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Eleventh meeting
Montreal, 28 November - 2 December 2005
Item 6.6 of the provisional agenda*

REPORT OF THE MEETING OF THE AD HOC TECHNICAL EXPERT GROUP ON BIODIVERSITY AND ADAPTATION TO CLIMATE CHANGE

INTRODUCTION

1. The Ad Hoc Technical Expert Group (AHTEG) on Biodiversity and Adaptation to Climate Change was established to assist the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) in its further work on the interlinkages between biodiversity and climate change (decision VII/15), by undertaking a supplementary assessment on the integration of biodiversity considerations in the implementation of adaptation activities to climate change, and preparing advice taking into consideration the thematic areas of the Convention for planning and/or implementing activities to address adaptation to climate change.

2. With the generous support of the Government of Finland, the Executive Secretary convened the meeting in Helsinki from 13 to 16 September 2005 at the premises of the Finnish Environment Institute.

3. The meeting was attended by 15 experts nominated by Governments, 8 experts from organizations, and two resource persons.

ITEM 1. OPENING OF THE MEETING

4. The meeting was opened at 9.30 a.m. on Tuesday, 13 September 2005, by Mr. Kalemani Mulongoy on behalf of the Executive Secretary of the Convention on Biological Diversity. He welcomed all the participants; thanked the Government of Finland for supporting participants and hosting the meeting, and the other Governments and invited organizations for sponsoring their representatives. He then described the objectives of the meeting in the context of the work on biodiversity and climate change of the Convention on Biological Diversity. Participants were also welcomed by Mr. Stefan Wallin, State Secretary of the Environment on behalf of the Government of Finland. Mr. Mikael Hildén, from the Finnish Environment Institute provided an overview of the Institute's administrative structure, overall mission, and described topics being addressed on biodiversity and climate change, including adaptation.

* UNEP/CBD/SBSTTA/11/1.

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ITEM 2. ORGANIZATIONAL MATTERS

2.1. Election of Co-Chairs

5. After a brief self-introduction of the participants, the Group elected as its Co-Chairs Mr. Heikki Toivonen from Finland and Mr. Nagmeldin Goutbi Elhassan from Sudan.

2.2. Adoption of the agenda

6. The provisional agenda prepared by the Executive Secretary (UNEP/CBD/AHTEG-BDACC/1/1) was adopted without amendments.

2.3. Organization of work

7. The Group agreed on the contents of the proposed organization of work for the meeting contained in the annex to the annotated agenda (UNEP/CBD/AHTEG-BDACC/1/1/Add.1). The Group started its work in plenary, and subsequently broke into working groups. As necessary, the working groups reconvened in plenary.

ITEM 3. SUBSTANTIVE ISSUES

3.1. Integration of biodiversity considerations into the implementation of adaptation activities to climate change

3.2. Advice or guidance for use at local, national, regional, and international level for planning and/or implementing activities to address climate change, biodiversity conservation, and land degradation and desertification.

8. Mr. Manuel Guariguata from the Secretariat briefly reviewed the mandate of the Group as contained in SBSTTA recommendation X/13, recalling decision VII/15 on biodiversity and climate change of the Conference of the Parties. Ms. Habiba Gitay summarized the scope and content of the two background documents prepared for the meeting (UNEP/CBD/AHTEG-BDACC/1/2 and UNEP/CBD/AHTEG-BDACC/1/3), and gave a synthesis of the main observations and suggestions provided by experts, Parties, and members of the Group to these documents during the review process. Her presentation was followed by a general discussion on how to best respond to the mandate of the Group.

9. The following documents, among others, were also used by the experts in addition to the official documents prepared by the Executive Secretary:

(a) Ecosystems and Human Well-being—Biodiversity Synthesis. Millennium Ecosystem Assessment (2005).

(b) Arctic Climate Impact Assessment (2004).

(c) United Nations Framework Convention on Climate Change. Synergy among multilateral environmental agreements in the context of national adaptation programmes of action (FCCC/TP/2005/3)

(d) Resolution VII.3 of the Conference of the Parties to the Ramsar Convention on Wetlands, on climate change and wetlands: impacts, adaptation and mitigation.

10. The Group then considered the two agenda items jointly and decided to carry out its work by developing key messages and drafting explanatory texts under the following headings: (i) identification of the major properties that contribute to ecosystem resilience including the role of biodiversity; (ii) integration of biodiversity considerations in the implementation of adaptation activities to climate change; and (iii) approaches, methods, and tools for planning, designing, and implementing directed adaptation activities. The Group carried out its work in three break-out groups, one for each topic agreed upon by the Group. These were later combined and finalized in plenary. The output is contained in annex I below.

ITEM 4. PREPARATION AND ADOPTION OF THE REPORT

4.1 Determination of need for follow-up work

11. The Group stressed the fact that while annex I to the present report summarizes some lessons learnt from recent work on climate change, biodiversity, and adaptation, and provides some key points of advice, there is ample opportunity for further developing an in depth assessment on the topic, in particular, by adding more case studies and including additional information derived from the work of the United Nations Convention to Combat Desertification (UNCCD).

12. In this context, the Group encouraged the further development of synergies in the implementation of the Convention on Biological Diversity and UNCCD, including by sharing best practice.

13. It was further agreed that focusing on adaptation to climate change for the conservation and sustainable use of biodiversity warrants more attention as it is a rapidly developing area with many relevant case studies and projects being formulated, including the preparation of new national adaptation plans of action by national Governments, in the framework of the United Nations Framework Convention on Climate Change (UNFCCC).

14. The Group also recognized that adaptation to the effects of climate change due to both natural and human factors is a high priority for all nations, as stated in paragraph 55 (c) 2005 World Summit Outcome adopted by the General Assembly at its sixtieth session, taking into account that nations committed themselves to assist developing countries to improve their resilience and integrate adaptation goals into their sustainable development strategies.

4.2. Adoption of the report

15. The Group considered and adopted its report, on the basis of a draft presented by the Co-Chairs with the support of the Secretariat.

ITEM 5. OTHER MATTERS

16. Under this item, the Group made:

(a) Expressed its gratitude to the co-chairs of the meeting, the coordinators of the break-out groups and the Government of Finland.

(b) Acknowledged the usefulness and relevance to its work of having experts and representatives from the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change (UNFCCC), and other biodiversity conventions, such as the Ramsar Convention on Wetlands;

(c) Expressed its gratitude to the comments provided by experts and Governments to the background documents used in the preparation of annex I to the present report.

(d) Expressed their hope that additional time and financial resources could be found to expand and refine the contents of annex I of the report with the view of producing a peer-reviewed publication in the *CBD Technical Series*.

ITEM 6. CLOSURE OF THE MEETING

17. After the customary exchange of courtesies by the participants, the meeting was closed at 10 p.m. on Friday, 16 September 2005.

Annex I

BIODIVERSITY AND ADAPTATION TO CLIMATE CHANGE: FURTHER ASSESSMENT AND ADVICE ON THE INTEGRATION OF BIODIVERSITY CONSIDERATIONS IN THE IMPLEMENTATION OF ADAPTATION ACTIVITIES TO CLIMATE CHANGE

I. INTRODUCTION

1. As noted in the Millennium Ecosystem Assessment, climate change is one of the most important drivers of biodiversity loss 1/ and is projected to further adversely affect the role of biodiversity as a source of goods and services. The impacts of climate change on biodiversity have been of major concern to the Convention on Biological Diversity since 2002 when, following a request from the Conference of the Parties and the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), an Ad Hoc Technical Expert Group (AHTEG) was established to carry out an assessment of the interlinkages between biodiversity and climate change. The report 2/ was completed in 2003 and focused on the links to, and impacts on, biodiversity in relation to mitigation options in the context of the Kyoto Protocol.

2. In 2004, the Subsidiary Body on Scientific and Technological Advice of the United Nations Framework Convention on Climate Change (UNFCCC) welcomed the report of the AHTEG and encouraged Parties to the UNFCCC to make use of it for their national purposes as a relevant source of information for their national purposes. Subsequently, the Conference of the Parties to the Convention on Biological Diversity also considered the report, welcomed it and requested its wide dissemination. In its decision VII/15, the Conference of the Parties requested SBSTTA, as the next stage of its work on the interlinkages between biodiversity and climate change to develop, for the consideration of the Conference of the Parties, advice or guidance for promoting synergy among activities to address climate change at the national, regional and international level where appropriate, including activities to combat desertification and land degradation, and activities for the conservation and sustainable use of biodiversity.

3. At its tenth meeting, held in February 2005, SBSTTA, taking into account decision VII/15, recognized:

(a) That the framework adopted by the Conference of the Parties in its decision VII/30 to measure progress in achieving the 2010 biodiversity target includes activities aimed at maintaining and enhancing resilience of the components of biodiversity to adapt to climate change; and

(b) The need to further assess the integration of, and impacts on, biodiversity into adaptation activities.

4. Following a request by the Conference of the Parties, SBSTTA established an Ad Hoc Technical Expert Group on Biodiversity and Adaptation to Climate Change in its recommendation X/13 in order to:

(i) Undertake a supplementary assessment on the integration of biodiversity considerations in the implementation of adaptation activities to climate change at the local, subnational, national, subregional, regional, and international levels, whenever appropriate drawing on case-studies and seeking also to identify and avoid duplication in activities between the Rio conventions. In particular, the assessment shall contemplate: (i) the identification of the major biological factors that contribute to ecosystem resilience under the current and projected impacts of climate change, and the identification of particular adaptation activities carried out under the current thematic areas of the Convention: agricultural biodiversity, dry and sub-humid lands biodiversity, forest biodiversity, inland waters biodiversity, marine and coastal biodiversity, mountain biodiversity, and island biodiversity; (ii) the potential consequences for biodiversity of those particular adaptation activities, taking into account, but not limited to, technical

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1/ Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well Being: Synthesis. Island Press, USA.

