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WAYS AND MEANS TO ACHIEVE MULTIPLE BENEFITS FOR CARBON SEQUESTRATION AND BIODIVERSITY CONSERVATION AND SUSTAINABLE USE IN A RANGE OF ECOSYSTEMS

Note by the Executive Secretary

INTRODUCTION

1. The terms of reference for the Second Ad Hoc Technical Expert Group (AHTEG) on Biodiversity and Climate Change include identifying opportunities to deliver multiple benefits for carbon sequestration and biodiversity conservation and sustainable use in a range of ecosystems, including peatlands, tundra and grasslands. 1/

2. It is clear that climate change mitigation policy has the potential to impact biodiversity both positively and negatively. In particular, due to the important role of biodiversity in the carbon cycle, it is clear that the potential exists to develop 'win-'win' mitigation policies that are beneficial for both climate change mitigation and biodiversity (Paterson *et al.* 2008). As outlined in CBD Technical Series No. 10

> *'Terrestrial and oceanic ecosystems play a significant role in the global carbon cycle and their proper management can make a significant contribution to reducing the build up of greenhouse gases in the atmosphere. Each year about 60 gigatons (Gt) of carbon (C) are taken up and released by terrestrial ecosystems and about another 90 Gt C are taken up and released by ocean systems…Terrestrial ecosystems appear to be storing about 3 Gt C each year and the oceans another about 1.7 Gt.'*

3. In fact, where mitigation strategies are beneficial to biodiversity, they can also reduce vulnerability to climate change impacts, maintain future capacity for climate change mitigation, and promote adaptation (Betts 2007).

4. In order to facilitate the consideration of multiple benefits by the AHTEG, the Executive Secretary, in collaboration with the United Nations Environment Programme World Conservation

* UNEP/CBD/AHTEG/BD-CC-2/1/1.

1/ Decision IX/16 B of the Conference of the Parties to the Convention on Biological Diversity, annex III, paragraph 3 (i).

Monitoring Centre (UNEP-WCMC), has prepared the present document on case-studies on ways and means to achieve multiple benefits for carbon sequestration and biodiversity conservation and sustainable use in a range of ecosystems.

I. ACHIEVING MULTIPLE BENEFITS IN AGRICULTURAL ECOSYSTEMS

5. Good agricultural practices have the potential to reduce biodiversity impacts and mitigate climate change, whilst also acting as an adaptation strategy to increase the resilience of agricultural land to climate change impacts (Lal 2008, Berry et al. 2008); (Rosenzweig & Tubiello 2007; Berry *et al.* 2008; Lal 2008).

6. In fact there are two main avenues for achieving multiple benefits for carbon sequestration and biodiversity conservation and sustainable use in agricultural ecosystems. First through reducing the extent of soil degradation or restoring soil fertility (Lal 2008) and second, through the promotion of agroforestry.

7. With regards to reducing the degradation of soil or restoring soil fertility, the extent and nature of multiple benefits for biodiversity and carbon vary depending on the soil type and location. In fact, soil organic carbon in the top meter of soil ranges from 30 tons per hectare in arid lands to 800 tons per hectare in cold climate soils (Lal, 2007). The carbon store in soils is also significantly impacted by land use and land management with agricultural practices reducing soil organic content by 75% in some areas (Sivakumar and Stefanski, 2007). In the United Sates of America, for example, improved land management on farms and rangelands has the potential to store an additional 180 million tons of carbon annually (USDA, 2001).

8. At the same time that improved agricultural practices can contribute to carbon sequestration in soils, multiple benefits can be achieved for biodiversity conservation and sustainable use. For example, over 1000 species of invertebrates may be found in a single square meter of a European beech forest. A single gram of soil may contain millions of individuals and several thousand species of bacteria. This soil biodiversity contributes to ecosystem services such as organic waste disposal, soil formation, nitrogen fixation, and bio-control; services which are valued at US$ 1.5 trillion per year.

9. Techniques that have been identified by Parties as delivering multiple benefits for carbon and biodiversity in soils within agricultural ecosystems include: enhancing tree cover and shelterbelts, integrated pest management, conservation tillage, intercropping, and the planting of cover crops. In fact, when cover crops are used in combination with conservation tillage soil carbon content can increase annually for a period of up to 50 years. Many of these practices may also have positive benefits for biodiversity.

