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INPUT INTO THE IN-DEPTH REVIEW OF THE FOREST BIODIVERSITY PROGRAMME OF WORK

Integration of climate change impact and response activities

Note by the Executive Secretary

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I. INTRODUCTION

1. Forests represent a significant global carbon stock, and forest biodiversity has a potentially important role to play in climate change adaptation planning through maintaining ecosystem services and providing livelihoods. Forests also offer options for the mitigation of climate change, through afforestation and reforestation, and they offer considerable potential for the reduction of current greenhouse gas emissions from deforestation and degradation.

2. Climate change is increasingly a cause of forest biodiversity loss as outlined in the Millennium Ecosystem Assessment and the recent reports of the Intergovernmental Panel on Climate Change (IPCC). Forests, with their long-living trees, are particularly threatened by relatively sudden changes in their environment. Forests are also the most important carbon sink in most terrestrial ecosystems. Deforestation and forest degradation are not only destroying biological diversity but are also generating a large amount of greenhouse gases, accounting for around 20% of global emissions.

3. This note was prepared in response to recommendation XII/5 of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to the Convention on Biological Diversity (CBD), which requests the Executive Secretary, when conducting the in-depth review of implementation of the programme of work on forest biodiversity, to conduct an analysis to identify the elements of the guidance (presented below) already included in the existing programme of work and an assessment of the state of implementation, as well as the identification of gaps in implementation including a review of barriers and suggestions to overcome them. This note provides additional information to the in-depth review of the programme of work on forest biodiversity (UNEP/CBD/SBSTTA/13/3).

4. The guidance presented by SBSTTA includes:

(i) Indications or predictions of climate-change impacts and response activities on relevant ecosystems;
(ii) The most vulnerable components of biodiversity;
(iii) The risks and consequences for ecosystem services and human well-being;
(iv) The threats and likely impacts of climate change and response activities on biodiversity and opportunities they provide for the conservation of biodiversity and its sustainable use;
(v) Monitoring of the threats and likely climate-change impacts and response activities on biodiversity;
(vi) Appropriate monitoring and evaluation techniques, related technology transfer and capacity-building initiatives within the programmes of work;
(vii) Critical knowledge needed to support implementation including, *inter alia*, scientific research, availability of data, appropriate measurement and monitoring techniques technology and traditional knowledge; and
(viii) The ecosystem approach principles and guidance and the precautionary approach.

5. Main sources of information for this study include the reports and recommendations of the Third and Fourth Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC), the Millennium Ecosystem Assessment, the Technical Series No. 10 and No. 25 of the Convention on Biological Diversity, third national reports submitted by Parties to the Convention on Biological Diversity and responses by Parties to notification 2007-102. Additional sources are presented in annexes I and II.

II. INDICATIONS OR PREDICTIONS OF CLIMATE-CHANGE IMPACTS AND RESPONSE ACTIVITIES ON FOREST ECOSYSTEMS

6. This section describes expected impacts of climate change on forest biodiversity, based on the IPCC Fourth Assessment Report and the Millennium Ecosystem Assessment.

7. Forests have been fairly well monitored for the impacts of climate change. As a result a number of changes have been observed including: increased stomatal densities in temperate woodlands,

community reorganization, poleward shifts in species ranges, changed seasonal patterns of growth and flowering, and the loss or reduction in productivity of certain forest systems.

8. Globally, predictions suggest that climate change will aggravate the adverse impacts of forest cover loss thereby causing extensive forest die back and composition change. In some cases, though, these changes may occur gradually providing time for adaptation.

A. Increased carbon dioxide concentrations

9. Even though there has been a large amount of research done on the changes of tree growth due to increased CO2 concentrations, it remains difficult to predict future forest growth and productivity under elevated atmospheric CO2. Likewise, it is difficult to predict how forest ecosystem processes will respond to enriched CO2. According to the fourth assessment report of the IPCC, if CO2 concentrations reach 550 parts per million (by 2050), young trees may experience an increase in above-ground biomass of up to 30% while mature trees are not likely to see any increase. The increase in above-ground biomass is expected to be greatest among fast-growing trees.

10. Regionally, predictions in forest production by 2045 under elevated CO2 conditions list reductions in North America, Russia and Eastern Europe, while increases may be realized in South America, Oceania, Northern Asia and Western Europe.

11. In many cases, however, potential increases in production as a result of elevated CO2 are likely to be offset by the negative impacts of rising temperatures, changing precipitation regimes and other climate change effects. Furthermore, initial increases in growth may be limited by nutrient limitations, competition, disturbances and other site-specific and species-specific factors. For example, the projected increases in production in Northern Asia as a result of carbon fertilization are likely to be offset by increased forest fires as a result of human activities and climate change impacts from extreme weather events.

B. Increased air and surface soil temperature

12. Increased air and surface soil temperatures are expected to cause significant shifts in forest species distribution, the expansion of forest pests, pathogens and invasive alien species, and changes in forest fire regimes. For example, warmer temperatures will generally cause a poleward or upwards shift of most species with high elevation and northern forests declining, while low elevation forests are expected to expand. The boreal forests in Alaska, for example, are expected to experience a northward shift of 100 kilometers for every 1°C rise in mean annual temperatures. These shifts may add further stress to forest ecosystems with possible negative impacts on overall ecosystem diversity and health, and with possible effects on the carbon sequestration potential of boreal forests. Recent studies indicate that certain parts of boreal forests could become a source of atmospheric carbon rather than a sink due to the effects of climate change.

