Draft Principles and Guidelines for Integrating

Ecosystem-based Approaches to Adaptation in Project and Policy Design

A Discussion Document

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Draft Principles and Guidelines for Integrating

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A Discussion Document

Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)
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Angela Andrade[1]
Commission on Ecosystem Management (CEM) of the International Union for the Conservation of Nature (IUCN) and Conservación Internacional Colombia, a.andrade@conservation.org

Rocío Córdoba[2]
International Union for the Conservation of Nature (IUCN), Mesoamerica and Caribbean Initiative, rocio.cordoba@iucn.org

Radhika Dave[3], Conservation International (CI), r.dave@conservation.org

Pascal Girot, CARE[4], pgirot@careclimatechange.org

Bernal Herrera-F.[5], Tropical Agricultural Research and Higher Education Center (CATIE), bernalhf@catie.ac.cr

Robert Munroe[6], BirdLife International, robert.munroe@birdlife.org

Judy Oglethorpe[7], World Wildlife Fund – United States (WWF-US), judy.OGLETHORpe@wwfus.org

Pía Paaby[5], Tropical Agricultural Research and Higher Education Center (CATIE), paabyp@hotmail.com

Emilia Pramova[8], Center for International Forestry Research (CIFOR), E.PRAMOVA@cgiar.org

James Watson[9], Wildlife Conservation Society (WCS), jwatson@wcs.org

Walter Vergara[10], IADB, WVERGARA@contractual.iadb.org

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Introduction and Background

Human and natural systems are influenced by climate variability and hazards, though the negative impacts are most severely felt in developing countries. Increased climate variability, such as the occurrence of more frequent droughts and storms and more erratic or intense rainfall patterns, is associated with climatic change. Such climate change effects will intensify significantly in the future.

The Intergovernmental Panel on Climate Change (IPCC) defined adaptation in 2001 as the "*adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities"* (IPCC 2001: Third Assessment Report [TAR] on Climate Change, p. 982). But it was not until 2007, at the Thirteenth Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC COP-13), when a comprehensive process was launched through the convention's Bali Action Plan in which adaptation was clearly highlighted together with three other pillars: mitigation, technology transfer, and deployment and financing (Decision -1c/CP.13 Bali Action Plan, December 2007).

Adaptation occurs in physical, ecological and human systems, and takes place through adjustments to reduce vulnerability or enhance resilience in response to experienced or expected changes in climate. Other stressors affecting vulnerability include meteorological hazards, poverty and unequal access to resources, food insecurity, trends in economic globalization, conflict, and incidence of disease. Adaptation should build on adaptive capacity to address climate change impacts (IPCC 2007, Burton 2006, McGray et ál. 2007).

In the 2008 Tenth Conference of the Parties of the Convention on Wetlands known as the Ramsar Convention (Ramsar COP-10), climate change and wetlands were both highlighted in an integrated manner, through technical guidelines for projects such as, promoting "*integrated coordination in developing and implementing national policies related to water management ensuring that they mutually support climate change impacts*" and to "*study the potential role of wetland ecosystems to climate change mitigation and adaptation*" (Ramsar COP-10 Decision X 24, 2008). Subsequently, a start was made to ensure these topics -particularly regarding coastal and marine ecosystems (Hale et ál. 2009)- would be included in the Eleventh Conference of the Parties to the Ramsar Convention (Ramsar COP-11), to be held in 2012 as a central part of the Post-2012 Climate Agreement.

Since 2009, the International Union for Conservation of Nature (IUCN) has promoted the adoption of Ecosystem-based Adaptation (EBA) as an operational tool for climate change adaptation. In 2010, the IUCN Commission on Ecosystem Management (CEM) prepared a compilation of case studies on ecosystem-based approaches to adaptation (Andrade Pérez et al. 2010). The lessons learned and conclusions from this effort were presented at the Tenth Conference of the Parties to the Convention

on Biological Diversity (CBD COP-10). They served as a the stimulus for the development of the current guidelines. In this context, the Ecosystems and Livelihoods Adaptation Network (ELAN; see: http://www.elanadapt.net/) and partner organizations consider it strategic to work together to provide guidance as to how ecosystem-based approaches to adaptation can be incorporated into developing climate change public policies and planning adaptation processes in an operational way.

At the Sixteenth Conference of the Parties (COP-16) of the UNFCCC held in 2010 in Cancún, a global agreement on adaptation was delivered through the establishment of the so-called "*Cancún Adaptation Framework*", elevating adaptation to the same level as topics like climate change mitigation, in negotiations among parties. The framework defines several principles which should be applied to adaptation action and should help prioritize broad adaptation actions. Principles relate to transparency, stakeholder participation, gender sensitivity, consideration of vulnerable groups, communities and ecosystems, use of indigenous knowledge and best available science, and the integration of adaptation into relevant social, economic and environmental policies and plans. The priorities defined include national adaptation planning, implementation of sub-national projects, assessments of vulnerability and adaptation strategies, institutional capacity-building, enhancement of socio-economic and ecological resilience, disaster risk reduction, and technology transfer.

Ecosystem-based approaches to adaptation constitute a promising option for sustainable and efficient adaptation to climate change. Ecosystem-based Adaptation (EBA) is '*the use of biodiversity and ecosystem services to help people adapt to the adverse effects of climate change'* (CBD 2nd Ad Hoc Technical Expert Group (AHTEG) on Biodiversity and Climate Change). This definition was added at COP-10 of the CBD held in Nagoya, Japan, in 2010, as part of decision X/33 on Climate Change and Biodiversity. It also said that ecosystem-based approaches to adaptation may include sustainable management as well as conservation and restoration of ecosystems, as part of an overall adaptation strategy that takes into account the multiple social, economic and cultural co-benefits for local communities[1].

Losses in ecosystem services due to climate change and other pressures directly affect human well-being (MEA 2005) and further increase the vulnerability of societies (Locatelli et ál. 2008, Vignola et ál. 2009). Badly planned engineering solutions for adaptation could work against nature by constraining regular ecological cycles, which may lead to mal-adaptation and increased social vulnerability (BirdLife International 2009, CBD 2009). This could be the case with a poorly designed dam, for instance.

