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Legal and Policy Tools to Adapt Biodiversity Management to Climate Change

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RESOURCE MANUAL

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Preface: The Climate Change Challenge for Biodiversity Governance

This resource manual is a call to use laws and regulations to adapt biodiversity management to the expected effects of climate change. Climate change will likely impact species and ecosystems that are already facing severe threats from invasive species, habitat degradation and fragmentation, overexploitation, and pollution. As climate change becomes more severe, gaps and weaknesses in existing legal frameworks and government policies are starting to appear. Current laws frequently assume or emphasize preservation of a status quo that may no longer be possible to maintain; they may impose burdensome requirements that do not advance rational policy objectives. Meanwhile, first efforts at adaptive management have tended to overlook the role of the law as a powerful adaptation tool.

This resource manual will help policymakers and stakeholders determine how their laws can be changed to meet these new policy objectives. Because the impacts of climate change are highly localized and uncertain, the manual is designed to offer a range of options for managing natural resources that can be adapted to a variety of contexts and capacities. Climate change presents an opportunity. We are at a moment when "longstanding and long-ossified legal and institutional arrangements over natural resources are destabilized, opening the door to new, creative, problem-solving approaches." [1]

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[1] Bradley C. Karkkainen, *Getting to "Let's Talk": Legal and Natural Destabilizations and the Future of Regional Collaboration*, 8 Nev. L.J. 811, 822, 825 (2008).

Using the principles of adaptive, ecosystem-based management, the resource manual shows how legal frameworks, regulatory programs, and management plans can provide a more resilient approach for long-term, sustainable resource governance in the face of climate change. The manual focuses on *in situ* management types (e.g., forests, fisheries, protected areas), the sustainable use of natural resources, and conservation of biodiversity. It does not cover the agricultural sector and does not explicitly focus on genetic resources. However, many of the principles and dynamic models of governance presented in the resource manual are relevant outside the context of biodiversity and natural resources management, and can be applied in many other areas of law and policy.

ELI staff was guided by an Advisory Committee of environmental practitioners in six countries: Peru, Dominican Republic, Uganda, Madagascar, Bhutan, and Vietnam. These countries have distinct ecological contexts, legal systems, and political, social, and economic situations. Examples and illustrations have been drawn from these and other developing countries to demonstrate the feasibility of innovative legal programs for adaptation in countries with limited governance capacity. This resource manual was also reviewed by many internationally respected experts on biodiversity and climate change issues. ELI is, of course, responsible for the final content, analysis, and recommendations.

How to Use the Resource Manual

This resource manual is intended for people who design or use laws and policies affecting biodiversity in countries with (i) a significant interest in protecting biodiversity in their ecosystems, (ii) high vulnerability to climate change, and (iii) moderate-to-high capacity for environmental governance. It provides two tracks of use:

1. Options for creating new legal and policy frameworks to improve adaptive biodiversity governance for climate change; and
2. Guidance for handling specific legal and policy issues in a manner that accounts for climate change and creates flexible and resilient permits, management plans, laws, and policies governing resources.

ELI's companion publication, *Strategic Options for Adapting Laws and Policies*, provides an overview for policymakers of the importance of using adaptive management to protect biodiversity in the face of a changing climate. This resource manual provides specific, detailed guidance for those drafting the laws, regulations, and policies needed to implement adaptive management. The resource manual may also be helpful for on-the-ground resource managers to find new ways to work with existing legal authorities and policies.

The resource manual is organized into three parts, which are divided into thirteen chapters:

- **Part 1** presents an overview of the key elements of adaptive, ecosystem-based management that forms the model discussed throughout the resource manual.
- **Part 2** sets out a wide variety of legal, regulatory, and planning tools that will allow managers to adapt to climate change.
- **Part 3** applies these functions in four distinct resource management situations: permitting, licensing, and concessions for natural resource access and extraction; community based natural resource management; protected areas on public lands and waters; and private lands conservation.

Options to incentivize and support participation and compliance in these approaches are presented throughout the manual, along with examples, case studies, and other suggested resources.

Acknowledgments

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About ELI Publications

ELI publishes Research Reports that present the analysis and conclusions of the policy studies ELI undertakes to improve environmental law and policy. In addition, ELI publishes several journals and reporters—including the Environmental Law Reporter, The Environmental Forum, and the National Wetlands Newsletter—and books, which contribute to education of the profession and disseminate diverse points of view and opinions to stimulate a robust and creative exchange of ideas. Those publications, which express opinions of the authors and not necessarily those of the Institute, its Board of Directors, or funding organizations, exemplify ELI's commitment to dialogue with all sectors. ELI welcomes suggestions for article and book topics and encourages the submission of draft manuscripts and book proposals.

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Part One: The Need to Adapt Biodiversity Management to Climate Change

Earth's biodiversity may be threatened by the worst extinction crisis in 65 million years.[2] Mounting evidence shows that climate change is accelerating the extinction rate and could have enormous negative consequences on natural resources that sustain livelihoods and economies.[3] The degree of climate change expected by 2050 may be enough to drive thirty percent of all species to extinction.[4] More than twenty percent of animal and plant species are likely to be exposed to a greater risk of extinction under a 2-3 oC increase in temperature.[5] Population declines are not limited to rare species. Climate change is affecting organisms long considered "immune" to extinction risk, such as timber species and oceanic fish stocks.[6] While some species and ecosystems may tolerate or even thrive with moderate levels of climate change,[7] previous predictions have consistently underestimated the impact of climate change on the environment and the global economy (see Figure 1). The security of human livelihoods, communities, and economic development gains are all at grave risk.[8] The more we learn, the clearer it becomes that actions to adapt or adjust to changing climatic conditions are urgently needed.

[2] IUCN, Extinction Crisis Continues Apace (Nov. 3, 2009), http://www.iucn.org/?4143/Extinction-crisis-continues-apace.

[3] Wendy B. Foden et al., *Species Susceptibility to Climate Change Impacts, in* Wildlife in a Changing World: An Analysis of the 2008 IUCN Red List of Threatened Species 77 (IUCN 2008).

[4] Chris D. Thomas et al., *Feeling the Heat: Climate Change and Biodiversity Loss*, 427 Nature 145 (2004).

[5] *See* A. Fischlin et al., *Ecosystems, Their Properties, Goods and Services, in* Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change 211-72 (M.L. Parry et al. eds. 2007).

[6] R.T. Kingsford et al., *Conservation Policy Issues for Biodiversity in Oceania*, 23 Conservation Bio. 834 (2009).

[7] Alan Lucier et al., *Forest Responses and Vulnerabilities to Recent Climate Change, in* Adaptation of Forests and People to Climate Change: A Global Assessment Report 29, 30 (IUFRO 2009).

[8] See Edward H. Allison et al., *Vulnerability of National Economies to the Impact of Climate Change on Fisheries*, 10 Fish & Fisheries 173 (2009); Jacob Silverman et al., *Coral Reefs may Start Dissolving when Atmospheric CO2 Doubles*, 36 Geophysical Research Letters L05606 (2009). Peter G. Jones and Philip K. Thornton, *Croppers to Livestock Keepers: Livelihood Transitions to 2050 in Africa Due to Climate Change*, 12 Envtl. Sci. & Pol'y 427, 434 (2008); U.B. Confalonieri et al., *Human Health, in* Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change 391 (M.L. Parry et al. eds., 2007); IUCN, Ecosystems, Livelihoods and Disasters: An Integrated Approach to Disaster Risk Management 13 (Karen Sudemeier-Rieux et al. eds. 2006).

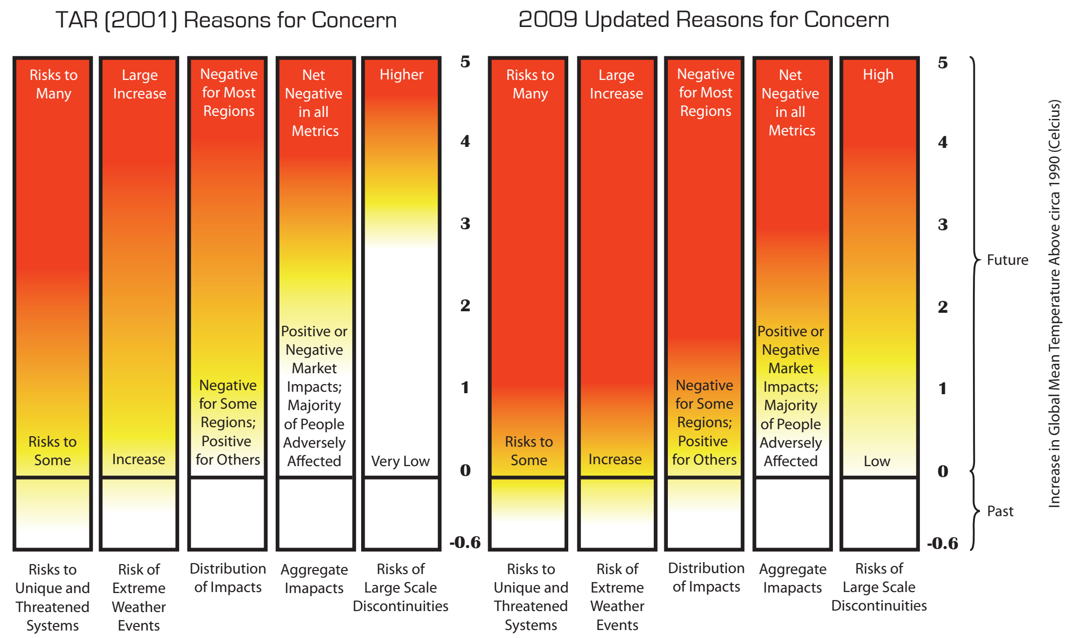

Figure I-1 "Burning Embers" In its 2001 "Third Assessment Report" (TAR), the Intergovernmental Panel on Climate Change (IPCC) used the five bars on the left to demonstrate how increasing temperatures increase the levels of risk in five specific reasons for concern. In 2009, researchers updated these bars with the latest research (on the right). They found the level of risk associated with each of the "reasons for concern" much higher than previously thought. An increase of just 1.0 ºC above 1990 levels (to which the planet may already be committed) poses a high risk to "unique and threatened systems."[1]

[1] Joel B. Smith et al., *Assessing Dangerous Climate Change through an Update of the Intergovernmental Panel on Climate Change (IPCC) "Reasons for Concern,"* 106 Proc. Nat'l Acad. Sci. 4133, 4134 (2009).

Photo credit: Frank Vassen

Figure I-2 Climate Threats to Wildlife Climate change is driving the resplendent quetzal higher up mountainsides in Costa Rica, but it will soon run out of higher-elevation habitat. One researcher calls this the "elevator to extinction." Seventy-nine percent of land-based bird species predicted to go extinct due to climate change currently are not legally categorized as threatened.[1] Another paper suggests that under only a 1 °C temperature rise, the suitable habitat of high-elevation bird species is likely to be reduced by half.[2]

[1] Adapted from Cagan H. Sekercioglu et al., *Climate Change, Elevational Range Shifts, and Bird Extinctions,* 22 Conservation Bio. 140 (2008); *Climate Change will Significantly Increase Impending Bird Extinctions, Study Says,* Stanford Report (Dec. 6, 2007); Nicolas Ruggia, *Climate Change a Threat to Costa Rican Fauna, Another Study Finds,* Tico Times (Jul. 17, 2008).
[2] N. L. Rodenhouse et al., *Potential Effects of Climate Change on Birds of the Northeast,* 13 Mitigation & Adaptation Strategies for Global Change 517 (2008).

Figure I-3 Projected Impacts of Climate Change on Biodiversity[1]

Climate Change Impacts		Effects on biodiversity in vulnerable regions, subregions and ecosystems
Increased air temperatures	Increased number of hot days	• Increased heat stress on biodiversity • Increased exposure to pests and diseases • Increased drying of wetlands and waterways
	Melting permafrost	• Changes in nutrient cycling and soil biodiversity • Reduced access to food sources as a result of repeated freeze-thaw cycles • Loss of cryosoil-based ecosystems and species • Drainage of lowland Arctic tundra • Sea level rise resulting in particular on islands, salt water intrusion in coastal wetlands and other inland waters (particularly on islands), increased mortality and disturbance of critical habitats, and increased erosion (beaches / coastal cliffs)
	Decreased ice cover in polar regions, oceans, and high elevations (later freeze and earlier breakup)	• Reduced winterkills of both species of concern and pests • Decreased spring flooding leading to reduced deposition of sediments in floodplains • Sea level rise resulting in salt water intrusion in coastal wetlands and other inland waters, increased mortality and disturbance of critical habitats, and increased erosion (beaches / coastal cliffs)
	Increased water temperature	• Decreased dissolved oxygen • Increased vulnerability to invasive alien species • Coral bleaching and/or coral mortality • Increase of disease among fish • Loss of habitat for cold- and cool-water fish • Reduced productivity of marine systems (coral reefs and seagrass beds)
	Glacial retreat and decreased snow cover	• Changing hydrological regimes • Changes in seasonal cues for mountain biodiversity • Increased predation • Disruptions in hibernation patterns • Reduced insulating protection from snow • Loss of snow bed ecosystems and species
Changes in precipitation regimes	Increased instances of drought during the dry season in some areas	• Loss of ground cover leading to desertification and loss of soil biodiversity • Increased water stress on biodiversity • Reduced availability of food and fodder • Salinization in irrigated areas • Increased risk of fire • Changes in natural flow regimes of rivers and streams • Changes of alpine grassland to steppe
	Increased flooding during the wet season in other areas	• Increased erosion of soil • Increased land degradation • Increased threats from water-borne disease • Increased habitat destruction from flooding • Changes in natural flow regimes of rivers and streams
Increased frequency of extreme climatic events	Disruption in growth and reproduction	• Decreased overall productivity • Increased mortality
	Heightened storm surges	• Increased mortality and disturbance of critical habitat • Habitat loss (especially mangroves, reefs, sandbars and beaches)
Sea level rise	Salt water intrusion in coastal wetlands	• Increased mortality and disturbance of critical habitat • Salt water intrusion (coastal wetlands) • Increased erosion (beaches / coastal cliffs)

[1] Adapted from Convention on Biological Diversity, Biodiversity and Climate Change, UNEP/CBD/SBSTTA/12/7, annex 1 (Mar. 27, 2007).

Figure I-3 illustrates the broad categories of impacts on biodiversity anticipated from climate change.

Policymakers and Managers Face High Uncertainty

Despite wide recognition that action is necessary, it is often not clear what should be done to adapt biodiversity protection to climate change. Which adaptations should be prioritized? Which measures will be effective not just in the short term but the long term? Policymakers and resource managers face high uncertainty in climate change impacts, especially when in the short term these impacts are more the result of increased climate variability rather than a clear trend in one direction or another. Models are not always able to predict the frequency, severity, and location of extreme weather events, much less secondary and synergistic effects, such as fire and invasive species spread. In many parts of the world, incomplete or very short historical records make it difficult to establish baselines against which to compare changing conditions.[9]

A 2009 survey by the U.S. Government Accountability Office of nearly two hundred natural resource managers in the United Kingdom and at the U.S. state and federal level found that their climate adaptation efforts were weak to nonexistent because of the following factors:

- **Low Priority:** Limited resources are dedicated to more immediate needs while long-term threats like climate change go unaddressed.
- **No Data:** Insufficient site-specific data make it hard to predict the localized impacts of climate change and more difficult for officials to justify current expenses for adaptation efforts for potentially less certain future benefits.
- **Weak Frameworks:** Adaptation efforts are constrained by a lack of clear roles and responsibilities among different levels of government officials.[10]

While these responses may not hold true in all countries, they point to the need for a new approach to resource law that drives and directs adaptive, proactive resource conservation and management.

Building Legal and Policy Tools for Responding to Climate Change

Constitutions, statutes, regulations, management plans, permitting rules, guidance documents, and other legal instruments have an extremely important role in responding to climate change impacts. There is a vast and growing set of policies, initiatives and projects to adapt to climate change around the

[9] *See, e.g.*, Ariel E. Lugo, *Novel Tropical Forests: The Natural Outcome of Climate and Land Cover Changes, in* Climate Change and Biodiversity in the Americas 135, 136-39 (Adam Fenech et al. eds. 2009).

[10] U.S. GAO, Climate Change Adaptation: Strategic Federal Planning Could Help Officials Make More Informed Decisions, GAO-10-175T, at 4 (October 2009), *available at* http://www.gao.gov/products/GAO-10-113.).

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CLIMATE VARIABILITY: *This manual uses the term "climate change" to refer both to the increased variability of climate conditions in the short term and uni-directional shifts in climate conditions over the long term.*

"Bad" Adaptation?