2/ CBD Technical Series No. 10. *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.*

and technological interventions, highlighting gaps in current scientific knowledge and identifying research needs; and (iii) the role of biodiversity as an adaptation element by itself;

(ii) Based on existing work, including the information contained in the report of the Ad Hoc Technical Expert Group on Biological Diversity and Climate Change and the above supplementary assessment, as well as other relevant sources referred to in the chapeau to the present paragraph, prepare advice or guidance under the thematic areas of the Convention, for use at local, national, regional and international level as appropriate, for planning and/or implementing activities to address adaptation to climate change and that interlink across climate change, biodiversity conservation and sustainable use and land degradation and desertification. The draft advice or guidance may include relevant tools and technologies, including those under the Convention, and take into account traditional knowledge, innovations, and practices of indigenous and local communities, on the integration of biodiversity considerations in the design, implementation, and monitoring of projects aimed at addressing climate change.

5. The need to focus on adaptation to climate change was also emphasized by the Joint Liaison Group (JLG) of the three Rio conventions (UNFCCC, UNCCD and the Convention on Biological Diversity) at its fifth meeting, 3/ held in January 2004. The Joint Liaison Group recognized that adaptation to climate change is an important area for the three conventions, and that activities that promote adaptation to climate change also contribute to the conservation and sustainable use of biodiversity and sustainable land management. The Joint Liaison Group further noted the potential for creating synergy among the objectives of the three Conventions through activities geared at adapting to climate change.

6. In addition, at the High-level Plenary Meeting of the General Assembly at its sixtieth session, the Heads of States and Governments noted 4/ that adaptation to the effects of climate change due to both natural and human factors is a high priority for all nations, and committed themselves to assist developing countries to improve their resilience and integrate adaptation goals into their sustainable development strategies.

7. In response to its mandate in paragraph 4 above, the AHTEG on Biodiversity and Adaptation to Climate Change met in Helsinki from 13 to 16 September 2005, and prepared the present document. Section II contains the supplementary assessment of the integration of biodiversity considerations in adaptation activities. Section III describes some approaches, methods and tools for planning, designing and implementing adaptation activities including biodiversity considerations. Drawing upon the contents of the previous two sections, section IV contains key points for advice that could be forwarded to the Conference of the Parties. While this report summarizes some lessons learnt from recent climate change adaptation work and provides key points of advice, it is not based on an in depth assessment.

II. FURTHER ASSESSMENT OF THE INTEGRATION OF BIODIVERSITY CONSIDERATIONS IN THE IMPLEMENTATION OF ADAPTATION ACTIVITIES TO CLIMATE CHANGE

8. **Adaptation is an adjustment by an ecosystem to a new or changing environment without simplification or the loss of structure, functions and components**. Adaptation to climate change moderates harm or exploits beneficial opportunities. Adaptation activities are human interventions aimed at minimizing loss of biodiversity and ecosystem characteristics. Such activities may include scientific, technological, institutional, behavioural, political, financial, regulatory and/or individual adjustments.

9. **Even if all anthropogenic additions of greenhouse gases to the atmosphere were to be stopped immediately, global warming and associated impacts such as sea level rise would be expected to continue for centuries**. Due to inertia in climatic, ecological, and socio-economic systems,

3 UNEP/CBD/SBSTTA/10/INF/9

4/ Paragraph 55 (c) of the draft General Assembly resolution on 2005 World Summit Outcome (A/60/L.1)

they have both fast and slow responses to climate change, with adverse consequences for sustainable economic development, maintenance of food production, and natural adaptation of ecosystems. 5/

10. **Climate change is already affecting many ecosystems.** Biodiversity's natural responses to changing environmental conditions are called autonomous adaptation. A number of ecosystem properties contribute to autonomous adaptation capacity. These include resistance, resilience, inertia, vulnerability and sensitivity (see glossary in the appendix below). Although each of these properties merits consideration, this report focuses on the maintenance of resilience as an essential component for successful adaptation.

11. **Resilient ecosystems maintain biodiversity and continue to deliver ecosystem goods and services under climate change.** In the geological past, biodiversity at ecosystem, species and genetic levels has adjusted to changes in climate, e.g. through changes in growth, population size, and migration patterns. In the light of the projected magnitude and rate of climate change and increasing climate extremes, as well as of the levels of habitat conversion, fragmentation, and degradation, the ability of natural and managed ecosystems to adapt autonomously is expected to be insufficient to arrest the rate of loss of biodiversity.

12. **Directed adaptation activities are urgently needed to slow the rate of biodiversity loss.** The roles of autonomous and directed adaptation in slowing the rate of biodiversity loss are depicted in Figure 1. Directed adaptation actions are necessary across all sectors including water management, forestry, agriculture and infrastructure development. Adaptation activities are best carried out as part of an overall approach to sustainable development and integrated into national development plans, as well as national biodiversity strategies and action plans. They can attenuate loss at local, sub-national, national, sub-regional, regional, and international levels. Directed adaptation requires a better understanding of the sensitivity of biodiversity to the potential impacts of climate change, measures and means to assess adaptive capacity, the ability to reduce vulnerabilities, and enhance resilience.

13. **Directed adaptation for biodiversity requires that resilience be maintained and restored.** Activities to maintain and restore resilience can be thought of in terms of three components. The first component is to maintain adequate and appropriate space, structure and services to respond over temporal and spatial scales. This includes consideration for movement and replacement due to climate change, as well as all levels of biodiversity. The second component is to limit stresses that amplify the impacts of climate change. This includes addressing stresses such as habitat fragmentation and loss, over harvest, invasive species, and pollution (contaminants and nutrients). These are generally approachable on more local scales. The final component is to employ adaptive management, including monitoring to allow testing of approaches while implementation is underway. This is important due to significant existing knowledge gaps, which are coupled with the need to begin taking some action now due to increasing costs and option limitations as climate change progresses. Additionally adaptive management can provide lessons learned to be shared beyond the locations with the capacity to undertake such projects.

14. **Many factors confer resilience.** These include population size, habitat area and shape, presence of environmental gradients, existence of habitat refugia, degree of habitat connectivity, presence of ecotones and seres, degree of genetic heterogeneity, species richness, regenerative capacity, intermediate disturbance regimes, behavioural plasticity, multiple stable states and stable hydrological cycles. Key biological factors for successful directed adaptation are:

(i) Maintaining **genetic heterogeneity** is both a goal and a tool of directed adaptation. Replicate, viable and heterogeneous populations minimize their shared risk and maximize their opportunities for successful autonomous adaptation;

(ii) **Regenerative populations** are essential for the sustainability of species populations and community structure. The maintenance of climatic conditions necessary for all life cycle phases is crucial

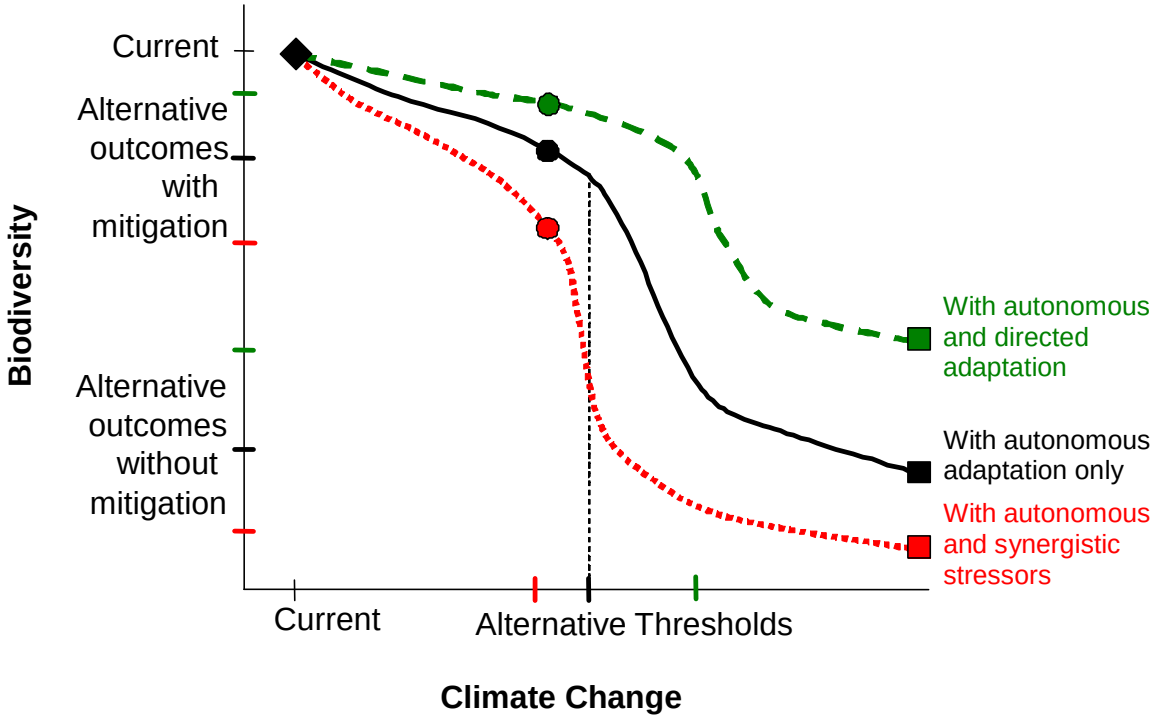
5/ Article 2 of the United Nations Framework Convention on Climate Change includes as its objective the stabilization of greenhouse gas concentrations in the atmosphere at the level that would prevent dangerous anthropogenic interference with the climate system.

for the long-term viability of populations. The management of habitats to ensure suitable micro-climates for key phases is an essential component;

(iii) Maintaining **multiple successional states** can confer contrasting resource and habitat types under which selected species are able to persist and reproduce throughout the landscape;

(iv) Climate change will cause species with limited tolerance to relocate to more suitable locales requiring **habitat connectivity across environmental gradients**. Directed adaptation needs to provide access to these new locations often across fragmented or disturbed landscapes or seascapes. These new habitat needs cannot necessarily be predicted. As a result it may be prudent to ensure a range of habitat options along environmental gradients.