In June 2011, the Subsidiary Body for Scientific and Technological Advice (SBSTA) at its 34th session (UNFCCC/SBSTA/2011/2), under the Nairobi Work Programme on impacts, vulnerability and adaptation to climate change, requested that the UNFCCC Secretariat compile information on ecosystem-based approaches to adaptation for SBSTA's 35th session.

This document proposes a series of draft principles and guidelines that were produced at a workshop with participation of its authors in June 2011, with the aim to serve as a foundation for planning ecosystem-based approaches to adaptation. The principles are intended to be used by decision makers in national policy in national, territorial and sector planning initiatives, in financial planning, and in project and research design. Hence, the draft set of guidelines is meant to support best-practices for the design and implementation of ecosystem-based approaches to adaptation.

1 The authors of this document prefer this specific terminology since Convention on Biological Diversity (CBD) Decision X/33 provided clarity to Parties that such approaches should be part of an overall adaptation strategy, that different ecosystem management options should be assessed for the different services they provide, reminding proponents that such approaches are not the 'only game in town' regarding adaptation options, and that there can be trade-offs associated with these approaches that also must be addressed.

Principles for Ecosystem-Based Approaches to Adaptation

The principles proposed can be a foundation for considering approaches for Ecosystem-based Adaptation (EBA) in overall policy making and planning processes to adaptation. Priorities will differ in different countries and situations, and each principle will then be given a different weight according to specific circumstances.

1. **EBA promotes multisectoral approaches**
   Ecosystems underpin the functions of diverse sectors and segments of society with multiple stakeholders depending on the services they provide in different landscapes. In fact, all people depend on well-functioning ecosystems. However, ecosystem benefits arise and management costs are incurred in different locations and affect different sectors and divisions of society. Therefore, EBA should work towards ensuring:
   - Collaboration and coordination between the sectors managing ecosystems and those benefiting from ecosystems services;
   - Cooperation across multiple levels and sectors to avoid conflicting priorities and mandates; and
   - Multi-stakeholder teams are established when developing adaptation policies.

2. **EBA operates at multiple geographical scales**
   Local strategies to secure ecosystem services for adaptation are of great value. But the functional scale of ecosystems and their drivers span across broader spatial scales. This is important to take into account to avoid mal-adaptation2. To do this:
   - Landscape-scale approaches and impact assessments are considered as an important step in identifying cumulative and indirect drivers of vulnerability (Hale et ál. 2009).
   - Lessons from integrated approaches for natural resource and ecosystem management should be drawn upon[3]; and
   - Institutions involved in EBA should develop strong and multi-scale linkages, as ecosystems do not necessarily relate to political or administrative units, nor to the scale in which the private sector operates (i.e. ecosystems may cover areas that fit neatly into one provincial administrative boundary or large parts of a nation state's territory, but these may not be the locations where the decision is made on whether to include EBA using that ecosystem).

2 For example, when one country or region applies adaptation measures to a transboundary watershed to the detriment of another bordering country or region.

3 Integrated Water Resources Management (IWRM), the Ecosystem Approach, Integrated Coastal Zone Management (ICZM), the Forest Landscape Restoration approach (FLR), etc.

3. **EBA integrates flexible management structures that enable adaptive management**
   EBA will have to operate under conditions of imperfect knowledge and uncertainties, as it is difficult to extrapolate from current ecological knowledge on how ecosystems will adapt, on how cumulative ecosystem vulnerability will evolve, and how the form, scale, location and distribution of ecosystem services will be altered by future climate change. Flexibility in adaptation policy/ project design is essential to address short-term challenges whilst at the same time promoting long-term socio-ecological resilience, and this will require:
   - Decentralized management to the lowest most appropriate level in order to enable greater efficiency, effectiveness, equity and ownership (as advocated by the ecosystem approach of the Convention of Biological Diversity [CBD]);
   - Addressing the lack of resources that may prevail at these local levels to ensure ecosystem processes and services are not adversely affected.
   - Enabling local institutions, private and public, NGOs and civil society to be key actors in adaptation planning as they have the greatest understanding of their environment and ability to detect changes in vulnerability. While informal institutions are rarely supported by government or external interventions, they may nonetheless be powerful vehicles for supporting EBA; and
   - Adequate institutional frameworks of monitoring systems to enable multi-stakeholder reflection, social learning and the adoption of new management decisions.

4. **EBA minimizes trade-offs and maximizes benefits with development and conservation goals to avoid unintended negative social and environmental impacts**
   EBA can result in multiple benefits, including increased livelihood assets, biodiversity conservation, and increased water and food security. This might however involve the active management of ecosystems for the provision of certain services at the expense of others, for example managing forests for water flow regulation rather than harvesting of timber and non-timber forest products. In such cases, while net benefits may increase, their distribution may mean that some people or communities loose while others gain. Trade-offs can also occur between short and long-term benefits, as well as among alternative land-uses. Because of this:
   - Participatory planning recognizing the needs of the poorest and most vulnerable is essential for balancing trade-offs. Strategies should balance current vulnerabilities and needs for resources and development with the preparation for longer-term climate change impacts, taking into account the limits of ecosystem functioning and the varying temporal scales and lag effects of ecosystem processes; and
   - Planners should ensure that the multiple benefits of EBA are maximized and are channeled effectively to the stakeholders including local communities concerned.

5. **EBA is based on the best available science and local knowledge, and should foster knowledge generation and diffusion**
   The challenge for effective responses to uncertainty lies in understanding how to improve management and adequately adjust to changes. While the generation of knowledge can be achieved passively, an active approach would focus on the inclusion of stakeholders so as to balance scientific based knowledge and experimental frameworks coming from multiple sources. For this to happen:
   - Agencies implementing EBA should facilitate networks for knowledge sharing, ensure that information is regularly updated and provided in easily usable forms, and that the media through which knowledge is shared are culturally appropriate and understandable;
   - The best available scientific knowledge and climate modeling should be used in conjunction with local knowledge; and

- It should be recognized that enhancement, sharing and incorporation of indigenous and local knowledge in a way that complies with the principles of free, prior, and informed consent, is critical to ensure effective and locally appropriate adaptation.

