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BIODIVERSITY AND CLIMATE CHANGE – GOOD PRACTICE EXAMPLES FOR THE INTEGRATION OF CLIMATE CHANGE ACTIVITIES WITHIN THE PROGRAMMES OF WORK OF THE CONVENTION

Note by the Executive Secretary

I. INTRODUCTION

1. In response to growing awareness of the links between biodiversity and climate change, decision VIII/30 of the Conference of the Parties to the Convention on Biological Diversity requested the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to prepare guidance on the integration of climate change impacts and response activities into the programmes of work of the Convention taking into account, *inter alia*, best practices based on the analysis of case studies.

2. In light of the above decision, the Executive Secretary prepared the following information document, which presents case studies on climate change adaptation and mitigation activities in each of the programmes of work of the Convention.

3. The case studies were selected for their relevance to biodiversity and climate change interlinkages. They provide examples of the use of biodiversity conservation for climate change adaptation and mitigation. The descriptions of the case studies provide information on the nature of the activities undertaken and on the lessons learned from the implementation of these activities.

II. GOOD PRACTICE EXAMPLES FOR THE INTEGRATION OF CLIMATE CHANGE ACTIVITIES WITHIN THE PROGRAMMES OF WORK OF THE CONVENTION

4. The following case studies were identified through an analysis of the Third National Reports and through research conducted by the Secretariat.

2.1 Agricultural Biodiversity

5. Climate change is projected to affect agricultural biodiversity through increased temperatures, changes in rainfall patterns, and extreme weather events, diminishing crop yields and declining food

* UNEP/CBD/SBSTTA/12/1.

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security. The conservation of crop and livestock genetic resources is important for maintaining options for future agricultural needs.

Conservation of Traditional Plant Varieties in India

6. In India, the tribal communities of the Jeypore district of Orissa state, with the support of the M.S. Swaminathan Research Foundation[1/], have started working to conserve their agricultural biodiversity. These tribal communities are regarded as the primary conservers of local land races of rice and holders of traditional knowledge on agricultural biodiversity. Over the years, the number of plant varieties has been declining, largely due to the widespread use of commercial varieties. Climate change could exacerbate agricultural biodiversity loss. Local communities concerned with the threat to biodiversity and with the sustainability of their food supply have started working to preserve local varieties and to protect the environment. The maintenance of traditional plant varieties is an important tool in adapting to climate change, ensuring that varieties suitable for different conditions are available.

7. The objective of the project was the revitalisation of conservation traditions and livelihood systems through community farming and conservation of agricultural biodiversity with local participation. The approaches involved[2/]:

- Preparation of a Community Biodiversity Register to identify plants with medicinal value;
- Participatory plant breeding;
- Creating a link between ecological security and livelihood security; and
- Networking and capacity building.

8. The activities involved the development of community seed banks and grain banks. The project also encouraged cultivation of overexploited medicinal plants in community gardens, to reduce dependence on, and damage to local forests.

9. *Lessons learned* [3/]

- Regular village meetings and exhibitions at the village and district level are useful.
- Farmer friendly technology and transfer are crucial. Technologies should not be cost-intensive nor have inconsistent economic return.
- There is a need for clearer cultivation protocols.
- The full participation of local communities is essential to ensure sustainability.
- Importance of an appropriate legal and legislative enabling environment.

The Soil and Water Research Management Network (SWMnet) in Eastern and Central Africa

10. In Eastern and Central Africa, smallholders produce more than 95 percent of crops using low-input systems, which have degraded soil quality[4/]. In addition, Eastern and Central Africa experience frequently alternating floods and droughts, leading to severe land degradation and famines.

11. To address these issues, the Soil and Water Research Management Network (SWMnet)[5/] was created to enhance investments in the management of soil and water to improve productivity, and to add value and increase the competitiveness of agricultural enterprises in the Eastern and Central African

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[1/] M.S. Swaminathan Research Foundation. http://mssrf.org/index.htm

[2/] Equator Prize 2002. Tribal Communities of the Jeypore Tract, Orissa. http://www.equatorinitiative.net/content.lasso

[3/] Arunachalam, V. (1999). Farmer-friendly Technologies enhancing Economic and Livelihood Options in Orissa, India. The Global Biodiversity Forum. South and Southeast Asia (Sri Lanka). 2nd Regional Session for Asia, 24-26 October 1999, Colombo, Sri Lanka.

[4/] Klein, R.J.T., et al. 2006. Application of environmentally sound technologies for adaptation to climate change. United Nations Framework Convention on Climate Change (UNFCCC) Technical Paper, FCCC/TP/2006/2.

[5/] Soil and Water Research Management Network (SWMnet) (2006). http://www.asareca.org/swmnet/home.htm

sub-region. A particular focus of this program is the development of effective strategies to enable farmers, communities and countries to adapt and cope with climate variability.

12. SWMnet provides demand-driven knowledge and technologies for integrated management of soil and water for agriculture and promotes improved strategies for adaptation to climate change. SWMnet promotes effective participation of stakeholders, who take part in implementing the technologies. One of the main problems for soil and water management technologies is the inadequate understanding of their performance in locations other than those where they were originally developed. SWMnet facilitates and supports research to establish the spatial and temporal applicability of proven options and verify their suitability under different conditions.