Figure 1: Schematic Diagram of Biodiversity Response to Climate
Applicable to each CBD Thematic Area



Biodiversity responses to climate change are non-linear, with critical inflection points (solid line). Stressors that operate synergistically with climate change increase the rate of biodiversity loss (dotted line). Directed adaptation reduces the rate of biodiversity loss as compared to autonomous adaptation alone (dashed line). Both mitigation and adaptation influence biodiversity outcomes for a given CBD thematic work programme. If mitigation constrains climate change below the critical threshold, outcomes (•) will be significantly less severe than unmitigated outcomes (■).

15. **Adaptation strategies have limits, requiring that action also be taken to limit the rate and extent of climate change**:

(a) Cost increases and options decrease with delay in action as climate change proceeds. Biodiversity responses to climate change are non-linear, with thresholds that research indicates occur

between 1-3 ^{o}C above current levels. 6/ 7/ These thresholds vary between ecosystems and species. For example, a 1^{o}C increase is "likely to lead to extensive coral bleaching" and similar dramatic effects relating to loss of ice habitat in the Arctic. Modelling suggests that under linear conditions, an increase of temperature of this magnitude could occur as early as 2015. 8/ After a threshold is passed, most adaptation strategies are unlikely to be successful and remaining ones prohibitively costly. Avoidance of this threshold requires action on mitigation concurrent with adaptation efforts;

(b) Under current constraints prioritization may be necessary in selecting adaptation projects as the need for adaptation is large but capacity (including cost) limited;

(c) Our ability to design and implement adaptation activities is limited by knowledge gaps, synthesis of existing knowledge and experience, technology, awareness and political will to act. Overcoming these hurdles requires addressing the gaps and challenges relating to tools, research, synthesis and communications (section III);

(d) Given the current concerns with the growing incidence of natural disasters and their impact on biodiversity, national biodiversity strategies and action plans could benefit from the integration of knowledge on prevention, preparedness, and response strategies developed by the natural disaster management community.

16. **Directed adaptations are already being implemented to reduce many of the adverse impacts of climate change to produce economic and social benefits in the future. These adaptations can have positive, neutral or negative effects on biodiversity and ecosystem goods and services**. Planned or directed adaptations carry implications for all ecosystems covered under the thematic work programmes under the Convention on Biological Diversity. Table 1 illustrates how some of these thematic programmes (e.g., agricultural biodiversity) can be impacted through planned adaptation activities. The impacts contained in the table have been evaluated as positive, adverse, or neutral for biodiversity. The construction of seawalls, for example, poses a serious risk to biodiversity, as they prevent the ingress and egress of coastal, estuarine and marine species. Common adaptation measures, such as soil and water conservation, are applicable across many ecosystem types/CBD thematic work programmes. Yet it is advisable to further explore commonalities among these work programmes drawing on other assessments such as the Arctic Climate Impact Assessment and its implications e.g., for the Programme of Work on Mountain Biodiversity.

17. **Understanding changes of biological diversity due to climate change may include active participation of local and indigenous communities**. Sustainable development in light of adaptation to climate change needs to document, analyse and apply their traditional knowledge in ways that help to complement scientifically-based knowledge and vice versa. Enhanced competency is needed in indigenous organisations, their institutions, and their universities. New information technology will facilitate communication between local and indigenous communities, such as web based, multi-lingual tools.

6/ Tirpak, D., J. Ashton, Z Dadi, L.G.M. Filho, B. Metz, M. Parry, J. Schellnhuber, K.S. Yap, R. Watson and T. Wigley. 2005 Avoiding Dangerous Climate Change: International Symposium on the Stabilisation of Greenhouse Gas Concentrations. Report of the International Steering Committee. Hadley Centre, Met Office, Exeter, UK 1-3 February 2005.

7/ IPCC 2001. Third Assessment Report: The Scientific Basis.

8/ IPCC 2001. Third Assessment Report: The Scientific Basis.

Table 1. Indicative list of adaptation activities 9/ relevant to the thematic areas considered under the Convention on Biological Diversity, their potential impacts on and risks to biodiversity, and possible actions as part of adaptive management

Adaptation activity	***Types of adaptation 10/***	***Potential impacts on biodiversity***	***Potential risk to biodiversity***	***Possible action for adaptive management***
Marine and coastal biodiversity				
Sea walls, dykes and tidal barriers	Technological and economic	Adverse	High-very high if concrete/rock structures Low-medium if using mud walls and vegetation	Include biodiversity (terrestrial and coastal/marine) considerations in Environmental Impact Assessment (EIA)
Bridges to cross potentially inundated areas due to climate change	Technological and economic	Adverse	Medium-high depending on the location	Include terrestrial and aquatic biodiversity considerations in EIA
Buildings on stilt	Technological and economic	Adverse to neutral	Low if already in urban areas	Monitor for likely effects on biodiversity and include adaptive management
Rezoning in coastal areas	Institutional and regulatory	Adverse or positive	High-very high if urbanization of high biodiversity areas; low otherwise	Strategic environmental assessment should consider the impact on biodiversity and zone accordingly; allow for appropriate conservation areas for biodiversity
Migration of people from coastal areas and/or marginal lands (e.g. in semi-arid areas)	Behavioral and individual	Adverse or positive	Low if moving to urban areas although could place additional pressure on water and energy resources; high if moving to slightly less marginal areas	Educate the urban planners to minimise the exploitation of natural resources; effect of other migration may be hard to manage
Introduction of salt tolerant varieties	Scientific and economic	Neutral to adverse	High as areas could become more saline and reduce the endemic biodiversity	Monitor for likely effects on biodiversity and include adaptive management
Establishment of aquaculture including mariculture to compensate for climate-induced losses in food production	Technological and economic	Neutral to adverse	Escape of alien or GMOs fish or other aquatic including marine organisms, eutriphication, release of harmful chemical	Monitor for likely effects on biodiversity and include adaptive management
Rehabilitation of ecosystems	Scientific, regulatory and institutional	Positive	Use of potentially invasive exotic species, damage to neighbouring areas	Monitor for likely effects on biodiversity and include adaptive management
Establishment of protected areas or management for sustainable use	Regulatory and institutional	Positive or neutral	Medium-high	Monitor for likely effects on biodiversity and include adaptive management
Inland water biodiversity				
Buildings on stilt	Technological and economic	Adverse to neutral	Low if already in urban areas	Monitor for likely effects on biodiversity and include adaptive management

9/ The adaptation activities may be anticipatory or reactive. Usually they refer to human systems. Many of these activities are described in some detail in the CBD Technical Series No. 10 in section 4.11

10/ Human systems may require adjustments to the changing climate e.g. in the scientific, technological, institutional, behavioral, political, financial, regulatory and/or individual area.

Adaptation activity	*Types of adaptation 10/*	*Potential impacts on biodiversity*	*Potential risk to biodiversity*	*Possible action for adaptive management*
Diversion of freshwater to areas suffering water shortage (dams or irrigation channels) or increased extraction of groundwater supply	Technological, regulatory and economic	Adverse or neutral	Medium-high depending on environmental flow, the rate of withdrawal etc	Include terrestrial and aquatic biodiversity considerations in EIA
Introduction of higher temperature tolerant varieties	Scientific and economic	Neutral to adverse	High if using more water for growth	Monitor for likely effects on biodiversity and include adaptive management
Introduction of pest resistant varieties	Scientific, technological and economic	Neutral to positive	Low if neutral impact on biodiversity if pests not able to non-agrobiodiversity, high if doing so	Monitor for likely effects on biodiversity and include adaptive management
Wider landscape management	Scientific, regulatory and institutional	Positive	Low-very low as aimed to benefit biodiversity	Monitoring would still be necessary to ensure that the goals are being met Need to consider and if necessary enact policies to deal with land tenure issues and compensation for reduction in intensity of farming practices
Establishment of aquaculture including mariculture to compensate for climate-induced losses in food production	Technological and economic	Neutral to adverse	Escape of alien or GMO fish or other aquatic including marine organisms, eutrophication, release of harmful chemicals	Monitor for likely effects on biodiversity and include adaptive management
Rehabilitation of ecosystems	Scientific, regulatory and institutional	Positive	Use of potentially invasive exotic species, damage to neighbouring areas	Monitor for likely effects on biodiversity and include adaptive management
Island biodiversity				
All adaptation activities identified for the thematic areas marine and coastal biodiversity, inland waters, agricultural biodiversity , dry and subhumid biodiversity , forest biodiversity and mountain biodiversity might also be relevant for island biodiversity.				
Agricultural biodiversity				
Diversion of freshwater to areas suffering water shortage (dams or irrigation channels) or increased extraction of groundwater supply	Technological, regulatory and economic	Adverse or neutral	Medium-high depending on environmental flow, the rate of withdrawal etc	Include terrestrial and aquatic biodiversity considerations in EIA
Introduction of drought tolerant varieties	Scientific and economic	Neutral or adverse if extending into marginal lands not cultivated before	Low if the growth period is not extended	Monitor for likely effects on biodiversity and include adaptive management
Introduction of salt tolerant varieties	Scientific and economic	Neutral to adverse	High as areas could become more saline and reduce the endemic biodiversity	Monitor for likely effects on biodiversity and include adaptive management
Introduction of higher temperature tolerant varieties	Scientific and economic	Neutral to adverse	High if using more water for growth	Monitor for likely effects on biodiversity and include adaptive management