6. **EBA is about promoting resilient ecosystems and using nature-based solutions to provide benefits to people, especially the most vulnerable**
   This involves:
   - Understanding what makes resilient ecosystems – and the services they provide;
   - Working with rural communities and vulnerable people to create local ownership and resilient local institutions; and
   - Ensuring that local stewardship enhances both livelihoods and ecosystem management.
7. **EBA must be participatory, transparent, accountable, and culturally appropriate, while actively embracing equity and gender issues.**
   As with any adaptation action, EBA is context and place-specific, requiring knowledge, mobilization and action tailored to particular conditions. Broad stakeholder inclusion in formulating strategies has both an ethical as well as a practical value in terms of efficiency, efficacy and sustainability. Vulnerability is socially differentiated. During adaptation planning, there is a risk that the most vulnerable groups, especially the poorest of the poor, women, indigenous groups, elderly, and children, are marginalized. It is thus necessary to target the adaptation needs of those stakeholders that are likely to be disproportionately affected by climate change due to inherent structural and social inequalities, and who are also disproportionately dependent on ecosystem services. For this to happen:
   - EBA should recognize the underlying causes of differential vulnerability such as power imbalances and entitlements to resources;
   - Planning should be non-discriminatory, focusing on equality and the special needs of marginalized social groups and promoting active, free, meaningful and full participation of stakeholders.
   - Vulnerability assessment processes and adaptation measures must be gender sensitive; and
   - EBA should aim to empower people as rightful directors of their own future in the face of climate change and development.

Guidelines for Designing Projects with Ecosystem-Based Approaches to Adaptation

The following guidelines are suggested as an initial framework for best practices to be taken into account when designing EBA projects.

1. **Prepare project structure**
   - Define core multidisciplinary teams.
   - Identify ecosystems and ecosystem boundaries.
   - Scope potential climatic threats and non climatic threats that together affect levels of vulnerability.

2. **Gather relevant data and expertise**
   - Synthesize available information and knowledge from different disciplines and sectors on important socio-ecological system components.
   - Obtain or develop climatic projections, focusing on ecologically and socially relevant variables, and suitable spatial and temporal scales.
   - Obtain science-based information and traditional/local knowledge on past and current climate variability, as well as impacts.
   - Identify key ecosystem services and relevant stakeholders through exercises such as ecosystem service mapping.
   - Map, model and evaluate the multiple flows of ecosystem services to the diverse users and sectors on a national and sub-national level
   - Assess potential winners and losers of specific changes in socio-ecological systems.
   - Develop an understanding of the key social processes between system components and the institutions that govern them[4].
   - Evaluate data on ecosystem services and climate change impacts to identify gaps for research and specific elements to monitor.

3. **Conduct integrated vulnerability assessments and impact projections with flexible criteria that address the linkages between human and environmental systems**
   - Determine exposure, sensitivity and adaptive capacity of vulnerable groups, communities, and ecosystems to climate variability and future climatic change using data gathered in Guideline 2.

4 For example, the usage of services, entitlement to resources, institutions regulating resource use, migration, etc.

- Analyze past and current coping strategies used by communities. Coping strategies should be analyzed for their sustainability under climate change and for their long-term direct and indirect effects on critical ecosystem services and other processes in the system such as power relationships.
- Assess overall vulnerability of relevant groups, communities and ecosystems.
- Identify feedback linkages and loops between ecosystems and people[5].
- Analyze existing policy and institutional frameworks in the context of adaptation, and especially EBA, so as to identify strengths, constraints and opportunities for mainstreaming. On-going projects on adaptation and their effects should also be analyzed.
- Conduct participatory scenario exercises with stakeholders to consider how vulnerable groups, communities and ecosystems might fare under various development, management, and climatic projections.
- Document the level of confidence or uncertainty in assessments.

4. **Locate projects within robust national and sub-national frameworks so as to enhance the long-term chances of success**
   - Understand the national and sub-national frameworks and ensure that the planned and implemented activities contribute to them.
   - Share results with those coordinating and facilitating these frameworks.
   - Ensure that planned activities are recognized in relevant strategies (e.g., National Action Plan to Combat Desertification [NAP]; Adaptation Programme of Action on Climate Change [NAPA], Public Participation in Scientific Research [PPSR], other adaptation plans and strategies).

5. **Integrate EBA into wider plans for adaptation and wider regional settings**
   - Consider the maintenance of ecosystem services in plans based on people's needs and improvement of livelihoods.
   - Share assessment results with stakeholders and decision makers.
   - Agree on the spatial and temporal scales for the plan, which may require refinement of system boundaries.
   - Identify adaptation measures using the vulnerability ranking tool (see definitions).
   - Ensure that short term adaptation measures6 do not compromise long term options7, which should focus on building resilience.
   - Work towards ensuring that adaptation strategies and plans are coherent with other sector policies and convention action plans (e.g. under the CBD).
   - Make EBA resilience focused, or based on transformative change, or based on resistance.

6. **Ensure the sustainability of monitoring and adaptive management**
   - Ensure sufficient resources are available for adequate monitoring systems necessary to support adaptive "learning-by-doing" processes.
   - Design monitoring systems to cover an adequate length of time and operate at the most appropriate scale to assess project effectiveness and any changes in vulnerability.
   - Involve local communities in the monitoring process to enhance efficiency, local capacities and the overall learning process.

5 For example, analyze current land use practices and contrast them with climate change scenarios/predictions and analyze how changes in flows of ecosystem services affect adaptive capacities of vulnerable populations.