Actions people take in response to climate change that fail to provide necessary long-term adaptation benefits, or which cause additional problems to the ones they were meant to solve, are called **maladaptive**. For example, a coastal city might build a levy to keep out rising ocean tides but this has the effect of increasing flooding and fragments coastal habitat. This measure could be said to be maladaptive.

world. The role of environmental law in this effort is to ensure these efforts do not become a "train without tracks"[11]—a series of well-intentioned efforts without a guiding structure for long-term implementation. The law supplies political legitimacy, predictability, mechanisms to enforce obligations, and a framework for long-term, dedicated action.

[11] *See* Annecoos Wiersema, *A Train without Tracks: Rethinking the Place of Law and Goals in Environmental and Natural Resources Law*, 38 Envtl. L. 1239 (2008).

The law also provides a forum to mediate disputes over resources. This is especially important for climate adaptation because as impacts of climate change intensify, there will be increasing conflicts over scarce resources. Rural communities faced with failing agricultural systems due to extreme drought or flooding may turn to the exploitation of surrounding resources for alternative livelihoods. At the same time, many wild species will likely need more protection, not less, to help them adapt to the effects of climate change. The success of biodiversity conservation increasingly depends on measures to adapt to climate change in many sectors, including water management, forestry, fisheries, mining, and agriculture. An integrated management approach is essential, as is a legal framework for carrying it out.

This resource manual provides a set of options for assessing, using, and improving regulatory tools (or creating new ones) for adaptive ecosystem management in the face of climate change. The key elements of strongly adaptive legal frameworks are:

Goals: Achievable objectives and measurable benchmarks that drive conservation policies forward and provide a standard to evaluate laws' effectiveness

Flexibility: Ongoing, continuous decision making processes (rather than one-time-only assessments) to provide support for reassessing and adjusting policies, plans, and standards as conditions change and new information is gathered

Data: Monitoring requirements, incentives, and procedures for data collection and analysis that track changes in the biological, chemical, and physical characteristics of ecosystems over long time periods

Learning: Information collection, management, and sharing with the public, stakeholders, and other agencies and governments to inform future decision making

Cooperation: Coordinated and integrated policies and regulatory programs for coherent governance at the ecosystem level

Accountability: Effective balance between flexibility in on-the-ground decision making and enforceable standards and oversight to ensure improving outcomes over time

Box I-1. International Conservation Treaties and the Call for Adaptation Legislation

In undertaking legal reforms at the national and subnational levels, policymakers can draw on a range of international programs and authorities established by decisions of the Conferences of the Parties under several major conservation treaties (see Table 2). Above all, the call for policy and legal action to adapt biodiversity governance to climate change, in spite of uncertainty, is grounded in the **Precautionary Principle, as stated in Principle 15 of the Rio Declaration**: "*In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*"[1]

[1] Rio Declaration on Environment and Development, Principle 15, June 13, 1992, 31 I.L.M. 874, 879.

Box I-2. Financing Adaptive Legal Frameworks and Management Strategies

Many of the concepts presented in this resource manual require dedicated financial support to carry out—something many developing countries will find difficult to provide. Greater commitments of financial and human resources are critical to defending biodiversity in the face of climate change. This is an investment with long-term benefits. The relevant cost comparison is between (a) management that fails to consider climate change (the status quo), leading to biodiversity die-off and economic losses; and (2) management that considers climate change (the adaptive approach), which allocates resources where they will be most effective and ensures ecosystems continue to provide goods and services. Failing to act is itself an action and will lead to negative consequences.

Although assessing financing options for adaptation is outside the scope of this manual, there is a growing network of funding and financial mechanisms that developing countries can access. This is a non-exhaustive list of international funding sources:[1]

- Global Environment Facility (GEF)
  - Strategic Priority on Adaptation Fund
  - Least Developed Countries Fund
  - Special Climate Change Fund
- United Nations Framework Convention on Climate Change
  - Adaptation Fund (overseen by Adaptation Fund Board)
  - Commitments by developing countries made at Copenhagen in December 2009; overseen by Advisory Group on Climate Change Financing
- World Bank
  - Climate Investment Fund (with Regional Development Banks)
  - Pilot Program for Climate Resilience
  - Global Facility for Disaster Reduction and Recovery (with the U.N. International Strategy for Disaster Reduction and donor governments)
- Asian Development Bank
  - Small Grants for Adaptation Actions
  - Climate Change Fund
  - Water Financing Partnership Facility
  - Poverty and Environment Fund
- African Development Bank
  - Climate Risk Management and Adaptation Strategy
- Inter-American Development Bank
  - Sustainable Energy Climate Change Initiative
- Bilateral Opportunities
  - U.S. Aid for International Development (USAID)
  - UK Department for International Development (DFID)
  - Netherlands Climate Assistance Programme (NCAP)
  - Japan International Cooperation Agency (JICA)
  - European Union Global Climate Change Alliance

[1] Jordan Diamond and Carl Bruch, *The International Architecture for Climate Change Adaptation Assistance, in* Climate Change Adaptation and International Development: Making Development Cooperation More Effective (Fujikura and Kawanishi, eds. Japan International Cooperation Agency 2010).

This chapter introduces core concepts in biodiversity and natural resources management that will shape climate adaptation law, policy, and regulation:

- Climate change adaptation
- Adaptive management
- Ecosystem-based management

1.1 Adaptation: The Need to Consider Climate Change

Key Point: "Adaptation" includes a broad range of activities, policies, and social responses to climate change. By assessing and improving the design and function of legal frameworks governing biodiversity, policymakers, managers, and other stakeholders can develop a *planned* and *anticipatory* adaptation strategy that *reduces vulnerability* to climate change and *responds to impacts* of climate change.

The term "**climate change adaptation**" refers to the effects and consequences of climate change and measures to respond to those impacts. (Climate change **mitigation**, by contrast, refers to measures to reduce greenhouse gas emissions as a cause of climate change.) There are many definitions of climate adaptation. The IPCC defines it as:

> 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, autonomous and planned adaptation:
>
> **Anticipatory adaptation** – Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.
>
> **Autonomous adaptation** – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
>
> **Planned adaptation** – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.[12]

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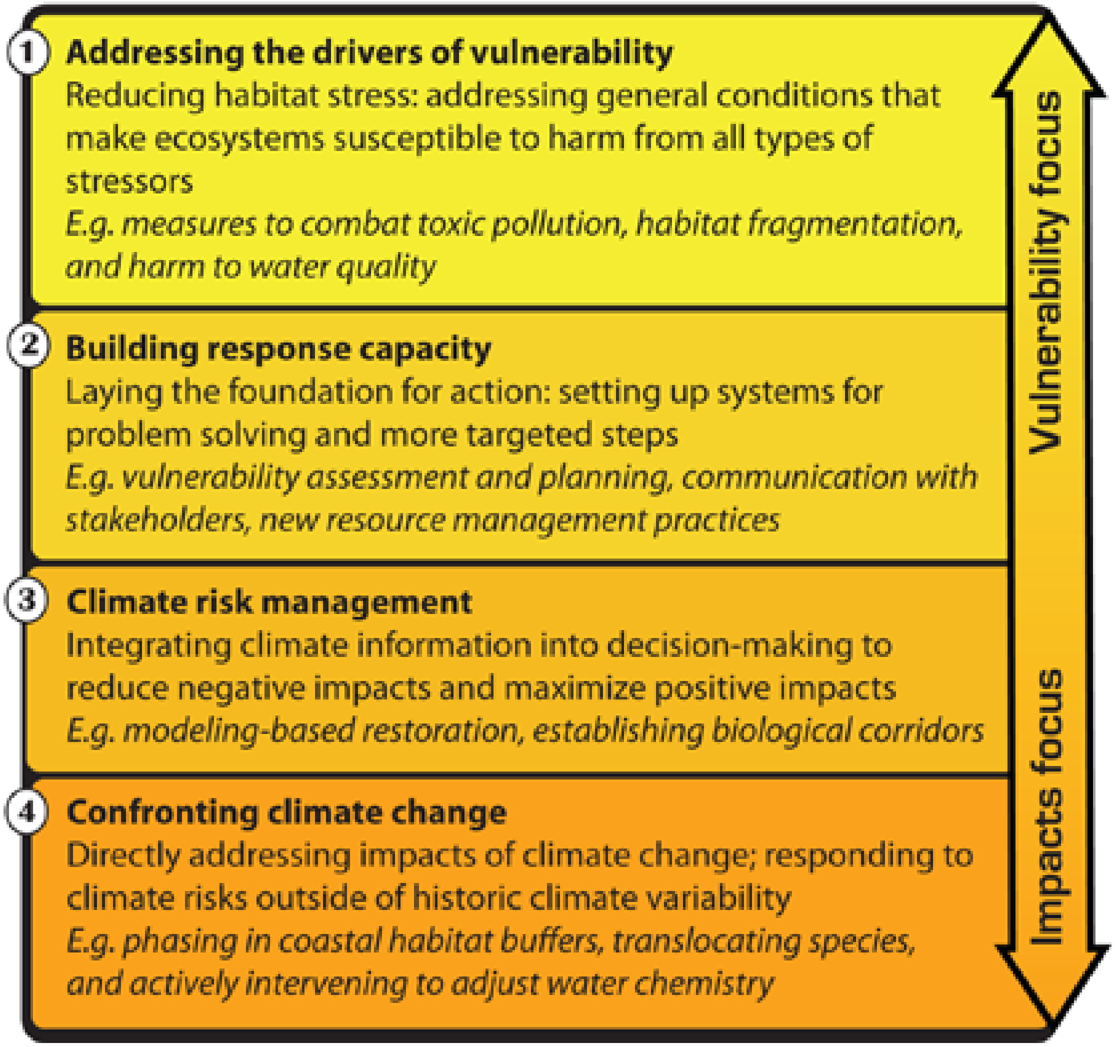
ADAPTATION refers to measures to respond to the effects of climate change.

[12] IPCC Fourth Assessment Report, Working Group II Report, Impacts, Adaptation and Vulnerability, Glossary, 869 (2007).

Figure 1.1 A Spectrum of Responses to Climate Change



[1] Adapted from Heather McGray et al., Weathering the Storm: Options for Framing Adaptation and Development (World Resources Inst. 2007), at 18.

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VULNERABILITY refers to the level of danger climate change poses to a resource or community.

This resource manual presents legal and policy options to carry out the first (anticipatory) and third (planned) types of adaptation to protect the biodiversity of resources. In the context of biodiversity conservation, this narrower definition of adaptation may be useful:

> Climate change adaptation for natural systems is a management strategy that involves identifying, preparing for, and responding to expected climate changes in order to promote ecological resilience, maintain ecological function, and provide the necessary elements to support biodiversity and sustainable ecosystem services.[13]

Adaptation takes place along a spectrum of policies and activities ranging from 'vulnerability-focused' to 'impacts-

[13] Katie Theoharides et al., Climate Change Adaptation across the Landscape: A Survey of Federal and State Agencies, Conservation Organizations and Academic Institutions in the United States (discussion draft, February 10, 2009).

focused' (see Figure 1.1).[14] Vulnerability-focused activities help reduce general risks that may put people and the environment in greater danger from climate change effects. Impacts-focused activities are designed to respond to specific climate change effects.

The adaptive management techniques presented here, particularly scenario planning (Chapter 4), information gathering tools (Chapter 5), and community outreach measures (Chapters 2 and 10), can all be used to support vulnerability assessments that will allow policymakers to identify priority areas for adaptation measures in their countries or regions.

Box 1.1. Vulnerability Assessments for Climate Change

Adaptation planning generally starts with a vulnerability assessment. The assessment helps to identify priorities for specific adaptation measures based on a determination of which groups, sectors, or communities are most at risk from the impacts of climate change. Vulnerability assessments can be done at the national level (such as the National Adaptation Programmes of Action (NAPAs) carried out by Least Developed Countries (LDCs)). Or they can be done at much smaller scales, such as for a specific economic development project. The U.S. Agency for International Development (USAID) uses a six-step approach to guide vulnerability and adaptation (V&A) planning at the project level:

1. Screen for vulnerability
2. Identify adaptation options
3. Conduct analysis
4. Select course of action
5. Implement adaptation
6. Evaluate the adaptation[1]

[1] USAID, Adapting to Climate Variability and Change: A Guidance Manual for Development Planning (2007).

[14] Heather McGray et al., Weathering the Storm: Options for Framing Adaptation and Development (World Resources Inst. 2007).

1.2 Adaptive Management: Basic Models and Core Elements

Key Point: Adaptive management is a process for making decisions in an iterative manner based on lessons learned and changing circumstances. It provides a set of tools for both policymakers and managers to confront uncertainties caused by climate change.

The tools of adaptive management include:

- A guide for taking effective action in the face of uncertainty
- A method of increasing understanding through collection, sharing, and use of information
- A framework for achieving improved management outcomes with flexibility in how to achieve them[15]

Adaptive management uses ongoing, periodic phases of implementation, monitoring, and adjustment to improve understanding and management of natural systems under conditions of uncertainty. This is distinct from many traditional methods of resource decision making in which little investigation, learning, or adjustment is done after an initial choice has been made. In contrast, adaptive management calls for "synthesizing existing knowledge, exploring alternative actions, making explicit predictions of their outcomes, selecting one or more actions to implement, monitoring to determine whether outcomes match those predicted, and using these results to adjust future plans."[16] Adaptive management is most often expressed in the simple phrase, "learning-by-doing."

"**Adaptation**" to climate change and "**adaptive management**" are not the same thing. There are aspects of climate adaptation other than adaptive management, and adaptive management has been used for many years outside the context of climate adaptation. However, adaptive management is a very important model for implementing climate change adaptation measures, because efforts to adapt are constrained by the problem of uncertainty and complexity of ecosystem responses, and adaptive management provides a framework for navigating and addressing that uncertainty.

Climate change adaptation requires adaptive management, and adaptive management requires a framework of law to guide its implementation. However, existing laws governing biodiversity have often proved to be a poor fit for adaptive management because they do not provide clear guidance, rules of procedure, and other safeguards to ensure it is done properly. In the United States, where adaptive management has been used for many years, this has at times resulted in lack of agency follow-through, management failures, and misuse of the process.[17] Adaptive management in the absence of clear rules of procedure has

[15] *See* Joseph Arvai et al., *Adaptive Management of the Global Climate Problem: Bridging the Gap between Climate Research and Climate Policy*, 78 Climate Change 217 (2006).

[16] Carol Murray and David Marmorek, *Adaptive Management and Ecological Restoration, in* Ecological Restoration of Southwestern Ponderosa Pine Forests 417-18 (Peter Friederici ed. 2003).

[17] J.B. Ruhl, *Regulation by Adaptive Management—Is it Possible?*, 7 Minn. J. L. Sci. & Pol'y 21 (2005).

Box 1.2. A Six-step Process for Adaptive Management[1]

Assess existing situation, information, stakeholders, and collective objectives

Design and adopt measures (e.g., law, policy, permit, or programme), which are necessarily provisional

Implement management as an experiment to test theories and learn best practices

Monitor key trends, compliance, and effectiveness of measures

Evaluate effectiveness through periodic reviews using the new information

Adjust strategies and continue the cycle; reassess overall situation periodically.

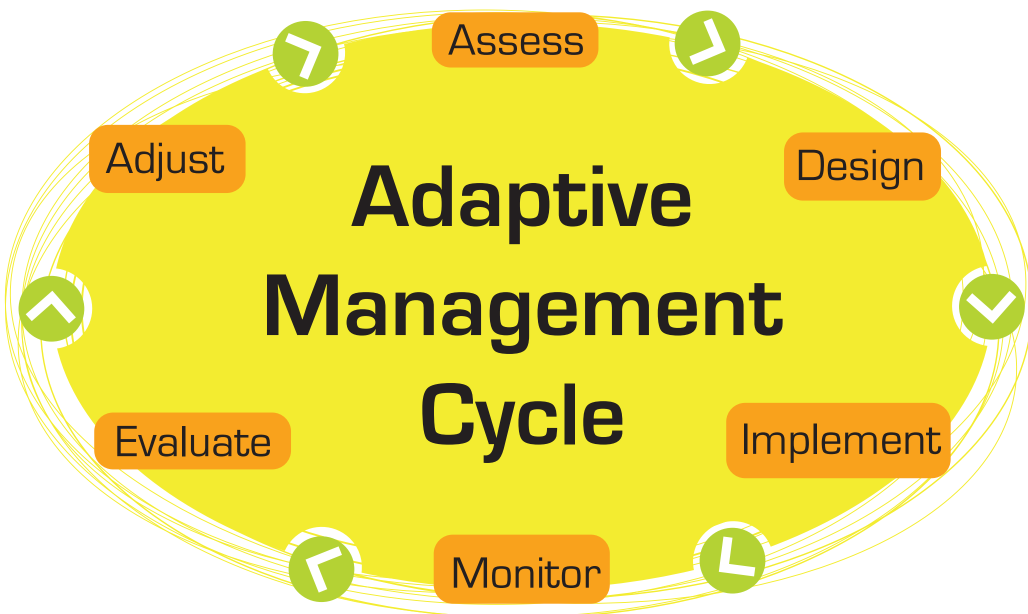


Figure 1.2 The Adaptive Management Cycle

[1] Copyright © Province of British Columbia. All rights reserved. Reprinted with permission of the Province of British Columbia. www.ipp.gov.bc.ca

been criticized for increasing discretion at the expense of accountability.[18]

[18] Bradley C. Karkkainen, *Adaptive Ecosystem Management and Regulatory Penalty Defaults: Toward A Bounded Pragmatism*, 87 Minn. L. Rev. 943 (2003).