13. *Lessons learned* [6/]

- Stakeholder participation is important including: individual farmers and farmers' organization, NGOs, public and private organizations, university departments, policy and planning organization, and regional and international organizations.
- There is a need for active dialogue with practitioners.

2.2 Dry and Sub-humid Lands Biodiversity

14. Dry and sub-humid lands are particularly vulnerable to climate change because small changes in temperature and rainfall patterns can have serious impacts on biodiversity. In addition, dry and sub-humid lands are already under stress from various activities, including conversion to agriculture, the introduction of invasive species, alterations to fire regimes, and pollution. The conservation of dry and sub-humid lands can reduce biodiversity loss and contribute to climate change adaptation and mitigation.

Climate Change Vulnerability and Adaptation in the Livestock Sector of Mongolia

15. Half of the population in Mongolia are engaged in pastoral livestock activities. Livestock and livestock processed exports amount to about one-third of the country's foreign exchange earnings.

16. The pastoral livestock sector is highly sensitive to climate change impacts. The key risks from climate change to livestock are increased incidence of drought and *dzud* (harsh winter). Considering the importance of the livestock-based subsistence for Mongolia's economy, adaptations to climate change impacts are vital in achieving sustainable development.

17. The project established under the Assessment of Impacts and Adaptation to Climate Change (AIACC) aimed to formulate adaptation measures that focus on those issues of national concern. Its goal was also to evaluate concrete and practical adaptations that could possibly decrease the livestock sector's vulnerability to climate change[7/].

18. The pastoral livestock industry depends on the availability of natural resources and is largely governed by climate, and animals' bio-capacity to cope with the environment. Impacts of climate change on pasture productivity are gradual and long term, and often associated with increasing intensity of extreme events, particularly droughts and dzud.

19. Different methods were used to identify adaptation options. These included computer modelling, household surveys, focus group discussions, multi-stakeholder workshops, GIS analysis and the use of an adaptation-screening matrix.

20. Several adaptation measures have been recommended on the basis of findings from this study. The selected adaptation measures included: (a) conservation of the natural resources; (b) strengthening

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[6/] Klein, R.J.T., et al. 2006. Application of environmentally sound technologies for adaptation to climate change. United Nations Framework Convention on Climate Change (UNFCCC) Technical Paper, FCCC/TP/2006/2.

[7/] Batima, P. 2006. Climate Change Vulnerability and Adaptation in the Livestock Sector of Mongolia. Assessment of Impacts and Adaptation to Climate Change (AIACC) Final Reports. Project No. AS 06.

animal bio-capacity; (c) management to enhance the livelihood of rural community; (d) food security and supply; and (e) climate extreme forecasting and monitoring.

21. Lessons learned

- Stakeholders' involvement is important. Stakeholders can be successfully involved through workshops, involvement in day-to-day activities, and round table discussion.
- There is a need for training and capacity-building at the grassroots level.
- It is more efficient to start with existing adaptations developed by local people.
- Adaptation requires actions in a coordinated way and incorporation in long-term planning.
- Many of the project activities require administrative decisions or actions.

2.3 Forest Biodiversity

22. Growth in some forests may initially increase as carbon dioxide concentrations rise. However, climate change may force species to migrate or shift their ranges far faster than they are able to. Some species may die off as a result. The conservation of forests is particularly important since they contain 80 percent of all the carbon stored in terrestrial vegetation. Deforestation and land-clearing activities emit 1.7 billion metric tons of carbon per year into the atmosphere. Thus, the conservation of forests offers important opportunities to protect biodiversity and slow climate change.

The Guaraqueçaba Climate Action Project in Brazil

23. After centuries of extensive human use, the Atlantic Forest in Brazil has been reduced to less than ten percent of its original range and is threatened by continued deforestation and degradation. The Guaraqueçaba Climate Action Project[8/] aims to restore and protect partially degraded or deforested tropical forest within the Guaraqueçaba Environmental Protection Area, one of the highest priorities for conservation in the world. More than half of the forest's tree species and nearly three-quarters of its other plants are found nowhere else on Earth. The vast majority of Brazil's endangered species rely on the Atlantic Forest for their existence.

24. The project is a collaborative effort between corporate investors, The Nature Conservancy, and the Sociedade de Pesquisa em Vida Selvagem e Educação Ambiental (SPVS), a Brazilian conservation organization. The primary purpose of the project is to sequester carbon dioxide by either having it absorbed and converted into plant biomass or through new forest growth or preventing it from being released into the atmosphere by further destruction. Over 40 years, the project is expected to sequester, reduce or avoid significant amounts of carbon dioxide.

25. An analysis of the Guaraqueçaba Environmental Protection Area identified ranching of the Asian water buffalo as the reserve's number-one threat. The project involves the purchase of active buffalo ranches, returning their pastures to native forest and preventing further deforestation. Once purchased, the properties are owned and managed by SPVS in perpetuity. The project also fosters sustainable development in local communities by providing alternative income generating activities and education on the importance of environmental conservation. Neighbouring buffalo ranchers are being shown more efficient ranching methods, thereby increasing productivity and reducing harmful effects on the forest.

26. In addition to climate change mitigation, the project is expected to provide numerous environmental services, including biodiversity protection, soil and water conservation, watershed protection, riverbank restoration, and environmental restoration with native species.

27. *Lessons learned*

- Local communities need be integrated into the conservation process and be provided with new options for environmentally compatible food sources or income generation.