6 For example, working on current pressures, water availability, disaster risk reduction, food security.

7 For example, adaptation of ecosystems by enhancing connectivity and refugia; increasing thermal resilience of coral reefs to secure fishery productivity, increasing water and carbon regulation in mountainous systems through restoration, water rights and land tenure reform.

- Choose indicators that reflect resilience of all components of the human-environment system and their inter-linkages.
- Regularly evaluate the effectiveness of adaptation actions[8] through the analysis of monitoring results, and use a participatory process to adapt measures when current strategies are not working.
- Design knowledge dissemination and learning mechanisms for an effective learning process.

8 For aspects to consider in this evaluation see the Cambridge Conservation Initiative Collaborative Fund project 'assessment framework "*Effectiveness of ecosystem-based approaches to adaptation: critical review of current evidence*". Results of this project will be presented at the Durban conference.

References

Andrade Pérez, A., B. Herrera Fernández and R. Cazzolla Gatti, eds. 2010. Building Resilience to Climate Change: Ecosystem-Based Adaptation and Lessons from the Field. Ecosystem Management Series No. 9. IUCN, Gland, Switzerland. 164 pp.

Barnett, J. and S. O'Neill. 2010. Maladaptation. Editorial. Global Environmental Change 20:211–213.

BirdLife International. 2009. Partners with Nature: How Healthy Ecosystems are Helping the World's Most Vulnerable to Adapt to Climate Change. BirdLife International. Cambridge, UK. 17 pp.

Boano, C. 2008. Environmentally Displaced People: Understanding the Linkages between Environmental Change, Livelihoods and Forced Migration. Refuge Station Center, Oxford Department of International Development, University of Oxford. Oxford, UK. 44 pp.

Burton, I. 2006. Adapt and thrive: Options for reducing the climate-change adaptation deficit. *Policy Options* 27:1, 33-38.

CBD (Convention on Biological Diversity). 2009. Connecting Biodiversity and Climate Change Mitigation and Adaptation. Report of the 2nd Ad Hoc Technical Expert Group (AHTEG) on Biodiversity and Climate Change. Technical Series No. 41. Secretariat of the Convention on Biological Diversity. Montreal, Canada.

CBD (Convention on Biological Diversity). 2010. Ecosystem Based Adaptation. Available online at: http://www.cbd.int/climate/intro.shtml. Secretariat of the Convention on Biological Diversity. Montreal, Canada.

CBD (Convention on Biological Diversity). 2011. CBD Article 2. Available online at: http://www.cbd.int/ecosystem/. Secretariat of the Convention on Biological Diversity. Montreal, Canada.

Gitay, H., A. Suárez, R. Watson and D.J. Dokken. 2002. Climate Change and Biodiversity. IPCC Technical Paper V. IPCC Working Group II, Technical Support Unit. Intergovernmental Panel on Climate Change (IPCC). Geneva, Switzerland. 86 pp.

Hale, L.Z., I. Meliane, S. Davidson, T. Sandwith, J. Hoekstra, S. Murawski, N. Cyr, K. Osgood, M. Hatziolos, P. van Eijk, N. Davidson an W. Eichbaum. 2009. Ecosystem-Based Adaptation in Marine and Coastal Ecosystems. Renewable Resources Journal 25(4): 21-28.

IPCC (Intergovernmental Panel on Climate Change). 2001. Climate Change 2001. IPCC Third Assessment Report (TAR). [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 881 pp.

IPCC (Intergovernmental Panel on Climate Change). 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Geneva, Switzerland.104 pp.

Locatelli, B., M. Kanninen, M. Brockhaus, C.J.P. Colfer, D. Murdiyarso and H. Santoso. 2008. Facing an Uncertain Future: How Forests and People can Adapt to Climate Change. CIFOR (Center for International Forestry Research). Forest Perspectives No. 5: 1-86. Bogor, Indonesia.

McGray, H., A. Hammill and R. Bradley. 2007. Weathering the Storm: Options for Framing Adaptation and Development. World Resources Institute (WRI). Washington, D.C.

MEA (Millennium Ecosystem Assessment). 2005. Ecosystems and Human Well-being: Synthesis. Island Press. Washington, D.C. 137 pp.

Resilience Alliance. 2001. Resilience Alliance Program Description. Available online at: http://www.resalliance.org

SM Resources Corporation (SMRC), Department of Geography at Pennsylvania State University, and U.S. Geological Survey (USGS). 2011. The Vulnerability Assessment Support System (VASS). Available online at: http://vass.smrc-research.com/

UNFCCC. 2010. UNFCCC Article 1, Paragraph 2. Available online at: http://unfccc.int/essential_background/convention/background/items/2536.php

United Nations. 1987. Report of the World Commission on Environment and Development (WCED, a.k.a. as Brundtland Commission), General Assembly Resolution 42/187, 11 December 1987. Available online at: http://www.un-documents.net/a42r187.htm

UNFCCC (United Nations Framework Convention on Climate Change). 2002. Report of the Conference of the Parties on its Seventh Session, held at Marrakesh from 29 October to 10 November 2001. Bonn, Germany. Available online at: www.unfccc.int.

Vignola, R., B. Locatelli, C. Martínez and P. Imbach. 2009. Ecosystem-based adaptation to climate change: what role for policy-makers, society and scientists? Mitigation and Adaptation Strategies for Global Change 14: 691–696.

Williams, B.K., R.C. Szaro and C.D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, D.C.

WRI (World Resources Institute). 2008. World Resources 2008: Roots of Resilience -Growing the Wealth of the Poor. World Resources Institute, in collaboration with United Nations Development Programme (UNDP) and United Nations Environment Programme (UNEP). Washington, D.C.

Key Definitions

Box 1.

Adaptive capacity is the ability to take action in order to overcome threats. The key outcome of adaptive capacity is that lives and livelihoods can be maintained despite the impact of a threat and without people falling deeper into poverty (Boano 2008).

Adaptive management is a management process promoting 'learning by doing' where policies and management operations are adjusted through flexible decision-making as outcomes from previous management actions and other occurring events become better understood (Williams et ál. 2009).