13. Warming trends have already enhanced the spread of insect pests in forests including, for example, in North America, where earlier spring events have facilitated the proliferation of insects such as the mountain pine beetle. This has resulted in widespread mortality in many temperate forest stands.

14. Finally, it is projected that boreal forests could suffer from floods and increased volume of runoff associated with melting of permafrost regions while mountain forests in Europe will suffer from increased winter flooding as a result of precipitation falling as rain rather than snow.

C. Increased instances of extreme weather

15. Increased frequency and intensity of extreme weather is expected to raise tree mortality rates from windfalls, especially in fragmented forests. In Puerto Rico, for example, tree mortality as a result of hurricanes has currently been assessed at more than seven times higher the background mortality rate.

16. Droughts normally associated with El Niño Southern Oscillation may worsen as a result

17. 1997 and 1998. More recently, during the 2001 El Niño Southern Oscillation cycle, one-third of the Amazon basin forest became susceptible to burning.

18. The IPCC Fourth Assessment states that it is likely that we will see further increases in hurricane intensity during the 21st century.

D. Changes in precipitation and wildland fires

19. Changes in precipitation, in combination with increased temperatures, are expected to impact the frequency and extent of forest fires. Recent studies show that the frequency and intensity of these disturbances are already increasing, *inter alia* in the Mediterranean and boreal regions. In the United States, the projected increase in burnt area could reach 50%. In Mongolia, an increase in forest fires has already been observed as a result of a 17% decline in spring precipitation and a rise in surface temperature by 1.5°C during the last 60 years while, in the Amazon, forest fire frequency is expected to increase by 60% for a 3°C temperature increase.

20. Decreased precipitation in the Amazon and Congo basins is expected to lead to eventual loss of rainforests as a result of expanding savannah with cloud forests being particularly vulnerable. On the other hand, in Australia, precipitation changes are likely to result in an expansion of rainforest at the expense of eucalypt forest and grassland.

21. Some of the negative impacts of precipitation changes on forest biodiversity may be offset by higher water-use efficiency and greater root densities which are expected under elevated CO2, however this process is not well understood.

E. Sea level rise

22. Sea level rise is expected to negatively impact mangroves as a result of salt water intrusion. It is suggested that mangroves could disappear from Antigua and Barbuda as early as 2030 while climate change impacts are expected to result in a loss of over half the mangroves in 16 Pacific island States by the end of the century. It is projected that the worst affected areas include American Samoa, Fiji and Tuvalu.

III. THE MOST VULNERABLE COMPONENTS OF FOREST BIODIVERSITY

23. Forest ecosystems which are particularly vulnerable to the impacts of climate change include: mangroves, boreal forests, dry forests, tropical forests and cloud forests. Isolated forests such as those on small islands are also vulnerable as a result of generally lower resilience and higher exposure to extreme events. Dry forests, particularly in Mesoamerica, New Zealand, North Asia and Mediterranean forests, are also likely to suffer from the negative impacts of changing precipitation patterns.

24. Forests that are particularly vulnerable to changing precipitation regimes include the Congo and Amazon basins. It is estimated that up to 40% of the Amazon forest could react to even a slight reduction in precipitation.

25. Rising temperatures are exposing the vulnerability of high-mountain forests and sub-arctic boreal forests including those in Alaska, Siberia and Northern Canada. In Alaska, an outbreak of spruce bark beetle linked to warmer temperatures in the 1990's affected over 16,000 km2 of boreal forest causing 10 – 20% tree mortality. Other montane forests which are expected to be vulnerable to climate change include montane rainforests in Australia.

26. Forest species which are expected to be particularly vulnerable to the impacts of climate change include native conifers in west and central Europe, which will likely be replaced by deciduous varieties, and frogs and toads in South and Central American cloud forests, which are already suffering from changing precipitation patterns and the spreading of infectious fungi. In fact, in Costa Rica a reduction in the number of mist days has been associated with reductions in populations among 20 of the 50 frog and toad species studied.

27. Forest birds are also susceptible to increased disease exposure as a result of rising temperatures. In Hawaii, for example, the spread of avian malaria in montane forests has doubled over the past ten years as a result of higher temperatures leading to increased exposure to mosquitoes.

IV. THE RISKS AND CONSEQUENCES FOR ECOSYSTEM SERVICES AND HUMAN WELL-BEING

28. It is estimated that forests generate 2% of global Gross Domestic Product and that they are the origin of more than 5000 different commercial products. Furthermore, forests provide approximately 1.6 billion people with food, medicines, fuel and other basic necessities, while an estimated 300 million people depend directly on forests for their livelihoods. As such, any threats to forests will have significant impacts on human well-being. The Millennium Ecosystem Assessment reports that many forest ecosystem services are in decline, including essential services as water purification, and that these trends undermine the achievement of the Millennium Development Goals. Climate change is identified as a key driver of these ecosystem changes.