[8/] The Guaraqueçaba Climate Action Project (2002). http://www.guaracap.com/Welcome.htm

- It is important to have accurate methods for the measurement and reporting of the amount of carbon sequestered as a result of the project.

Forest Conservation and Prevention of Deforestation in Bolivia

28. The Noel Kempff Mercado National Park in northern Bolivia is one the world's most biologically diverse area in the world. The area is home to unique and endangered species and encompasses five important ecosystems ranging from Amazonian rainforest, gallery forest and semi-deciduous tropical forest to flooded savannah and cerrado grasslands.

29. The Noel Kempff Mercado Climate Action Project[9/] is a large-scale conservation project undertaken by the Nature Conservancy and its partners to reduce build-up of greenhouse gases in the atmosphere by sequestering carbon dioxide that would have been released as a result of logging activities in the area.

30. Funds from the project were used to terminate logging rights on two million acres of government-owned land. This land was then incorporated into an adjacent national park, expanding the safe range for species. A significant reduction in carbon dioxide emissions is expected to be achieved through the project. Project partners are also working with local communities to create economic opportunities that provide an alternative to encroaching on other forested lands.

31. *Lessons learned*

- The needs of local communities need to be integrated into protected area management.
- The use of local labour and knowledge is beneficial.
- Accurately measuring and reporting the level of carbon dioxide captured as a result of the project is important.
- Importance of ensuring future forest conservation through the establishment of income-generating activities.

2.4 Inland Waters Biodiversity

32. Climate change is likely to affect inland waters biodiversity in many different ways. Climate-related changes in the hydrological regime may cause changes in growth, reproduction, and distribution of lake and stream biodiversity and changes in the reproduction of migratory birds that depend on lakes and streams for their breeding cycle.

33. Wetlands are the world's primary carbon sequestration mechanism, especially in peatlands of the boreal regions and tropical peat swamps and forests. Draining and drying peatlands can release significant amounts of carbon dioxide and methane. Actions that avoid degradation of these wetlands are beneficial mitigation options.

Tropical Peat Swamp Forest Rehabilitation in South-East Asia

34. Over the past four decades much of the once-extensive tropical peat swamp forests of South-east Asia have been heavily degraded, and large extents have been lost. The peatlands of Malaysia and Indonesia are especially threatened by persistent logging and clearing and by drainage to facilitate access or to establish agriculture, rice fields and palm plantations[10/] [11/]. Drainage and forest clearing has threatened the ecological stability of the swamps and made them susceptible to fire. Ongoing attempts are being made to harness the deep peat soils for agriculture, often with a high rate of failure and resulting in one of the environmental disasters of the last century, with millions of hectares of peatlands burned,

[9/] The Noel Kempff Mercado Climate Action Project. http://www.noelkempff.com/English/Welcome.htm

[10/] Page et al. 2002. The amount of carbon released from peat and forest fires in Indonesia during 1997. Nature 420, 61-5.

[11/] Tacconi, L. 2003. Fires in Indonesia. Causes, Costs and Policy Implications. Center for International Forestry Research (CIFOR). Occasional Paper No. 38. Bogor, 24 pp.

emitting large amounts of carbon into the atmosphere across south-eastern Asia and creating a noxious yellow haze.

35. Over the last two decades the destruction of the peat forests from logging has been further exacerbated by the conversion of peat swamp forests to agriculture, particularly for rice and oil palm plantations. The destruction in Kalimantan has been driven by a combination of political forces linked with population pressures and the development of agriculture and resulting in a cycle of landscape drainage and burning that has been exacerbated by climate variability.

36. The effects of forest logging leading to habitat destruction were well known when in 1995 a political decision was taken to convert more than one million hectares in Central Kalimantan from forested peatland to rice production to alleviate population pressure in nearby Java and increase food production. Loggers quickly felled large areas of forest while contractors dug some 4,600 km of drainage canals in what became known as the Mega Rice Project. The drainage pattern was unsuited to the soil conditions and sucked the peat dry. The soils were too acidic to grow rice. The emigrants were unable to grow sufficient rice and many left amidst increasing local resentment and wider political and economic uncertainty. The rice project was abandoned with a legacy of drained swamps and peat-fires that return each dry season. Some fires are now deliberately lit to clear land for conversion to oil palm plantations.

37. In 1997, during a drought linked with the El Niño-Southern Oscillation, land clearing and subsequent uncontrolled fires severely burned about 5 million hectares of forest and agricultural land in Kalimantan[12/]. In that year, the emissions from these fires could have amounted to a quarter of the land-based emissions. This is not only a considerable cost to the local health but also a loss of large amount of stored carbon (approximately US $3 billion of carbon is traded at US $7 per tonne) and great loss of local biodiversity.

38. The degradation of the swamp forests has resulted in wide-spread loss of wildlife habitat as well as reduced access by local people to products formerly produced by the forests. Drainage and burning has resulted in a loss of the deep layers of peat. Given that fires are also occurring elsewhere on the island of Borneo, and also in Sumatra, it is possible that a major global carbon sink is being turned into a source of atmospheric carbon dioxide. Hydrological changes have also been immense and it is expected that the ongoing changes to the peat-water balance will be felt for many years and in places limit response options, including rehabilitation, or establishment of alternate food production activities.

