase crop production, but has the potential to degrade water resources and aquatic ecosystems. Where feasible, it is important to include farmer-centred participatory approaches and consideration of local or indigenous knowledge and technologies, promote cycling and use of organic materials in low-input farming systems, and use a diverse array of locally adapted crop varieties.

26. **Improved management of grasslands (e.g., grazing management, protected grasslands and areas set-aside, grassland productivity improvements, and fire management) can enhance carbon storage in soils and vegetation, while conserving biodiversity.** The productivity, and thus the potential for carbon sequestration of many pastoral lands is restricted mainly by availability of water, nitrogen and other nutrients, and the unsuitability of some native species to high-intensity grazing by livestock. Introduction of nitrogen-fixing legumes and high-productivity grasses or additions of fertilizer can increase biomass production and soil carbon pools, but can decrease biodiversity. Introduction of exotic nitrogen fixers poses the risk of them becoming invasive. Irrespective of whether a grazing land is intensively managed or strictly protected, carbon accumulation can be enhanced through improvement practices, especially if native species are properly managed to enhance the biodiversity associated with the system.

27. **Avoiding degradation of peatlands and mires is a beneficial mitigation option.** Peatlands and mires contain large stores of carbon, however, in recent decades, anthropogenic drainage and climate change has changed peatlands from a global carbon sink to a global carbon source. Draining peatlands for afforestation and reforestation activities may not lead to a net carbon uptake and in the short term would lead to carbon emissions.

28. **Revegetation activities that increase plant cover on eroded, severely degraded, or otherwise disturbed lands have a high potential to increase carbon sequestration and enhance biodiversity.** Sequestration rates will depend on various factors, including revegetation method, plant selection, soil characteristics and site preparation, and climate. Soils of eroded or degraded sites generally have low

carbon levels and therefore a high potential to accumulate carbon; however, revegetation of these types of such sites will pose technical challenges. An important consideration is to match the plant species to the site conditions and to consider which key ecological functions need to be restored. Biodiversity can be improved if revegetation aids recruitment of native species over time or if it prevents further degradation and protects neighboring ecosystems. On some degraded sites, the use of exotic species and fertilizers may provide the best opportunity for reestablishing vegetation. However, care should be exercised to avoid situations where exotics that have invasive characteristics end up colonizing neighbouring native habitats, thereby altering plant communities and ecosystem processes.

29. **Marine ecosystems may offer mitigation opportunities, but the potential implications for ecosystem function and biodiversity are not well understood.** Oceans are substantial reservoirs of carbon with approximately 50 times more carbon than is presently in the atmosphere. There have been suggestions to fertilize the ocean to promote greater biomass production and thereby sequester carbon and to mechanically store carbon deep in the ocean. However, the potential for either of these approaches to be effective for carbon storage is poorly understood and their potentially large negative impacts on ocean and marine ecosystems and their associated biodiversity are unknown.

30. **Bio-energy plantations provide the potential to substitute fossil fuel energy with biomass fuels but may have adverse impacts on biodiversity if they replace ecosystems with higher biodiversity.** However, bio-energy plantations on degraded lands or abandoned agricultural sites could benefit biodiversity.

31. **Renewable energy sources (crop waste, solar- and wind-power) may have positive or negative effects on biodiversity depending upon site selection and management practices.** Replacement of fuelwood by crop waste, the use of more efficient wood stoves and solar energy and improved techniques to produce charcoal can also take pressure from forests, woodlots, and hedgerows. Most studies have demonstrated low rates of bird collision with windmills, but the mortality may be significant for rare species. Proper site selection and a case-by-case evaluation of the implications of windmills on wildlife and ecosystem goods and services can avoid or minimize negative impacts.

32. **Hydropower has been promoted as a technology with significant potential to mitigate climate change by reducing the greenhouse gas intensity of energy production but has potential adverse effects on biodiversity.** In some cases, emissions of carbon dioxide and methane caused by dams and reservoirs may be a limiting factor on the use of hydropower to mitigate climate change. Large-scale hydropower development can also have other high environmental and social costs such as loss of biodiversity and land, disruption of migratory pathways and displacement of local communities. The ecosystem impacts of specific hydropower projects vary widely and may be minimized depending on factors including type and condition of pre-dam ecosystems, type and operation of the dam (e.g., water-flow management), and the depth, area, and length of the reservoir. Run of the river hydropower and small dams have generally less impact on biodiversity than large dams, but the cumulative effects of many small units should be taken into account.