29. Mangroves, for example, provide critical ecosystem services including food, fodder, and protection from extreme events. In many developing countries, mangroves represent an important economic resource for coastal populations, providing firewood and timber, and acting as feeding, breeding, and nursery grounds for fish, insects, birds, and small animals. 1/ In Malaysia, the value of mangroves for coastal protection alone is estimated at US$ 300,000 per km of coast.

30. Forests also play a critical climate regulation and water cycling role. The sub-alpine Erica cloud forest on Mount Kilimanjaro, for example, is the most effective water catchment for the population living on and around the mountain. The loss of these forests since 1976 has resulted in an estimated 25% annual reduction in water availability, the equivalent of the annual drinking water demand of 1 million people.

V. THE THREATS AND LIKELY IMPACTS OF CLIMATE CHANGE AND RESPONSE ACTIVITIES ON BIODIVERSITY AND OPPORTUNITIES THEY PROVIDE FOR THE CONSERVATION OF BIODIVERSITY AND ITS SUSTAINABLE USE

31. Forest management options that are expected to have an impact on forest biodiversity include: improved regeneration, choice of species, fertilization, forest fire management, pest management and harvest level and timing. These management options are relevant both for mitigation and adaptation activities in relation to climate change.

A. Mitigation

32. Forests represent a carbon pool of 1,037 Gt of CO2, accounting for as much as 80% of the total above-ground terrestrial carbon. The top one meter of forest soils contains an additional 787 billion tons of carbon while the amount of carbon stored in litter and deadwood is estimated at 321 billion tons. Forest carbon stores are currently decreasing in Africa, Asia, Oceania and South America, while they are increasing in North and Central America.

33. Growing-season length, temperature and humidity index appear to be the important variables determining the potential size of the carbon sink in forests. As such, forest stands in the temperate region tend to be stronger carbon sinks than comparable boreal forest stands, although boreal evergreen conifer stands in an oceanic climate are a sink comparable with the best of the temperate forest stands.

34. The Intergovernmental Panel on Climate Change has confirmed that forest-related mitigation options can be designed and implemented to be compatible with adaptation, and can have substantial co-benefits in terms of employment, income generation, biodiversity and watershed conservation, renewable energy supply and poverty alleviation. Emerging investment opportunities such as reducing emissions from deforestation and degradation (REDD) may present a source of funding for the conservation and sustainable use of forest biodiversity which can achieve such benefits.

1/ OECD, Development and Climate Change in Tanzania: Focus on Mount Kilimanjaro, 2003.

B. Adaptation

35. Adaptation in forest ecosystems can reduce vulnerability to the negative impacts of climate change. Specific actions to this end include:

- reducing fragmentation;
- establishing corridors;
- extending rotation cycles in production forests;
- replanting with better adapted tree species;
- adaptive fire management including maintaining natural fire regimes where possible;
- enhancing resilience of managed forests, by increasing the diversity of species, age, and spatial distribution;
- implementing soil conservation measures;
- reducing illegal logging;
- providing buffer zones;
- practicing low-intensity forestry;
- protecting primary forests; and
- identifying and protecting ‘functional’ groups of similar / ecologically important species.

36. Particular attention should also be paid to peat swamp forests which provide habitat for some of the world’s most endangered species, such as the Orangutan, while also representing a significant carbon store. Indonesian peat swamp forests alone account for an annual rate of carbon sequestration of between 10 and 93 million tonnes. A key adaptation activity in peat swamp forests is sustainable water management to prevent harmful decreases in water levels which could lead to the release of greenhouse gases and the loss of ecosystem services.

37. Some knowledge on management options for the adaptation of forest ecosystems to expected impacts of climate change exists, but there is a lack of comprehensive information to address climate change related challenges and opportunities for forest biodiversity in a systematic way, in particular at national and local level.

C. Forest biodiversity and bio-energy 2/

38. Bio-energy production is an important and welcome contribution to climate protection, and is considered a response activity to climate change. But if not produced sustainably – and the effects on forests would be a key sustainability concern – the pressure to convert forests to various energy crops could grow tremendously over the next years. To reconcile bio-energy production objectives and forest preservation is a major challenge.

39. The relationship between forest biological diversity and biofuel production is complex. Forests are sources for biomass made from wood. Harvesting this biomass can be a sustainable use of forest resources, but it can also threaten forest biological diversity if not harvested in a sustainable manner. At the same time forest areas are converted into agricultural land and forest biological diversity is lost due to increased production of agricultural biomass for energy generation – either directly or indirectly through more complex shifts in land use.

40. The programme of work on forest biodiversity call for Parties to “Promote forest biodiversity conservation and restoration in climate change mitigation and adaptation measures” and to “Prevent and mitigate losses due to fragmentation and conversion to other land uses”. However, no Party reported specifically on addressing biodiversity aspects in relation to the production of bio-energy.

41. For further information on this topic is available in documents UNEP/CBD/SBSTTA/12/9, UNEP/CBD/SBSTTA/13/INF/5, and UNEP/CBD/SBSTTA/13/3 (available at http://www.cbd.int/).

2/ Based on European Commission (2004), Doornbosch et al. (2007), Kim et al. (2005), Perlack et al. (2005), and Worldwatch Institute/GtZ (2006).