Climate change adaptation refers to the *"adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation*" (IPCC Third Assessment Report [TAR] 2001).

Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC Article 1, Paragraph 2; UNFCCC 2011).

Development is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for generations to come (United Nations 1987). Development cannot be defined without incorporating an element of sustainability.

Ecosystem-based approaches to adaptation are '*the use of biodiversity and ecosystem services to help people adapt to the adverse effects of climate change*. *This may include sustainable management, conservation and restoration of ecosystems, as part of an overall adaptation strategy that takes into account the multiple social, economic and cultural co-benefits for local communities*.' (CBD 2010).

Ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way (CBD 2011).

Ecosystem means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (CBD 2011).

Ecosystem resilience is the capacity of a system to resist/absorb disturbance and/or rapidly recover from disturbance, without crossing a threshold to a different ecosystem structure or state. The disturbance may be natural, like a storm, or human-caused, like deforestation, pollution, or climate change (WRI 2008).

Box 1.

Ecosystem services express the usefulness of biodiversity. The , divided Ecosystem services can be divided into four categories (MEA 2005):

a. *Provisioning services*, or the supply of goods of direct benefits to people, and often with a clear monetary value, such as timber from forests, medicinal plants, and fish from the oceans, rivers and lakes;

b. *Regulating services*, the range of functions carried out by ecosystems which are often of great value but generally not given a monetary value in conventional markets. They include regulation of climate through the storage of carbon and control of local rainfall, the removal of pollutants by filtering the air and water, and protection from disasters such as landslides and coastal storms;

c. *Cultural services*, are not providing direct material benefits, but contributing to wider needs and desires of society, and therefore to people's willingness to pay for conservation. They include the spiritual value attached to particular ecosystems such as sacred groves, and the aesthetic beauty of landscapes or coastal formations that attract tourists;

d. *Supporting services*, not of direct benefit to people but essential to the functioning of ecosystems and therefore indirectly responsible for all other services. Examples are the formation of soils and pollination services in agriculture.

Maladaptation is the action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of other systems, sectors or social groups through: (i) increasing emissions of greenhouse gases; (ii) disproportionately burdening the most vulnerable; (iii) rising opportunity costs; (iv) reducing incentives to adapt; and (v) increasing the likelihood of path dependency (Barnett and O'Neill 2010).

Resilience (from socio-ecological systems thinking) is a measure of: (i) the amount of change a system can undergo and still retain the same controls on function and structure; (ii) the degree to which a system is capable of self-organization; and (iii) a system's ability to build and increase its capacity for learning and adaptation (Resilience Alliance 2001).

Vulnerability refers to the degree to which a species, population, community, ecosystem, agricultural system, region, or other entity is susceptible to, or unable to cope with, adverse effects of climate change. Also, it refers to the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extreme events. Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (Gitay et ál. 2002).

Vulnerability ranking tool)is a tool that allows users to define, prioritize, and classify a set of vulnerabilities according to exposure, sensitivity and adaptive capacity. Estimates on the relative severity of the vulnerability and on the estimated frequency of occurrence can also be added (SM Resources Corporation et ál. 2011).

Integrated National Adaptation Pilot to Climate Change, Colombia[9]

Angela Andrade

This study case exemplifies principles 5, 6 and 7. It is based on the best available science and local knowledge, fostering knowledge generation and dissemination. It promotes resilient ecosystems and uses nature-based solutions to provide benefits to people, especially the most vulnerable. At the same time, its approach is participatory, transparent, accountable, and culturally appropriate while actively embracing equity and gender issues.

An Integrated National Adaptation Pilot (INAP) to climate change has been developed from 2006 to 2011 by the Government of Colombia. It counted on the participation of the National Institute of Hydrology, Meteorology and Environmental Services (IDEAM), the environmental NGO Conservation International (CI) in Colombia, the National Institute of Marine and Coastal Resources (INVEMAR), the Regional Environmental Authority of San Andrés and Santa Catalina Provinces (CORALINA), the National Institute of Health (INS), and the World Bank as implementing agency.

INAP is the first climate change adaptation project, funded by the Global Environmental Facility (GEF), addressing impacts of climate variability and change on the most vulnerable ecosystems and regions of Colombia, including the high mountain ecosystems and *páramos* (a type of tropical high-altitude grasslands above the upper forest line), and the coastal and insular areas. It addressed issues like human health and the reduction of the vulnerability of ecosystem services on which people depend mostly. It also focused at generating basic information and knowledge on weather scenarios for the coming 100 years, and paid attention to monitoring essential ecological processes including water and carbon cycles in high mountain and *páramo* ecosystems , as well as to glacier dynamics, ecological changes and impacts on Caribbean coral reefs, oceanographic models in the Caribbean Sea, and outbreaks of diseases like dengue and malaria.

Adaptation measures implemented by INAP are based on the Ecosystem Approach, allowing a comprehensive understanding of socio-economic, cultural and ecological work in the country needed to build social and ecological resilience of terrestrial and marine systems in the face of current and upcoming climate change impacts. Adaptation measures that were implemented were developed with a broad participation of local communities and relevant sectors, by applying interdisciplinary methods, conducting intercultural action research, and involving communities.

9 Further details are available online at: www.conservation.org.co

Major achievements resulting from the application of these ecosystem-based approaches to adaptation are:

a. Generation of information on climate, climate variability and climate change, and ecological systems to support decision making:
b. Development of climate change scenarios which constitute the basis for the formulation of national policies and dialogue with the most vulnerable sectors: agriculture, health and energy.
c. Monitoring of more than 15 oceanographic parameters in 2 new stations in the Caribbean to improve knowledge of marine ecological dynamics and formulation of adaptation measures in coastal areas and on islands.
d. Monitoring of climate impact on coral communities in order to better understand the behavior of coral reefs and their impact on ecosystem services.
e. Water and carbon cycle monitoring in high mountain ecosystems and evaluation of its impact on ecosystem services. Models of glacier dynamics and their impact on the water cycle in high mountain ecosystems.