10. The sustainable management of grazing land can provide similar co-benefits since such lands contain between 10 and 30% of the world's soil carbon stocks. The introduction of nitrogen fixing legumes is one management technique however, which, while providing benefits for mitigation, can have negative impacts on biodiversity though the introduction of potentially invasive alien species.

11. With regards to agroforestry, the management of shade trees species with agricultural crops provide conservation benefits as well as significant carbon storage. While agroforestry systems may have lower endemic species richness when compared to natural forests, they contribute to conservation efforts in three ways. First, agroforestry systems can serve as habitats outside of protected areas as well as corridors between forest fragments. For example, shade coffee plantations in Nicaragua have been found to serve as corridors between forest fragments by mantled howling monkeys. Secondly agroforestry systems have been found to enhance heterogeneity, with individual land holders using different species of trees in their agroforestry systems. A study of 201 farms in Kenya found significant differences in species of trees used. And finally, agroforestry systems can reduce the pressures on resources within protected areas. In a study of Kerinci Seblat National Park in Indonesia, researchers found that households with mixed gardens where much less likely to use national park resources than households which cultivated only wetland rice (Bhagwat *et al,* 2008).

12. From a carbon sequestration standpoint, agroforestry systems have carbon storage potentials that are highly dependant on their eco-zone. Median carbon storage ranges from 9 tons of carbon per hectare in semi-arid, 21 tons of carbon per hectare in sub-humid, 50 tons of carbon per hectare in humid, up to 63 tons of carbon per hectare in temperate eco-zones (Shroder, 1994). Additionally, agroforestry systems can reduce land clearing and associated emissions from deforestation.

13. A number of obstacles to the implementation of agroforestry for multiple benefits exist however. Land-tenure issues and the small scale of many operations combine to create an environment in which it is difficult to generate the carbon revenue necessary for the implementation of agroforestry systems.

14. Activities which have been identified as having potential co-benefits for carbon sequestration and biodiversity in agroforestry systems include: farmer participatory approaches, consideration of local knowledge and technologies, the use of organic materials, the use of locally adapted crop varieties, water management, and crop diversification.

II. ACHIEVING MULTIPLE BENEFITS IN FOREST ECOSYSTEMS

15. Forests represent a carbon pool of 1,037 Gt of carbon, 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.

16. 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.

17. 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) and an expansion of afforestation and reforestation activities may present a source of funding for the conservation and sustainable use of forest biodiversity which can achieve such benefits.

18. In many cases, afforestation schemes involve monoculture plantations of fast growing trees (Bekessy & Wintle 2008); but where multispecies plantations are established on degraded land they can have biodiversity benefits, as can agroforestry schemes (Berry *et al.* 2008). This can act in support of both the Convention on Biological Diversity (CBD) and the UN Convention to Combat Desertification (UNCCD) (Cowie *et al.* 2007a).

19. Ways and means to enhance multiple benefits for carbon and biodiversity in forest ecosystems include: increasing rotation length, decreasing the intensity of harvesting, leaving woody debris, post-harvest silviculture to restore the local forest types, paying attention to landscape structure, harvesting that emulates natural disturbance regimes and the maintenance of natural fire regimes.

20. Additional guidance on afforestation and reforestation for the achievement of multiple benefits is provided in CBD Technical Series No. 10 which emphasizes that:

(a) Plantations of exotic species support only some of the local biodiversity but may contribute to biodiversity conservation if appropriately situated in the landscape;

(b) Tree plantations may be designed to allow for the colonization and establishment of diverse under-storey plant communities by providing shade and by ameliorating microclimates;

(c) Specific sites may make better candidates for implementing such activities than others, based on past and present uses, and the local or regional importance of their associated biodiversity, and proximity to other forests across a landscape;

(d) Involvement of local and indigenous communities in the design and the benefits to be achieved from a plantation may contribute to local support for a project and hence contribute to its longevity;

(e) Plantations may contribute to the dispersal capability of some species among habitat patches on a formerly fragmented landscape;

(f) Even plantations of a single species can confer some benefits to local biodiversity, especially if they incorporate features such as allowing canopy gaps, retaining some dead wood components, and providing landscape connectivity.

III. ACHIEVING MULIPLE BENEFITS IN WETLAND ECOSYSTEMS

21. Wetlands cover approximately 6% of the Earth's surface and contain about 35% of global terrestrial carbon. Peatlands are the most efficient carbon stores of all terrestrial ecosystems. They also store twice as much carbon as is present in the world's forest biomass.