VI. MONITORING OF THE THREATS AND LIKELY CLIMATE-CHANGE IMPACTS AND RESPONSE ACTIVITIES ON BIODIVERSITY

42. Guidance on cost effective tools and methods to assess the threats and likely impacts of climate change faced by biodiversity in the identified vulnerable areas was compiled from a literature review conducted by the Secretariat, as well as from the Technical Series No. 10 and No. 25; the report of the twenty-fourth meeting of the Subsidiary Body for Scientific and Technological Advice of the United Nations Framework Convention on Climate Change on the five-year programme of work on impacts, vulnerability, and adaptation to climate change; 3/ the Intergovernmental Panel on Climate Change Technical Guidelines for Assessing Climate Change Impacts and Adaptations; 4/ and the Further Development of Tool Kits for the Identification, Designation, Management, Monitoring and Evaluation of National and Regional Systems of Protected Areas (UNEP/CBD/WG-PA/1/4).

43. The Intergovernmental Panel on Climate Change technical guidelines for assessing climate change impacts 5/ identifies six steps for analysing vulnerability:

(a) Definition of the problem;

(b) Selection of the methods;

(c) Testing the methods;

(d) Selection of scenarios;

(e) Assessment of biophysical and socio-economic impacts; and

(f) Assessment of autonomous adjustments.

44. Tools identified in the technical guidelines include: experimentation, impact projections, empirical analogue studies, and expert judgment. To evaluate current impacts, observations and literature reviews are also useful tools.

45. For forest biodiversity, tools and methods assessing the impacts of climate change are particularly relevant and closely linked to indicators of forest-based livelihoods. Examples of such tools and methods are presented in table 1 below. The tools and methods presented below do not represent all possibilities; rather they provide examples of some of the more commonly implemented tools and methods as identified through research conducted by the Secretariat.

46. In addition to the tools below, there is a good deal of ongoing work on monitoring and assessment including, satellite-based monitoring and tools to assess carbon sequestration. Much of this work is being conducted within the framework of the FAO Global Forest Resources Assessment and the 2010 Biodiversity Indicators Partnership.

Table 1: Examples of tools and methods to assess vulnerability

Impacts of Climate Change	Tools and Methods	
	Physical Processes	**Vulnerability**
Sea Level Rise	Sea level Fine Resolution Acoustic Measuring Equipment (SEAFRAME) 6/	Coastal Vulnerability Index (CVI) 7/
	Continuous Global Positioning System 8/	

3/ UNFCCC. 2006. FCCC/SBSTA/2006/L.17

4/ T.R.Carter, M.L.Parry, H.Harasawa, and S.Nishioka. Technical Guidelines for Assessing Climate Change Impacts and Adaptations. 1994

5/ T.R.Carter, M.L.Parry, H.Harasawa, and S.Nishioka. Technical Guidelines for Assessing Climate Change Impacts and Adaptations. 1994

6/ http://www.icsm.gov.au/icsm/tides/SP9/PDF/IOCVIII_acoustic_errors.pdf

7/ http://cdiac.ornl.gov/epubs/ndp/ndp043c/sec9.htm

Impacts of Climate Change	Tools and Methods	
	Physical Processes	**Vulnerability**
Increased Air Temperatures	Meteorological Stations (e.g. National Climate Data Center, 9/ Climate Anomaly Monitoring System 10/)	Community-based Risk Screening Tool – Adaptation & Livelihoods 11/
		ILRI: Mapping Climate Vulnerability 12/
Changing Precipitation Regimes	Meteorological Stations (e.g. Global Precipitation Measurement 13/)	Palmer Drought Severity Index 14/
	Satellite Monitoring (e.g. International Satellite Land Surface Climatology Project 15/)	The Mesoamerican Regional Visualization and Monitoring System 16/
		Global Information and Early Warning System 17/
Increased Frequency of Extreme Events	Global Hazards / Extremes Monitoring (e.g. Tropical Atmosphere Ocean Project 18/)	Emergency Food Security Assessment 19/
		Disaster Risk Index 20/

VII. APPROPRIATE MONITORING AND EVALUATION TECHNIQUES, RELATED TECHNOLOGY TRANSFER AND CAPACITY-BUILDING INITIATIVES WITHIN THE PROGRAMMES OF WORK

47. The programme of work on forest biodiversity agrees 'that the availability of new and additional financial resources from public, private, domestic or international sources, with the transfer of technology and capacity-building is necessary to facilitate the effective implementation of the expanded work programme by developing countries'. As such, although there is no specific reference to capacity building related to climate change impact and response activities, there are a number of calls, within the programme of work, for capacity building through *inter alia*, case-study databases, the development of guidance, the adoption of early warning systems, strong monitoring and evaluation planning, and the provision of adequate financial resources.