39. Local scale rehabilitation has started both through local action and with international support, especially for demonstration projects involving local people and NGOs. The key to reversing the losses seems to be to raise the water table and plant saplings in the peat once it contains sufficient moisture. This may involve building dams to retain the water and allow it to seep into the peat; building the dams is done largely by hand with local materials brought in by boat. In some instances these have been successful, but not in others; the successes though needed to be repeated on a much larger scale. Along with seeking international support for building dams and for monitoring their effectiveness a lot of effort has been placed on involving the local community. This includes economic incentives and investigating livelihood options that do not involve further degradation of an already degraded environment. Indonesia, which bore the brunt of the 1997-98 peat fires in Southeast Asia, has started a community-based program of protection and restoration of peatland by local people called Restorpeat[13/].

40. At a regional level, the Association of Southeast Asian Nations (ASEAN) has taken an active and formal interest in the problem, particularly given the regional health implications. The 10 ASEAN governments have established the ASEAN Peatland Management Initiative (APMI)[14/] to facilitate active cooperation and sharing of expertise and resources among the countries to prevent peatland fires and

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[12/] Wooster, M.J. and N. Strub (2002). Study of the 1997 Borneo fires: quantitative analysis using global area coverage (GAC) satellite data. *Global Biogeochemical Cycles* 16.

[13/] Restorpeat. Restoration of Tropical Peatland: www.geog.le.ac.uk/staff/sep5/restorpeat/restorpeat.pdf

[14/] ASEAN Peatland Management Initiative (APMI) (2003). www.haze-online.or.id/misc/apmi

manage peatlands wisely. The objectives of the regional initiatives are linked with national action plans that are being developed and cover three areas, namely: preventing further fires through better management policies and enforcement; monitoring fires; and strengthening regional fire-fighting capability and other mitigation measures. Monitoring mechanisms are in place based on analysis of meteorological data and imagery-based identification of fire hotspots, and predictions of the spread of the smoke haze. A policy of zero burning for further land clearing has also been established and promoted with land users, in particular oil palm plantations.

41. *Lessons learned* [15/]

- Use multi-level and multi-stakeholder approaches including: governments, research institutions and agencies of the Southeast Asia region, as well as local and international NGOs.
- Need to translate climate change and adaptation into easily understood issues, e.g. fires, storms, coastal erosion, etc.
- Utilize local capacity and knowledge.
- Build, where possible, on existing mechanisms.

Management of Peatlands in China for Biodiversity and Climate Change

42. The Ruoergai Plateau, located in the northeast corner of the Qinghai-Tibetan Plateau, is one of the world's largest high altitude peatlands. These peatlands play many roles: from biodiversity conservation and water storage and supply, to carbon storage and food and water security for the local Tibetan communities. One of the main development activities in the area was the creation of large networks of drainage canals to increase the area for grazing. This drainage system was one of the main root causes of degradation of the peatlands in the area.

43. The degradation of the peatlands in the Ruoergai Plateau lead to environmental problems, including reduction water level, water quality decline, changes in vegetation types, and desertification. A project, financed by the Netherlands government and co-financed by the Canadian government and the Global Environment Facility (GEF), supported implementation of measures to restore peatlands in the Ruoergai Plateau and enhance information exchange related to peatlands restoration. The project aimed to provide recommendations on how peatlands could be managed in the future to maintain their role as carbon sinks, while at the same time conserving biodiversity.

44. Project activities included:

- Working with local agencies to design management measures;
- Awareness-raising activities to local communities on the impact of peatland loss;
- Implementation of management measures in conjunction with local agencies;
- Monitoring of the results;
- Gathering experience from other peatland sites in China; and
- Dissemination of experience through website, newsletter and e-groups.

45. As a result of the project, peat mining and drainage are no longer allowed in Ruoergai and the neighbouring counties. The main benefit of the project was the increased understanding by local officials of the importance of peatlands for biodiversity, water management, climate change and local economy.

46. *Lessons learned* [16/]

- Information flow through stakeholders meetings can contribute to the success of the project.

[15/] Bratasida, L. (2004). Mainstreaming Adaptation in Development-Idealistic or realistic-Case studies from vulnerable ecosystems. Integrating Adaptation into Development in SE Asia. United Nations Framework Convention on Climate Change (UNFCCC) COP 10. http://www.iges.or.jp/jp/news/cop10/adaptation/indonesia.pdf

[16/] Global Environment Facility (GEF) Mid-term Evaluation Report. (2003). Wetlands Biodiversity Conservation and Sustainable Use.

- Projects that involve development of new models and approaches are by their nature experimental and innovative. To succeed, the design and implementation of such projects must be strategic, flexible and suited to country realities.
- Need to find ways to ensure continuity of project supervision and guidance despite staff changes.
- Need to share project responsibilities and benefits with provinces and other partners.
- Need to develop partnerships with organizations and individuals to work together to solve complex problems.

2.5 Island Biodiversity

47. Despite the fact that small island developing States have minimal greenhouse gas emissions and thus do not contribute much to climate change, they bear the brunt of climate change. Most island communities are dependent on natural resources such as fisheries, agriculture, or forestry to earn a living. These resources may become scarcer due to climate change. Seal level rise and extreme weather events particularly threaten island ecosystems and people.