Based on past attempts to implement adaptive management, there are several things that we can safely say it is **not**:

- Adaptive management is not an excuse to forego gathering all available information before developing a management plan. The phrase

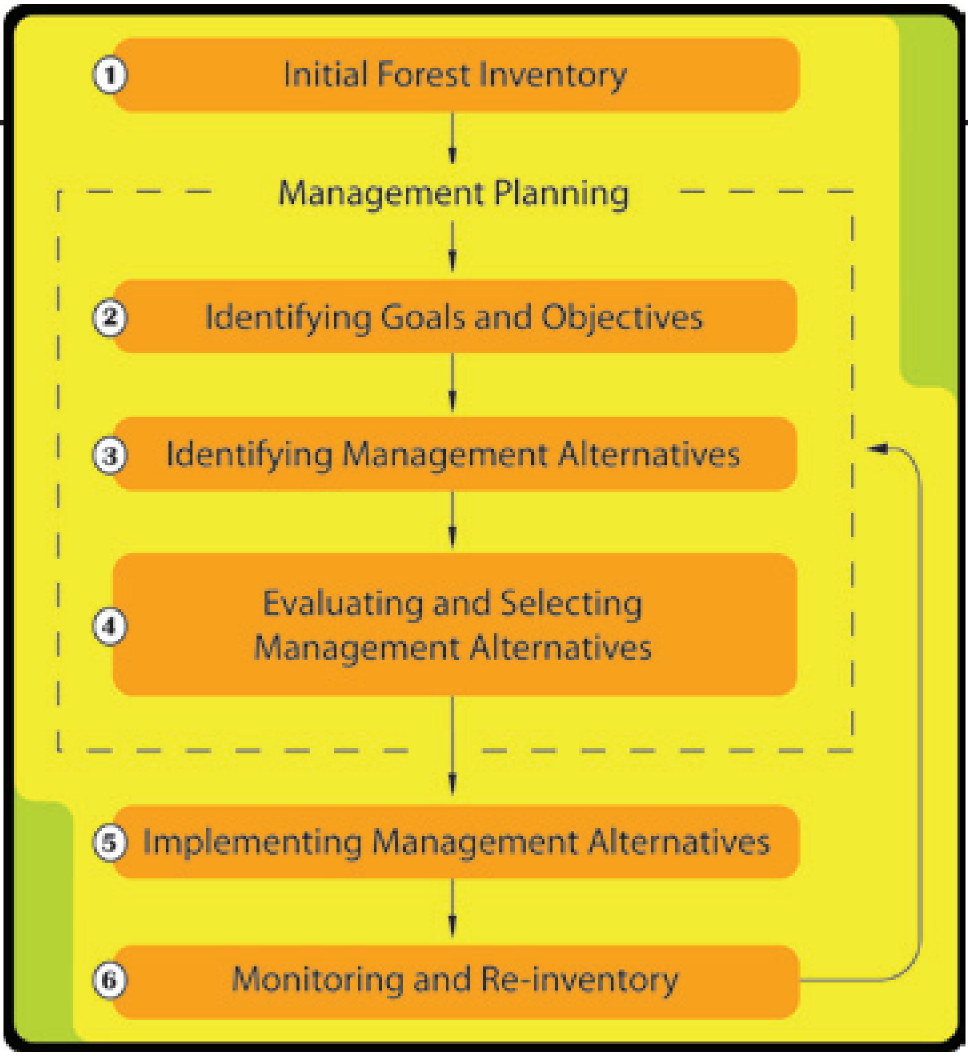


Figure 1.3 Adaptive Natural Resource Management
This diagram demonstrates adaptive management as applied in a forest resources management context. This could be adjusted to apply to other types of natural resource management. The requirement to complete an "initial inventory" is explicit here. Establishing an historical baseline against which to measure future trends is essential for effective management of resources in fluctuation due to climate change. [1]

[1] McDill, Marc. 1999. Forest Management Planning: A Vision for the Pennsylvania DCNR Bureau of Forestry. Presentation to the PA DCNR Ecosystem Management Advisory Committee. February 10, 1999. http://www.personal.psu.edu/mem14/FOF_FPI.PDF, p. 3.

"learning-by-doing" is not intended to be an excuse to avoid rigorous analysis of information at hand prior to the "doing."

- Adaptive management does not favor more intensive use of natural resources over non-consumptive conservation options. Adaptive management is not a deregulatory structure, and it calls for a more rigorous program of implementation and testing to identify the most ecologically sound strategies for managing and conserving natural resources.

- Adaptive management is not a purely scientific exercise in which stakeholders, democratic processes, and value choices have no role. Rather, adaptive management uses a rigorous scientific process to develop, test, and improve management strategies. But these strategies will be used to accomplish goals and objectives that are defined in large part by economic needs and social values.

1.3 Ecosystem-based Management

Key Point: Effective biodiversity management in the face of climate change requires close attention to trends in the physical, chemical, and biological elements of ecosystems. Ecosystem-based management provides a model for holistic biodiversity governance rather than focusing exclusively on a particular species, resource, threat type, or sector.

Ecosystem-based management (also called the "ecosystem approach") is closely related to adaptive management. The two models are increasingly linked as part of the same basic management approach. Ecosystem management emphasizes the importance of taking into account the complexity of interactions between the biological, chemical, and physical elements of a defined area. Changes in these patterns caused by climate change might include: warming and chemical changes in water bodies, the arrival of new species, the loss of endemic species, and changes in nutrient cycles and water cycles. Whereas older models of resource management tended to focus only on a single target resource (such as an economically valuable timber species), ecosystem management calls on managers and stakeholders to take into account the relationships between the target resource and other ecological features and services, such as predator-prey relationships, nutrient and hydrological cycles, and the influence of human activities on the system.[19]

Like adaptive management, ecosystem-based management is a very important tool for biodiversity adaptation to climate change. The Convention on Biological Diversity urges member governments to take an ecosystem-based approach to adaptation, in order to ensure

> a flexible management framework to address climate change mitigation and adaptation activities in a broad perspective. This holistic framework considers multiple temporal and spatial scales and can help to balance ecological, economic, and social considerations in projects, programmes, and policies related to climate change mitigation and adaptation. "Adaptive management," which allows for the reevaluation of results through time and alterations in management strategies and regulations to achieve goals, is an integral part of the ecosystem approach.[20]

Chapter 7 covers in detail legal and policy tools for coordinating and integrating different agencies, institutions, businesses, and other societal actors in order to ensure that adaptation to climate change systematically incorporates the larger ecosystem.

[19] *See* Envtl. L. Inst. (ELI), Ocean and Coastal Ecosystem-Based Management: Implementation Handbook (2009), *available at* http://www.eli.org/Program_Areas/ocean_ebm.cfm.

[20] Interlinkages between Biological Diversity and Climate Change: Advice on the Integration of Biodiversity Considerations into the Implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol, CBD Technical Series No. 10, at 4 (2003), *available at* http://www.cbd.int/doc/publications/cbd-ts-10.pdf.

terms on page

ECOSYSTEMS are a combination of the organisms and non-living elements that exist in a particular space, over a period of time. They occur at different scales, from the micro-organisms in a drop of water to the size of an entire island. Humans are powerful actors within ecosystems, even if they do not always realize it.

Box 1.3. The 12 Principles of the Ecosystem Approach of the Convention on Biological Diversity

The objectives of management of land, water and living resources are a matter of societal choice.

Management should be decentralized to the lowest appropriate level.

Ecosystem managers should consider the effects (actual and potential) of their activities on adjacent and other ecosystems.

Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-based management programs should:
a.) Reduce those market distortions that adversely affect biological diversity (i.e., eliminate perverse subsidies, etc.);
b.) Align incentives to promote biodiversity conservation and sustainable use;
c.) Internalize costs and benefits in the given ecosystem to the extent feasible (including full accounting for ecosystem goods and services).

Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

Ecosystems must be managed within the limits of their functioning.

The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

Recognizing the varying temporal scales and lag effects that characterize ecosystem processes, objectives for ecosystem-based management should be set for the long term.

Management must recognize that change is inevitable.

The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

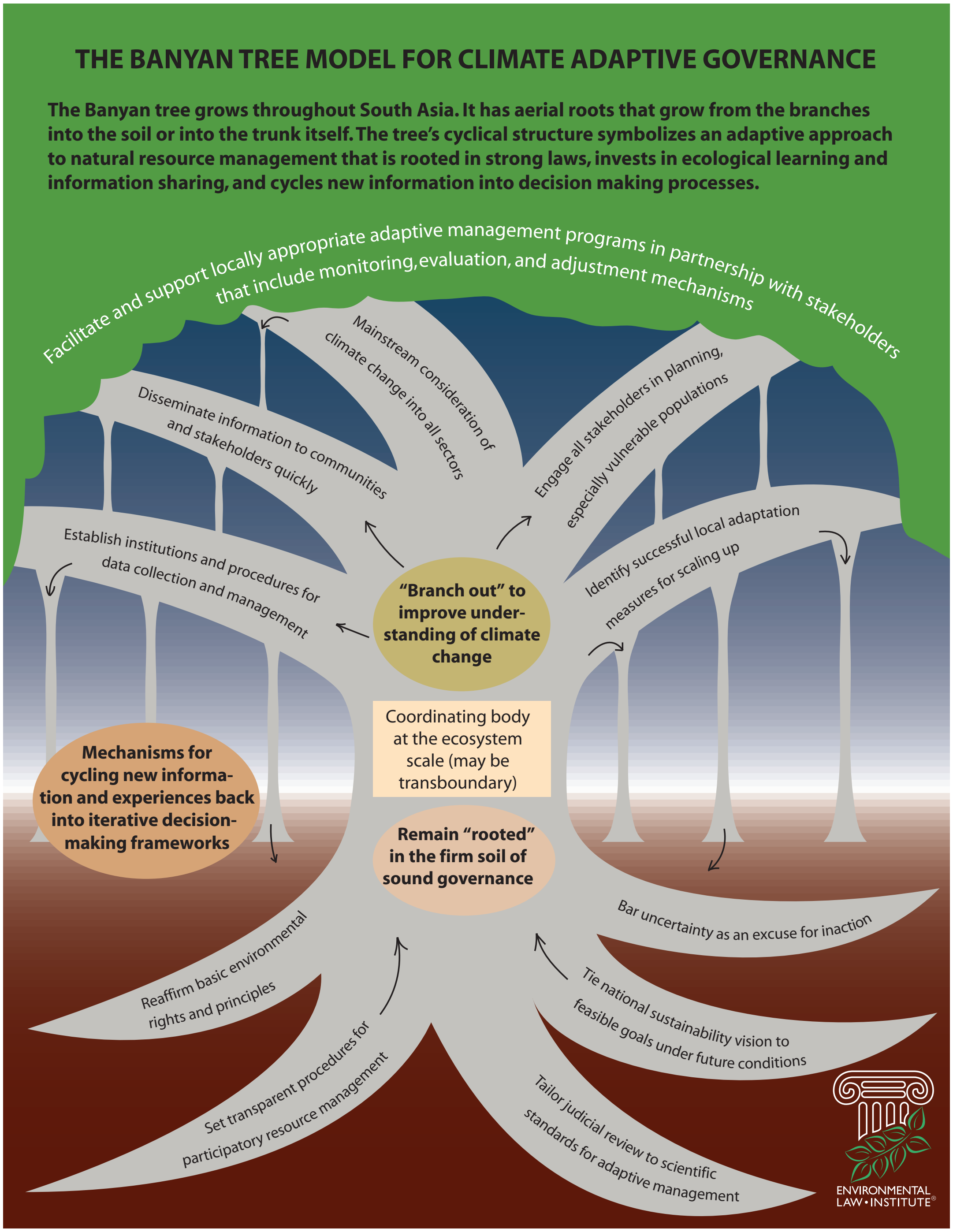


Figure 1.4 The Banyan Tree: Putting it All Together A fully adaptive, ecosystem-level structure for biodiversity management might look something like this. The banyan tree grows throughout South Asia. It has aerial roots that grow down from the branches back into the soil. This symbolizes the cyclical nature of adaptive resource governance. In this model, information and lessons learned from localized management (the 'branches') is systematically used to improve decision making at larger scales and in other regions. This system relies on many of the existing principles and values in environmental law, but adds a set of more robust information-forcing mechanisms to improve learning and increase the resilience of the system to climate change. This resource manual covers each of these elements in greater detail.

Adaptive management experiments can be categorized into two types: "passive" and "active." In passive adaptive management, alternatives are assessed, and the management action deemed best is designed and implemented. Monitoring and evaluation then lead to appropriate adjustments. In active adaptive management, managers explicitly recognize that they don't know which activities are best, and then select several alternative activities to design and implement. Monitoring and evaluation of each alternative help in deciding which was more effective in meeting objectives, and adjustments to the next round of management decisions can be made based on those lessons.[21]

Box 2.1 Adapting with the Tools Available There are a variety of methods of actively learning while engaged in management activities, including computer modeling, laboratory work, extrapolation from other systems, and compiling and analyzing historical data.[1] For resource agencies in developing countries, however, these methods may actually be more difficult than designing "do-it-yourself" experiments that rely less on technological instruments and more on a strong commitment of human resources and good organization.

[1] Holly Doremus, *Precaution, Science, and Learning While Doing in Natural Resource Management*, 82 Wash. L. Rev. 547, 570 (2007).

Active adaptive management, even more than "passive" adaptive management, calls on managers to question initial assumptions and intentionally test management hypotheses by "navigating through trial and error and conscious experimentation." Though more difficult to implement, it may be more effective for ecological learning and management in the face of climate change.[22] Use of active adaptive management techniques on several plots or zones may be an appropriate response to climate change, but will likely need legal authorization and guidance before managers can use it responsibly and effectively.

[21] Murray and Marmorek, *supra* note 16, at 420-21.

[22] *See* Bd. on Sustainable Dev., Nat'l Research Council, Our Common Journey: A Transition Toward Sustainability 6-7, 10 (1999).

2.1 Using Test Plots or Zones as a Tool for Learning

Key Point: Active adaptive management uses testable hypotheses and "experimental" management plans to improve learning about ecosystems. The more active experimental approach allows managers to more quickly determine how climate change is affecting managed resources and which techniques best respond to its impacts.

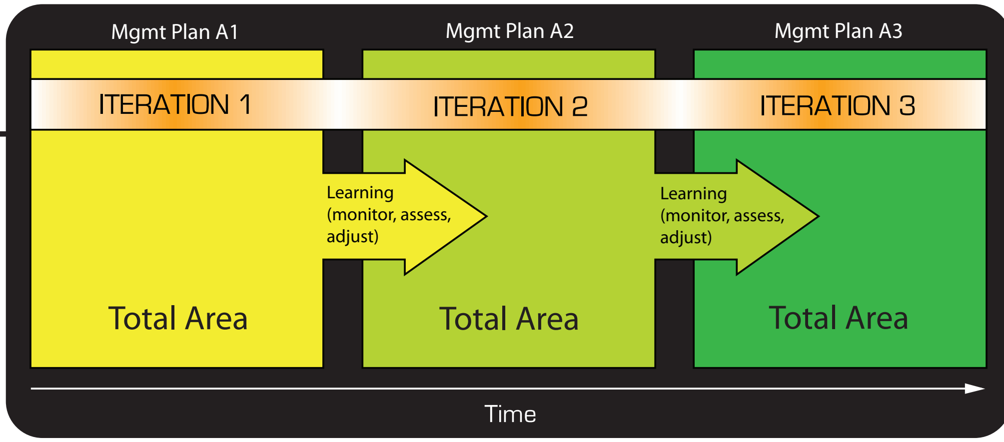
The key element of active adaptive management is the concurrent implementation of several different management strategies to see which performs best over a given time period. An important consideration in setting up a project like this is that the zones or areas selected for different strategies should be as similar as possible in all characteristics except the element to be tested. This needs to be done in order to isolate the factors in management that are driving the different outcomes. For example, let's say managers are working to protect a coral reef system that is highly stressed due to climate change and a host of other human factors. They believe one way to protect the coral reef is to reduce the harvest of a species of fish that consumes an algae that prefers warmer water and harms the coral. By reducing harvest of the fish species, the managers believe the algae population can be kept in check, giving the coral reef a better chance of surviving the warmer water temperatures. At the same time, managers believe that agricultural runoff from nearby lands is also negatively impacting the coral reef. But they are unsure whether the high levels of nutrient pollution or the algae are a greater threat to the coral.