48. Examples of monitoring and evaluation techniques, technology transfer and capacity-building within other frameworks include:

(a) The World Bank Forest Carbon Partnership Facility; 21/

8/ http://www.bom.gov.au/pacificsealevel/cgps/cgps_fact_sheet.pdf
9/ http://www.ncdc.noaa.gov/oa/ncdc.html
10/ http://www.cpc.noaa.gov/products/global_precip/html/wpage.cams_opi.shtml
11/ http://www.iisd.org/security/es/resilience/climate_phase2.asp
12/ http://www.ilri.org/Infoserv/webpub/Fulldocs/MappingClimateVulnerability/MappingClimateVulnerability.pdf
13/ http://gpm.gsfc.nasa.gov/
14/ http://www.drought.noaa.gov/palmer.html
15/ http://www.gewex.org/islscp.html
16/ http://servir.nsstc.nasa.gov/
17/ http://www.fao.org/giews/english/index.htm
18/ http://www.pmel.noaa.gov/tao/
19/ http://www.wfp.org/operations/Emergency_needs/index.asp?section=5&sub_section=6
20/ http://gridca.grid.unep.ch/undp/
21/ http://carbonfinance.org/Router.cfm?Page=FCPF&FID=34267&ItemID=34267

(b) FAO, Definitional issues related to reducing emissions from deforestation in developing countries; 22/

(c) FAO, Central America Series on Forests and Climate Change; 23/

(d) FAO, Global Forest Resources Assessment 2010;

(e) CIFOR, Tropical Forests and

(f) CPF, Sourcebook for Funding for Sustainable Forest Management;24/

(g) Report on the International Conference on the Contribution of Criteria and Indicators for Sustainable Forest Management: the way forward. 25/

VIII. CRITICAL KNOWLEDGE NEEDED TO SUPPORT IMPLEMENTATION, INCLUDING *INTER ALIA*, SCIENTIFIC RESEARCH, AVAILABILITY OF DATA, APPROPRIATE MEASUREMENT AND MONITORING TECHNIQUES TECHNOLOGY AND TRADITIONAL KNOWLEDGE

49. There remains some uncertainty with regards to the actual impact of CO2 fertilization on forest ecosystems since current models do not consider precipitation changes and temperature increases. Additional knowledge gaps exist with regards to the impacts of climate change on non-tree species within forest ecosystems.

50. Technical Series No. 10 and No. 25 identify additional key research needs although these are not specific to forest biodiversity. Knowledge needs identified by the Technical Series include additional research on:

(a) The relationship between biodiversity and ecosystem structure and the delivery of ecosystem services;

(b) Which ecosystem functions are most vulnerable to species loss;

(c) Stand-level modelling to understand the true potential of forests to sequester carbon over time;

(d) Predictive modelling on rates of plant herbivory;

(e) The ability of migrating species to use planted forests as corridors; and

(f) The effects of energy activities on forest biodiversity.

IV. THE ECOSYSTEM-APPROACH PRINCIPLES AND GUIDANCE AND THE PRECAUTIONARY APPROACH

51. Since the ecosystem approach takes a broad perspective to management, it has been identified as a potential methodology through which the multiple impacts from climate change, including on biodiversity, can be reflected in comprehensive and responsive adaptation planning.

52. In forests, the ecosystem approach is often referred to as sustainable forest management of forest landscape management. Sustainable forest management consists of six main themes:

(a) Extent of forest resources;

(b) Forest health;

(c) Biological diversity;

22/ http://www.fao.org/forestry/site/climatechange/en/

23/ http://www.fao.org/forestry/site/climatechange/en/

24/ http://www.fao.org/forestry/site/8015/en/

25/ http://www.fao.org/DOCREP/005/Y8694E/Y8694E00.HTM

(d) Productive functions of forest resources;

(e) Protective functions of forest resources; and

(f) Socio-economic functions of forest resources

53. Additional information on the ecosystem approach is available in the review of implementation of the ecosystem approach conducted at the twelfth meeting of SBSTTA (UNEP/CBD/SBSTTA/12/2) which recommended that the Conference of the Parties:

(a) *Urges* Parties, other Governments and relevant organizations, as appropriate, and subject to funding and availability of technical capacity, to:

(i) Strengthen the promotion of the ecosystem approach in ongoing communication, education and public awareness activities;

(ii) Further promote the use of the ecosystem approach in all sectors and enhance inter-sectoral cooperation, as well as promote the establishment of concrete national and/or regional initiatives and pilot projects;

(iii) Implement further capacity-building initiatives to applying the ecosystem approach, using, inter alia, the tools made available through the sourcebook and other sources of information, as appropriate;

(iv) Recalling decisions VI/12, paragraph 2 (a), and VII/11, paragraph 9 (d), of the Conference of the Parties, urge Parties, other Governments and relevant organizations to continue submitting case-studies and lessons learned and provide further technical input to the Source Book;

(v) Further facilitate the full and effective participation of indigenous and local communities in the development of tools and mechanisms for the application of the ecosystem approach;

(vi) Strengthen and promote the use of the ecosystem approach more widely and effectively as a useful tool for formulation of national biodiversity strategies and action plans and in other relevant policy mechanisms; and

(b) *Invites* Parties to:

(i) Take into account the application of the ecosystem approach in the achievement of the Millennium Development Goals;

(ii) Develop effective cooperation at all levels for the effective application of the ecosystem approach;

(iii) To provide a framework for the promotion of the ecosystem approach, as appropriate;

(iv) Give consideration to the challenge of incorporating land and marine tenure in the application of the ecosystem approach; and

(v) Provide information on outcomes and progress in these activities through the national reporting process and their national clearing houses