Capacity Building for the Development of Adaptation Measures in Pacific Island Countries (CBDAMPIC)

48. The three-year Capacity Building for the Development of Adaptation Measures in Pacific Island Countries (CBDAMPIC)[17/] project was undertaken by the Secretariat of the Pacific Regional Environment Programme (SPREP) and the Canadian International Development Agency (CIDA). The project, which took place in the Cook Islands, Fiji, Samoa, and Vanuatu, was designed to help local people adapt to climate change.

49. More specifically, the goal of the CBDAMPIC project was to build the capacity of Pacific island countries to adapt to climate change by increasing policy-makers' awareness and understanding of climate change. Another goal was to mainstream climate change into national planning and budgeting processes of government departments. Additional work has been done to test pilot projects in small communities to assess their climate-related vulnerabilities and find strategies to reduce these vulnerabilities.

50. *Lessons learned* [18/]

- Approaches to engage local stakeholders at each stage are critical to project outcomes.
- Implementation should effectively balance the needs and interests of a variety of stakeholders.
- Capacity building in all facets of climate change needs to be an evolutionary process.
- Cost effective and culturally appropriate technologies can enhance communities' resilience to climate-related risks.
- There is a need to find out how the machinery used during the project can continue to be used after the project's end.
- Long-term success requires factoring climate change adaptation into sustainable development planning at national, regional and international levels.
- Working simultaneously through top-down and bottom-up approaches can be particularly effective.

[17/] South Pacific Regional Environment Programme (SPREP) (2003). Climate Change Portal. Capacity Building for the Development of Adaptation Measures in Pacific Island Countries (CBDAMPIC). http://www.sidsnet.org/pacific/sprep/climate_change/cdbmpic.htm

[18/] Nakalevu, T. (2006). Final Report: Capacity Building for the Development of Adaptation Measures in Pacific Island Countries Project. Secretariat of the Pacific Regional Environment Programme (SPREP), Canadian International Development Assistance (CIDA).

Caribbean Planning for Adaptation to Climate Change (CPACC)

51. In 1994, Barbados hosted the Global Conference on the Sustainable Development of Small Island Developing States. The resulting Barbados Programme of Action (BPoA) focused on sustainable development through adaptation to climate change impacts. In response to the BPoA, Caribbean governments approached the Organisation of American States (OAS) to request support for the development of regional projects aimed at building capacity to adapt to climate change. The OAS and Caribbean Community (CARICOM) jointly organized a series of national and regional workshops to facilitate maximum stakeholder consultation on climate change issues.

52. The result was a proposal for the Caribbean Planning for Adaptation to Climate Change (CPACC)[19/] project, which was submitted for funding to the Global Environment Facility (GEF). CPACC was approved and granted US $5.6 million. Lasting from 1997 to 2001, CPACC was implemented by the World Bank, executed by the OAS, and overseen by a Project Advisory Committee chaired by CARICOM. Implementation was carried out by a Regional Project Implementation Unit based in Barbados.

53. The goal of the CPACC project was to build capacity in the Caribbean region for the adaptation to climate change impacts, particularly sea level rise. This was accomplished through the completion of vulnerability assessments, adaptation planning, and capacity-building activities. Participating countries included: Antigua and Barbuda, the Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Saint Lucia, St. Kitts and Nevis, St. Vincent, and Trinidad and Tobago.

54. CPACC consisted of four regional projects and five pilot projects. The regional projects were:

- Design and establishment of a sea level/climate monitoring network;
- Establishment of databases and information systems;
- Inventory of coastal resources; and
- Use and formulation of initial adaptation policies.

55. The five pilot projects were:

- Coral reef monitoring for climate change (Bahamas, Belize, and Jamaica);
- Coastal vulnerability and risk assessment (Barbados, Guyana, and Grenada);
- Economic valuation of coastal and marine resources (Dominica, Saint Lucia, and Trinidad and Tobago);
- Formation of economic/regulatory proposals (Antigua and Barbuda, and St Kitts and Nevis); and
- National communications (St Vincent and the Grenadines).

56. Specific project achievements included:

- Establishment of a sea level and climate monitoring system;
- Improved access and availability of data through the Inventory for Coastal Resources and the institutionalization of coral reef monitoring;
- Increased appreciation of climate change issues at the policy-making level;
- Establishment of coral reef monitoring protocols resulting in a significant increase in monitoring and early warning capabilities; and
- Articulation of national climate change adaptation policies and implementation.

[19/] Caribbean Community (CARICOM) Secretariat (2006). Caribbean Planning for Adaptation to Climate Change (CPACC). http://www.caricom.org/jsp/projects/macc%20project/cpacc.jsp

57. *Lessons learned* [20/] [21/]

- Regional projects can be beneficial at a national level as long as participants are involved in the process.
- Importance of annual regional and national focal point meetings enhance the understanding local participants have of the process.
- Training sessions can be used as means of public sensitization of the regional project.
- Multidisciplinary and multi-sectoral teams are vital to the success of the project locally.
- Technology transfer should be accompanied with intensive training of local experts, both formally, through workshops, and informally, hands-on.
- Project ownership is a key element for implementation success.

2.6 Marine and Coastal Biodiversity

58. Climate change and associated sea level rise are likely to have significant impacts on coastal ecosystems and on the livelihood of local people. Marine and coastal ecosystems are also particularly vulnerable to the impacts of climate change since they already face myriad stresses, including overharvesting, habitat destruction, and pollution.