33. **Adaptation is necessary not only for the projected changes in climate but also because climate change is already affecting many ecosystems.** Adaptation activities can have negative or positive impacts on biodiversity, but positive effects may generally be achieved through: maintaining and restoring native ecosystems; protecting and enhancing ecosystem services; actively preventing and controlling invasive alien species; managing habitats for rare, threatened, and endangered species; developing agroforestry systems at transition zones; paying attention to traditional knowledge; and monitoring results and changing management regimes accordingly. Adaptation activities that can be beneficial to biodiversity include the establishment of a mosaic of interconnected terrestrial, freshwater and marine multiple-use reserve protected areas designed to take into account projected changes in climate, and integrated land- and water-management activities that reduce non-climate pressure on the biodiversity and hence make the system less vulnerable to changes in climate. Adaptation activities can also threaten biodiversity either directly—through the destruction of habitats, e.g., building sea walls, thus affecting coastal ecosystems, or indirectly—through the introduction of new species or changed management practices, e.g., mariculture or aquaculture.

34. **Conservation of ecosystem structure and function is an important climate change adaptation strategy because species and genetic rich ecosystems have a greater potential to adapt to climate change.** While some natural pest-control, pollination, soil-stabilization, flood-control, water-purification and seed-dispersal services can be replaced when damaged or destroyed by climate change, technical alternatives may be costly and therefore not feasible to apply in many situations. Therefore, conserving biodiversity (e.g., genetic diversity of food crops, trees, and livestock races) means that options are kept open to adapt human societies better to climate change.

Approaches for supporting planning, decision making and public discussions

35. **There is a clear opportunity to implement mutually beneficial activities (policies and projects) that take advantage of the synergies between the United Nations Framework Convention on Climate Change and its Kyoto Protocol, the Convention on Biological Diversity and broader national development objectives.** These opportunities are rarely being realized due to a lack of national coordination among sectoral agencies to design policy measures that exploit potential synergies between national economic development objectives and environmentally focused projects and policies. In addition, there is a lack of coordination among the multilateral environmental agreements, specifically among the mitigation and adaptation activities undertaken by Parties to the UNFCCC and its Kyoto Protocol, and activities to conserve and sustainably manage ecosystems undertaken by Parties to the Convention on Biological Diversity.

36. **Experience shows that transparent and participatory decision-making processes involving all relevant stakeholders, integrated into project or policy design from the beginning, can enhance the probability of long-term success.** Decisions are value-laden and combine political and technocratic elements. Ideally, they should combine problem identification and analysis, policy-option identification, policy choice, policy implementation, and monitoring and evaluation in an iterative fashion. Decision-making processes and institutions operate at a range of spatial scales from the village community to the global level.

37. **A range of tools and processes are available to assess the economic, environmental and social implications of different climate-change-mitigation and adaptation activities (projects and policies) within the broader context of sustainable development.** Environmental impact assessments (EIAs) and strategic environmental assessments (SEAs) are processes that can incorporate a range of tools and methods including decision analytical frameworks, valuation techniques, and criteria and indicators.

38. **Environmental impact assessments and strategic environmental assessments can be integrated into the design of climate change mitigation and 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.** EIAs and SEAs can be used to assess the environmental and social implications of different energy and land-use, land-use change and forestry (LULUCF) projects and policies undertaken by Parties to the UNFCCC and the Convention on Biological Diversity and to choose among them. While the Convention on Biological Diversity explicitly encourages the use of EIA and SEA tools as a means to achieve its objectives there is no respective reference to them in the UNFCCC or its Kyoto Protocol. The operational rules for the Kyoto Protocol included in the Marrakech Accords only stipulate that participants in the clean development mechanism (CDM) and in some cases joint implementation (JI) projects have to carry out an EIA in accordance with the requirements of the host Party if, after a preliminary analysis, they or host countries consider the environmental impacts of the project activities significant.

39. **Decision-analytic frameworks are tools that can be used to evaluate the economic, social and environmental impacts of climate change mitigation and adaptation activities and those of biodiversity conservation activities.** Decision-analytic frameworks can be divided into four broad categories, i.e., normative, descriptive, deliberative, and ethically and culturally based. These include decision analysis, cost-benefit analysis, cost-effectiveness analysis, the policy exercise approach and cultural prescriptive rules. The diverse characteristics of possible climate change mitigation and adaptation activities and biodiversity conservation activities imply the need for a diverse set of decision-

analytic frameworks and tools so those most relevant to the decision-making can be selected and applied, e.g., if cost-effectiveness is the most important decision criteria this would suggest conducting a cost effectiveness analysis. Use of decision-analytic frameworks prior to implementing a project or a policy, can help address a series of questions that should be part of the project or policy design.