Specific actions to build resilience and adaptation to address climate change impacts in high mountains, coastal areas and islands:

i. Reduction of vulnerability at the local level through land use and watershed management plans, integrating disaster risk reduction. Participatory ecological restoration to create connectivity between protected areas and reduce land degradation and regulation of water resources in priority areas.
ii. Generation of participatory mechanisms for the management of the commons and creating social and ecological resilience.
iii. Development of production systems resilient to climate change at local level, including sustainable production and soil recovery practices.
iv. Recovery of traditional knowledge for rain water harvesting, and development of complementary technologies that allow facing extreme events of water shortage, to marginalized populations in insular areas.
v. Strengthening protected areas management plans in high mountains and seascapes. Strengthening of integrated surveillance systems and control of diseases like dengue and malaria, including an early warning system to improve survival of both diseases in pilot areas. The sustainability of adaptation measures requirs support efforts in the fields of education, research, institutional strengthening and social organization at local level.

Participatory Multi-level Vulnerability Assessment in Northern Mali: Understanding Socio-Ecological Complexity

Emilia Pramova

This case study exemplifies the EBA principles 4, 6 and 7. It shows how trade-offs can be minimized and benefits maximized when integrating development and conservation goals in order to avoid unintended negative social and environmental impacts. It demonstrates how resilient ecosystems can be promoted and nature-based solutions applied to provide benefits to people, especially the most vulnerable. Simultaneously, it is a good example of a case study that is participatory, transparent, accountable, and culturally appropriate, while actively embracing equity and gender issues. It also exemplifies guideline 3 as an EBA project, since it integrates vulnerability assessments and impact projections with flexible criteria that address linkages between human and environmental systems.

Livelihoods in Mali are highly dependent on natural resources such as pasture, fodder, forest products and water, all of which are climate-sensitive. Political and economic changes, power relations and perceptions play an additional role in shaping socio-ecological vulnerability.

Three researchers of the Center for International Forestry Research (CIFOR), Djoudi, Brockhaus and Locatelli, explored the vulnerability of local communities depending on livestock and forests in northern Mali, through a participative approach at different levels and scales[10]. Interviews and workshops where conducted at national, regional and district levels. Field research was undertaken at two sites and communities north of the Lake Faguibine area, combining bio-physical research with workshops and participatory social research related to livestock production systems, natural resources utilization, and coping and adaptation strategies.

The research was conducted in a place of drastic ecological and political change. Lake Faguibine has been almost completely dry since the droughts of the 1970s and has transformed from a water-based to a forest ecosystem, with *Acacia* and *Prosopis* trees now covering more than a third of the former lake area. The distribution of vulnerabilities within livelihoods and groups shifted when the ecosystem evolved from a lake to a forest and new vulnerability drivers emerged. Several programmes have sought to bring the water back and restore related economic activities. However, it is questionable whether refilling the lake is a viable and sustainable option under climate change.

10 The research mentioned above was undertaken from July to October 2008, as part of the EU-funded project TroFCCA (Tropical Forests and Climate Change Adaptation). A related manuscript has been submitted to the journal *Regional Environmental Change* (Djoudi et ál., in press).

The interviews and workshops at the various levels showed different views of climate change impacts and vulnerability. The community-level perception focused more on adaptation strategies, social and ecological interactions, and local dynamics such as the lake-to-forest transition, migration and conflicts, land tenure reforms and the rebellion.

At the national and sub-national level, focus was on the impacts on resources and sectoral and technical adaptation such as refilling the lake and sedentarisation of herders. During workshops conducted in the district capital, government and development agents considered that sedentary, transhumant and nomadic herders were similarly sensitive to impacts on livestock, water, pasture and trees. Local representatives differentiated livelihoods, considering the sedentary and mixed ones as more sensitive to flood, wind, and droughts (water-scarcity) than transhumant and nomadic. Climate-induced pasture loss was considered to affect transhumant and nomadic herders much more than sedentary and mixed livelihoods, because of their higher dependence on pastures.

Local level research showed that forests currently support responses to cumulative stressors and play an integral part in the coping strategies of different livelihood groups (*e.g.*, with fodder, charcoal production, wood gathering). Both communities highlighted the importance of forests, but the one containing the *Prosopis*-based forest expressed strong concerns about the forest's further expansion and its invasive characteristics. The sustainable use and provision of forest ecosystem services can be jeopardized because state and development agencies do not consider the new role played by forests. This is further aggravated by their unclear legal status.

Forest-based coping strategies have enabled people to deal with stress in the short-term, but forest users lack knowledge and capacity for forest management and are not incentivized for it. Different temporal scales were considered when working with the various stakeholders. In the short term, forests contribute to local adaptive strategies but, in the long term, implementation of strategies could lead to forest degradation and higher social vulnerability. Strategies based on migration were considered adaptive in the short term but appeared to have the capacity to originate possible negative consequences in the mid- and long term, especially with respect to women.

Local groups have also shown a strong preference for a 'return of the lake', rather than keeping the forest as such, demonstrating a strong discrepancy between the perception of the forest and the *de facto* use of its products. 'Losing the lake' is perceived as an expression of vulnerability, and only the lake's return would allow for a prosperous future - a vision nurtured by political leaders for electoral purposes. This does little to foster long-term strategic planning around the now available forest resources.

It is essential that vulnerability assessments capture differences in perception; otherwise they may lead to *maladaptation* or inefficient adaptation efforts. Power relationships, different interests, norms and values may influence the judgment about who is to a certain extent vulnerable, or about one's own vulnerability. For a deeper understanding of vulnerability, the research results discussed above suggest the use of ecosystem-based approaches to climate change adaptation with four important features: i) multi-level (from local to national and vice versa); ii) participatory (with different tools for eliciting people's views, depending on the level); iii) integrative (with consideration of ecological, social, economic and political factors); and, iv) gender-sensitive.