Mangrove Rehabilitation in Viet Nam

59. Certain coastal ecosystems, such as mangroves, provide coastal protection against rising sea level and storm surges. However, many mangroves are already under stress from excessive exploitation, reducing resilience to projected sea level rise.

60. In Viet Nam, extreme weather events such as typhoons already cause considerable damage. Climate change is likely to exacerbate this problem. Since 1994, the Viet Nam National Chapter of the Red Cross has worked with local communities to rehabilitate mangroves[22/]. Project activities include:

- Planting and protection of mangroves and upland trees;
- Disaster preparedness training;
- Capacity-building activities in term of planning and management skills;
- Awareness-raising about mangroves and disaster preparedness; and
- Advocacy, including workshops and studies of mangroves.

61. Approximately 12,000 hectares of mangroves were planted. Although planting and protecting the mangroves cost approximately US $1.1 million, it saved US $7.3 million per year in dike maintenance. Moreover, during the devastating typhoon Wukong in 2000, project areas remained unharmed while neighbouring provinces suffered great losses in lives, property and livelihoods. The Viet Nam Red Cross estimates about 7,750 families benefited from mangrove rehabilitation. People can also earn additional income from selling crabs, shrimps and mollusks.

62. *Lessons learned* [23/]

- The community is actively involved and plays an important role in implementation.

[20/] Small Island Developing States Network. Caribbean Planning for Adaptation to Climate Change. http://www.sidsnet.org/successstories/22.html

[21/] Metz, et.al. IPCC Special Report on Climate Change: Methodological and Technological issues in Technology Transfer. Case study 20: Caribbean Planning for Adaptation to Global Climate Change (CPACC): Design and Establishment of Sea-Level/Climate Monitoring Network, by Volonté, C.R.

[22/] Dharmaji, B., Raban, A., Pisupati, B., and H. Baulch, 2005. A guiding frame for mainstreaming biodiversity and development into National Adaptation Programmes of Action (NAPAs). The Conservation Union (IUCN).

[23/] Hammill, A. Livelihoods and Climate Change. Combining disaster risk reduction, natural resources management and climate change adaptation to reduce vulnerability. International Institute for Sustainable Development (IISD).

- Many training courses and public awareness exercises have been carried out to assist the local community.
- Need for supportive policy and institutional environment.

2.7 Mountain Biodiversity

63. Climate change can have serious impacts on mountain biodiversity as it causes the retreat and sometimes disappearance of alpine species that become trapped on mountain summits. Mountain regions are also already under stress from various human activities, reducing their natural resilience to climate change. Moreover, the shrinking of glaciers modifies the water-holding capacities of mountains, thus affecting downstream ecosystems. The melting of glaciers may also cause dangerous glacier lake outbursts.

Stress reduction in the Andean Paramos

64. The Andean paramo ecosystem is a collection of lakes, peat bogs and alpine grasslands that are intermingled with shrub land and forest patches. The paramos occur in the upper region of the Andes and provide critical hydrological services for many of the lower countries (Venezuela, Colombia, Ecuador, Costa Rica and Peru). The region is also very species rich, with up to 60% of the plant species endemic to the area.

65. Climate models project an increase in seasonality for the northern half of South America, with an increase in rainfall in the wettest months and a decrease of rainfall in the driest months. Climate change in areas of high variability in topography and meteorology such as the paramos, is expected to result in an overall reduction of rainfall.

66. In the region above the paramos, the melting of glaciers and the reduction in permanent snow cover will obviously have an impact. The decrease in permanent snow-covered area in Columbia has been estimated at a rate of 0.64 percent to 1.65 percent per year, with snow cover of the Columbia Andes predicted to virtually disappear by the end of the 21st century. This will reduce snowmelt contributions to the hydrology of the paramos and may intensify the shift towards a drier paramos climate.

67. The El Niño Southern Oscillation (ENSO) phenomenon, which causes deficit rainfall in mountainous areas of Colombia and Ecuador, is an additional uncertainty in this region. ENSO under climate change is expected to increase in length and intensity and would thus result in a stronger and longer dry period for the paramos.

68. Impacts of climate change include an upward shift of the downslope montane cloud forests. This will decrease the paramos area by as much as 75 percent. One of the likely consequences of this reduction is that the agricultural border will shift upwards and the paramos, already under pressure, will be replaced with cultivated land.

69. Adaptation options to minimize the impacts of climate change on the paramos ecosystems involve the alleviation of other pressures through the reduction of agriculture expansion and grazing pressure. Protection of hydrological flows is also essential – as recognized by the Government of Columbia, which has put in place a number of measures to identify and protect hydrological services in mountain ecosystems.

70. Moreover, the IUCN Netherlands Committee was able to facilitate, through the Global Peatland Initiative, funding of a regional network (Grupo Paramo) for promoting the wise use and conservation of the paramos in the Andes, involving eight Andean countries[24/]. A regional project, funded by the Global Environment Facility (GEF), entitled Conservation of the Biodiversity of the Paramo in the Northern and

[24/] Diemont, H. et al., 2004. The Global Peatland Initiative as a partnership. Paper presented at the XII International Peat Congress: Wise Use of Peatlands in Tampere, Finland. http://www.globalpeatlands.net/docs/tamp223.htm

Central Andes (Colombia, Ecuador, Peru and Venezuela), was also implemented to ensure the conservation and sustainable use of the unique biodiversity of the paramos[25/].