40. **Methods are available to determine changes in the use and non-use values of ecosystem goods and services from climate-change-mitigation and adaptation activities.** The concept of total economic value is a useful framework for assessing the utilitarian value of both the use and non-use values of ecosystem goods and services now and in the future. The use values arise from direct use (e.g., provisioning of food), indirect use (e.g., climate regulation) or option values (e.g., conservation of genetic diversity), where-as the non-use values include existence values[7]. Valuation techniques can be used to assess the "economic" implications of changes in ecological goods and services resulting from climate change mitigation and adaptation, as well as biodiversity conservation and sustainable use, activities. In contrast, the non-utilitarian (intrinsic) value of ecosystems arises from a variety of ethical, cultural, religious and philosophical perspectives cannot be measured in monetary terms. Hence, when a decision-maker assesses the implications of the possible alteration of an ecosystem, it is important that they are aware of the utilitarian and non-utilitarian values of the ecosystem.

41. **Without a set of minimum common international environmental and social standards, climate-change-mitigation projects could flow to countries with minimal or non-existent standards, adversely affecting biodiversity and human societies.** If agreed internationally, such standards could be incorporated into national planning efforts. Furthermore, the Marrakech Accords affirm that it is the host Party's prerogative to confirm whether a CDM project assists in achieving sustainable development.

42. **National, regional and possibly international systems of criteria and indicators are needed for monitoring and evaluating the impact of climate change and to assess the impacts of climate change mitigation and adaptation activities on biodiversity and other aspects of sustainable development.** An important aspect of monitoring and evaluation is the choice of suitable criteria and indicators, which should be, whenever possible, meaningful at the site, national and possibly international level, as well as consistent with the main objectives of the project or policy intervention. Criteria and indicators consistent with national sustainable development objectives are to some degree available. For example, many international processes (e.g., Ministerial Conference on the Protection of Forests in Europe) have developed or are currently developing specific biodiversity and sustainable development criteria and indicators in management guidelines for forestry that could be useful for afforestation, reforestation and conservation (avoided deforestation) projects and policies.

43. **A critical evaluation of the current criteria and indicators developed under the Convention on Biological Diversity, the Ministerial Conference on the Protection of Forests in Europe, and the many other national and international initiatives could assist in assessing their utility to evaluate the impact of activities undertaken by Parties to the UNFCCC and the Kyoto Protocol.** Such an evaluation would allow the presentation of an array of eligible standards and procedures for validation and certification that could enable national and international initiatives to select a scheme that best serves their project circumstances.

44. **Monitoring and evaluation processes that involve the communities and institutions most affected by climate change mitigation and adaptation activities and recognize that different spatial and temporal scales will be required to assess the implications of these activities, are likely to be the most sustainable.** Methods are available to monitor components of biodiversity at the local and regional scale, but few countries have an operational system in place. Determining the impact of climate-change projects and policies on biodiversity is, in some instances, likely to remain problematical given the long lag-time between the intervention and the response of the system.

[7] Where individuals are willing to pay to for the conservation of biodiversity

Lessons learned from case-studies: harmonization of climate-change-mitigation and adaptation activities with biodiversity considerations

45. **The individual and collective experience from several case-studies provides insights on key practical challenges and opportunities for improving the design of projects.** There are some lessons learned for the harmonization of climate-change-mitigation and adaptation activities with biodiversity considerations, based on analyses of 10 case-studies being implemented at various scales (site, regional, national). Some of these case-studies were pilot projects launched in anticipation of the Kyoto Protocol; others preceded the Kyoto discussion.

46. ***Lesson 1*: There is scope for afforestation, reforestation, improved forest management and avoided deforestation activities to be harmonized with biodiversity conservation benefits.** It has to be noted that improved forest management and avoided deforestation are not eligible under the CDM. Improved conservation of biodiversity can occur through reforestation [Uganda-Netherlands/private investor 1, Romania 10][8]; afforestation [Sudan 6, Romania 10], avoided deforestation [Costa Rica 2, Belize 5] and improved forest management [Belize 5]. These projects included specific design features to optimize conservation benefits, including the use of native species for planting, reduced impact logging to ensure minimal disturbance; and establishment of biological corridors. In addition, sustainable use of forest products and services was also secured through various incentive measures, particularly in the cases of Uganda/Netherlands, Costa Rica and Sudan [1, 2, 6]. Nevertheless, there is room for improvement in existing projects to further explore synergies between climate mitigation activities and biodiversity conservation; for example, the Mesoamerican Biological Corridor Project [8], originally conceived as a regional strategy for biodiversity conservation, and not to address climate change, clearly has significant potential and scope for mitigation and adaptation options to be designed into the particular national-level implementation of projects.