African Wetlands at Hadejia-Nguru, Nigeria

Robert Munroe

This case study exemplifies principles 2,4,5,7: the need to operate at multiple geographical scales; consideration of the multiplicity of benefits that ecosystem-based approaches to adaptation can provide; the need to be sensitive to current and future needs and ensuring this through appropriate monitoring systems; and, the importance of a participatory method in applying ecosystem-based approaches to adaptation.

The Hadejia-Nguru Wetlands lie on the southern edge of the Sahel savanna in north-eastern Nigeria and are comprised of permanent lakes and seasonal pools, all connected by channels. These wetlands provide essential ecosystem services including water for irrigation of export products such as peppers, as well as dietary staple foods such as millet and sorghum. The seasonal pools are particularly important as they support: irrigation of land outside of the wet season; livestock grazing (250 herds with an annual cattle trade turnover of about US$ 2.75million); and fishing for the majority of the 1.5 million people living in the floodplain, with fishing providing a major component of household cash income (approximately 6% of Nigeria's inland fish catch with a market value of about US$ 300,000 per annum). The diverse nature of these services ensures flexibility in resources and income, which is vital to the ability of communities to adapt to environmental shocks like drought. The wetlands also provide water to groundwater reservoirs that supply wells and boreholes for a large proportion of this Sahelian area.

Climate change has compounded wetland shrinkage caused by upstream dams built to provide a more consistent supply of water for irrigated agriculture in response to droughts that were affecting communities both upstream and downstream. These developments did not consider downstream effects, nor provision for current needs without jeopardizing mid- to long-term benefits. As water levels have dropped and the velocity of water flow in the rivers has decreased, *Typha*, a native wetland plant species, has thrived and blocked waterways (with invasion increasing from 550 ha to over 200 km^2 in the last 5 years). Local communities reported that this phenomenon has prevented a natural flooding regime to occur, so that water was not able to reach the floodplain and pools, whilst at the same time causing flooding of productive farmland areas upstream of the blocked channels.

The Nigerian Conservation Foundation –the BirdLife of Nigeria– has empowered local communities by providing technical guidance on ecology, as well as tools and credits for food and transportation, and facilitating multi-stakeholder action groups (including dam operators and local government authorities), to counter the mal-adaptation impacts of the dams by restoring wetland ecosystems through clearing of *Typha* fields. Such an approach has put into practice one of the principles of

ecosystem-based approaches to adaptation: the need for multi-scale considerations in order to capture upstream-downstream effects. This work by the communities has not only restored a more 'natural' flood pattern, but has also increased household incomes – an example of the multiplicity of benefits that ecosystem-based approaches to adaptation can provide. Malam Maman Kaniniyo, the village head of Dabar Magini said: "*Apart from getting bigger and more fish catches, farmers have also reclaimed most of their farm lands and grazing areas, and no over-flooding was experienced in the rainy season*". Building on this success, the communities have now set up their own maintenance programme that includes a substantive monitoring component to ensure the continued success of the project.

Adaptive Ecosystem Management to Improve Resilience to Climate Change in Fiji

Stacy Jupiter

This case study exemplifies principles 3, 6 and 7: it integrates flexible management structures that enable adaptive management; it promotes resilient ecosystems and uses nature-based solutions to provide benefits to people, especially the most vulnerable; and, it is participatory, transparent, accountable, and culturally appropriate, and actively embraces equity and gender issues.

Engagement of local communities in policy, incorporation of traditional and local knowledge, and the design of adaptation responses that recognize the diversity of local contexts and aspirations are essential for successful local adaptation strategies. This is particularly true in developing nations in the tropical Pacific where the 'ownership' of adaptation approaches is without doubt necessary for effective implementation.

Since 2005, the Wildlife Conservation Society (WCS) and conservation partners from the government and civil society have been working together with the communities of the Kubulau District, Fiji, to develop a flexible and responsive governance model for a ridge-to-reef protected area network. The initial locations of the community-managed protected areas were informed by baseline surveys of resource condition and resource use patterns, and determined through a participatory, consultative process. The resulting network of 17 village-managed fisheries closures (known as *tabu* areas), three district-wide no-take marine protected areas, one island nature reserve and one proposed forest park is managed under Fiji's first ridge-to-reef management plan. The Kubulau Ecosystem-based Management (EBM) plan, endorsed by the high council of chiefs in 2009 and overseen by the Kubulau Resource Management Committee (KRMC), contains management rules to regulate human activities and resource use within the protected areas network and adjacent lands and waters of the district.

Surveys by WCS of local residents in 2009 indicated high overall satisfaction with the management scheme due to perceived increases in resource availability and financial incentives to the community arising from a user fee scheme initiated by the Coral Reef Alliance (CORAL) through which divers pay for access to world class reefs in the Namena Marine Reserve. However, rigorous biological monitoring of fisheries resources by WCS showed mixed performance of the marine protected areas (MPAs) due to non-compliance with rules and overharvesting during periodic openings. Some of the non-compliance was due to lack of communication by KRMC members to the broader community about protected area boundaries and the rationale for closures.

In response to these issues and in order to improve socio-ecological resilience in Kubulau, WCS is working with village chiefs and the KRMC to adapt the protected area network, as well as make the EBM plan more “climate-ready”. To strengthen social resilience, WCS, CORAL and SeaWeb are piloting a new communications tool, the Community Educators Network, to help the KRMC deliver conservation and management messages to their constituents. Through tailored workshops, the KRMC learn how to draw upon traditional ecological knowledge as well as scientific information to empower them to communicate effectively in the village setting, particularly to target groups who have been previously under-represented in past management planning workshops, such as women and youth. To date, the training has resulted in increased enthusiasm for coral reef conservation, increased community organization, and improved awareness of how to mitigate threats to reefs, particularly from climate disturbance.