Adaptation activity	*Types of adaptation 10/*	*Potential impacts on biodiversity*	*Potential risk to biodiversity*	*Possible action for adaptive management*
Introduction of pest resistant varieties	Scientific, technological and economic	Neutral to positive	Low if neutral impact on biodiversity if pests not able to non-agrobiodiversity, high if doing so	Monitor for likely effects on biodiversity and include adaptive management
Introduction or extending multi-cropping or mixed farming systems Introduction of new crop/animal species and varieties	Scientific and economic	Impacts: positive if there is reduction in chemical use for pest and disease control and/or decrease in erosion due to crop cover all year round	Low –medium if replacing an existing crop without extending the cropland; High-very high if the crop/animal becomes an invasive species	Assess the potential invasiveness risk of the introduced species; minimise the land under intensive agriculture
Low tillage cropping, maintaining cropping residues and reducing fallow periods 11/	Scientific, technological and economic	Impacts: positive due to possible decreased soil erosion and decreased loss of soil biodiversity	Low	Monitor for the gains in biodiversity or reduction in erosion and potential water use
Changes in timing and type of irrigation and fertiliser use	Technological, institutional and economic	Positive if introducing water saving (e.g. drip irrigation) in areas that were already irrigated, negative if introducing irrigation	Low	Monitor for the changes and or look at the possibility of introducing the most appropriate irrigation for the crop; for fertiliser; timing of fertiliser application can be important in minimising the risk to biodiversity
Changes in grazing management[3]	Economic	Positive if reducing the intensity of grazing, negative if extending the areas grazed	Low to moderate	Monitor the effects on biodiversity
Abandonment of agriculture	Economic and regulatory	Positive if native/endemic species colonize old fields; negative if old fields colonized by non-native and/or invasive species	Low to moderate	Management of the abandoned land is necessary to provide maximum benefits to biodiversity
Establishment of corridors	Scientific, regulatory and institutional	Positive	Low-medium if allowing migration of invasive species	Monitor the migration of plant and animal species in the corridors and the connected cells of the landscapes and manage invasive species when detected

11/ Can be a Land Use, Land Use Change and Forestry (LULUCF)-based mitigation option too under the Kyoto Protocol.

Adaptation activity	*Types of adaptation 10/*	*Potential impacts on biodiversity*	*Potential risk to biodiversity*	*Possible action for adaptive management*
Wider landscape management	Scientific, regulatory and institutional	Positive	Low-very low as aimed to benefit biodiversity	Monitoring would still be necessary to ensure that the goals are being met Need to consider and if necessary enact policies to deal with land tenure issues and compensation for reduction in intensity of farming practices
Rehabilitation of ecosystems	Scientific, regulatory and institutional	Positive	Use of potentially invasive exotic species, damage to neighbouring areas	Monitor for likely effects on biodiversity and include adaptive management
Establishment of protected areas or management for sustainable use	Regulatory and institutional	Positive or neutral	medium-high	Monitor for likely effects on biodiversity and include adaptive management
Reduction of other pressures on biodiversity arising from habitat conversion, over-harvesting, pollution, and alien species invasions	Scientific, technological and regulatory	Positive	Methods can have secondary effects on biodiversity	Monitor for likely effects on biodiversity and include adaptive management EIA and Strategic Environmental Assessment.
Dry and sub-humid land biodiversity				
Diversion of freshwater to areas suffering water shortage (dams or irrigation channels) or increased extraction of groundwater supply	Technological, regulatory and economic	Adverse or neutral	Medium-high depending on environmental flow, the rate of withdrawal etc	Include terrestrial and aquatic biodiversity considerations in EIA
Introduction of drought tolerant varieties	Scientific and economic	Neutral or adverse if extending into marginal lands not cultivated before	Low if the growth period is not extended	Monitor for likely effects on biodiversity and include adaptive management
Introduction of salt tolerant varieties	Scientific and economic	Neutral to adverse	High as areas could become more saline and reduce the endemic biodiversity	Monitor for likely effects on biodiversity and include adaptive management
Introduction of higher temperature tolerant varieties	Scientific and economic	Neutral to adverse	High if using more water for growth	Monitor for likely effects on biodiversity and include adaptive management
Introduction of pest resistant varieties	Scientific, technological and economic	Neutral to positive	Low if neutral impact on biodiversity if pests not able to non-agrobiodiversity, high if doing so	Monitor for likely effects on biodiversity and include adaptive management

Adaptation activity	*Types of adaptation 10/*	*Potential impacts on biodiversity*	*Potential risk to biodiversity*	*Possible action for adaptive management*
Introduction or extending multi-cropping or mixed farming systems Introduction of new crop/animal species and varieties	Scientific and economic	Impacts: positive if there is reduction in chemical use for pest and disease control and/or decrease in erosion due to crop cover all year round	Low –medium if replacing an existing crop without extending the cropland; High-very high if the crop/animal becomes an invasive species	Assess the potential invasiveness risk of the introduced species; minimise the land under intensive agriculture
Low tillage cropping, maintaining cropping residues and reducing fallow periods12	Scientific, technological and economic	Impacts: positive due to possible decreased soil erosion and decreased loss of soil biodiversity	Low	Monitor for the gains in biodiversity or reduction in erosion and potential water use
Changes in timing and type of irrigation and fertiliser use	Technological, institutional and economic	Positive if introducing water saving (e.g. drip irrigation) in areas that were already irrigated, negative if introducing irrigation	Low	Monitor for the changes and or look at the possibility of introducing the most appropriate irrigation for the crop; for fertiliser; timing of fertiliser application can be important in minimising the risk to biodiversity
Changes in grazing management[3]	Economic	Positive if reducing the intensity of grazing, negative if extending the areas grazed	Low to moderate	Monitor the effects on biodiversity
Abandonment of agriculture	Economic and regulatory	Positive if native/endemic species colonise old fields; negative if old fields colonised by non-native and/or invasive species	Low to moderate	Management of the abandoned land is necessary to provide maximum benefits to biodiversity
Natural forest regeneration, sustainable forest management13 and avoided deforestation	Regulatory, institutional and economic	Positive, if natural forest regeneration occurs and sustainable forest management harvesting practices are applied	Low	Monitoring to assess the gains for biodiversity
Establishment of corridors	Scientific, regulatory and institutional	Positive	Low-medium if allowing migration of invasive species	Monitor the migration of plant and animal species in the corridors and the connected cells of the landscapes and manage invasive species when detected

12 Can be a LULUCF-based mitigation option too

13 Some Annex B Parties can declare this as an activity under the Kyoto Protocol

Adaptation activity	*Types of adaptation 10/*	*Potential impacts on biodiversity*	*Potential risk to biodiversity*	*Possible action for adaptive management*
Wider landscape management	Scientific, regulatory and institutional	Positive	Low-very low as aimed to benefit biodiversity	Monitoring would still be necessary to ensure that the goals are being met Need to consider and if necessary enact policies to deal with land tenure issues and compensation for reduction in intensity of farming practices
Rehabilitation of ecosystems	Scientific, regulatory and institutional	Positive	Use of potentially invasive exotic species, damage to neighboring areas	Monitor for likely effects on biodiversity and include adaptive management
Establishment of protected areas or management for sustainable use	Regulatory and institutional	Positive or neutral	medium-high	Monitor for likely effects on biodiversity and include adaptive management
Reduction of other pressures on biodiversity arising from habitat conversion, over-harvesting, pollution, and alien species invasions	Scientific, technological and regulatory	Positive	Methods can have secondary effects on biodiversity	Monitor for likely effects on biodiversity and include adaptive management EIA and SEA
Use of prescribed grazing management regimes	Scientific and regulatory	Positive or neutral	Overgrazing	Monitor for likely effects on biodiversity and include adaptive management
Eficient management of rain water	Technological, Behavioral and Individual	Positive	Low	Monitor for likely effects on biodiversity and include adaptive management
Forest biodiversity				
Introduction of pest resistant varieties	Scientific, technological and economic	Neutral to positive	Low if neutral impact on biodiversity if pests not able to non-agrobiodiversity, high if doing so	Monitor for likely effects on biodiversity and include adaptive management
Abandonment of agriculture	Economic and regulatory	Positive if native/endemic species colonise old fields; negative if old fields colonised by non-native and/or invasive species	Low to moderate	Management of the abandoned land is necessary to provide maximum benefits to biodiversity
Natural forest regeneration, sustainable forest management 14/ and avoided deforestation	Regulatory, institutional and economic	Positive, if natural forest regeneration occurs and sustainable forest management harvesting practices are applied	Low	Monitoring to assess the gains for biodiversity
Establishment of corridors	Scientific, regulatory and institutional	Positive	Low-medium if allowing migration of invasive species	Monitor the migration of plant and animal species in the corridors and the connected cells of the landscapes and manage invasive species when detected

14/ Some Annex B Parties can declare this as an activity under the Kyoto Protocol