Traditional laws governing resource management do not give managers much authority or guidance for organizing management experiments to test their theories. Active adaptive management, however, gives them a framework for trying several different approaches and learning which works best for the coral reef.

Another consideration before implementing an active adaptive management program is that larger-scale projects (e.g., covering an entire forest unit rather than a single timber permit) will be in a better position to use a zone-based, experimental approach. In the United States, the Northwest Forest Management Plan covering several states is the strongest example of the benefits of a regional-scale approach to adaptive ecosystem management. These types of projects provide economy-of-scale benefits:

- Broader assessment of regional trends caused by the effects of climate change
- Greater use of trade-offs to build consensus between competing interests
- Greater manipulation of variables among different zones, including the establishment of "control" areas to be used as the standard against which results can be compared
- Greater flexibility to revise management guidelines to reflect lessons learned
- Greater engagement from high-level political actors

I. Passive Adaptive Management



II. Active Adaptive Management

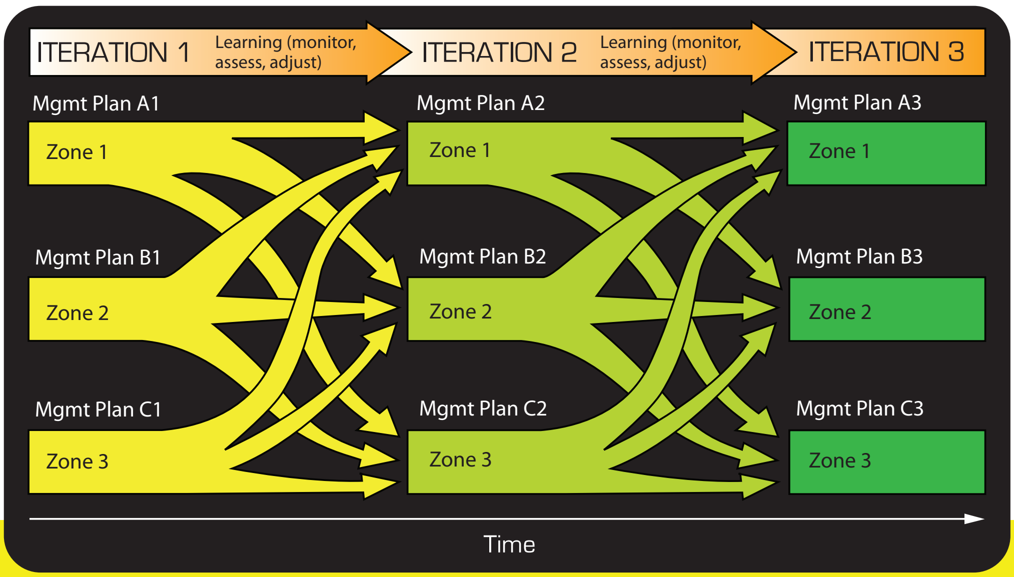


Figure 2.1 Passive v. Active Management In passive adaptive management (top), a single management strategy is selected for implementation, monitoring, evaluation, and periodic adjustment. In active adaptive management (bottom), managers may select a number of management techniques to apply in separate zones. This allows them to more quickly test hypotheses about the ecosystem and the most effective management strategies.

- National legislatures more willing to allocate specific funding for projects that allow an "integrated resource planning" approach intended to provide co-benefits across sectors
- Greater ability to command deference for experimental activities from reviewing courts due to the higher level of scientific and regulatory expertise[23]

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[23] Robert Fischman and J.B. Ruhl, *Adaptive Management in the Courts*, 95 MINN. L. REV., draft at 23-31 (forthcoming 2010), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1542632&rec=1&srcabs=1528963.

2.2 Negotiating Trade-offs and Avoiding Inequitable Results

Key Point: Despite the potential benefits of active adaptive management in terms of accelerated learning and improved outcomes, special care must be taken to ensure vulnerable resources and communities are not exposed to greater harm from climate change as a result of a poorly designed experimental plan.

Active adaptive management requires trust, cooperation and equity across stakeholder groups. Careful planning and monitoring of ecosystem status are necessary to ensure damage is not done to a resource. If harm does occur, it may exacerbate preexisting tensions between stakeholders and cause an escalation in resource conflict. The active method is most appropriate where all stakeholders are capable and prepared to commit themselves to an equitable distribution of its risks and benefits.

To avoid or reduce these problems and ensure equity among participating resource users, a strong foundation of legal rights and relationships is essential. The rights and duties of the various stakeholders should be recognized and, depending on the complexity of the management plan, clarified with respect to the proposed strategy. This can be done through an agreement or contract negotiated among stakeholders under the leadership of or mediated by government officials. Such an agreement will be shaped by many local, place-based considerations, but might include:

- Provisions for dispute resolution, including court review or neutral arbitration
- Indemnification of a particular user group if that group suffers a substantial loss in value of their resource as a result of the experimental management strategy under which they are operating
- Benefits obtained from one management variant shared equitably by all stakeholder groups engaged in the program
- Special evaluation of the impacts on any identified marginalized groups such as women, low-income, or racial, ethnic or religious minorities
- Frequent reviews of implementation of variants to quickly identify and halt those management variants that are determined to be harmful to the resource
- Swift and severe penalties of any attempt to sabotage, alter, or falsify the scientific information gathered from implementation, or to in any way disrupt the process of learning and evaluation established in the management plan
- Multiple, redundant safeguards using a mixture of independent oversight and checks and balances to prevent capture of the process by any one interested party (See the first bullet)

2.3 Case Study: Active Adaptive Shark Fisheries Management in Mexico

Key Point: Mexico's shark management program is strongly adaptive and provides a model for adaptive frameworks for climate change because it:

- Sets achievable objectives at the whole ecosystem level
- Acknowledges uncertainties and establishes a framework for answering them
- Uses multiple strategies that can be evaluated simultaneously to learn the best management techniques more quickly
- Sets comprehensive monitoring requirements that respect different capacities

Sharks are a vital natural resource for the Mexican economy, providing a source of food, tourism revenues through sport fishing and diving excursions, and income for Mexico's shark fisherfolk. Although the numbers of shark vessels and permits for shark fishing have remained stable over the last decade, there has been a decrease in the volume of coastal shark captures. Moreover, recent studies show that approximately half of the production of commercially important shark species in the Gulf of Mexico consists of immature or neonate organisms, indicating instability in the reproduction and maintenance of the shark populations.[24]

In response, the Mexican government has developed two evolving legal instruments: the National Plan of Action for the Management and Conservation of Sharks, Rays, and Related Species (the Plan) and the Official Mexican Regulatory Norm for the Responsible Fishing of Sharks and Rays (the Regulation). The Plan is explicitly designed to be an adaptive, transparent, permanent, yet flexible management plan that contains important scientific information, considers stakeholder needs, and includes policy recommendations.[25] The Regulation establishes strict and enforceable regulations governing the shark fisheries. The interworking of these two instruments provides an effective model for collaboration between stakeholders and regulators in which the Plan development process generates management strategies as new threats emerge and provides an institutional mechanism to move new information into the legal requirements of the Regulation.

The Mexican management scheme demonstrates high adaptive management capacity in other respects. The legally-binding Regulation establishes achievable **ecosystem-based management objectives**, for example: reducing capture of neonate and juvenile sharks, and reducing the detrimental effect of over-fishing of sharks not just on shark

[24] Norma Oficial Mexicana NOM-029-PESC-2006, Pesca responsable de tiburones y rayas.
Especificaciones para su aprovechamiento [Official Mexican Norm NOM-029-PESC-2006, Responsible Fishing of Sharks and Rays], Diario Oficial de la Federación [D.O.], 0.10, .011, 14 de febrero de 2007 (Mex.) [hereinafter NOM-029-PESC-2006].

[25] Comisión Nacional de Acuacultura y Pesca y Instituto Nacional de la Pesca, Plan de Acción Nacional para el Manejo y Conservación de Tiburones, Rayas y Especies Afines en México [Mexican National Action Plan for the Management and Conservation of Sharks, Rays, and Related Species] 7 (2004) [hereinafter PANMCT].

populations, but other deepwater fishes and the marine ecosystem. The Plan explicitly identifies **knowledge gaps** that impede the development of best management practices and makes them learning objectives to be met over the course of implementation. Among these objectives, the Plan lists the following: (a) identification and location of critical shark habitat areas; (b) the improvement and systematization of biological data collected from shark captures; and (c) the evaluation of threats to shark populations.[26]

The Plan specifies focus areas for research to improve future management, such as studies to determine what time periods and in which locations ships are catching pregnant females.[27] Incidental taking by fishing vessels not licensed to take sharks is not well quantified, so this is an area for study as well.[28] (Incidental takes also create a regulatory gap that could threaten the entire management program.) Similarly, the Regulation makes clear that there are many unknown regulatory factors related to biological and environmental conditions, fishing technology, and cultural and economic needs, that must be determined, evaluated, and implemented.[29] The Regulation directs the National Commission on Aquaculture and Fishing (CONAPESCA), Mexico's fisheries authority, to determine these factors in consultation with all stakeholders, including state and regional governments, non-governmental environmental organizations, and the fishing industry.[30] By defining at the outset the information needed in order to develop effective management, the Plan creates a motivating framework for data gathering and information assessment.

The Plan allows for an **active adaptive management** approach through use of multiple fishing zones. The Plan lists possible alternative management strategies without endorsing any one in particular and recommends that multiple strategies be allowed and employed through the Regulation. Through actual experience and evaluation, the various management plans will be allowed to adapt and develop in future versions of the Regulation. The Plan identifies five ocean zones with similar climatic, ecological, and economic conditions and calls for the application of different management strategies in different zones so that the most adequate matches for each zone can be determined.[31] Because a wide range of techniques are encouraged to be used simultaneously within a range of specified ocean zones, the Plan can accurately be described as an active adaptive management scheme. Such a system of zones and multiple management strategies allows CONAPESCA and regional fisheries offices the flexibility to employ the form of management best matched to their local resources, monitoring capability, and learning objectives. Thus, management and learning can occur simultaneously, and what is learned from

[26] *Id.* at 7.
[27] *Id.* at 20.
[28] *Id.* at 23.
[29] NOM-029-PESC-2006, *supra* note 24, at 0.16.
[30] *Id.* at 0.16.
[31] PANMCT, *supra* note 25, at 41-42.

earlier stages of management can then be employed to adjust future regulation.

The Plan and the Regulation employ **diverse monitoring and reporting techniques**. The Regulation goes beyond monitoring for compliance with regulations and requires data to be collected on multi-factor ecological indicators of the status of the fisheries and habitat. Monitoring programs provide for the systematic collection of data on shark species abundance, percentage of juvenile sharks per catch, size of sharks, and numbers of pregnant sharks caught. This data can then be used to inform future changes to the regulations and management programs authorized by CONAPESCA. (In many countries, this level of monitoring may not be feasible; options for supporting monitoring programs are discussed in Chapters 5.3 and 10.5.)

Differences in stakeholder capacities are respected by monitoring and reporting regulations that apply differently to licensees depending on the size of the fishing vessel. The rules for shark vessels greater than ten meters in length are more stringent, and include participation in satellite mapping and reporting precisely on catches by volume and species.[32] This allows Mexico's agriculture and fisheries ministry, SAGARPA, to coordinate information about species and shark characteristics in each catch to specific oceanic zones so that information on migration areas, reproductive regions, and species abundance can be more readily evaluated.

Large ships must also participate in the On-Board Observers program that requires a ship's captain to admit, house, and feed a technical observer designated by SAGARPA; to provide the observer with adequate work space; and to take actions to facilitate the activities of the observer during fishing expeditions. Such actions may include helping to liberate sea turtles from fish hooks, supporting the observer in recording accurate information, especially related to fish captures, and providing communication and navigation instruments.[33] The On-Board Observers program provides a means to both ensure licensee compliance with Regulation provisions and to confirm the accuracy of licensee-reported statistics.

There remain gaps in Mexico's shark management system. Most critically, although the Plan and the Regulation call for evaluation of many ecological indicators, chemical and physical changes to the environment caused by climate change are not among them. The adaptive characteristics of the program may allow these impacts to be assessed, but this analysis may be fragmented or incomplete without clearer guidance in the framework documents. Also, the management framework does not comprehensively address undocumented catches, by-catch, small vessel non-compliance, and other means by which individual or small-scale actions in the aggregate undermine management ob-

[32] NOM-029-PESC-2006, *supra* note 24, at 4.3.10.3-7.

[33] *Id.* at 4.3.10.7.

jectives.[34] In Mexico, fishing for personal consumption requires neither a license nor a permit.[35] Although the Regulation applies to vessels that incidentally take sharks pursuant to other activities,[36] very little information is available on the extent of impact of these vessels on the shark fisheries.[37] A lack of incentives to encourage shark fisherfolk to participate and comply with the management plan increases the likelihood that illegal fishing will continue.

[34] Exequiel Ezcurra et al., *Gulf of California, Mexico, in* Ecosystem-Based Management for the Oceans 227, 242 (Karen McLeod and Heather Leslie eds. 2009).
[35] Reglamento de la Ley de la Pesca [Rules for the Law of Fisheries], *as amended*, Diario Oficial de la Federación [D.O.], Artículo 31º, 28 de Enero de 2004 (Mex.).
[36] NOM-029-PESC-2006, *supra* note 24, at 1.2.
[37] PANMCT, *supra* note 25, at 23.

Chapter 3 Public Participation in Adaptation and Adaptive Management

This chapter discusses several different roles for the public and communities in adaptation measures for biodiversity. In many societies, the close proximity of communities to rich biodiversity areas makes it essential that they be included in management efforts generally. These programs and elements are an intrinsic and fundamental part of the ecosystem-based management model for adaptation presented in the two preceding chapters. **Public participation** programs enhance climate adaptation efforts by:

- Including all stakeholders, who may have different experiences, ideas, or lessons to share about climate change
- Helping to avoid independent or individual actions to adapt to climate change that are maladaptive or cause unnecessary harm to ecosystems or biodiversity
- Providing checks and balances to ensure efforts at adaptive management are implemented fairly and according to correct procedures
- Integrating different modes of knowledge (scientific, multi-disciplinary, traditional, local, and indigenous knowledge), each of which contributes different insights on adapting to climate change
- Creating a vested, growing, and informed base of local actors engaged in management issues related to climate change over the long term

terms on page

PUBLIC PARTICIPATION refers broadly to the requirements, opportunities, and resources used to ensure all members of the public have the opportunity to learn about and influence official decision making.

Box 3.1 Local Communities and Climate Change The Convention on Biological Diversity calls on parties "when addressing research needs and activities on the impacts of climate change on biodiversity, to involve indigenous and local communities and other relevant stakeholders, particularly on issues related to ecosystem health, human health, traditional knowledge, and livelihoods."[1]

[1] CBD COP, Decision VIII/30 (2006).

3.1 Applying the Tools of Participation and Collaboration to Biodiversity Adaptation

Key Point: Existing public participation requirements, information disclosure rules, and programs for decentralized or community-based natural resource management can be used to strengthen adaptation to climate change.

The tools of public participation, collaboration, and citizen oversight used in environmental law have important roles to play in building more adaptive governance structures. By increasing the pool of participants in management and giving voice to a larger number of perspectives and considerations, management institutions can more quickly identify emerging concerns and develop response strategies.[38] Tools to increase participation in management include:

- Public comment periods on proposed government activities
- Public surveys of attitudes and experiences with climate change
- Personal interviews about attitudes and experiences with climate change
- Mapping projects for indigenous or local lands and resources to establish baselines of resource availability
- Broad right of stakeholders and the public to comment on government actions or private activities requiring an environmental impact assessment related to climate change, and enforceable requirements

[38] *See* Claudia Pahl-Wostl, *A Conceptual Framework for Analysing Adaptive Capacity and Multi-level Learning Processes in Resource Governance Regimes*, 19 Global Envtl. Change 354, 361 (2009); J. Sendzimir et al., *Assessing the Resilience of a River Management Regime: Informal Learning in a Shadow Network in the Tisza River Basin*, 13 Ecol. & Soc'y 11 (2007).