47. ***Lesson 2*: The linkages between conservation and sustainable use of biodiversity with community livelihood options provides a good basis for projects supported under the Clean Development Mechanism to advance sustainable development.** In some cases, project "success" [Costa Rica, 2, Sudan, 6] stemmed from combining key local development and livelihood concerns with those relating to carbon sequestration and biodiversity conservation, where-as in one case [Uganda-Netherlands/private investor, 1] the restrictions imposed on the livelihoods of the local communities almost led to project failure.

48. ***Lesson 3*: The neglect and/or omission of social, environmental and economic considerations can lead to conflicts which could undermine the overall success of carbon mitigation projects, and long-term biodiversity conservation.** For example, omission of social and environmental issues in the Uganda-Norway/private investor project [9] during planning and negotiation of agreements resulted in losses to key stakeholders; land conflicts which undermined the security of carbon credits for the investor, livelihood loss for local communities, and unsustainable forest management for the Ugandan forest authorities. This was also initially the case in the Uganda-Netherlands/private investor project [1], although later the project took a proactive approach to address these issues. Continued attention to economic and environmental considerations in Costa Rica [2] has proved to be useful for balancing the carbon and biodiversity objectives; after an initial period reforestation contracts were excluded because the higher financial rewards for these contracts over those for forest conservation were serving as a disincentive for conservation.

49. ***Lesson 4*: Countries and key stakeholders need to have the necessary information, tools and capacity to understand, negotiate, and reach agreements under the Kyoto Protocol to ensure that the resulting projects are balanced with respect to environment, social and development goals.** The tensions between key stakeholders and wavering commitment to the agreement in the Uganda-Norway/private investor project [9] can be partly attributed to the asymmetry of information and understandings of their roles and responsibilities at the time of finalizing the deal. It is critical that all stakeholders understand the benefits and the costs of proposed interventions to each partner, including the

[8] These numbers refer to the relevant case-study in chapter 6 of the report.

opportunities and synergies to be achieved with conservation. In this regard, Costa Rica's experience [2] has been more positive in part due to the country's sound institutional and policy environment, and its capacity to deal with key project issues and key stakeholders as equal partners.

50. ***Lesson 5*: Some minimum environmental and social norms (or guiding frameworks) when purchasing carbon credits through CDM projects could avoid perverse outcomes.** Without such minimum norms, e.g., between 'private investors/parent countries', projects could still be able to claim carbon credits even when they have detrimental environmental and/or social impacts, as indicated by the Uganda-Norway/private investor project [9].

51. ***Lesson 6*: The application of appropriate analytical tools and instruments can provide constructive frameworks for *ex ante* analysis to guide decision making; provide adaptive management options during implementation; and provide a basis for learning and replication through *ex post* evaluations.** In most cases, only a sub-set of the available tools were used in designing the projects. However, several of the case-studies reviewed illustrated the application of at least one of the various analytical tools and instruments, which in turn influenced processes at key stages of the project/programme. The application of cost-benefit analysis at a specific site in Madagascar [4] provided the rationale for retaining the Masaola forest as a national park instead of converting it to a logging concession, but concluded that conservation would only succeed in the long term if the benefits outweigh costs at all scales. The application of the strategic environmental assessment at a national level in Finland [3] revealed that the scenarios initially chosen for the climate change strategy had been too narrowly defined, and the Parliament has since requested more scenarios and longer-term analyses be undertaken. Similarly a strategic modelling approach to inform the adaptation of nature conservation policy and management practice to climate change impacts was undertaken in Britain and Ireland [7]. The comprehensive approach taken by Costa Rica [2] is also exemplary in that it combined various tools (valuation, strategic sector-level analysis, and decision analytical frameworks) to unleash the power of the market to meet multiple objectives of conservation, climate change mitigation, and hydrological services.

52. ***Lesson 7*: Measuring the impact of CDM and joint implementation projects on biodiversity requires baseline data, inventories and monitoring systems.** The Belize and Costa Rica projects [2,5] are simultaneously monitoring and measuring carbon and certain aspects of biodiversity, whereas the Sudan project [6] discontinued the biodiversity inventory and monitoring component due to resource constraints.

53. ***Lesson 8*: The ecosystem approach provides a good basis to guide the formulation of climate change mitigation policies/projects and conservation of biodiversity.** Most of the case-studies analysed have not used the ecosystem approach as a guiding framework, but the overall analyses of the case-studies suggests that several projects benefited from the consideration of the intent of the various principles of the approach.