X. CLIMATE CHANGE RELATED ACTIVITIES IN THE PROGRAMME OF WORK ON FOREST BIODIVERSITY

54. The forest biodiversity programme of work includes Goal 2, Objective 3, which calls for Parties to “Mitigate the negative impacts of climate change on forest biodiversity”, taking into account the work of the Ad Hoc Technical Expert Group on Climate Change and Biodiversity. Specifically, this Objective calls for Parties to:

(a) Promote monitoring and research on the impacts of climate change on forest biological diversity and investigate the interface between forest components and the atmosphere;

(b) Develop coordinated response strategies and action plans at global, regional and national levels;

(c) Promote the maintenance and restoration of biodiversity in forests in order to enhance their capacity to resist to, and recover from and adapt to climate change;

(d) Promote forest biodiversity conservation and restoration in climate change mitigation and adaptation measures;

(e) Assess how the conservation and sustainable use of forest biological diversity can contribute to the international work relating to climate change.

A. Assessment of implementation

55. In the review of third national reports under the Convention on Biological Diversity, thirty-four Parties reported on the implementation of climate change related activities within the forest biodiversity programme of work. 26/ No Parties, however, reported on assessing how the conservation and sustainable use of forest biological diversity can contribute to the international work relating to climate change. Furthermore, only two Parties (Australia and Indonesia) reported on investigating the interface between forest components and the atmosphere.

56. Examples of activities implemented by Parties in support of Goal 2, Objective 3 of the programme of work include:

(a) Reforestation and afforestation;

(b) Forest rehabilitation activities within the Clean Development Mechanism;

(c) Creation of protected areas for protection of biodiversity;

(d) Creation of habitat linkages such as vegetation corridors;

(e) Building ecological resilience to buffer the habitat of vulnerable species and populations against the additional pressure of climate change by putting in place measures to reduce the existing impacts of threatening processes;

(f) Reduction of physical barriers to movement to facilitate migration and dispersal of species and communities that are vulnerable to climate change;

(g) Sustainable management and rehabilitation of peat swamp forests to increase carbon storage;

(h) Identification of ecotypes and genotypes resistant to climate change; and

(i) Planting and planning of mixed species forests to enhance resilience to climate fluctuations.

57. CBD Notification 2007-102 was sent to Parties on 3 August 2007, requesting additional information on the implementation of relevant activities on climate change impact and response activities and forest biodiversity. Eight Parties 27/ reported on activities linking climate change and forest biodiversity including:

(a) The establishment of working groups and research programmes on forests and climate change (for example the European Union Forestry Action Plan and Working Group on forest related

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26/ Algeria, Armenia, Australia, Austria, Canada, Cambodia, Colombia, Cuba, Denmark, Egypt, El Salvador, Finland, Germany, India, Indonesia, Israel, Kenya, Latvia, Lebanon, Malaysia, Mexico, Morocco, Nepal, Norway, Republic of Korea, Romania, Rwanda, Saint-Lucia, Syria, Thailand, The FYR of Macedonia, Uganda, Vietnam, Zimbabwe.

27/ Belgium, Czech Republic, Philippines, Mexico, Republic of Slovenia, State of Qatar, United Kingdom, Portugal on behalf of the European Community and its Member States.

sinks, the Investigation of Carbon Cycle in Terrestrial Ecosystems of the Czech Republic, and the Republic of Slovenia Climate Change – impacts on forest and forestry study);

(b) Maintaining diversity at the genetic, species and ecosystem levels;

(c) Fire control management plans;

(d) Identification of the likely impacts of climate change on forests;

(e) The legal protection of vulnerable species;

(f) Awareness raising on forest biodiversity – climate change linkages;

(g) Adoption of the ecosystem approach through, for example, landscape management programmes and adaptive ecosystem management; and

(h) Integration of climate change considerations within forest sector strategies (for example, Czech Republic National Forest Programme II, the Forest Strategies for England, Wales, Scotland and Northern Ireland).

B. Gaps in the integration of climate change impact and response activities in the programme of work on forest biodiversity

58. The relevant knowledge on climate change impacts and response activities in relation to forest biodiversity has evolved since the adoption of the expanded programme of work on forest biodiversity in 2002 during the sixth meeting of the Conference of the Parties (COP). Several new challenges and opportunities have emerged, such as the discussions to establish a mechanism to reduce emissions from deforestation. As the programme of work includes both mitigation and adaptation measures under Goal 2, Objective 3, it allows for activities to address these emerging challenges and opportunities. While there may be no need to expand the forest biodiversity programme of work, SBSTTA may wish to recommend that implementation of the existing climate change impact and response activities is strengthened, particularly with regards to:

(a) Assessing how the conservation and sustainable use of forest biological diversity can contribute to the international work relating to climate change;

(b) Developing coordinated response strategies and action plans at global, regional and national levels; and

(c) Investigating the interface between forest components and the atmosphere.

59. Furthermore, the Ad Hoc Technical Expert Group (AHTEG) on the Review of the Expanded Programme of Work on Forest Biological Diversity at its fourth meeting in May 2007, in its recommendations for improved implementation of the programme of work, recommended to:

(a) "Develop tools and mechanisms to maximize contributions for forest biodiversity and avoid negative impacts on forest biodiversity from possible financing mechanisms for reducing emissions from deforestation"; and

(b) "Improve collaboration between the secretariats and Subsidiary Bodies of the Convention on Biological Diversity and UNFCCC, enhance coordinated implementation of both conventions at the national level, and include biodiversity experts, including holders of traditional forest related knowledge, in current discussions on reducing emissions from deforestation."