71. Lessons learned [26/]

- The team that executed the PDF-B phase consisted of one international consortium (CONDESAN), four national organizations (2 NGOs, 1 University and 1 Mixed-governmental organization), and two international Universities. This collaborative effort sometimes increased communication problems and time needed to adjust activities, but in general was evaluated very positively since the diversity of expectations and experiences resulted in a proposal that is strong at all points.
- Given the large amount of organizations involved and the large distance between project implementation sites, the adjustment of agendas and internal communication was difficult and sometimes slowed down the process.
- When regional projects are executed, electronic as well as personal (face to face) communication is important. Enough opportunities should be created to meet each other in person. A way to do this without extra costs or time investments is to carefully plan and combine international meetings on different themes into one event.
- Overrepresentation of biological expertise in general (botany in particular) was solved by an active selection of the national coordinators.

The Himalayas and glacier lakes

72. The Himalayas have the largest glacier concentration in the world outside the polar caps, covering an estimated 33,000 km^2. They are the water tower for the entire Indo-Gangetic plain, feeding seven of Asia's great rivers and influencing the South Asian monsoons.

73. Climate change has caused the retreat of sixty-seven percent of glaciers in the Himalayas. In fact, since the mid 1970s, the average air temperature measured at 49 stations in the Himalaya rose by 1°C, with high-elevation sites rising the most. Glacial retreat is anticipated to have a negative affect on the biodiversity of the Indo-Gangetic plain which will suffer from changing hydrological regimes.

74. One specific adaptation option that has been implemented addresses the issue of increase in the volume of glacial lakes and the possibility of catastrophic discharges. For one lake, Tsho Rolpa where there has been an eight-fold increase in its area over a 40-year period, a scheme to drain down the glacial lake was implemented to reduce the risk to infrastructure, people and biodiversity. The objective of the Tsho Rolpa Glacier Lake Outburst Flood Risk Reduction Project, funded by the Netherlands government, was to reduce the water level sufficiently to minimize the risk of breach forming in the natural moraine dam by constructing an open channel[27/]. Although the cost of the programme was about US $3.2 million, this is estimated to be much less than the potential cost of a catastrophic discharge[28/].

75. *Lessons learned* [29/]

- Full public participation, use of traditional skills and knowledge, due respect to the local values/norms, holistic approach for improving the people's livelihoods are necessary for the implementation of such measures.

[25/] Proyecto Paramo Andino (2006). http://www.infoandina.org/ppa/sitio.shtml?s=I

[26/] Andean Paramo Project Terminal Report. (2005). Accessed online at http://www.infoandina.org/ppa/sitio.shtml?s=I

[27/] Government of Nepal, Ministry of Science and Technology, Department of Hydrology and Meteorology. Tsho Rolpa GLOF Risk Reduction Project. http://www.dhm.gov.np/tsorol/riskred.htm

[28/] Agrawala S. V. Raksakulthai, M. van Aalst et al. (2003a). Development and climate change in Nepal: Focus on water resources and hydropower. Organisation for Economic Co-operation and Development (OECD)

[29/] Chaulagain, N. (2005). Glacier Lake Outburst Floods: Physical and Human Dimensions. 4th Thematic Workshop for Global Change in Mountain Regions on Process Studies along Altitudinal Gradients to Serve Conservation and Sustainable Development, Samedan, Switzerland, 27-10 July 2005.

- Multidisciplinary and holistic approach with proper combination of science and society is necessary,
- Identification of potential dangers glaciers lakes, their regular monitoring and the establishment of early-warning systems in these areas are useful approaches.
- As their means of livelihoods is limited to particular places, viable alternative livelihoods must be presented.

2.8 Programme of Work on Protected Areas

76. Climate change will impact the traditional range of species and will cause shifts along temperature and precipitation gradients. Protected areas established under current climatic conditions may find that the species they were designated to protect shift outside of the borders of the protected areas. Climate change may also contribute to the degradation of habitat within vulnerable protected areas including mountain, coastal and marine protected areas.

77. Climate change will also increase the need for corridors connecting existing protected areas so as to ensure that species have continuous habitat along which to migrate.

The Great Barrier Reef Marine Park Authority

78. Climate change has major direct implications for the Great Barrier Reef (GBR). It is projected to affect a range of animals and plants including corals, sea birds, marine mammals, turtles, plankton and fish. Climate change could also impact on ecosystem function through changes to ocean chemistry, sea level rise, circulation patterns and loss of reef structure.

79. Coral bleaching associated with increased sea surface temperature is emerging as one of the most significant threats to the GBR. Coral bleaching often results in coral death. Bleaching events are predicted to increase in frequency and severity under climate change scenarios.

80. In recognition of the enormous threat climate change poses to the GBR, the Great Barrier Reef Marine Park Authority (GBRMPA)[30/] has established a Climate Change Response Program in partnership with the Australian Greenhouse Office, to better understand and respond to climate change threats, including coral bleaching.

81. The GBRMPA has established a comprehensive Coral Bleaching Response Plan that aims to increase the coral reef's chances of survival under future climate change scenarios. The program consists of five key elements: prediction, early warning, monitoring, communication and building resilience.