22. Additionally, wetlands are considered biodiversity "hotspots". Wetlands are critically important ecosystems, providing significant social, economic and ecological benefits. They provide a number of ecosystem services such as: freshwater, food, climate regulation, pollution control, hydrological regimes, nutrient cycling, soil formation, recreation, tourism etc.

23. However, amongst the major biomes, biodiversity loss is fastest for wetlands than for any other major biome. Even climate change is already having an impact on wetlands and wetland species. For example, sea-level rise causes greater coastal flooding, erosion, loss of wetlands, and salt-water intrusion into freshwater sources.

24. The degradation of wetlands releases great quantities of carbon. For example, peatland emissions in South-east Asia far exceed fossil fuel contributions from major polluting countries. The release of carbon from wetlands degradation therefore offsets the gains made by the world community to reduce greenhouse gas emissions. As such, there is a need to generate improved scientific information on greenhouse gas fluxes for wetlands and to invest in carbon emission avoidance through wetland conservation or peatland restoration.

25. The global Assessment on Peatlands, Biodiversity and Climate Change reveals that peatlands are the most efficient carbon stores of all terrestrial ecosystems. Peatlands cover 3% (some 4 million squared km) of the Earth's land area and store a large fraction of the Worlds terrestrial carbon resources: up to 528, 000 Megatonnes, equivalent to one third of global soil carbon and to 70 times the current annual global emissions from fossil fuel burning. According to the report "*Peat-CO_2: Assessment of CO_2 emissions from drained peatlands in S- E Asia",* the current total peatland CO_2 emissions of 2000 Mt/y equals almost 8% of global emission from fossil fuel burning. Deforested and drained peatlands in South-east Asia are a globally significant source of CO_2 emissions.

26. Peatlands, biodiversity and climate change have very strong mutual feedback relations. Peatlands are often the last remaining natural areas in degraded landscapes. They also support adaptation by providing habitats for endangered species and those displaced by climate change.

27. There is some understanding of the role of non-peatland wetlands but it is limited in comparison to peatlands. There is a low understanding of fluxes (the way in which greenhouse are absorbed and released by wetlands). Basic estimates of gases/vapours stored/emitted from ecosystems are required. Where data are available they confirm positive carbon sequestration attributes of wetlands.

28. Attention needs to be given to forested wetlands. A considerable amount of the "forest" biome is wetland dependent (e.g., the Amazon). These systems have very high biodiversity and are very productive.

29. To achieve multiple benefits for climate change mitigation and biodiversity conservation in the case of wetlands mostly related to avoidance of increased emissions. The focus should be on net emissions generated through degradation, or what can be avoided through rehabilitation.

30. A common strategy to deal with wetland management, aquatic biodiversity conservation and climate change measures, depends on a critical degree of coherence between sectors that are responsible for water resource protection and management, biodiversity conservation, land use management (including agricultural resources), and integrated development planning. However, there has been little attention given so far by policy-makers to the relationship between climate change and the conservation and wise use of wetlands.

31. Finally, wetlands, in particular peatlands, are significant carbon stores, and so the role of their conservation also needs to be considered in the development of climate change mitigation strategies. A clear mitigation strategy is to avoid deforestation on wetlands.

IV. ACHIEVING MULTIPLE BENEFITS IN PROTECTED AREAS

32. With 12.7% of the world's terrestrial surface under protection, and with protected areas now numbering 106,000, there is growing recognition of the role protected areas will play in both mitigating and adapting to climate change. In fact, a recent study by UNEP-WCMC found that protected areas in the humid tropical forest biome are losing carbon at a lower rate than surrounding areas, and that there is significant scope to further reduce carbon loss from deforestation and degradation by improving the effectiveness of protected areas management.

33. In 2000, protected areas within the humid tropical forest biome contained an estimated 70Gt of carbon in 2000. However, forest loss from within protected areas between 2000 and 2005 is estimated to have resulted in emissions of 822-990 Mt of CO_2 equivalent. Approximately 75% of total emissions from deforestation in protected areas were from the Neotropics with up to 15% coming from tropical Asia.

34. Improving the effectiveness of protected area networks, particularly in regions like the Neotropics and Tropical Asia that have large carbon stocks subject to high deforestation pressures, could therefore be an important strategy for achieving multiple benefits for carbon and biodiversity.