Adaptation activity	*Types of adaptation 10/*	*Potential impacts on biodiversity*	*Potential risk to biodiversity*	*Possible action for adaptive management*
Wider landscape management	Scientific, regulatory and institutional	positive	Low-very low as aimed to benefit biodiversity	Monitoring would still be necessary to ensure that the goals are being met Need to consider and if necessary enact policies to deal with land tenure issues and compensation for reduction in intensity of farming practices
Rehabilitation of ecosystems	Scientific, regulatory and institutional	Positive	Use of potentially invasive exotic species, damage to neighbouring areas	Monitor for likely effects on biodiversity and include adaptive management
Establishment of protected areas or management for sustainable use	Regulatory and institutional	Positive or neutral	Medium-high	Monitor for likely effects on biodiversity and include adaptive management
Reduction of other pressures on biodiversity arising from habitat conversion, over-harvesting, pollution, and alien species invasions	Scientific, technological and regulatory	Positive	Methods can have secondary effects on biodiversity	Monitor for likely effects on biodiversity and include adaptive management EIA and SEA
Practice of low-intensity forestry	Scientific and regulatory	Positive	Medium-high	Monitor for likely effects on biodiversity and include adaptive management
Mountain Biodiversity				
Introduction of higher temperature tolerant varieties	Scientific and economic	Neutral to adverse	High if using more water for growth	Monitor for likely effects on biodiversity and include adaptive management
Introduction of pest resistant varieties	Scientific, technological and economic	Neutral to positive	Low if neutral impact on biodiversity if pests not able to non-agrobiodiversity, high if doing so	Monitor for likely effects on biodiversity and include adaptive management
Natural forest regeneration, sustainable forest management15 and avoided deforestation	Regulatory, institutional and economic	Positive, if natural forest regeneration occurs and sustainable forest management harvesting practices are applied	Low	Monitoring to assess the gains for biodiversity
Establishment of corridors	Scientific, regulatory and institutional	Positive	Low-medium if allowing migration of invasive species	Monitor the migration of plant and animal species in the corridors and the connected cells of the landscapes and manage invasive species when detected
Wider landscape management	Scientific, regulatory and institutional	Positive	Low-very low as aimed to benefit biodiversity	Monitoring would still be necessary to ensure that the goals are being met Need to consider and if necessary enact policies to deal with land tenure issues and compensation for reduction in intensity of farming practices
Rehabilitation of ecosystems	Scientific, regulatory and institutional	Positive	Use of potentially invasive exotic species, damage to neighbouring areas	Monitor for likely effects on biodiversity and include adaptive management

15 Some Annex B Parties can declare this as an activity under the UNFCCC Kyoto Protocol

Adaptation activity	*Types of adaptation 10/*	*Potential impacts on biodiversity*	*Potential risk to biodiversity*	*Possible action for adaptive management*
Establishment of protected areas or management for sustainable use	Regulatory and institutional	Positive or neutral	Medium-high	Monitor for likely effects on biodiversity and include adaptive management
Reduction of other pressures on biodiversity arising from habitat conversion, over-harvesting, pollution, and alien species invasions	Scientific, technological and regulatory	Positive	Methods can have secondary effects on biodiversity	Monitor for likely effects on biodiversity and include adaptive management EIA and SEA

18. **Adverse consequences to biodiversity can be minimized, and positive benefits enhanced to it, if biodiversity considerations are incorporated formally and routinely into adaptation planning.** Planned adaptation actions should proactively take into account biodiversity considerations that are mainstreamed into development policies, plans and projects at national, sub-national and local scales. For example, adaptation actions to climate change in different ecosystems, e.g., actions already planned under the implementation framework of UNFCCC and UNCCD for drylands should take into account biodiversity considerations already considered in the CBD programme of work on dry and sub-humid lands biodiversity. However, some thematic work programmes, such as marine and coastal biodiversity and mountain biodiversity, will have limited capacity for including adaptation activities.

19. **As an adaptation strategy, maintaining biodiversity allows ecosystems to provide goods and services while societies cope with climate change. This is essential if UNFCCC objectives and Millennium Development Goals for poverty alleviation, food production and sustainable development are to be met**. The categorization of ecosystem services (provisioning, supporting, regulating and cultural), as presented in the Millennium Ecosystem Assessment, 16/ is useful in determining their importance for the subsistence of human beings. Many ecosystem services are largely unrecognized in their global importance or in the role they play in meeting societal needs. Ecosystem services play a role in mitigation and adaptation to climate change. Nearly 60 per cent of the carbon that is now emitted to the atmosphere from human activities is absorbed and stored by terrestrial and ocean ecosystems, thereby slowing the rate of global climate change. An estimated 40 per cent of the global economy is directly based on biological products and processes, and the goods provided by biodiversity represent an important part of many national economies. Ecosystems also provide essential services for many local and indigenous communities such as non-timber forest products and other needs for subsistence and traditional medicines. Successful adaptation to climate change thus includes procuring the continuous flow of ecosystem services.

20. **Greater synergy in implementing the Convention on Biological Diversity and other relevant multilateral environmental agreements (MEAs) is needed for improving the delivery of the three objectives of the Convention.** The rationale for collaboration among the multilateral environmental agreements stems from the interlinkages between the issues that they address. Climate change can be an important driver of biodiversity loss and desertification. Ecosystem dynamics can impact the earth's carbon, energy and water cycles and therefore affect climate. Furthermore, measures undertaken under one convention may have consequences for the objectives of the other conventions:

(a) In recognition of the distinct mandates of relevant multilateral agreements and conventions, the importance of enhanced cooperation has been identified several times in various forums;

(b) Enhanced cooperation between international conventions, organizations and bodies aim at ensuring the environmental integrity of the conventions and promoting synergies under the common objective of sustainable development, avoid duplication of efforts, strengthen joint efforts and use available resources more efficiently;

(c) The Joint Liaison Group (JLG) between the secretariats of the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change and the United Nations Convention to Combat Desertification has assessed past and current forms of collaboration and identified options for enhanced cooperation among three Rio conventions (UNEP/CBD/SBSTTA/10/INF/9 and FCCC/SBSTA/2004/INF.19). Options for further enhancing cooperation include:

(i) Cooperation at the national and international levels: such as encouraging collaboration among national focal points and collaboration at the level of the convention bodies and secretariats;

16/ Source: Millennium Ecosystem Assessment 2003 Report “People and Ecosystems: A Framework for Assessment"

(ii) Cooperation on issues addressing climate change impacts, adaptation, mitigation, land degradation and the conservation and sustainable use of biodiversity;

(iii) Cooperation in specific areas: capacity-building; technology transfer; research, monitoring and systematic observation; information exchange and outreach; reporting, and financial resources.

21. **As illustrated in table 2, provisions and decisions/resolutions from the governing bodies of the UNFCCC, CBD, the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention), and the Convention on the Conservation of Migratory Species of Wild Animals (CMS) have identified concrete adaptation activities under the following elements**:

(a) Development of adaptation options;

(b) Assessment of adaptation options;

(c) Effective management of particular ecosystems;

(d) Promotion of societal actions;

(e) Restoration of degraded ecosystems; and

(f) Integration of adaptation activities into other policies and strategies.

22. The list above demonstrates the wide variety of options for complementary work across multilateral environmental agreements to fulfil their objectives whilst contributing to adaptation. At the same time, the list is useful for identifying possible areas where more complementary work could be undertaken in the future, such as in recognizing the role of ecosystems in adaptation, promoting biological diversity in climate change adaptation measures, and minimizing the adverse effects of adaptation actions on the environment.

23. **An integrated adaptation framework to climate change would benefit from a proactive attempt at developing a comprehensive complementarity strategy that engages the various multilateral environmental agreements, for instance, through the Joint Liaison Group**. Synergy between biodiversity, climate change, desertification, sectoral policies and programmes (e.g. land management, wetlands, agriculture, forests) is essential at the national and local levels. It is considered that adaptation options are best carried out as part of an overall approach to sustainable development, integrated, for example, with national biodiversity strategies and action plans, and related projects.

Table 2. Examples of complementarity in adaptation options/activities/objectives between selected multilateral environmental agreements (MEAs) 17/

Activities	*Source*
Element 1. Develop adaptation options	
Ramsar Convention	
Encourage the development of appropriate methods of integration of flood and natural hazard management and water quality control through maintaining natural coastal wetland processes in all phases of integrated costal zone management (ICZM)	**Ramsar Resolution VIII.4**, Wetland issues in Integrated Coastal Zone Management (ICZM), Annex (Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM)): Action 5.5, Guideline No. 5 –Ensuring the recognition by Contracting Parties of the role of coastal wetlands in regulating water flows and water quality

17 This is a sample of the activities listed under the adaptation section of the biodiversity and climate change module of UNEP's Issue-Based Modules for Coherent Implementation of Biodiversity Conventions (http://svs-unepibmdb.net/)

Activities	*Source*
CBD	
Develop methods for adapting marine and coastal protected areas management in response to possible changing species and habitat distribution patterns, which may result from climate change	**CBD Decision VII/5**, Marine and coastal biological diversity, Annex I (Elaborated programme of work on marine and costal biological diversity): Paragraph (c), Priority 2.3: Identifying the best indicators for assessing management effectiveness at various scales within an overall system, Appendix 4, research priorities, including research and monitoring projects associated with programme element 3: marine and coastal protected areas
Element 2: Assess adaptation options	
Component 1: protected areas	
UNFCCC	
Provide opportunity for research, including for adaptive measures for protected areas to cope with climate change:	**UNFCCC Article 4.1(e)**, **KP Article 11.2**
Component 2: coastal wetlands	
Ramsar Convention	
Assess the feasibility of adaptation options for coastal wetlands in relation to climate change and sea-level rise scenarios	**Ramsar Resolution VIII.4**, Wetland issues in Integrated Coastal Zone Management (ICZM), Annex (Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM)): Action 6.3, Guideline No. 6 – Ensuring recognition by Contracting Parties of the role of coastal wetlands in mitigating impacts of climate change and sea level rise
Review opportunities for the rehabilitation or restoration of degraded coastal wetlands:	**Ramsar Resolution VIII.4**, Wetland issues in Integrated Coastal Zone Management (ICZM), Annex (Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM)): Action 5.2, Guideline No. 5 – Ensuring the recognition by Contracting Parties of the role of coastal wetlands in regulating water flows and water quality
Consider the creation of additional constructed wetlands within coastal areas	**Ramsar Resolution VIII.4**, Wetland issues in Integrated Coastal Zone Management (ICZM), Annex (Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM)): Action 5.2, Guideline No. 5 – Ensuring the recognition by Contracting Parties of the role of coastal wetlands in regulating water flows and water quality
Assess options for maximizing benefits of coastal wetlands in mitigating climate change and sea-level rise impacts:	**Ramsar Resolution VIII.4**, Wetland issues in Integrated Coastal Zone Management (ICZM), Annex (Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM)): Action 6.2, Guideline No. 6 – Ensuring the recognition by Contracting Parties of the role of coastal wetlands in mitigating impacts of climate change and sea-level rise
Component 3: coral reefs	
CBD	
Support further target research programmes that investigate management options to building resilience to mass coral bleaching	**CBD Decision VII/5**, Marine and coastal biological diversity, Annex I (Elaborated programme of work on marine and costal biological diversity): Subparagraph