Figure 3.1 Options for Level of Community Participation[1]

Level of Participation	Description
1. Fully active (Highest)	Community members make decisions in partnership with implementing agency or groups and are committed to acting together
2. Deciding together (Higher)	Community members are empowered and facilitated in order to determine options and make decisions
3. Consultation (Moderate)	Community members participate actively in discussions but lack decision making authority
4. Information collection (Lower)	Community members are surveyed and results are analyzed externally
5. Passively informing (Lowest)	Community members are informed of the situation or process

[1] Govan, H., Aalbersberg, W., Tawake, A., and Parks, J. (2008). Locally-Managed Marine Areas: A guide to supporting Community-Based Adaptive Management. The Locally-Managed Marine Area Network. http://www.lmmanetwork.org/files/lmmaguide.pdf.

on agencies to consider those comments

- Legal right of non-governmental organizations (NGOs) and community groups to participate in regulatory or judicial proceedings related to climate change or adaptive management
- Information disclosure requirements, including limits on information that can be withheld as confidential by agencies (with protections for business)
- Publicly accessible and easy-to-use databases of information on regional climate impacts

There are varying degrees of public participation. (See Figure 3.1.) Mechanisms and methods of participatory resource governance, ranging from assessment of stakeholder attitudes about climate change to fully active, devolved community management, are presented in Chapter 11.

3.2 Active Information Exchange with Stakeholders and the Public

Key Point: Actively providing information to stakeholders and the public is as important as gathering and storing data. Institutions, networks, technology, and other strategies that get information to the right people quickly improve responsive capacities for climate change and can also improve methods of responding to climate-related disasters such as hurricanes, flooding, or forest fires.

Building institutional capacity for information sharing can improve the relationship between governments, civil society, resource users, and other stakeholders. Information sharing also gives resource users the ability to make smart choices about when and how they harvest or extract resources in response to changing climate conditions. Both sides have something to gain by sharing information with one another.

The existence and scope of information-sharing laws should be explored and their mandates adapted to build institutions for robust, real-time information exchange on climate change. Allowing the public relatively wide access to environmental information ensures that it moves quickly to those who need it. (See Chapter 9.3 on legal rights to environmental information.) In organizing the data gathered through ecosystem monitoring programs, it will be useful to develop a user-friendly **database** that is easily accessible.[39] The use of a searchable online "clearinghouse" is an effective means to do this.[40]

The next step in information management is active information dissemination. Disclosure rules that allow government to withhold data until it is specially requested can significantly delay adaptation measures by the public. Climate change requires that resource agencies communicate in a much more active and timely manner with communities and resource users. Active information dissemination can be done through a number of venues:

- Radio/TV announcements
- Billboards and other large advertisements (e.g., on buses or trains)
- VHF shortwave radios
- Social networking websites
- Text messages
- Newspapers, churches, schools, community bulletin boards

The nature of the audience is an important consideration in undertaking climate adaptation outreach and information campaigns for the public. Climate data, especially when presented in dense, scientific terminology, may frighten, confuse, or alienate some communities.

terms on page

DATABASES or clearinghouses refer to systems that allow people to easily locate and access documents, reports, data or other information relevant to management decisions.

[39] Sergej Olenin, *Online Alien Species Database: Experience of Regional Cooperation in the Baltic Sea Area, in* Report prepared for the Experts Meeting Towards the Implementation of a Global Invasive Species Information Network (GISIN), 6-8 April, 2004, *available at* http://www.gisinetwork.org/Documents/ProceedingsPDF/GISINProc2004_Olenin.pdf.

[40] For examples, see Baltic Marine Biologists Working Group on Non-indigenous Estuarine and Marine Organisms, http://www.corpi.ku.lt/nemo/; Clean Air Initiative for Asian Cities, CitiesACT, http://www.citiesact.org/; SERVIR, http://www.servir.net/en/; and DAISIE European Invasive Alien Species Gateway, http://www.europe-aliens.org/.

Explaining climate impacts and uncertainties in terms and by methods that are locally meaningful and context-specific will improve people's receptivity of the information.

example

Research on fishing communities on the Rio de la Plata in South America found maladaptive, over-exploitative patterns of fishing due to uncertainties resulting from climate variability.[41] The fish moved depending on the location of suitable water temperatures, making them difficult to locate. When they were found, the fishermen tended to overharvest out of uncertainty that the fish could be located again. Researchers concluded the most immediate need for both the fish and the fishermen was not more stringent regulation: this would only weaken the strained level of trust between managers and resource users. Rather, the fishermen needed better information on where the fish would be found and how to avoid overharvesting. They proposed an "Adaptation Control Information System," to allow for collaborative adaptive management between stakeholders and agencies that would prioritize "integration of local and scientific knowledge, training, enhancement of data collection systems, weather and climate forecasting, and real-time communication to users (fishermen [and the] Coast Guard)."[42]

[41] Gustavo Nagy et al., *Adaptive Capacity for Responding to Climate Variability and Change in Estuarine Fisheries of the Rio de la Plata*, AIACC Working Paper No. 36, at 8 (August 2006).
[42] *Id.* at 13.

3.3 Community-led Adaptation Strategies

Key Point: Adaptation to climate change necessarily occurs at a local level to respond to localized impacts of climate change. Community engagement and ownership of the adaptation planning process is a crucial component of any larger adaptation policy framework.

Long-time residents of an area, including traditional or indigenous communities, often have extensive knowledge of their local ecology. This knowledge can supplement scientific knowledge, or may be sufficient on its own to guide a local community's development of adaptation strategies. Traditional knowledge includes information related to climate change trends and impacts, such as:

- Interpretation of meteorological and climatic phenomena
- Management of relationships between society and ecosystems
- Adaptation to environmental and social change[43]

For many communities, drawing on their own traditions for adaptation

Box 3.2. Respecting Indigenous Peoples' Rights in Adaptation Decision-making

Indigenous people are "peoples" as that term is used in international law to denote groups with inherent rights, including rights to self-determination. Often they possess rights to and management authority over land and resources—powers recognized in Article 26 of the U.N. Declaration on the Rights of Indigenous Peoples. Although the particular contours of these rights are complex and varied, and their current authority over aboriginal lands and resources may be in the form of **co-management**, indigenous peoples are different from other local communities or groups. For example, a decision to impose hunting limits on a species determined to be at risk under severe climate conditions may conflict with tribal rights to take that animal. While there is no simple answer in these cases, conservation officials and policymakers will need to give due consideration to legal issues of sovereignty and self-determination before going forward with an adaptation plan. When indigenous peoples are affected by adaptation strategies taken by other governmental entities, their involvement is likely better understood in terms of "consultation" rather than "participation."[1]

[1] *See generally* Mirjam Macchi et al., Indigenous and Traditional Peoples and Climate Change (IUCN 2008).

terms on page

CO-MANAGEMENT refers to any resource management program in which decision-making power is shared between multiple parties.

[43] Int'l Council for Science, Science, Traditional Knowledge, and Sustainable Development (2002).

Box 3.3. Media Campaigns in Peru to Educate and Motivate Adaptation

In the Pirua region of Peru, the government led a Climate Change Press Campaign to bring climate change awareness to the local community and promote adaptive responses to climate change.[1] The Campaign engaged more than 120 local community members, including farmers and fisherfolk, and was supported by municipal and regional governments. The goal was to increase awareness in the Pirua community of climate change adaptation and advocate the development of a regional strategy. This effort resulted in several significant accomplishments:

Regional government enacted a law establishing a technical group to make recommendations on climate change adaptation

Community resolved to plan for adaptation to climate change

Information on climate change and adaptation was disseminated through regional media, including to neighboring cities outside the awareness campaign

The parties developed a regional adaptation strategy.

[1] Julio Garcia, *Country Experience in Bottom-up Approach in V&A Assessments*, Presentation at CGE Hands-on Training Workshop on V&A Assessments, Paraguay (2006), *available at* http://unfccc.int/national_reports/non-annex_i_natcom/cge/items/3775.php.

mechanisms will promote the acceptance of such measures. For example, traditional breeds of livestock and agricultural produce that have been displaced by foreign breeds or hybrids may prove more adaptive to climate change than their replacements. Traditional methods of insurance that covered disaster or famine victims could be helpful. However, it is also important to recognize that there will be situations where climate change impacts are so significant that they are beyond the ability of the local community to cope, and outside assistance or support is necessary.

Experiences over the last twenty years with community-based management and decentralization of resource governance provide important lessons for what role such management can play in adaptation strategies. The Assessment of Impacts and Adaptations to Climate Change (AIACC) project synthesized these lessons into a set of indicators for determining when conditions are appropriate for community-based management for adaptation. They include:

- Maintenance of a diverse and flexible range of livelihood options
- Maintenance or improvement of the production potential of the resource base
- Effectively functioning institutions for local governance and resource management

- Economic and other benefits to incentivize sustainable use of the resource
- Implemented policies and laws that are effective, with the authority to apply them handed down to the lowest capable level
- Responsible external facilitation
- Local power relations that are favorable to community-based resource management[44]

Discussion of options for community resource management and decentralization is provided in Chapter 11.

[44] G.P. Von Maltitz et al., Adapting Conservation Strategies to Accommodate Impacts of Climate Change in Southern Africa, S. Africa AIACC Working Paper No. 35, at 27 (2006).

3.4 Building Collaboration into Adaptive Ecosystem Management

Key Point: While science is critical in designing adaptive management projects, local communities and stakeholders who may not have formal scientific backgrounds should also be involved in their design and in making the non-scientific value choices that may be required.

Adaptive management is often presented as a science-heavy, technocratic process. In reality, there is nothing contradictory about including the public, resource stakeholders, community members, business interests, or civil society in adaptive management programs (see Figure 3.3). Adaptive management is designed on scientific principles and should follow the scientific method (e.g., making hypotheses about the ecosystem; designing experiments in management; taking measures to control variables; and rigorous monitoring and information management). And at a minimum, scientific experts should be retained as consultants or facilitators to assist communities in designing their management experiments. However, non-scientists have multiple, essential roles to play in adaptive management:

- Identifying ethical, legal, or rights-based concerns with a proposed management plan
- Identifying interests that will be impacted and trade-offs that may be necessary in carrying out a management plan
- Participating in decision-making about core choices or values (e.g., questions related to ultimate goals and rights-based concerns)
- Using local, traditional, or indigenous knowledge to design hypotheses about the system for testing through adaptive management
- Contributing to the implementation of a management plan through assistance with monitoring, outreach, education, and compliance assurance activities

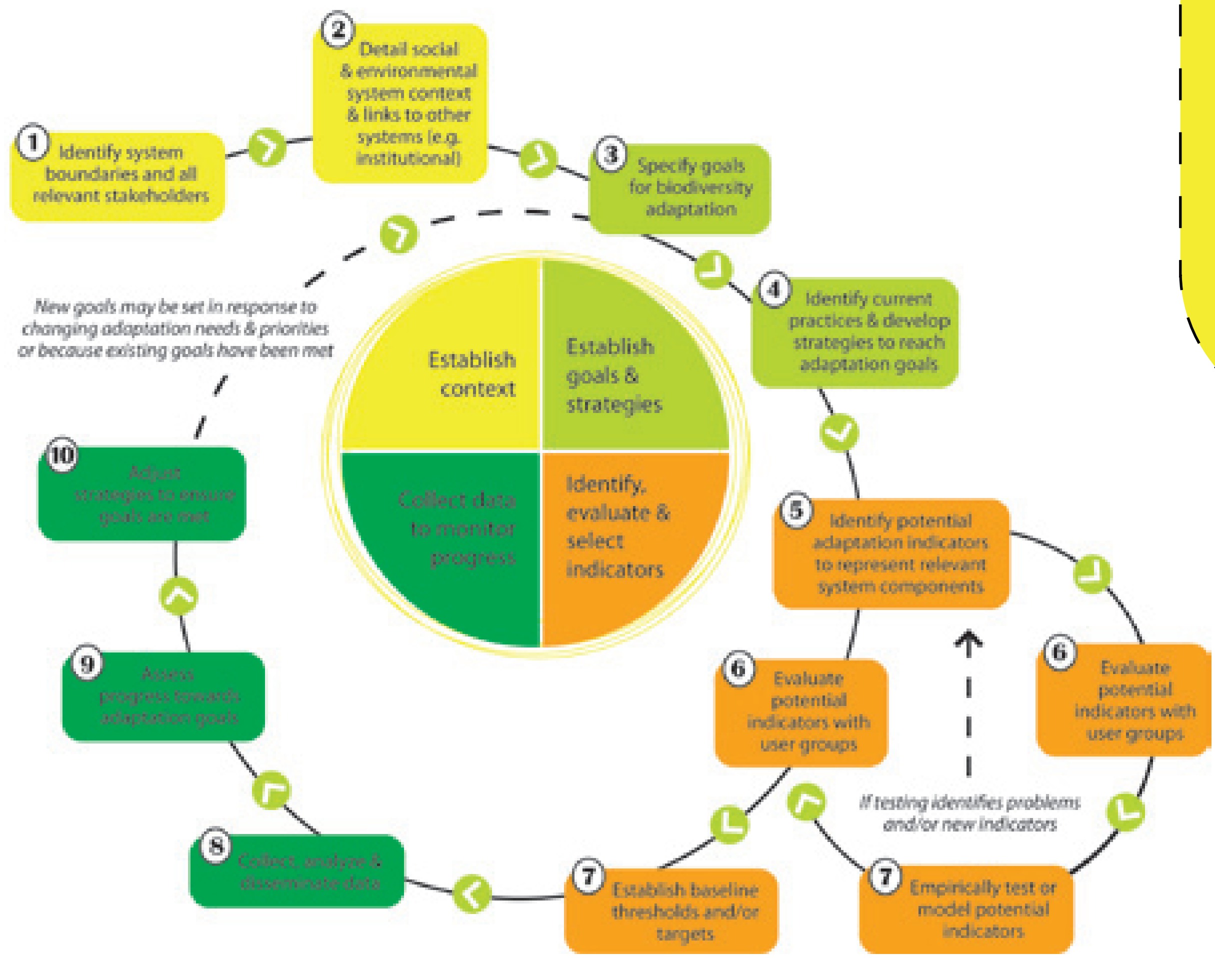

Figure 3.3 Social Values Inform Adaptive Management This adaptive management model incorporates community and stakeholder values and interests in identifying boundaries, goals, strategies, and indicators. In this model, even the "goals" (Box 3) are adjustable. The ability to revisit and adjust goals and priorities is important but should not be allowed to undermine long-term sustainability objectives. Adaptive management should be rooted in both science and societal needs and use a process that is itself subject to periodic reevaluation.[1]

[1] Reprinted from Ecological Economics, Vol. 59, Mark S. Reed et al., *An Adaptive Learning Process for Developing and Applying Sustainability Indicators with Local Communities*, Page 414 (2006), with permission from Elsevier.

Part 2: Legal and Regulatory Options for Adaptive Resource Management

This part presents options for using legal and policy tools to guide adaptive management programs for resilient biodiversity protection in the face of climate change.

At different levels of government, being "adaptive" means different things. A legal and policy structure for adaptive resource management programs will likely rely on mandatory reporting requirements, audits, inspections, compliance and enforcement mechanisms, and other 'hard' legal requirements. These will look very different from the flexibility mechanisms in the management plans they authorize. Frameworks for adaptation through adaptive management create a resilient, feasible, and enforceable legal framework where flexible, adaptive management can take place.

The chapters in this Part are broken down by "functional" area of law. Within any statutory framework there are provisions related to planning and policy setting, management authority, standard setting, enforcement, judicial review, etc. Each of these aspects of a law accomplishes a specific task within the overall framework—it has a "function." The specific language of the provisions related to that function should be examined to see how they may be used (or changed) to allow for effective regulatory planning and response to climate change. Six basic functional areas for adaptation frameworks are explored in this Part.