82. The goals of the program are to: increase understanding about how the rate and extent of warming will impact the GBR, ensure managers have timely and credible information on coral bleaching and its ecological implications for the GBR and strengthen efforts to build coral reef resilience to climate change.

83. Indirect impacts, such as pressure from terrestrial run-off, over-fishing and loss in biodiversity, compromise the reef's resilience, and its ability to cope with climate change-related stress. The GBRMPA aims to ensure that coral reefs are relieved from other pressures when exposed to coral bleaching stress, and are given a better chance to survive and recover from these events.

84. The Authority has also established a Climate Change Response Programme which, aims to

- Sustain Great Barrier Reef ecosystems;
- Sustain industries and communities that depend on the Great Barrier Reef; and
- Foster supportive policy and networks.

[30/] Australia Governement. Great Barrier Reef Marine Park Authority. http://www.gbrmpa.gov.au/

85. *Lessons Learned*

- It is important to involve local communities.
- There is a significant scope for public-private partnerships.
- It is important to consider the socio-economic consequences of climate change and adaptation planning.
- Cross-sector cooperation is key.

2.9 Programme of Work on Traditional Knowledge, Innovations and Practices

86. Traditional and local communities have been identified as being particularly vulnerable to the impacts of climate change since many traditional livelihoods are based on biodiversity resources. Indigenous people also tend to inhabit marginal lands such as desert margins and polar regions which are expected to be most severely impacted by climate change.

Arctic Climate Impact Assessment

87. The Arctic Council and the International Arctic Science Committee produced the Arctic Climate Impact Assessment. As such, it represents a collaborative effort between Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States of America.

88. The Assessment evaluates the impacts of climate change on indigenous people in the Arctic including changes in reindeer grazing lands, changing ice conditions in hunting grounds, and damage to local infrastructure. The Assessment also acknowledges the importance of indigenous knowledge to climate change impact monitoring and, as such, conducted a review of indigenous peoples observations.

89. *Lessons learned*

- Importance of integrating local and traditional knowledge in climate change impact assessment.
- The need to combine scientific and traditional knowledge.
- The importance of adaptive management and learning by doing.

Community-based Rangeland Rehabilitation in Sudan

90. Rangelands cover approximately 60 percent of Sudan, providing grazing for one of the largest concentrations of livestock in Africa. Overexploitation of rangelands is a major cause of land degradation in Sudan. Climate change is likely to exacerbate degradation and biodiversity loss through increased frequency and intensity of droughts.

91. Beginning in 1992 and continuing through 2000, a group of 17 villages in the drought-prone Bara Province in Western Sudan took part in a project funded by the Global Environmental Facility (GEF), to rehabilitate overexploited and highly-vulnerable rangelands through the use of community-based natural resource management techniques[31/].

92. The cumulative impact of recurring droughts, cultivation of marginal lands, fuel wood gathering and overstocking of livestock have drastically depleted the vegetation. As a result, soil erosion, desertification and atmospheric dust have emerged as significant environmental challenges.

93. The project had two overall objectives: 1) to create a locally sustainable natural resource management system that would both prevent overexploitation of marginal lands and rehabilitate rangelands for the purpose of carbon sequestration, preservation of biodiversity and reduction of atmospheric dust; and 2) to reduce the risk of production failure by increasing the number of alternatives for sustainable production strategies.

[31/] Dougherty, B., A. Abusuwar and K.A. Razik. 2001. Sudan: Community-based rangeland rehabilitation for carbon sequestration and biodiversity. Report of the Terminal Evaluation, SUD/93/G31. Global Environment Facility (GEF)

94. Project activities included:

- Development of land use and rangeland management master plans;
- Improvement of 100 hectares of rangeland with native perennial grasses, browse species and native trees (results exceeded original expectations: 700 hectares were actually improved);
- Stabilization of sand dunes by planting trees and grass; and
- Creation of 195 kilometres of windbreaks comprising two rows of trees.

95. The project promoted alternative livelihoods that reduce damage to forests. A carbon sequestration monitoring contract was also established.

96. Benefits from this project included: increased soil cover, reduced soil erosion, greater carbon sequestration, increased biodiversity, sustainable resource management, and overall healthier ecosystems. The activities allowed communities to strengthen their capacity to manage and preserve the ecosystem, while increasing their resilience to climate-related shocks such as drought.

97. *Lessons learned* [32/]

- National policy processes need to integrate adaptation strategies at the community level.
- Importance of the active participation of community members in the initiation, design, implementation and monitoring of project activities.
- Importance of establishing or building upon social institutions to carry out activities in a structured, participatory and efficient manner.
- Importance of strong participation from women, recognizing their role as household and community resource managers.
- Need for effective mechanisms for information exchange and sharing of experiences.
- Importance of training and capacity building in a range of technical, financial and managerial skills.
- Need to acknowledge potential social consequences of the project.
- Need for adequate financial and logistical resources.
- Need for clear land use and land tenure policies, rangeland legislation and coordination between the local people and the rangeland administration.
- Need for political recognition and support.
- Need to work with broader policy frameworks that support decentralized natural resource management.

[32/] Livelihoods and Climate Change Information Paper no. 3. Sustainable Drylands Management. International Institute for Sustainable Development (IISD), Intercooperation, The Conservation Union (IUCN), Stockholm Environment Institute.