60. The AHTEG also concluded that "The lack of knowledge on the impacts of climate change and climate mitigation measures on indigenous and local communities is being addressed by the Advisory Group on Article 8(j) of the Convention and by the United Nations Permanent Forum on Indigenous Issues. The work done under the Convention on Biological Diversity needs to be done in synchronization with these efforts."

61. The above-mentioned recommendations are reflected in the draft in-depth review of the programme of work on forest biodiversity (UNEP/CBD/SBSTTA/13/3).

C. Obstacles to implementation identified by Parties

62. Information available in the third national reports under the Convention on Biological Diversity indicates that Parties encountered a number of obstacles with direct or indirect relevance for the implementation of goal 2, objective 3.

63. Obstacles with direct relevance for the implementation of goal 2, objective 3 include:

(a) The lack of cross-sectoral coordination and integration between ministries and departments;

(b) Inadequate financial resources committed to implementation;

(c) Inadequate capacity including lack of equipment, facilities and expertise;

(d) Lack of understanding of the impacts of climate change on forest ecology and ecosystem functions;

(e) Gaps between scientific studies and the design and dissemination of management options;

(f) Lack of tools to measure carbon sequestration in forests and forest soils;

(g) Lack of adequate information relating to the forest area damaged by disturbances such as diseases, insect pests, weather and forest fires, in most countries;

(h) Lack of regional models;

(i) Poor incentive frameworks;

(j) Lack of consensus with regards to the integration activities related to climate change and biodiversity in forest sector strategies; and

(k) Continued causes of deforestation and forest degradation, including urban development, road construction, mining, building of hydroelectric facilities (construction of dams), extraction of oil, gas and other mineral resources, land conversion (e.g. for agricultural expansion), soil erosion, fires, pest and forest disease, and the effects of atmospheric deposition.

64. Obstacles with indirect relevance to the implementation of goal 2, objective 3 include:

(a) Weak collaboration between non-governmental organizations and government agencies;

(b) Lack of appropriate information and tools for forest fire management;

(c) Lack of an international agreement on monitoring systems and criteria to assess the impacts of climate change on forest biodiversity;

(d) The lack of knowledge on methods to allow for greater involvement of non-forest-related sectors and in particular the private sector in the conservation and sustainable use of forest biodiversity; and

(e) Lack of harmonization of information (and reporting requirements) from relevant regional and international processes.

65. Document UNEP/CBD/SBSTTA/13/3 includes suggestions to overcome identified obstacles.

XI. CONCLUSIONS

66. While an increasing amount of information on the risks of climate change for forest biodiversity is available, notably in the fourth IPCC Assessment and the Millennium Ecosystem Assessment, there is a lack of necessary comprehensive information to formulate effective sector-specific policies and management options for the conservation and sustainable use of forest biodiversity in relation to expected impacts of climate change, in particular at national and local level. Further attempts to increase the knowledge on such adaptation options are required. In this context, the Expert Panel on Adaptation of

Forests to Climate Change as part of the "Joint Initiative on Science and Technology" of the Collaborative Partnership on Forests, under the leadership of the International Union of Forest Research Organizations (IUFRO), could be instrumental to bridge this gap.

67. Forests play an important role for the mitigation of climate change, as well as for the adaptation of ecosystems and human societies to expected climate change impacts. The role of forest for climate change mitigation is not yet fully explored, but emerging opportunities such as "Reducing Emissions from Deforestation and Degradation" in developing countries, and other mitigation opportunities, hold enormous potential to generate co-benefits for biodiversity conservation. At the same time, the impacts of climate change response activities on forest biodiversity, including through the increasing production of biofuels, are potentially severe. These developments should be monitored closely, pursuant to the programme of work on forest biodiversity (Goal 2, Objective 3).

68. Regarding the inclusion of climate change aspects into the programme of work on forest biodiversity under the Convention on Biological Diversity, the Ad Hoc Technical Expert Group on Review of Implementation of the Expanded Programme of Work on Forest Biodiversity recommended in its fourth report that the expanded programme of work on forest biological diversity be continued in its present form, as adopted in the annex of decision VI/22. Expected climate change impacts, and response activities, are adequately covered under Goal 2, Objective 3 of the programme of work. While there might be no need to change the programme of work, it is strongly recommended that the implementation of these climate change related activities be strengthened and accelerated in view of the 2010 target. There is in particular a need to overcome the obstacles listed in this note, and in document UNEP/CBD/SBSTTA/13/3, and to address the climate change related challenges to forest biodiversity through relevant strategies and action plans, and to enhance international collaboration in the fields of research and monitoring. In particular, there is a need to address the threats of climate change impacts to forest biodiversity through coordinated response strategies and action plans at national, regional, and global level, and to observe and address the impacts of climate change response activities, including the production of biofuels, on forest biodiversity.