- **Vision and planning** (defining adaptation objectives and strategies to achieve them)
- **Information management** (establishing historical baselines, identifying information gaps, monitoring, information sharing)
- **Periodic review** (reassessing plans and policies using new information)
- **Coordination of policies and activities** (within government and between sectors)
- **Compliance and enforcement** (balancing discretion or flexibility with oversight)
- **Enforceable rights and duties** (constitutional sources of law and the role of courts)

Box II-1. Incorporating Legal and Policy Reform into Adaptation Planning

Many processes are available for countries to assess the role of laws in reducing vulnerability to climate change. The UNFCCC established the National Adaptation Programmes of Action (NAPA) process as a method for countries to assess their vulnerability to climate change and adaptation needs.[1] Guidelines for carrying out NAPAs include policy reform as a "priority activity" and "key adaptation need."[2] The NAPA process could be a valuable instrument for assessing and improving legal frameworks. For example, Uganda's NAPA establishes a project on "Climate Change and Development Planning" that acknowledges natural resources are key to its socio-economic development and proposes to "review existing relevant policies and laws/regulations in relation to climate change" and "develop policy, laws, regulations and byelaws [sic] on climate change."[3]

The completion of a NAPA is by no means the end of the planning effort. In 2008, the Government of Madagascar convened a workshop, "Assessing the Impacts of Climate Change on Madagascar's Biodiversity and Livelihoods." The workshop participants recommended four main policy actions related to government responses to climate change. The first is the establishment of an inter-ministerial task force on climate change to facilitate environmentally sound adaptation measures across sectors. This body would be responsible for facilitating the integration of ecologically sensitive adaptation measures across diverse sectors such as mining, oil and gas, tourism, agriculture and fisheries within the Madagascar Action Plan (MAP) – a strategy document developed by the Government of Madagascar to guide development planning in the country and within regional action plans. Second, participants suggested the re-examination and review of Madagascar's Programmes d'Action Nationaux d'Adaptation (PANA) to allow for the integration of data and recommendations emerging from this workshop. Third, the gathered experts highlighted the need to develop a rural development policy around areas most vulnerable to climate change, for which one avenue is updating the Rural Development Policy Letter to integrate workshop recommendations. Finally, participants recommended the development and dissemination of methods of information–education–sensitization on climate change across all levels and sectors.[4]

[1] *See, e.g.,* UNFCCC, National Adaptation Programmes of Action (NAPA), http://unfccc.int/national_reports/napa/items/2719.php (last visited Aug. 27, 2009).

[2] UNFCCC Decision 28/CP.7, Annex §§ 8(c)(ii) and 14 (Jan. 21, 2002), *available at* http://unfccc.int/resource/docs/cop7/13a04.pdf#page=7.

[3] Gov't of Uganda, National Adaptation Programmes of Action 65-66 (2007).

[4] MEEFT, CI, WWF, USAID, MacArthur Foundation, Workshop Report 2008. Special thanks to Lalaina Rakotoson and the Development and Environmental Law Center, Madagascar for this summary.

Figure II-1. Connecting Climate Change, Resource Management, and the Law

Resource	Climate Change Impacts	Management Needs	Enabling Laws & Policies
Marine Fisheries	• Fish species shift in population size and distribution, generally to higher, cooler latitudes • Warming oceans killing coral reefs and associated species • Acidification threatens shellfish and other species	• Real-time monitoring of fish stocks to adjust catch quotas • Protection of spawning areas and other critical habitat from overfishing and other uses • Informing fishermen of safe fishing locations • Control of land use practices to reduce pollution runoff and other land-based stressors	• On-board observer program for catch-limit enforcement and scientific data gathering • Institutional mechanisms for information exchange • Strategic environmental assessment for multi-sector approach to ecosystem services • Marine Spatial Planning that sets aside critical habitat areas
Forestry	• Rising temperatures and drying conditions cause shifts in vegetation types • Loss of canopy species • Emergence of new plant communities • Carbon markets (e.g. REDD) create new mix of incentives for conservation	• Timber permits adjustable based on monitoring for change in indicators such as nutrient and water cycles • Remediation of logged areas targeted to future conditions • Ability to manage areas for ecosystem services other than carbon storage	• Permits contain reopener clauses to adjust terms and conditions, and must require consideration of new information • Remediation requirements intensify if logging more damaging than expected • REDD frameworks that include social and ecological values
Protected Areas	• Plants and animals migrate out of protected areas and onto non-public lands • Historical ecological relationships unravel; new communities form • Increased pressure to access scarce resources in protected areas by humans	• Authority to protect habitat on marginal lands and lands lacking full protected status • Ability to prioritize protection and restoration activities • Local stakeholder engagement and education to build conservation buy-in	• Set long-term targets based on future conditions • Statutory instruments for land swaps to protect priority habitat • Coordination of private and public land conservation efforts • Communities hold secure land tenure to ensure sustainable use • Revenue-sharing with locals
Freshwater Supply	• Extreme fluctuations in water cycles • Lack of water for basic human needs and aquatic and riparian habitats • Flooding and inundation in other areas	• Rationalized prioritization of water uses • Adjustment of water quotas to reflect changing conditions • Protection of aquatic and riparian habitats	• Water-sharing agreements adjust to future flow expectations • Regulation of water usage • Minimum in-stream flow standards to protect habitat
Coastal Zones	• Sea level rise inundates coastal habitat • Increasing storm risks • Erosion undermines coastal structures • Salinization of freshwater aquifers	• Coastal planning incorporates long-term changes in shoreline • Revision of acceptable land uses in high-risk areas • Restoration efforts targeted to future conditions	• Planners required to consider climate change in land use zoning • Insurance programs reflect heightened risk of coastal zones • Rolling easements alter land uses, protect property values

Effective management depends on thorough planning. This is true even within adaptive frameworks that emphasize learning after initial plans have been set in motion. Climate change poses a challenge for planners due to the high uncertainty it creates about future conditions. Rather than setting out strategies for the future that respond only to known problems, planning processes can confront the problem of future uncertainty caused by climate change head-on.

This chapter walks through three steps for conservation planning for uncertain futures. The first step for planning will be to explore possible future scenarios based on an understanding of trends in the key drivers of change. Once stakeholders and planners have a better sense of the possible futures, the second step will be to evaluate current and proposed policies to determine which will likely be most effective over the long term.

This information can be used at the third step to define core objectives for conservation based on a fuller understanding of feasible outcomes as well as key uncertainties that may undermine those goals.

By setting tangible goals for conservation that acknowledge uncertainties, those engaged in planning will set the stage for adaptive ecosystem management. They will transform planning efforts from reactive exercises into forward-looking, implementable strategies for conservation over the long term.

Box 4.1. Planning at National and Local Scales

Most countries already have robust legal authorities in place for conservation planning at both local and national levels. At the national level, for example, the Dominican Republic has developed "la Visión de la Biodiversidad para el 2025," a set of actions and principles for conserving species, habitats, natural areas, and genetic resources by means of sustainable use, as well as laws for protected areas and invasive species. Countries will also be engaged in planning through international programs such as National Adaptation Programmes of Action (NAPA) under the UNFCCC and National Biodiversity Strategic Action Plans (NBSAP) under the Convention on Biological Diversity (CBD). An example of local-scale planning is found in Bhutan's law for forested areas under private or community management. Plans prepared by the person or entity responsible for management must:

- Describe the area and its resources, their uses and their role in the biological diversity of Bhutan
- Describe the management regime required for the protection and sustainable utilization of the resources, including logging and reforestation requirements and designation of protected areas
- Assess the environmental and socio-economic impact of the proposed management regime[1]

Planning processes such as these can be adapted to foster strategic thinking by assessing the future condition of resources and identifying key uncertainties. For example, if climate change jeopardizes the supply of freshwater because of glacier melt, a community forester in Bhutan may benefit by considering options for dealing with water scarcity.

[1] Forest and Nature Conservation Act § 5 (1995) (Bhutan).

4.1 Step 1: Using Scenario Planning for Long-term Climate Change

Key Point: Scenario planning is a tool that allows policymakers to plan for highly uncertain futures and is thus an ideal approach for responding to complex ecological changes brought about by climate change in combination with other drivers of change.

There are six basic steps to scenario planning:

1. Identification of the focal issue (this can be allowed to emerge from the negotiation of participants)
2. Assessment of system status and function (identifying key indicator variables and uncertainties)
3. Identification of alternatives (identifying multiple ways the system might evolve)
4. Creation of scenarios (framed as an overall narrative that emerges from the interaction of the variables and explicit assumptions about uncertainties)
5. Testing of scenarios for consistency (may involve role playing or interviews in order to determine whether expected behaviors actually occur)
6. Use of scenarios to screen policies (identifying which policies hold up most robustly under the widest range of possible scenarios—in other words, which are the most resilient (see Chapter 4.2 below)[45]

> "A scenario is a coherent, internally consistent and plausible description of a possible future state . . . . It is not a forecast; rather, each scenario is one alternative image of how the future can unfold."[1]
>
> [1] IPCC, Fourth Assessment Report, Working Group II: Impacts, Adaptation and Vulnerability ¶ 2.4.1 (2007), *available at* http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch2s2-4.html.

Scenario planning is not about predicting the future, but rather envisioning several plausible alternative futures and identifying the drivers and the key uncertainties using the best information currently available. Scenario-building exercises should be broadly participatory and use the best available science to construct plausible future scenarios. It is the process itself that may confer the real value. These exercises are "conversations designed to help a group of people trick themselves to see past their own blind spots."[46] The goal is to develop alternative management practices depending on which scenario unfolds. Annex II of the U.N. Fish Stocks Agreement provides an example of how to establish this type of framework. It directs parties to define precautionary reference points and then to design alternative management strategies that must be implemented depending on which of those reference points is met.[47]

[45] Adapted from Gary D. Peterson et al., *Scenario Planning: A Tool for Conservation in an Uncertain World*, 17 Conservation Bio. 358 (2003).
[46] *Id.*
[47] Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, art. 6(3), 34 I.L.M.

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SCENARIO PLANNING is a tool to systematically compare which management options will perform the best under the widest range of plausible future conditions.

Box 4.2. Scenario Planning for Ecosystem Services in the Gariep Basin

The Gariep River Basin in South Africa and Lesotho is a rapidly developing, resource rich area that has seen accelerated economic growth, evolution of governance institutions, and increasing strains on natural resources. It is a place of growing inequality between the industrial rich and rural communities closely bound to ecosystems. Through five meetings over two years, a team of scientific experts guided by an advisory group of local resource users from all sectors performed a scenario planning process to explore possible futures for ecosystem services in the area. First, the group identified five key services to look at: food production, water, energy from resources, biodiversity, and minerals (due to its importance in resource livelihoods). Next, the group identified key drivers of change such as birth rates, urbanization, HIV/AIDS, national policies, wealth distribution, and others. The group developed four possible future scenarios for the Basin:

"**Market Forces**": Commercial and industrial activity are the main drivers, creating increasing inequalities and loss of biodiversity while mining incomes increase. Societal values favor development and environmental governance declines.

"**Policy Reform**": Governance improves while foreign investments favoring fair trade and environmental values increase. However, agricultural intensity increases and climate change and water issues are not fully addressed. Ecotourism to Lesotho increases.

"**Fortress World**": The Basin divides on class lines, and political struggles intensify. Resources are overexploited and conservation efforts plummet.

"**Local Resources**": Strong civil society networks emerge though national governance is lacking. Despite strong local self-reliance in both economic and conservation matters, environmental quality declines in areas of waste disposal and water treatment.

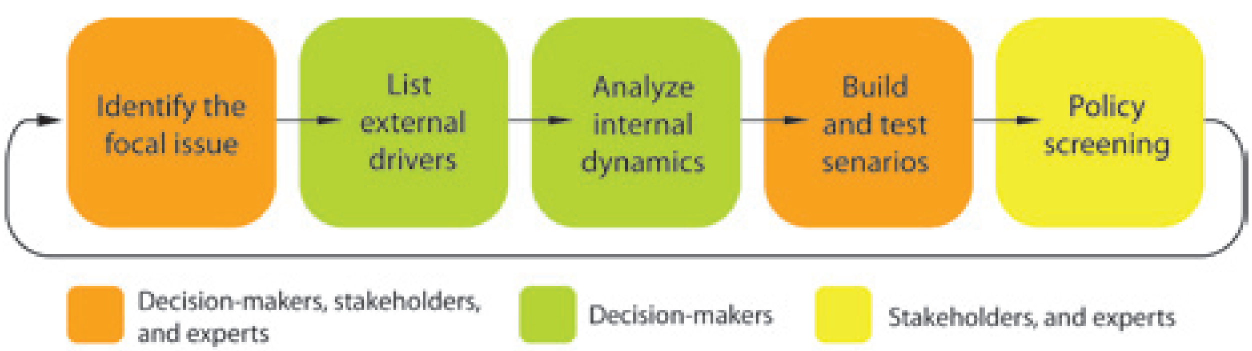
The qualitative story-telling approach proved to be highly effective at motivating creative and imaginative approaches to policies for collective problem solving. Patterns emerged that were not evident before, such as the key role of trade-offs in present and future use of resources in all scenarios and the importance of considering the impact of drivers at multiple scales (e.g., global climate change interacting with local tourist trends). The process was not intended to result in policy recommendations on specific issues, but follow-up exercises are planned to use scenarios with the intent of identifying and solving specific conservation problems. See Figure 4.2.

The process of scenario planning should use the best available scientific information, but participants should include a broad range of stakeholders, not just scientists, experts, and officials. As a planning tool, scenario planning can be a key component of adaptive governance. It can be tailored to a specific problem like climate change and focus on decision-making needs, but the exact contours of the scope of planning should emerge from negotiations at an initial stage of the process. Scenario planning can be done at any scale from the local to the international. The Millennium Ecosystem Assessment, for example, developed global scenarios and sub-global scenarios at local (village) and regional levels.[48]

Because resource planning affects all aspects of a region's economy and society, planning meetings should be highly participatory.

[48] Millennium Ecosystem Assessment, Ecosystems and Human Well-being: Scenarios (2005), *available at* http://www.millenniumassessment.org/.

Figure 4.1 Steps and Participants in the Scenario Planning Process[1]



[1] Adapted from Leigh Welling, U.S. National Parks Service, Climate Change Scenario Planning: A Tool for Managing Resources in an Era of Uncertainty, Presentation at Joshua Tree Nat'l Park (2008) and Peterson et al., *supra* note 45, at 360-62.

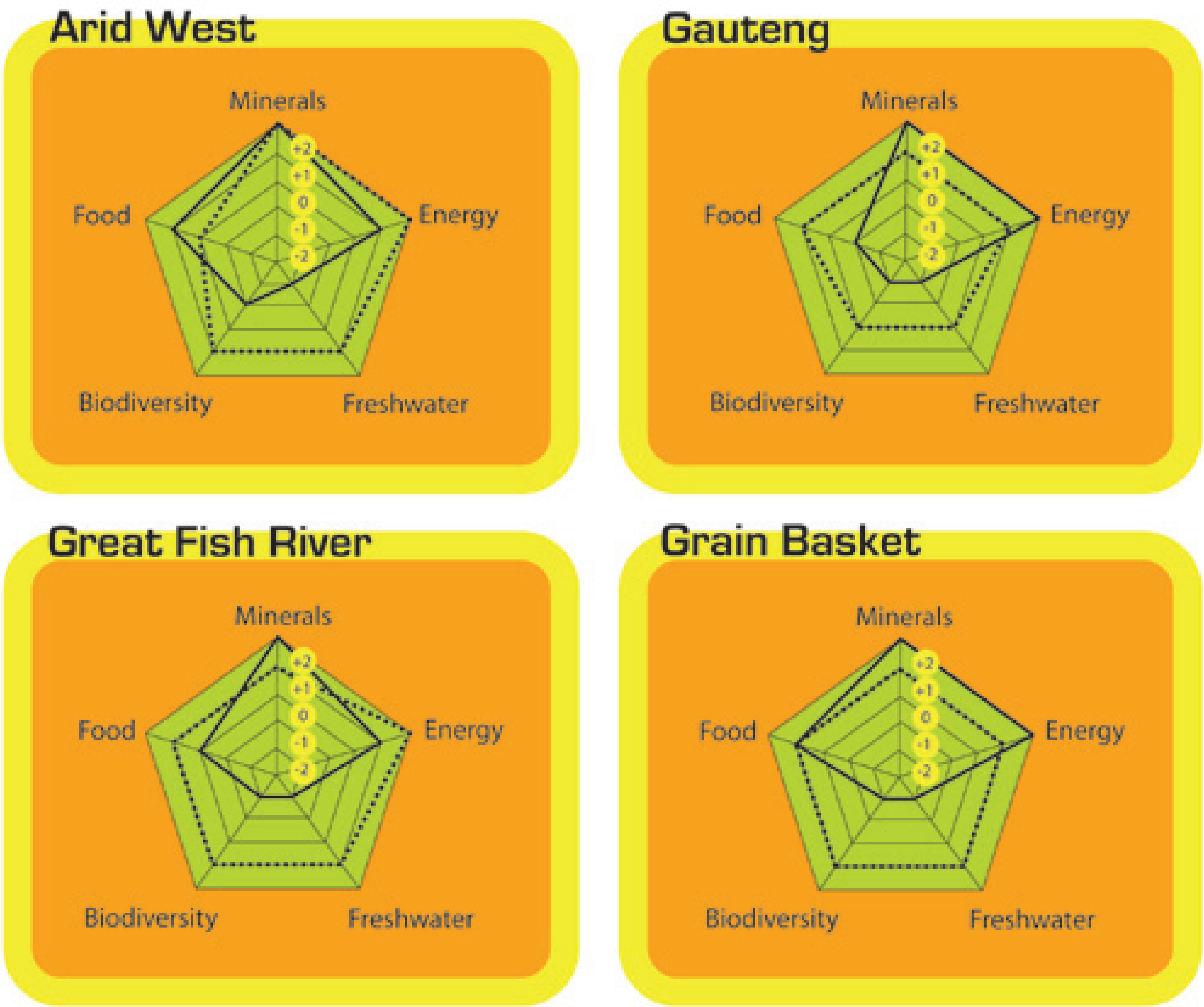


Figure 4.2 Charting the Future Graphic representation of the effect on ecosystem services of two possible scenarios in four regions of the Gariep Basin, developed through the scenario planning process. The amount of change in each service ranges from sharp increase (+2) to sharp decrease (-2).[1]

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[1] Case study adapted from Erin L. Bohensky et al., *Future Ecosystem Services in a Southern African River Basin: A Scenario Planning Approach to Uncertainty*, 20 Conservation Bio. 1051 (2006).