Activities	*Source*
on both short- and long-time frames	2(a)(v)(c) of Appendix 1, specific work plan on coral bleaching
Estimate the cost to implement the necessary activities to meet the targets of the programme of work on protected areas	**CBD Decision VII/28**; Protected areas (Articles 8 (a) to (e)), paragraph 10
Element 3: Effectively manage natural systems	
Component 1: general	
CBD	
Take measures to manage ecosystems so as to maintain their resilience to extreme climatic events and to help mitigate and adapt to climate change	**CBD Decision VII/15**, Biodiversity and Climate Change, paragraph 12
Component 2. marine and coastal zones	
UNFCCC	
Develop and elaborate appropriate and integrated plans for coastal zone management	**UNFCCC Article 4.1(e)** and **KP Article 11.2**
CBD	
Take measures to manage coastal and marine ecosystems, including mangroves, seagrass beds and coral reefs	**CBD Decision VII/5**, Marine and coastal biological diversity, paragraph 8. The objective is to maintain their resilience to extreme climatic events.
Maximize the effectiveness of marine and coastal protected areas and networks	**CBD Decision VII/5**, Marine and coastal biological diversity, paragraph 8. The objective is to enhance biodiversity by addressing threats.
Identify, test and refine management regimes	**CBD Decision VII/5**, Marine and coastal biological diversity, Annex I (Elaborated programme of work on marine and costal biological diversity): Subparagraph 1(a)(ii), Management actions and strategies to support reef resilience, rehabilitation and recovery, an action identified as being of highest priority for implementation. Specific examples given of means to implement these actions are the application of appropriate protective status, reduction of reef stressors, and management of reef communities. The objective is to enhance reef resilience to and recover from higher sea temperatures and/or coral bleaching.
Component 3: water resources and agriculture	
UNFCCC	
Develop and elaborate appropriate and integrated plans for water resources and agriculture	**UNFCCC Article 4.1(e)** and **Kyoto Protocol Article 11.2**
CBD	
Carry out a series of case studies to identify key goods and services provided by agricultural biodiversity	**CBD Decision V/5**, Agricultural biodiversity: review of phase I of the programme of work and adoption of a multi-year work programme, Annex 5 (Programme of work on agricultural biodiversity): Activity no. 2.1, Programme element 2. Adaptive management. One of the specific issues that the case studies are required to deal with is the role of genetic diversity in providing resilience, reducing vulnerability, and enhancing

Activities	*Source*
	adaptability of production systems to changing environments and needs. According to the Appendix to CBD Decision V/5 agricultural biodiversity provides the following climate-related ecological services: erosion control and climate regulations and sequestration.
Component 4: drought, desertification and floods	
UNFCCC	
Develop and elaborate appropriate and integrated plans for protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods	**UNFCCC Article 4.1(e)** and **Kyoto Protocol Article 11.2**
Component 5: wetlands	
Ramsar Convention	
Plan the management of mangrove ecosystems, including required adaptation measures	**Ramsar Resolution VIII.32**, Conservation, integrated management, and sustainable use of mangrove ecosystems and their resources, paragraph 20. The objective is to ensure that they may respond to impacts caused by climate change and sea-level rise.
Manage wetlands through effective strategies, among others, through promoting wetland and watershed protection and restoration.	**Ramsar Resolution VIII.3**, Climate change and wetlands: impacts, adaptation and mitigation, paragraph 14. The objective is to increase wetland resilience to climate change and extreme climatic events and to reduce the risk of flooding and drought in vulnerable countries.
Integrate fully the "Principles and guidelines for wetland restoration" into National Wetland Policies and Plans.	**Ramsar Resolution VIII.16**, Principles and guidelines for wetland restoration, paragraphs 11 and 12
Put priority on wetlands which are of special significance for coastal protection	**Ramsar Resolution VIII.25**, The Ramsar Strategic Plan 2003-2008, Annex (The Ramsar Strategic Plan 2003-2008): Action 3.3.1, Operational Objective 3.3: Increase recognition of significance of wetlands for reasons of water supply, coastal protection, flood defense, food security, poverty alleviation, cultural heritage, and scientific research, Operational Objective 3. Integration of wetland wise use into sustainable development.
Component 6: migratory species	
CMS	
Maintain a network of suitable habitats in relation to the migration routes of migratory species in CMS agreements	**CMS Article 5(f)**
Component 7: Effectively manage forest ecosystems	
CBD	
Promote the maintenance and restoration of forest biodiversity in forests	**CBD Decision VI/22**, Forest biological diversity, paragraph 10 and CBD Decision VI/22, Annex (Expanded programme of work on forest biological diversity): Programme element 1: conservation, sustainable use and benefit-sharing, goal 1: to apply the ecosystem approach to the management of all types of forests, objective 3: mitigate the negative impacts of

Activities	*Source*
	climate change on forest biodiversity, activity (c). The objective is to enhance the capacity of forests to adapt to climate change.
Develop coordinated response strategies and action plans on forest biological diversity at global, regional and national levels	**CBD Decision VI/22**, Forest biological diversity, paragraph 10 and CBD Decision VI/22, Annex (Expanded programme of work on forest biological diversity): 10: Programme element 1: conservation, sustainable use and benefit-sharing, goal 1: to apply the ecosystem approach to the management of all types of forests, Objective 3: mitigate the negative impacts of climate change on forest biodiversity, Activity (b)
Element 4: Promote societal actions	
Activities	Source
Ramsar Convention	
Increase the adaptive capacity of society to respond to the changes in wetland ecosystems due to climate change	**Ramsar Resolution VIII.3**, Climate change and wetlands: impacts, adaptation and mitigation, paragraph 15
CBD	
Consider and promote the mainstreaming of agricultural biodiversity into national plans, programmes and strategies	**CBD Decision VII/3**, Agricultural biological diversity, paragraph 10
Element 5: Restore degraded ecosystems	
CBD	
Develop and implement programmes to restore degraded mountain ecosystems.	**CBD Decision VII/27**, Mountain biological diversity, Annex (Programme of work on mountain biological diversity). The objective is to enhance the capacity of mountain ecosystems to restore and adapt to climate change.
Ramsar Convention	
Review opportunities for the rehabilitation and restoration of degraded coastal wetlands	**Ramsar Resolution VIII.4**, Wetland issues in Integrated Coastal Zone Management (ICZM), Annex (Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM)): Action 1.2.1 of Goal 1.2: To protect, recover and restore mountain biological diversity, Programme element 1: direct actions for conservation, sustainable use and benefit-sharing
Element 6. Integrate adaptation measures into other policies and strategies	
CBD	
Integrate climate change adaptation measures in protected area planning, management, and design	**CBD Decision VII/28**, Protected areas (Articles 8 (a) to (e)), Annex (Programme of work on protected areas): Suggested activity no. 1.4.5, Goal 1.4 – To substantially improve site-based protected area planning and management, Programme of Work on Protected Areas
Ramsar Convention	
Apply the *Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM)*	**Ramsar Resolution VIII.4**, Wetland issues in Integrated Coastal Zone Management (ICZM), Annex (Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM)): Action 6.2, Guideline No. 6 – Ensuring the recognition by

Activities	*Source*
	Contracting Parties of the role of coastal wetlands in mitigating impacts of climate change and sea-level rise of Principle 3. Coastal wetlands have important values and functions and provide multiple goods and services of high economic value: Ensure that information on the implications and vulnerability of coastal wetlands in relation to climate change and sea-level rise, and the options for maximizing their benefits in mitigating climate change and sea-level rise impacts are made available to the integrated coastal zone management (ICZM) processes

III. APPROACHES, METHODS AND TOOLS FOR PLANNING, DESIGNING AND IMPLEMENTING DIRECTED ADAPTATION ACTIVITIES

24. **Various approaches, methods, and tools can be used for planning, designing, and implementing directed adaptation activities**. Some of these are more relevant and applicable at the local to sub-national scale and others at national and fewer at global/international (see Table 3). Often at the national scale, the amalgamation of various methods and tools provide opportunities for exploiting and addressing the synergies between the objectives of multiple environmental conventions and sustainable development goals. The approaches fall into two main categories; "top-down" (modeling or scenario-driven) and "bottom-up" (community or vulnerability-driven) and incorporate information and policy link. They are complementary and in some ways form a continuum (for more details see chapter 4 of CBD Technical Series No. 10).

25. **In certain circumstances, one approach may have more strengths than the other**. For example, models are useful in depicting general trends and dynamic interactions between the atmosphere, biosphere, oceans, land and ice, but have low resolution and limited ability to project the impacts of climate change and are unable to provide the information needed to support planning and prioritization of adaptation activities at local level. However, models are continuously revised and thus gain credibility and robustness. The vulnerability-driven approach to adaptation usually involves assessing past and current climate vulnerability, existing coping strategies, and how these might be modified with climate change. They have the potential to address immediate needs to respond to extreme climatic events and adding to the coping capacity for future changes. Overall, there is a need for detailed information for the application of the different approaches and methods.