35. In fact forest conservation, including within protected areas is estimated to be one of the most cost-effective ways of capturing carbon benefits in forests. A baseline for the price of creating one tonne of carbon offsets in tropical forests has been estimated at US$ 11.06 while corresponding price for planting and agroforestry are US$ 17.98 and US$ 25.39 respectively. 2/

36. Furthermore, the value of Uganda's protected areas as a carbon sink is estimated at US$ 20.3 million annually which Mexico's federal and state protected areas store 2,446 $MtCO_2$, equivalent to 5.6 years of Mexico's CO_2 emissions at the 2004-year rate. The value of Mexico's protected areas as a carbon sink is estimated at US$ 12.2 billion (CBD, 2008).

37. It is important to remember, however, that despite their legal status, the designation of protected areas does not in itself guarantee protection of the carbon or biodiversity they contain. Recent research indicates that whilst protected areas generally reduce deforestation relative to unprotected areas, they do not entirely eliminate land use change within them (Clark *et al*. 2008).

38. Achieving multiple benefits, therefore, requires additional investments and commitments to protected areas including: generating reliable funding for protected areas, integrating climate change mitigation into protected area planning, consolidating and expanding protected area networks, making the best use of locally appropriate protected area governance structures, enhancing institutional arrangements for benefit sharing, and building an enabling environment for the realization and assessment of benefits (Sandwith, 2008).

2/ Van Kooten, Cornelis G. and Alison J. Eagle. Climate Change and Forest Ecosystem Sinks: Economic Analysis. Resource Economics and Polity Analysis Research Group, University of Victoria, 2003.

V. ACHIEVING MULTIPLE BENEFITS THROUGH THE APPLICATION OF THE ECOSYSTEM APPROACH

39. The ecosystem approach (also known as integrated land and water management, landscape management, etc.) is a strategy for the integrated management of land, water and living resources that promotes the conservation and sustainable use of biodiversity in a fair and equitable manner.

40. The main principles of the ecosystem approach focus on capacity building; participation; information gathering and dissemination; research; comprehensive monitoring and evaluation; and governance. As such, advantages of the ecosystem approach include: stakeholder participation; consideration of both scientific and technical and traditional knowledge; and the achievement of balanced ecological, economic and social costs and benefits.

41. Since the ecosystem approach takes a broad perspective to management, it is a good methodology through which multiple benefits for climate change mitigation and biodiversity conservation and sustainable use, can be reflected. This opportunity was highlighted in CBD Technical Series No. 10:

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

42. A review of the application of the ecosystem approach conducted by the CBD revealed many opportunities to strengthen ongoing efforts. Such opportunities include: developing standards for application of the ecosystem approach; adopting simplified and improved marketing approaches to appeal to a wider audience; and capacity building at all levels by developing a strategic approach through enhanced partnerships.

VI. LESSONS LEARNED FROM AN ANALYSIS OF CASE–STUDIES

43. The CBD Technical Series No. 10 identifies a number of lessons learned for the analysis of case-studies promoting synergies between biodiversity conservation and sustainable use and climate change mitigation and adaptation. These can be applied to projects and investments across all ecosystems and include:

- *Lesson 1:* There is scope for afforestation, reforestation, improved forest management and avoided deforestation activities to be harmonized with biodiversity conservation benefits;
- *Lesson 2:* The linkages between conservation and sustainable use of biodiversity with community livelihood options provides a good basis for projects supported under the Clean Development Mechanism to advance sustainable development;
- *Lesson 3:* The neglect and/or omission of social, environmental and economic considerations can lead to conflicts which could undermine the overall success of carbon mitigation projects, and long-term biodiversity conservation;
- *Lesson 4:* Countries and key stakeholders need to have the necessary information, tools and capacity to understand, negotiate, and reach agreements under the Kyoto Protocol to ensure that the resulting projects are balanced with respect to environment, social and development goals;
- *Lesson 5:* Some minimum environmental and social norms (or guiding frameworks) when purchasing carbon credits through Clean Development Mechanism (CDM) projects could avoid perverse outcomes;

- *Lesson 6:* The application of appropriate analytical tools and instruments can provide constructive frameworks for *ex ante* analysis to guide decision making; provide adaptive management options during implementation; and provide a basis for learning and replication through *ex post* evaluations;
- *Lesson 7:* Measuring the impact of CDM and joint implementation projects on biodiversity requires baseline data, inventories and monitoring systems;
- *Lesson 8:* The ecosystem approach provides a good basis to guide the formulation of climate change mitigation policies/projects and conservation of biodiversity.

Annex

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