Annex I

SELECTED FINDINGS FROM RECENT PEER-REVIEWED PUBLICATIONS

Indications or predictions of climate change impacts and response activities on relevant ecosystems
Most of the important direct drivers of ecosystem change are unlikely to diminish in the first half of the century and two drivers—climate change and excessive nutrient loading—will become more severe (MEA 2005)
The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g., flooding, drought, wildfire, insects, ocean acidification), and other global change drivers (e.g., land use change, pollution, overexploitation of resources). (High confidence) (IPCC 2007A)
The most vulnerable (forest) ecosystems
Particularly vulnerable areas include cloud forests, coral reefs, mangroves (threatened by the synergistic effects of climate change and habitat clearance), all but the very largest blocks of tropical forest […] (MEA 2005)
A number of studies suggest that the Amazon rainforest could be vulnerable to climate change, with models projecting significant drying in this region. One model, for example, finds that the Amazon rainforest could be significantly, and possibly irrevocably, damaged by a warming of 2 - 3°C (Stern 2006)
Climate change is likely to exacerbate the degradation of semi-arid lands that will be caused by rapidly expanding human populations during the next decade (Sivakumar 2006)
Soils exposed to degradation as a result of poor land management could become infertile as a result of climate change. Temperature increases would have negative impacts on natural vegetation in desert zones (Sivakumar 2006)
Risks and consequences for ecosystem services and human well-being
The degradation of ecosystem services is already a significant barrier to achieving the Millennium Development Goals agreed to by the international community in September 2000 and the harmful consequences of this degradation could grow significantly worse in the next 50 years (MEA, 2005)
[…] approximately 60% (15 out of 24) of the ecosystem services examined during the Millennium Ecosystem Assessment are being degraded or used unsustainably, including fresh water, capture fisheries, air and water purification, and the regulation of regional and local climate, natural hazards, and pests (MEA 2005)
In Asia, deforestation has contributed to the siltation of rivers, and wetland reclamation has reduced the ability of river basins to regulate flows and, consequently, extensive flooding has resulted. Both of these activities alter freshwater habitats, causing the decline or disappearance of species therein (Zhao et al 2006)
Threats and likely impacts of climate change and response activities on biodiversity and opportunities they provide for the conservation of biodiversity and its sustainable use
Forests [contain] up to 80% of the total above-ground terrestrial carbon and 40% of below-ground carbon (Keleş and Başkent 2007)
Forest-related mitigation options can be designed and implemented to be compatible with adaptation, and can have substantial co-benefits in terms of employment, income generation, biodiversity and watershed conservation, renewable energy supply and poverty alleviation (IPCC 2007B)

Reducing both loss of natural habitat and deforestation can have significant biodiversity, soil and water conservation benefits, and can be implemented in a socially and economically sustainable manner. Forestation and bioenergy plantations can lead to restoration of degraded land, manage water runoff, retain soil carbon and benefit rural economies, but could compete with land for food production and may be negative for biodiversity, if not properly designed (IPCC 2007B)
Research carried out for this report indicates that the opportunity cost of forest protection in 8 countries responsible for 70 per cent of emissions from land use could be around $5 billion per annum initially, although over time marginal costs would rise (Stern 2006)
More than $160 million has been invested in pilot programs aimed at protecting and expanding forest carbon stocks, mostly in the developing world (Sheeran 2006)
Globally, commercial timber productivity rises modestly with climate change in the short- to mediumterm, with large regional variability around the global trend. (Medium confidence) (IPCC 2007A)
The carbon reservoir in the world's forests is presently higher than the one in the atmosphere. Forests represent a carbon pool of 1,037 Gt CO_2e, most of all decreasing in Africa, Asia, Oceania and South America, increasing in North and Central America (GTZ 2007)
Over the course of this century, net carbon uptake by terrestrial ecosystems is likely to peak before mid-century and then weaken or even reverse, thus amplifying climate change (high confidence)(IPCC 2007A)
Whether or not the positive growth responses to elevated atmospheric CO_2 will be maintained through the life cycles of trees is not known (Karnosky 2003)
Few forest tree studies have as yet estimated impacts of elevated atmospheric CO_2 on carbon sequestration (Karnosky 2003)
Under changed climatic conditions, boreal forests may not act as a significant C sink, as it has been assumed they would be under current conditions (Mäkipää et al. 1999)
To date, the majority of results assessing individual pest species' response to climate change indicate intensification in all aspects of outbreak behavior… (Logan et al 2006)
Forest disturbances influence how much carbon is stored in trees or dead wood (Dale et al 2001)
Many authors predict climate change will have a number of effects on insects: sweeping shifts in herbivory rates; altered distribution and outbreak frequency of key insect pests; unpredictably altered relationships with natural enemies; and a general decrease in biodiversity (Logan et al 2006)
Current data and models suggest that global warming will result in the redistribution of insect pests, resulting in the invasion of new habitats and forest types Unusually hot, dry weather patterns are already responsible for increased insect outbreaks in forests from the US Southwest to Canada and Alaska (Logan et al 2003)
Monitoring of threats and likely climate change impacts and response activities on biodiversity
There is very high confidence that recent warming is strongly affecting terrestrial biological systems, including: 1. earlier timing of spring events, such as leaf-unfolding, bird migration and egg-laying 2. poleward and upward shifts in ranges in plant and animal species (IPCC 2007A)

Annex II

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