Table 3: Some approaches and tools that are used for designing and implementing adaptation activities. In many cases, participatory/multi-stakeholder approaches and cooperation between stakeholders are an essential component. Other tools such as cost-benefit analysis, and multi-criteria analysis, are also relevant at a wide range of scales. A more comprehensive list of tools and approaches to design and implement adaptation activities has been prepared under the UNFCCC. **18**/

Approach/methods tools	**Scale (local, sub-national, national, regional and international/global) at which it is most appropriate**
Strategies and action plans	International, national
Legislation	National, regional (e.g. EU)
Environmental Impact Assessments	Project based so local
Strategic Environmental Assessments	National, regional
Modelling (quantitative and qualitative)	Global, regional, limited at national –local
Sustainable livelihood approach	National-local
CBD Ecosystem Approach	Local, sub-national and regional (watersheds)

26. **The various approaches and methods can be combined into a climate change adaptation framework for biodiversity and specific tools can be used in different stages of the framework**. Adaptation is an iterative process and the climate change adaptation framework for biodiversity is designed to assist countries in the integration of consideration of biodiversity in adaptation to climate-change-related risks (figure 2). The suggested framework incorporates the both scenario driven and vulnerability driven approaches. It is also consistent with the framework for assessment of impacts, vulnerability and adaptation suggested by the IPCC, 19/ adaptation policy framework, 20/ risk management approaches, Ramsar risk assessment framework, and national adaptation programmes of action (NAPAs).

27. **The climate change adaptation framework for biodiversity (fig. 2) includes iterative steps including the indemnification of the problem, ensuring and seeking participation from multiple partners, assessing the knowledge base, preparing and implementing adaptation action plans**. These stages are followed by monitoring of the outcomes the plan and when needed supplementing and strengthening the information/knowledge base and research activities. Communication and transparency are important components throughout the process. The overall framework should be seen to be part of a risk management approach.

18/ http://unfccc.int/adaptation/methodologies_for/vulnerability_and_adaptation/items/2674.php

19/ IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations with a Summary for Policy Makers and a Technical Summary

20/ UNDP-GEF. 2005. Adaptation policy frameworks for climate change.

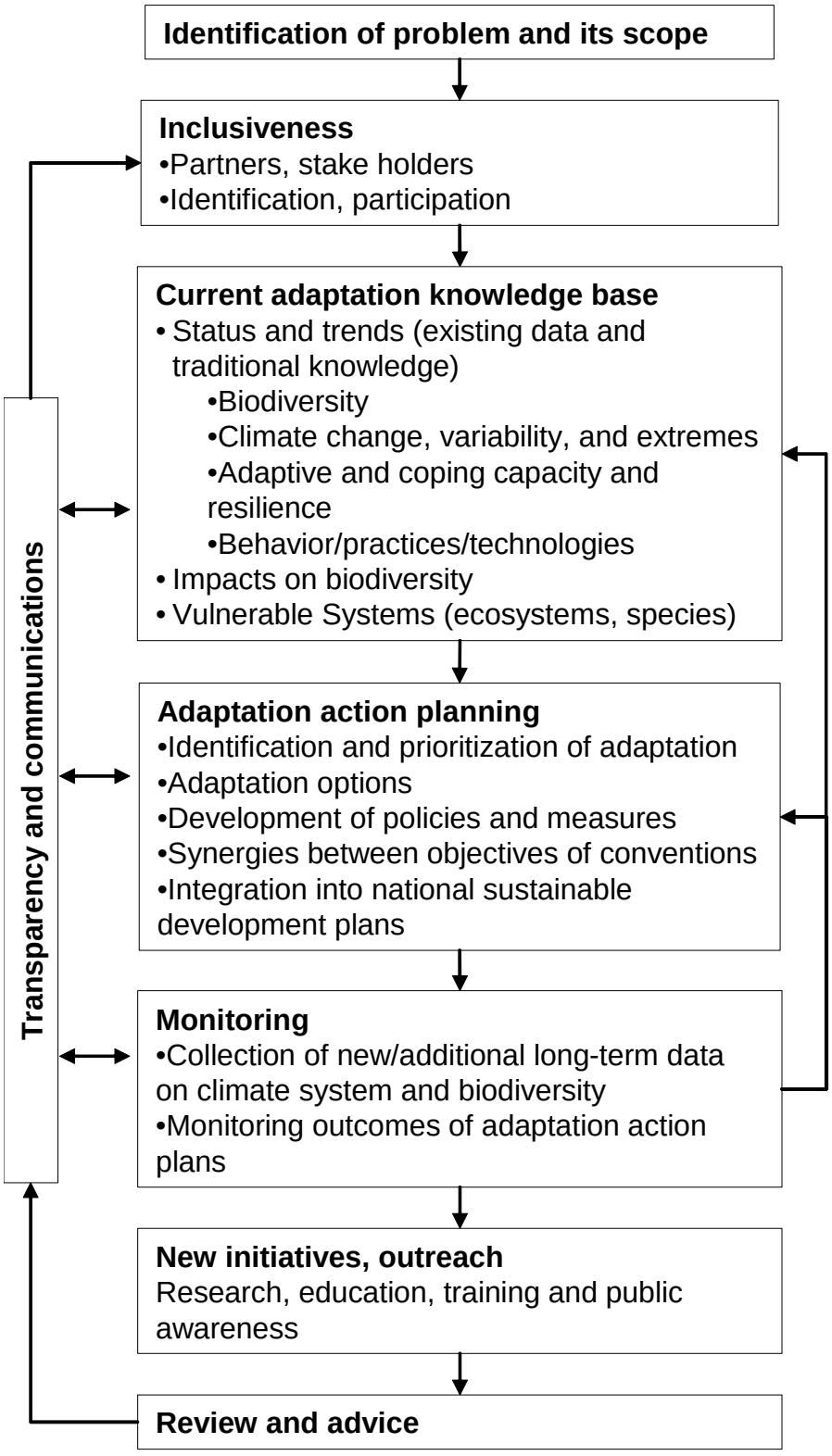


Figure 2. Climate change adaptation framework for biodiversity

28. **There have been some planned adaptation activities, that have been designed, but fewer have been implemented**. These activities have used different approaches and combinations of methods and tools (see box 1) as either "stand alone" projects (e.g. Sudan, Kiribati, Mexico) or embedded within national development plans (e.g. South Africa, Finland, Canada). In the case of both Kiribati and Sudan, the aim is to move from the "stand alone" project to being part of a national development planning. Yet

there is an urgent need to implement more adaptation activities, extract lesson learned, document best practices and modify methods and tools as needed.

Box 1. Selected case studies illustrating the diverse ways in which different approaches and tools can be integrated for development and implementation of adaptation actions. The list is not exhaustive and reported information is of ongoing nature.

1. *South Africa: Cape floral kingdom and Succulent Karoo*. The Succulent Karoo, the world's richest arid hotspot and the diverse Fynbos Biome are strongly dependent to climate change trends. Climate change is projected to lead to extensive loss of especially rare species causing changes in species composition and their distribution. Approaches taken include: (i) modeling of vulnerable areas by assessing the impacts of climate change; (ii) development of policy frameworks and legal instruments; (iii) activities to conserve vulnerable areas including regional planning; expansion of protected areas and conservation farming; (iv) development of seed banks and DNA banks; (v) monitoring of the activities and their expected outcomes; (vi) research (e.g. possible future impacts of elevated CO_2, changes in precipitation patterns); (vii) information exchange and capacity building.

2. Sudan: sustainable livelihood framework Sudan, like many other parts of Africa, is prone to drought and land degradation resulting in loss of biodiversity, displacement of people and human livelihood. Included concept of the five capitals (natural, physical, financial, human and social) to examine the coping capacity of communities in the face of current climate variability, and to better understand their potential resilience and adaptive capacity in the face of future climate change. Documented experiences of sustainable livelihood measures that had been successfully used to reduce a communities' vulnerability to drought. Adaptation actions – win-win actions – that also reduce poverty, increase human security, improve natural resource stocks and ecosystem integrity.

3. Kiribati. Local consultation. Kiribati is one of the most isolated Least Developed Countries in the world, consisting of 33 low-lying islands highly susceptible to sea-level rise and prone to other environmental pressures. Using established risk management tools the Kiribati Adaptation Project held two major national consultations, which built awareness of, and commitment for adaptation and climate change. The consultation brought together Chief Councillors, government staff, clerks, *unimanwe* representatives (traditional elders), women and youth from each of the islands. Key results included: (i) awareness that the changes they faced were spread across all islands; (ii) a catalogue of kinds of changes experienced over the last 20-40 years, and traditional coping mechanisms used to deal with those changes; (iii)a preliminary assessment of areas where people felt they needed additional assistance in coping with their vulnerabilities; (iv) a strategy to take results back to their islands for further local level consultations; (v) a shared and distinctively Kiribati definition of what is *vulnerability* and *adaptation.*

4. Finland. National Strategy for Adaptation to Climate Change. By request from the Finnish Parliament the Government completed the preparation of the National Strategy for Adaptation to Climate Change in 2005, based on available information and expert assessments and judgements. The strategy describes the impacts of climate change in the sectors of food production, forestry, fisheries, reindeer husbandry, game management, water resources, biodiversity, industry, energy, traffic, land use and communities, building, health, tourism and recreation, and insurance. The main content of the Adaptation Strategy and priorities for implementation will be included in the National Climate and Energy Strategy. Priorities for increasing adaptation capacities include (i) mainstreaming climate change impacts and adaptation into sectoral policies, (ii) addressing long-term investments and (iii) coping with extreme weather events, (iv) improving observation systems, (v) strengthening research and development base, and (vi) international cooperation (www.mmm.fi/sopeutumisstrategia/).

5. *Canada. Agri - Environmental standards for biodiversity, air and water.* Canada has initiated projects to improve the economic competitiveness of Canadian farmers by developing agri- environmental standards for biodiversity, air and water. The impact of agriculture on biodiversity will be evaluated and new agri - environmental standards developed to reduce the impacts of climate related and other stresses. Thematic work programmes of the CBD and national biodiversity strategies have been used to guide the development of these standards. The implementation of these standards will be applied at the farm level scale.