4.2 Step 2: Developing Resilient Conservation Policies and Objectives

Key Point: Plans that expressly incorporate adaptive strategies such as monitoring, periodic reassessment, and modification will be able to adjust to future conditions. If done properly, scenario planning will reduce the element of surprise when change does occur.

The primary goal of conservation planning for climate change and its uncertainties is **resilience**. Resilience describes

> the "persistence of relationships within a system and . . . a measure of the ability of these systems to absorb changes" and still persist. Thus it can help us to describe the degree of disturbance a system can tolerate .... Resilience expresses the ability of a system to rebound from disturbance and the point at which a disturbance triggers a shift in the structure of the system.[49]

Scenario planning for climate change will produce a set of screened policies that participants have determined are the most resilient (i.e., the most likely to achieve their objectives under the broadest range of possible future scenarios). If done effectively, this will allow decision makers to immediately begin evaluating whether current actions are consistent with the best policy options given future uncertainties, or whether current actions will foreclose resilient policy options in the future. "By building the 'wrong' structures now or by not modifying existing structures, we may actually limit our future options for climate adaptation."[50]

> "By building the 'wrong' structures now or by not modifying existing structures, we may actually limit our future options for climate adaptation."

Resilience should be the goal for the ecosystem and its management. Scenario planning is a precursor for adaptive management. It allows participants to identify several policy options, each of which can be implemented through an adaptive management plan, with monitoring and assessment to determine which prove most effective.

[49] Alyson C. Flournoy, *Protecting a Natural Resource Legacy While Promoting Resilience: Can it be Done?*, 87 Neb. L. Rev. 1008, 1024 (2009) (quoting C.S. Holling, *Resilience and Stability of Ecological Systems*, 4 Ann. Rev. Ecology & Systematics 1, 17 (1973)).

[50] SA Water, In Detail- Permanent Water Conservation Measures 33 (2004), *available at* http://www.sawater.com.au/SAWater/Environment/WaterRestrictionsConservationMeasures/PWCM.htm.

4.3 Step 3: Creating a Long-term Vision Based on Resilient Objectives and Benchmarks

Key Point: Strategic planning for climate change should include ultimate, defined management objectives, intermediate benchmarks for reaching those objectives, and reference points to determine when changes in strategy are required.

Scenario planning for climate change is not an alternative to setting tangible goals for improved conservation planning. It is a tool used to set ambitious but feasible goals and then achieve them. Environmental planning under most existing regimes is long on vision but rarely provides a road map to getting there. Broad mandates for sustainability conflict with actual resource-use authorizations in practice.[51] Ideally, in developing national adaptation plans or sustainability visions, countries will also establish tangible goals and intermediate benchmarks or "check-points" to ensure those goals are on track to being met. Bhutan, for example, has a visionary concept of "Gross National Happiness" (a holistic concept that incorporates social, cultural, and environmental integrity along with "hard" economic measures like "gross national product") promulgated by Fourth King Jigme Singye Wangchuck that guides the country's development planning.[52] This vision is embodied in a constitutional requirement to preserve in perpetuity sixty percent of the country's land as forested areas.[53] With this overarching goal set, Bhutan's forest ecosystems can be managed in a way that allows them to change and evolve over time in response to ecological disturbances like climate change.

Establishing hard deadlines for meeting defined and tangible conservation objectives holds regulatory actors accountable to their commitments. A timeline also gives participants a way to envision the future. This is important for adapting to climate change, as it will allow planners to overlay timelines of anticipated climate change impacts onto timelines for achieving conservation objectives. This provides planners a better sense of what management alternatives make the most sense, not just in the present but at strategic points in the future.

example

The Seychelle's National Plan of Action (NPOA) for shark fisheries uses a series of timelines to accomplish objectives. For each of eleven "Work Programmes" to address management needs for the sharks, the NPOA drafters developed a list of recommendations for actions that needed to be taken to address those needs. For each action item under each Work Programme, the planners assigned a "priority" value between "A" and "G" corresponding to a timeframe as follows:

A: Action initiated immediately and completed within 6 months (e.g., develop standardized terminology and nomenclature)

[51] Flournoy, *supra* note 49, at 1022.
[52] Gov't of Bhutan, Fourth National Report to the CBD 22 (2009); *see also* Gov't of Bhutan, Planning Comm'n, Bhutan 2020: A Vision for Peace, Prosperity, and Happiness (1999).
[53] Const. art. 5 (2008) (Bhutan).

B: Action initiated immediately and completed within 12 months (e.g., develop standardized data gathering methods and user-friendly data charts)

C: Action initiated immediately with open-ended implementation (e.g., determine if listed species are caught)

D: Action initiated within 12 months and completed in shortest possible timeframe (e.g., develop criteria for sharks to be landed in form that facilitates species identification)

E: Action initiated within 12 months of completion of prerequisite work and completed in shortest possible timeframe (e.g., develop, implement and facilitate prioritized research program)

F: Action initiated and completed within 4 years (e.g., establish mechanisms for the validation of biological, catch, and trade data)

G: Action initiated within 4 years, if not sooner, and completed in shortest possible timeframe (e.g., develop and pilot risk assessment criteria to identify priority shark species)[54]

In order to make timelines enforceable, accountability mechanisms are essential. This might be accomplished through judicial review or removal or transfer of underperforming officials, or through positive incentives such as bonuses for officials or working groups that accomplish objectives on time.

[54] Gov't of the Seychelles, National Plan of Action for the Conservation and Management of Sharks 28-33 (2007) [hereinafter Sharks NPOA]; examples adapted from id. Work Programme No. 3 (Data Gathering and Management) and No. 4 (Research).

Chapter 5 Information Management: Legal Mandates for Monitoring and Using Data

Once management plans go into effect, monitoring and information-gathering are critical for adaptive resource governance. They provide decision makers the information they need to know whether current management plans are working as expected or need to be changed. Too often under existing resource laws, such requirements are nonexistent, not mandated, unenforced, or unfunded. (The need to actually use the information gathered will be discussed in Chapter 6.) To effectively and sustainably manage a resource under conditions of ecological change and uncertainty requires sound and comprehensive monitoring.

This chapter looks at key considerations for legal drafters and policymakers in setting up effective monitoring protocols for resource governance. This includes procedures for establishing baselines and identifying information gaps, such as determining what will be monitored and where, how often monitoring will take place, and who will do the monitoring. The key consideration of ensuring compliance and enforcement of monitoring requirements is discussed in Chapter 8.

5.1 Establishing Baselines and Identifying Information Gaps

Key Point: Policymakers can give managers regulatory tools, funding, resources, and incentive programs to obtain useful information about how ecosystems evolve in response to climate change. This will better inform all types of management efforts, from rehabilitation of degraded ecosystems to setting harvest quotas for fish or timber species.

The previous chapter discussed the use of scenario planning to identify key indicators and uncertainties driving change in ecosystems. To actually measure change in a system, managers will need to set one or more **baselines**. A baseline is a fixed (often numerical) expression of the status of a resource. Because many resources are already in a degraded state, it is important not only to look at the status of a resource or ecosystem in its current condition, but to include past trends for that resource (see Box, "Setting Baselines Using Deep Historical Records"). Management goals can then be defined by reference to the historical baseline (e.g., at the end of a timber harvest period, ninety percent of the baseline population of trees of species X greater than one-foot diameter should remain).

However, climate change in some regions may be so severe over the coming century that the historical baseline for a given resource (e.g., the population of a particular tree species in an area) can no longer be used to establish effective management targets. The ecological system will have changed so dramatically that it is impossible or impractical to try to obtain or restore the baseline. Using the timber harvesting example, climate change may cause the tree species to die out in the management area as conditions change. Managers would find themselves in violation of the conservation target through no fault of their own. While a baseline is essential to the process of defining a conservation target, climate change may require that target to be something other than the baseline status of the resource. In other circumstances, restoration of historic levels of a resource may indeed be a valid objective where climate change does not render the target impossible in the management area.

At the same time managers are determining the historic baseline and appropriate management targets under future conditions, they will also need to identify key **information gaps**. Scenario planning techniques discussed in Chapter 4 are one valuable way to identify information gaps. Managers will also need continuing authority to reassess information needs, especially when new unknown variables emerge. Many agencies may lack the capacity to undertake this task systematically and would view such authority as unnecessary or burdensome;" however, several countries' laws make the reassessment of information needs an explicit step in the management process. Under Uganda's environmental impact assessment (EIA) regulations, an EIA must include, among other things, "identification of gaps in knowledge and uncertainties which were encountered in compiling the required information."[55] (Chapter 7.2 below discusses the role of EIA in climate

[55] Uganda, Environmental Impact Assessment Regulations 1998, No. 13, art. 14(h), (j), and (k) (Statutory Instruments Supp. to the Uganda Gazette No. 28 volume XCI dated 8th May, 1998).

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BASELINE refers to a fixed (often numerical) expression of the status of a resource.

Box 5.1: Setting Baselines Using Deep Historical Records

Critical for long-term planning in the face of ecological change is a full understanding of the natural cycles of a resource over long time periods in the past. This means that stakeholders and managers should be creative in finding out as much information as they can about the historic population levels of a given species or group of species. An excellent example of how this can be done comes from the Seychelles' 2007 *National Plan of Action for the Conservation and Management of Sharks* (NPOA). Rather than look at the current status of shark fisheries, or even to the recent past of the late-twentieth century, the NPOA drafters went as far back in the historical record as they could, starting with a survey of the journals of sailors in the 1700s who reported that waters around the Seychelles teemed with large and aggressive shark populations. The NPOA then traces the history of the development of artisanal and then commercial shark fisheries over the past two hundred years, relying on academic articles, first-person accounts, government reports, and field research.

Taking a longer view allowed managers and stakeholders to reach the conclusion that "the weight of evidence indicates a significant decline in shark stocks during the second half of the 20th century" and "the fishery as a whole [can] be characterized as overexploited and depleted." Armed with the new understanding that the shark populations currently are vastly diminished from the levels present in the marine ecosystems of the area prior to significant human exploitation, the planners could make a determination that strong immediate action was needed. Under Work Programme 5: "Managing Effort in Line with a Precautionary Approach," the NPOA briefly reviews the findings from the baseline survey and states: "This decline . . . is sufficient to warrant an active and progressive application of a precautionary approach to the management of effort in both targeted and incidental shark fisheries." The NPOA called for legislation within 6 months to establish a strict licensing and catch-limit regime, to prohibit techniques and technologies that overexploit the sharks, and to close the fishery to new operators for a four-year review period.[1]

[1] *Id.* at 34.

change more broadly.) Legal regimes structured around the principles of adaptive management can provide an avenue by which regulators identify information gaps and then begin filling those gaps in the course of implementation. Thus, the Mexican regulation for shark fisheries management (see case study in Chapter 2.3, above) makes clear that there are many unknown factors related to biological and environmental conditions, fishing technology, and cultural and economic needs that require further study. The regulation directs Mexico's fisheries authority to consult with all stakeholders, including state and regional governments, non-governmental environmental organizations, and the fishing industry to set goals for answering these questions during the management process.[56] Without an awareness of what is unknown and a process to find the answer to those questions, management may proceed on the basis of ecological assumptions that will be false in light of climate change. Identifying and reassessing information gaps are initial steps.

[56] NOM-029-PESC-2006, *supra* note 24, § 0.16.

5.2 Choosing Indicators for Targeted Monitoring

Key Point: Indicators for monitoring set by statute, regulation or management plan should include climate-related changes in the environment in order to provide resource managers and users the fullest understanding of the dynamic systems they use and rely on.

Monitoring the effects of climate change on an ecosystem is much easier when managers identify a list of **indicators** rather than attempt to monitor all facets of the system. Indicators, or "metrics," are measurements of a specific, narrowly defined ecological phenomenon that provides information on the status of the larger ecosystem. By identifying key indicators, managers can learn a good deal about an ecosystem without expending enormous resources trying to keep track of every observed change in the system.

Identifying indicators is largely a place- and resource-based exercise. For example, officials in Canada are monitoring the growth rings on Blanding's turtles in order to predict the impacts of climate change on turtle population levels several decades into the future.[57] In addition to ecosystem indicators such as this, at the national level monitoring increasingly needs to include climate indicators, including but not limited to:

- Temperature patterns (especially extremes)
- Precipitation patterns
- Storm activity and extreme weather patterns
- Changes in ocean and freshwater chemistry
- Changes in species' growth patterns and geographic distribution

This monitoring will likely be conducted by a governmental, academic, or international scientific body. The imperative is to get this information to the public and stakeholders quickly, along with recommendations for preparation and response.

Officials and managers setting up monitoring systems must also be sensitive in choosing the most effective locations for monitoring to track climate change impacts on resources. Comprehensive monitoring takes into account both spatial (geographic location) and temporal (time period) variability in ecological indicators. The CBD recommends designing monitoring systems "on a temporal scale sufficient to ensure that information about the status of the resource and ecosystem is available to inform management decisions to ensure that the resource is conserved."[58] Monitoring requirements can be further tailored to the specific needs entailed in managing a particular resource, ecosystem, or species. For example, monitoring efforts to detect new infestations of invasive species might be focused along conduits that may open up as a result of climate change, such as high mountain passes or formerly ice-bound shipping routes.[59]

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INDICATORS, or "metrics," are measurements of a specific, narrowly defined ecological phenomenon that provides information on the status of the larger ecosystem.

[57] Cliff Drysdale et al., *Climate Change and Adaptive Resource Management in the Southwest NOVA Biosphere Reserve, in* Climate Change and Biodiversity in the Americas 231, 245 (2009).

[58] CBD Secretariat, Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity 12 (2004).

[59] *See* Envtl. L. Inst., Halting the Invasion: State Tools for Invasive Species Management 10 (2002).

example

Kenya's framework environmental law contains a broad monitoring mandate. It requires monitoring to be performed for "environmental phenomena with a view to making an assessment of *any possible changes in the environment and their possible impacts*."[60] This includes a "baseline survey to identify basic environmental parameters in the area before implementation" and a "measurement of environmental changes that have occurred during implementation."[61] These requirements for monitoring go beyond impacts caused by the project itself, allowing consideration of the effects of climate change. However, the breadth of the law is likely unworkable given limited agency resources. Identifying a limited set of indicators of environmental change for monitoring may be more feasible.

[60] Kenya Environmental (Impact Assessment and Audit) Regulations art. 40.1(a) (Legal Notice No. 101, Kenya Gazette Supp. No. 56, June 13, 2003) (emphasis added).
[61] *Id.* art. 40.1(c) and (e).

5.3 Deciding Who Does the Monitoring

Key Point: Dedicated authorities, resources, institutions, and funding are necessary to collect data and interpret how climate change is impacting ecosystems. Government partnerships with academic institutions, civil society, or community-led monitoring programs can be formalized through official, signed agreements.

A variety of actors can do environmental monitoring. Often under existing laws, the permit holder or resource user reports environmental information to authorities. These reporting requirements are important and undergird much environmental law. However, these government-required reports may not be sufficient to capture large-scale changes in the environment caused by climate change because they are limited to particular processes or geographic areas. Dedicated institutions, resources, and funding are essential to collate, synthesize, and analyze raw data and interpret what it means.

example

Vietnam is addressing this concern in its fisheries program. Provincial departments had been unable to fund monitoring and lacked information related to marine resources, stock status, and conditions of the habitats around fishing grounds. The primary source of information came from permitted fishing vessels, which officials knew to be unreliable.[62] In 2007, Vietnam established a national-scale program with funding to identify and monitor key ecological indicators for land, wetlands, freshwater, and the ocean—giving officials an independent view of the status and trends of marine resources.[63]

While resource users can provide valuable localized information, user-level reporting requirements should be supplemented with other sources of ecological data. International efforts like UNEP's World Conservation Monitoring Centre[64] and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)[65] can provide valuable information, resources, and guidance. NGOs, local communities, and academic institutions are also ideal for this work.