To build ecological resilience, WCS conducted surveys to identify coral reef sites with characteristics that promote resistance to and recovery from climate disturbance. WCS presented these results to the KRMC and village representatives at an adaptive management workshop in July 2011, along with data on factors that contribute to maintaining freshwater biodiversity. As a result, the Kubulau communities proposed to create one new marine *tabu* and one freshwater *tabu* area, expand four existing *tabu* areas and establish buffer zones around the three district-level MPAs. In addition, the Kubulau EBM plan will be strengthened with management actions to support more sustainable strategies for coping with the three major climate hazards (drought, non-season weather patterns, sea level rise/king tides) identified to be currently affecting the district.

Strengthening the Ability of Vulnerable Island Communities to Adapt to Climate Change in Papua New Guinea (PNG)

John Ross Sinclair

This study case exemplifies principles 3, 4, 6, and 7: it integrates flexible management structures that enable adaptive management; it minimizes trade-offs and maximizes benefits with development and conservation goals to avoid unintended negative social and environmental impacts; it promotes resilient ecosystems and uses nature-based solutions to provide benefits to people, especially the most vulnerable; and it is participatory, transparent, accountable, and culturally appropriate, and actively embraces equity and gender issues.

Climate change is expected to have multiple and possibly devastating effects on vulnerable small island communities like those found in the coastal areas of Papua New Guinea (PNG). Papua New Guineans are particularly vulnerable to the impacts of climate change given their reliance on natural resources. The sustainability of economic development, food security and livelihoods of people in PNG depend largely on the ability of small communities to manage the risks associated with these extreme events. Successful adaption to climate change is contingent on these communities being supported by effective social institutions, sound socio-ecological data, and robust planning mechanisms, where climate change adaptation is mainstreamed into development planning and on-the-ground measures.

A joint program of work among The Wildlife Conservation Society (WCS), Oxfam International, and the Research and Conservation Foundation of PNG (RCF) is addressing the need to reinforce ecological resilience through effective resource management and to strengthen capacity within local social systems to better enable communities in the rural island province of Manus, PNG, to adapt to the impacts of climate change. The project is funded by AusAID and has two objectives. The first is to develop tools and information to augment existing resource management programs to help communities prepare for and adapt to climate change. This is being achieved through the development of spatial databases to assess, monitor and model threats and local vulnerabilities to climate change and the development of school curricula and materials about climate change, climate change impacts and the linkage between healthy ecosystems and resilience to change.

A second objective is to use a learning-by-doing approach meant to increase capacity for government and local communities to enable them to adapt to climate change. This is being achieved through a number of activities: i) conducting training to build local capacity to monitor biological and socio-economic change; ii) producing science-based awareness materials about climate change, impacts of climate change and ecosystem-based adaptation for the general public, local decision-makers and planners; iii) conducting capacity-building activities to ensure

sub-national government and local communities are better equipped to incorporate climate change adaptation into local planning processes; and iv) working with sub-national government and PNG's National Agricultural Research Institute to advise communities on and implement diversification strategies to improve food security outcomes.

These targeted activities will help generate information on climate change for decision-making, educate local people on climate change, integrate climate change adaptation into local-level planning, and develop model approaches to improve food security and coastal protection.

Adapting to Environmental Change in the Tonle Sap Lake in Cambodia: Assessing Vulnerability and Participatory Adaptation Design for Fisheries Communities

Radhika Dave, Bunaara Min and Annette Olssen

Conservation International (CI) is working on a project to assess the ecological vulnerability of critically important habitat types and identify the adaptive capacity of communities living on the Tonle Sap lake. This project embodies several of the principles of ecosystem-based approaches to adaptation (principles 1, 5, 6, and 7) illustrating the multiple scales of operations, use of cutting-edge scientific information, integration of local knowledge, inclusion of participatory approaches to assess household vulnerability, and participatory development of adaptation solutions necessary to address the threats faced by the socio-ecological system.

The Tonle Sap Lake is a critically important ecosystem for Cambodian people and wildlife alike. Livelihoods and food security for millions of inhabitants of the Tonle Sap Lake area and floodplains are strongly dependent on this biologically rich lake, its seasonally flooded forests, and its rivers. In fact, the lake and its floodplains form one of the most productive inland fisheries in the world and provide fertile land for rice production. However, the lake, its biologically and economically important wildlife and fish species, and the ecosystem services used by the local people, are under threat from various anthropogenic pressures including climate change. More than 95% of the lake's flooded forest cover has been lost during the last three decades. At the same time , these forests are the breeding and feeding grounds for fish and other species. Therefore, their disappearance causes a massive loss in biodiversity and leads local fisheries to collapse, events that threaten food security at large scales. Climate change-induced alterations to the duration and intensity of the annual surge of floodwaters from the Mekong River into the lake are additional, emerging and urgent considerations that need to be included in management practices and plans.

Community risk assessments in six communities are being conducted to gather information on household and community level risk, and risk management strategies during the first year of this project. The six corresponding communities are located in two provinces, Pursat and Kompong Thom, situated on either side of the lake – three in a vast tract of flooded forest adjacent to a fish sanctuary and three within the lake's *UNESCO Man and the Biosphere* core zone, a Ramsar wetland site. These assessments form the basis of an approach that empowers communities to develop joint activities and management practices to enhance food security and livelihood resilience, particularly for traditionally underrepresented groups. The ecosystem-based activities supported through this project in its second year will range from building institutional capacity and

gaining access to necessary information to developing methods of managing the use of flooded forest habitats. Additionally, adaptation actions for enhancing the ability of critical habitat types to withstand the effects of climate change are being informed by mapping important habitat zones vulnerable to changes in the extent and duration of the annual flood pulse experienced by the lake. In order to understand longer term impacts, a set of ecological indicators will be selected through a workshop-driven process with practitioners and experts from different fields of study for inclusion into a monitoring framework to be piloted in the second year of the project.

The results of this project will be integrated into the existing management plans and inform district level socio-economic development planning processes in order to ensure long term impact. The results will provide relevant information for policy-makers to develop a comprehensive strategy for adaptation that enhances ecosystem resilience and the ability of people to adapt to change in this complex and unique ecosystem.

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