6. Mexico. *Resilience of coastal wetlands.* The coastal region along the Gulf of Mexico is one of the most vulnerable areas in the country and it has been identified as susceptible to rises in sea leve which will cause changes in hydrology, salinity and in some places loss of wetland habitat. This project serves as a basis for developing specific adaptation measures for reducing the impacts of climate change to biodiversity and local communities. The project has two main phases (i) an assessment of the vulnerability of the flora, fauna, and economic assets of the region; (ii) design and implementation of restoration measures that will conserve coastal wetlands and their ecosystem services as the climate changes.

7. Colombia. *Synergies.* High-elevation páramo vegetation is one of the tropical mountain ecosystems heavily threatened by climate change. One of the ecosystem services at stake is capture and regulation of water indispensable to upper mountain communities who have no other source of water, and also carbon sequestration and storage in form of peat. Commitments with Ramsar Convention are also threatened. Consequently, synergistic implementation of the instruments off relevant conventions is needed. The case of Paramo Las Hermosas brings together resources from the Clean Development Mechanism "Amoya" project to generate hydropower, and resources from the pilot Global Environment Facility-INAP project on adaptation to climate change, addressing both conservation and development of adaptation strategies.

8. United Kingdom. National Adaptation Framework . Under development, and of cross-sectoral nature, but a range of partnerships and projects are currently tackling biodiversity and climate change impacts. The MONARCH project has modelled the impact of predicted changes in climate upon 120 species of conservation importance in Britain and Ireland. Through a stakeholder workshop involving those responsible for the conservation of these species, the implications of the results for policy changes and conservation management will be considered. Guidance on climate change adaptation for those involved in implementing work towards the National Action Plan will address seven principles: i) conserve Protected Areas and other high quality wildlife areas; ii) reduce other sources of ecological harm, such as pollution; iii) protect species and habitat range and ecological variability; iv) protect and enhance variation within the landscape; v) establish ecological networks and facilitate dispersal; vi) respond to decline and extinction by thorough ecological analysis and vii) adapt conservation priorities and targets in response to monitoring and surveillance.

9. Arctic Vulnerability Study: local knowledge applied to reindeer herding in a changing climate. An interdisciplinary, intercultural study that will assess the vulnerability of coupled human-ecological systems in the Arctic to variation and change in key aspects of the natural and human environments and biodiversity. The key projects from the Saami University College and Nordic Saami Institute focuses on reindeer herding in Arctic and sub-Arctic Eurasia. Its approach is holistic, integrating social and natural science and users' understanding in the co-production of knowledge. Climate variability, climate change and the societal/cultural transformations associated with globalisation have been, and continue to be, responsible for major changes in physical environment, the biota and the cultures of the indigenous communities in the Arctic. Little is known about the vulnerability of such systems to change. Herders' experience and understanding will, therefore, be documented, analysed and, under their guidance, combined with data in social and natural sciences.

29. **The knowledge base and participatory processes needed to support adaptation planning and implementation for biodiversity should be strengthened. Major gaps and challenges fall into four major categories: tools/data needs, research, synthesis/participation and communication.**

30. **For tools/data needs, specific gaps and challenges are**:

(a) Lack of baseline data and systematic monitoring to assess biodiversity response to climate change and adaptation activities (e.g. figure 2).

(b) Development of predictive models and decision support tools to guide the design and selection of adaptation strategies at different scales (biome, local, subnational, national, regional; landscape/seascape);

(c) Development of scenarios of likely future changes in drivers, status and condition of ecosystems, and biodiversity outcomes, reflecting both scientific and traditional knowledge;

(d) Strengthening expertise and institutional capacity in developing countries and indigenous communities for all the above.

31. **Regarding research, there is a need for**:

(a) Improved understanding of how biological and physical systems will respond to climate change and how their interactions influence outcomes on ecosystems. Discerning these complexities represents one of the largest uncertainties for projecting future biodiversity; 21/

(b) An analysis of the impacts on biodiversity of existing and planned adaptation activities in response to climate change and improved understanding of ecosystem/species adaptations to *current* environmental change as it can provide important information for designing future options;

(c) An improved understanding of the biological factors and ecosystem processes that contribute to resilience and natural adaptive capacity;

(d) A critical analysis of the use of key indicators and other methodologies, such as risk assessments, for assessing biodiversity status and trends;

(e) Improved sophistication, robustness, downscaling and coupling of climate and ecosystem models and improved capacity for simulating effects of multiple drivers and pressures (climate and non-climate) on biodiversity, distinguishing anthropogenic and natural climate impacts;

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(f) Long-term monitoring of key biophysical parameters so to provide time-series data for developing baselines as climate changes. Monitoring success of adaptation is equally important (see figure 2);

(g) Developing research agendas that reflect priorities for vulnerable communities such as local and indigenous populations and those with limited capacity for adaptation.

32. **With respect to synthesis/participation and collaboration, main issues are**:

(a) Incorporating both scientific and traditional knowledge to facilitate adaptation planning and implementation, and collecting traditional knowledge prior to is disappearance;

(b) Ensuring participatory approaches and partnerships for planning and implementing adaptation strategies;

(c) Documenting case-studies of adaptation in ecosystems and their limits in conjunction of the records of the present climate variability and extremes as a basis for designing adaptation options;

(d) Synthesizing information derived from top-down and bottom-up approaches leading to the development of directed adaptations for biodiversity (e.g. box 1).

33. **With respect to communication, there is a need for**:

(a) Cooperation, networking, and large-scale (biogeographical) approaches for documenting present distribution and future shifts in ecosystems and species ranges across political boundaries;

(b) Collection, systematic analysis, and dissemination of information and lessons learned from adaptation activities through the clearing-house mechanism under the Convention on Biological Diversityand similar approaches at national, subnational and local levels, including dissemination of information describing the effectiveness of impact assessment tools.

IV. SUMMARY OF KEY ISSUES FOR ADVICE AND GUIDANCE

34. Adaptation is an adjustment in natural or human systems to a new or changing environment. Adaptation that includes autonomous and directed actions, needs to be incorporated into the thematic work programmes and relevant cross cutting issues of the Convention on Biological Diversity. Yet, adaptation activities alone will not be adequate to reduce the rate of biodiversity loss. Mitigation activities are also essential if the three objectives of the Convention on Biological Diversity are to be met. Adaptation and mitigation activities to climate change are both needed within the context of sustainable development.

35. National policies, programmes and plans for adaptation should take biodiversity considerations into account. For example, planned adaptations are already being implemented to reduce many of the adverse impacts of climate change to produce economic and social benefits in the future. If biodiversity considerations are incorporated formally and routinely into adaptation planning, negative consequences can be minimized and positive benefits enhanced.

36. Adaptation options for biodiversity need to take into account natural disaster preparedness and relevant mitigation actions within the context of sustainable development.

37. Maintaining biodiversity should be part of all national policies, programs and plans for adaptation to climate change to allow ecosystems to continue providing goods and services. This is essential if the UNFCCC objective and Millennium Development Goals for poverty alleviation, food production and sustainable development are to be met.

38. In particular, programmes and plans for adaptation to climate change should take into account the maintenance and restoration of resilience, which is an essential element 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.

39. Various approaches, methods and tools are currently available and can be used for planning; designing and implementing directed adaptation activities as per the Climate Change Adaptation Framework for Biodiversity.

40. There is an urgent need to implement more adaptation activities, extract lesson learned, improve methods and tools, document best practices and disseminate this information through the clearing-house mechanism under the Convention on Biological Diversity.

41. An enhanced knowledge base, in particular for new adaptation research, data, tools, synthesis and communication, is needed to support adaptation planning for biodiversity. This knowledge base should include both traditional and scientific knowledge.

42. Training, capacity building and strengthening institutions is critical for building the much needed expertise in developing countries to implement different adaptation actions.

43. Effective collaboration and networking between biodiversity and climate change communities at all levels is essential for the successful implementation of adaptation activities for biodiversity.

44. A number of adaptation related activities have been identified in several multilateral environmental agreements (MEAs). Greater synergy in these adaptation efforts is needed for moving the adaptation agenda forward while contributing in effective implementation of the objectives of different multilateral environmental agreements.

45. It is recognised that adaptation to the effects of climate change due to both natural and human factors is a high priority for all nations, as stated in the paragraph 55 (c) of the draft resolution on the 2005 World Summit Outcome presented at the sixtieth session of the General Assembly. Moreover, nations committed themselves to assist developing countries to improve their resilience and integrate adaptation goals into their sustainable development strategies.

46. It is clear that adaptation to climate change for biodiversity is a rapidly developing area with many new national adaptation plans in preparation. Many opportunities to further develop synergies between Conventions or the sharing of best practice from on-going work warrant further consideration by national Governments and the Convention on Biological Diversity.

Appendix

GLOSSARY

Adaptive capacity is the ability of an ecosystem to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Inertia is the property of a dynamic ecosystem to preserve its prior rate of change after being perturbed. For example, the capacity of oceans to store large amounts of thermal energy slows climate change, but also ensures that climate will continue to change long after stabilization of greenhouse gas concentrations in the atmosphere.

Resilience is the ability of an ecosystem to maintain functions after being perturbed. A measure of resilience is the magnitude of disturbance required to move an ecosystem irreversibly to an alternative state. Resilience decreases an ecosystem's sensitivity.

Resistance describes the capacity of an ecosystem to persist unchanged despite environmental change. Resistance decreases an ecosystem's sensitivity.

Sensitivity measures the magnitude and rate of response in proportion to the magnitude and rate of climate change. Ecosystems will be particularly sensitive to changes in climate variability and the frequency and magnitude of extreme events.

Vulnerability measures an ecosystem's exposure to and sensitivity to climate change. Vulnerability is determined at specific spatial and temporal scales and is a dynamic property dependent on local conditions; for example, a forest during the dry season.

Annex II

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