Monitoring of ecological conditions is an appropriate task for academic institutions because they will already be interested in such data for research purposes. These efforts are enhanced by engaging the local community and lay volunteers, especially for monitoring of indicators that do not require high levels of scientific expertise. Monitoring programs can effectively employ volunteers with a minimum of training, but the following guidelines may improve the effort:

[62] World Bank and Vietnam Ministry of Fisheries, Fisheries Report 13 (2005), *available at* http://siteresources.worldbank.org/INTVIETNAM/Resources/vn_fisheries-report-final.pdf.

[63] Master Planning of National Monitoring Network of Natural Resources and Environment until 2010, issued by Directive 16/2007QD-TTg (Jan. 29, 2007).

[64] UNEP-WCMC, http://www.unep-wcmc.org/ (last visited March 18, 2010).

[65] *See* Governing Council of the United Nations Environment Programme, Report of the Executive Director, Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services, UNEP/GCSS.XI/7 (Nov. 19, 2009); *see also* IPBES, http://ipbes.net/en/index.asp (last visited March 18, 2010).

Box 5.2. Using On-Board Observers to Monitor Fisheries in the Solomon Islands

Deep-sea fisheries pose a challenge in ensuring compliance with the law and providing accurate monitoring and environmental reporting on ecological indicators. Many countries are turning to the use of on-board observers to ensure data collection is accurate and to report violations of fishery laws. Care must be taken to protect the integrity of observers and their work. Observers do not usually go on every ship and do not have enforcement powers.[1] The Solomon Islands Fisheries (Foreign Fishing Vessels) Regulations provide a model provision requiring access to boats by on-board observers as a condition of each foreign fishing operation permit. The conditions include:

- Observers are permitted to board or leave the ship as required by a head fishery official, including at ports of voyage commencement or unloading outside the fishery area
- Vessels must provide maintenance for the observer, including food, accommodation and medical care of a standard equivalent to that provided for officers of the vessel
- Vessels must allow the observer to observe and record any or all aspects of the fishing operations and allow her access to:
    - the catch on board and at unloading in order to obtain management-related or biological information and samples;
    - the daily catch records
    - charts and navigational records
    - communication channels with the Principal Licensing Officer for the purpose of the Officer's duties
    - such other facilities and equipment as may reasonably be required to enable the observer to carry out her duties[2]

This program improves legal compliance on the high seas and provides information on marine resource trends caused by climate change and other factors.

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[1] For more information about the Pacific Islands Forum Fisheries Agency (FFA) and its regional observer program, of which the Solomon Islands are a member country, see FFA, Observer Program, http://www.ffa.int/observers (last visited August 5, 2010).

[2] Solomon Islands Fisheries (Foreign Fishing Vessels) Regulations § 23, art. 7 (LN 84/1983), *available at* http://www.paclii.org/sb/legis/consol_act/fa110/.

Photo credit: Pacific Islands Forum Fisheries Agency; www.ffa.int

Figure 5.1 Compliance on the High Seas On-board observers monitor compliance with fisheries regulations. The data they collect can also be used to track changes in marine ecological indicators.[1]

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[1] Pacific Islands Forum Fisheries Agency, Observer Program, http://www.ffa.int/taxonomy/term/446 (last visited July 16, 2010).

Photo credit: David Vinualez/Oxfam

Figure 5.2 Tracking Climate Change A flood gauge for community weather tracking in Nicaragua.[1]

[1] Oxfam, Dealing with Disasters, http://www.oxfam.org.uk/oxfam_in_action/where_we_work/nicaragua/early_warning.html (last visited July 14, 2011).

- Lay persons or volunteers can be trained through workshops to ensure that participants understand methods of monitoring and processes for transmitting data.[66]
- Participants should meet at regular intervals to guarantee that they share a clear understanding of the goals, objectives, and steps of the project. Mutual respect and transparency are essential.[67]
- Seminars can facilitate the exchange of ideas between researchers and monitoring teams in different regions. They can be held at regular intervals to sustain a community of practice and provide a forum for exchange of new ideas.[68]
- Funding through government appropriations or grants may be necessary to ensure that volunteers have effective equipment and support to guide their efforts.

[66] National Botanical Institute, S. Africa, C.A.P.E. Threatened Plants Program 6 (March 2007), *available at* http://www.cepf.net/Documents/Final_NBI_ThreatenedPlants.pdf.
[67] Friends for Conservation and Development, Developing an Integrated Strategy and Project Plan to Conserve the Chiquibul/Maya Mountain Key Biodiversity Area in Belize 6-7 (June 15, 2006), *available at* http://www.cepf.net/Documents/Final.Friends.of.conservation.pdf.

[68] CitiesACT, http://www.citiesact.org/training_courses.aspx; Better Air Quality 2008, http://www.baq2008.org/; Yoshitoku Yoshida, Background and Objectives of Environmental Monitoring of POPs in East Asian Countries, http://www.env.go.jp/chemi/pops/3rd/mat02.pdf.

Box 5.3. Climate Monitoring Partnerships with Communities

Central governments often lack the resources to undertake the widespread, intensive monitoring necessary to keep track of regional climate impacts. Because local resource types, vulnerabilities, and anticipated impacts are diverse, programs to monitor the local environment for the effects of climate change are appropriate for partnerships with civil society, communities, and even businesses with operations in the area.

Local communities will be intimately familiar with weather patterns and indicator phenomena that can be used to detect and predict changing patterns. These observations may be as small as the location of an ant hill or as large as the shifting of the tide. When given an information-gathering role, local actors can feel empowered and gain knowledge of local resource vulnerabilities, adaptation strategies and programs, and protective mechanisms. The role of the coordinating organization (whether an NGO, international agency, business, or other group) includes:

- Communicating with the local community
- Providing technological knowledge and information transfer
- Assisting with funding and support

In Nicaragua, for example, "**early warning systems**" are being set up with indigenous communities to help them respond to climate change. This process is supported through a partnership between Oxfam, Acción Médica Cristiana (CMA), Centro Humboldt, and indigenous authorities. The partnership trains local communities to measure rainfall and provide data on variations in river levels in real time. Data is radioed to national weather and climate institutes to mitigate or prevent direct consequences of a hurricane and subsequent flooding. The Early Warning System will help the communities "to match the new patterns of rain, temperature and natural behavior with external signs . . . in order to understand better what is happening and how they can interact with nature."[1]

[1] Oxfam, A Tool against Climate Change. . . and Hurricanes, http://www.oxfam.org.uk/oxfam_in_action/where_we_work/nicaragua/early_warning.html (last visited October 30, 2009).

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EARLY WARNING SYSTEMS alert communities to a coming event, such as a typhoon or heat wave.

Mandates to systematically review and reevaluate policies and decisions affecting resources build adaptive capacity for climate change by allowing quicker responses to changes in conditions and new information. They can be built into all levels of management, from technical regulatory standards up to legislation itself. Mandates to review and reevaluate the highest levels of a country's laws are especially important in order to respond to fundamentally new and different challenges arising from the ecological disruptions caused by climate change. For example, requiring or emphasizing restoration of ecosystems to a historical status may result in programs that fail to consider future climate impacts, undermining restoration efforts. Reviewing laws periodically ensures that such "maladaptive" policies are assessed and revised in a timely manner.

This approach to governance benefits when policymakers openly admit the limitations of their ability to know in advance the conditions and challenges faced in the future, and whether and to what extent legal and policy efforts in the present will accomplish their intended goals. Uganda's Law Reform Commission Act of 1990 presents an example of an institutionalized framework for reviewing and updating laws and policies in light of new understandings and circumstances. The law establishes a Law Reform Commission charged with the task to:

> study and keep under constant review the Acts and other laws comprising the laws of Uganda with a view to making recommendations for their systematic improvement, development, modernisation and reform with particular emphasis on . . . the development of new areas in the law by making the laws responsive to the changing needs of the society in Uganda.[69]

With specific legislative direction or regulatory guidance, this body could play a key role in reviewing and making recommendations for adapting to climate change in Uganda. This chapter discusses the use of review requirements to adapt resource legal frameworks to climate change.

[69] Law Reform Commission Act, cap 25, § 10 (1990) (Uganda) (emphasis added), *available at* http://www.saflii.org/ug/legis/consol_act//ulrca284/.

6.1 Building Continuous Decision-making Processes and Institutions

Key Point: Periodic review points are used to evaluate knowledge about an ecosystem, current trends, and emerging threats. With this information at hand, adjustments in strategy can be made. The discretion to make changes, however, should be constrained by the needs of stakeholders and the ecosystem.

Reviews of natural resources management implementation are certainly not new legal tools. Like existing monitoring requirements, however, they have often been ineffective because the mandate to undertake reviews is rarely accompanied by specific regulatory instructions on how to perform them or the resources and funding to ensure the reviews produce meaningful results. The result has been that much law governing biodiversity relies on "front-loaded" decision making with little "back end" follow through.

FRONT-LOADED DECISION MAKING sets in place a course of action that is difficult to modify or reverse when circumstances later change.

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"Front-loaded" decision-making regimes are those in which choices made at the beginning of a project or implementation of a policy cannot be rethought or modified to reflect new information or changed circumstances later on. The uncertainty inherent in predicting future environmental conditions due to climate change means that regulatory actors need authority to make mid-course corrections. Donor-funded projects with heavy conditions and large-scale development work may be difficult to adjust after initial implementation. In such cases, it may be more appropriate to use review points to determine if additional mitigation measures should be implemented, rather than to halt or reverse the project outright.

Effective programs of review and oversight might include the following elements:

- A representative body (or bodies—see example below) legally empowered to meet regularly and assess the status of management efforts and new trends in the ecosystem
- Transparent procedures of operation, including clear rules on what is and what is not within the discretion of the body to change (if part of a fully active adaptive management program, this will mean tying the reviewing body's discretionary authority to the benchmarks or reference points that trigger changes in management strategy, such as reduced harvest quotas)
- Sufficient financial resources, technical capacity, and human resources to support the reviewing body's ability to meet its mandated obligations (funding might come through fees or excise taxes levied on resource users, government general funds, or the international donor community)

example

In Bolivia, each protected area within the National Service of Protected Areas (Servicio Nacional de Areas Protegidas, or SERNAP) has a Director, Technical Council, Management Committee, Advisory Council, and a Protective Body.

- The **Technical Council** is the body responsible for implementing the Management and Annual Operational Plans within the protected area.[70]
- The **Management Committee** functions like a board of directors, with six to ten representatives of indigenous groups, social organizations, and local municipalities or prefectures. At least fifty percent of the members must be from indigenous groups and all must have "a proven track record" of biodiversity conservation work. This committee participates in the development, implementation, and evaluation of management and operational plans and works to integrate local communities into such considerations.[71]
- The **Advisory Council** is a group of five to eight scientists and specialists that advise scientific research activities in protected areas and provide expertise on issues related to the management of SNAP areas.[72]
- The **Protective Body** is the functional arm of the National Protection System (Sistema Nacional de Protección, SNP), a set of rules and procedures designed to regulate, organize, train, and monitor protection activities in protected areas. Each area, through its Protective Body, is required to develop and implement a Protection Strategy to analyze emerging threats to the area.[73]

[70] Supreme Decree No. 24,781, arts. 41, 45, 47, 54, 59 (1997) (Bolivia).
[71] *Id*. arts. 47-53.
[72] *Id*. arts. 54-58.
[73] *Id*. arts. 2, 59-65.

6.2 Reviews Set at Periodic Intervals or by Triggering Events

Key Point: Resource laws that provide frequent, mandatory review points allow for quicker responses to new and emerging threats from climate change. Reviews can be set at periodic intervals (e.g., every year), and they can be set when thresholds are crossed (e.g., when a species population is reduced below a certain number).

A **policy lag** occurs when policymakers are aware of a problem but fail to address it. These lags can be reduced significantly through institutional bodies dedicated to assessing the effectiveness of conservation efforts. Reasons for extended lag times between identification of a problem and its solution through changes in policy may include:

- Lack of technical and scientific understanding necessary to define the problem and provide solutions
- Actors who do not share a common understanding of the issue
- Actors who share a common understanding, but who are otherwise intransigent
- Intervening distractions that push the issue lower on policymakers' lists of priorities[74]

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A POLICY LAG is the time between when a problem is first identified and the point at which steps are taken to address it.

To reduce policy lag times, policymakers may institute methods to periodically assess the status of a resource, quickly identify new threats, determine if existing policies are effectively providing for the sustainable management of the resource, and require changes as needed (for example, immediately closing a fishery upon a determination that the fish stock is dropping dramatically).

Reviews can also be triggered by certain "threshold" events. For example, when a species population drops below a certain level, this may trigger a meeting of a managing body to determine what new measures are needed. This approach has the benefit of triggering immediate meetings and action when a change is observed, rather than waiting for the periodic review date to come up. However, if no triggering events occur, it may cause the period between reviews to lengthen to such a degree that, if anything is happening to the resource that is not being observed, it may be overlooked until it is too late to take effective responsive action.

A combination of periodic review points that evaluate all available information and new concerns, coupled with a system of threshold triggers, may be the best way of ensuring that all possible threats to a system are detected and acted upon as early as possible.

example

In considering whether to reapprove environmental impact assessments (EIA) in Uganda, the relevant official is called upon to consider "the validity of the predictions made

[74] Adam B. Smith, *International Biodiversity Conservation and the Outpacing of Policy by Threats: How Can Conservation Regimes Address Global Climate Change, in* Handling Global Challenges: Managing Biodiversity/Biosafety in a Global World 398, 399 (Jo Swinnen et al. eds. 2009).

in the environmental impact statement."[75] Approval may be revoked "where there is a substantive undesirable effect not contemplated in the approval."[76] These powers can facilitate responses to climate change well after a project has been initially approved. These types of provisions are sometimes referred to as "**reopener clauses**" because they can "open up" a previous approval or authorization for review and possible revocation. They can provide important authority for managers seeking to act adaptively or respond to circumstances different from those at the time an EIA was adopted. It may be that a reopener is required prior to a formal review point if impacts are worse than anticipated. Thus, some redundancy—such as a list of triggering events that force an early reopener—may help bolster the power to make mid-course corrections. Reopeners are discussed in greater detail in Chapter 10.2.

[75] Environmental Impact Assessment Regulations 1998, No. 13, art. 24(1)(a) (Statutory Instruments Supp. to the Uganda Gazette No. 28 volume XCI dated 8th May, 1998) (Uganda).
[76] *Id.* art. 28(1)(c).

Chapter 7 Coordination of Policies and Activities: Integrating Adaptation Efforts across Institutions

Climate change affects many different types of natural resources. Because of this, climate adaptation requires significant improvements in coordination and integration of management efforts among existing institutions and stakeholders. These measures move resource governance closer to the "ecosystem management" model discussed in Chapter 1.3. This chapter looks at two primary types of relationships that should be strengthened in order to improve the transfer of information and the coordination and integration of policy objectives and management efforts. Those relationships are:

1. Among actors within government, including between different agencies, within the same agency, or at different levels of government (local, provincial, and national).
2. Among different economic sectors such as water, agriculture, and mining.

Strengthening these relationships facilitates an integrated approach to climate adaptation by building "**diagonal**" networks to govern ecosystems that cut across bureaucratic categories ("horizontal" integration) and that open up lines of communication between stakeholder groups to increase participatory governance ("vertical" integration).[77]

Figure 7.1. "Diagonal" Engagement
Building diagonal networks provides institutional capacity for engaging all relevant actors, ensuring policies are coordinated and consistent across sectors and levels. Such networks are facilitated by periodic meetings to discuss activities or projects, and liaison offices dedicated to ensuring cross-cutting issues like climate change are handled in each department's internal processes.

[77] The concept of 'diagonal regulatory initiatives' is presented in Hari M. Osofsky, *Climate Change Legislation in Context*, 102 Nw. U. L. Rev. Colloquy 245 (2008); *see also* Burns Weston and Tracy Bach, Recalibrating the Law of Humans with the Laws of Nature: Climate Change, Human Rights, and Intergenerational Justice, Appx. B, Recommendation 9 (2009).

7.1 Coordinating within Government

Key Point: By establishing permanent institutions, offices, positions, and processes for coordinating multiple agencies' policies and activities, governments can evaluate and improve the effectiveness and consistency of adaptation policies.

Given the **cross-cutting** nature of climate change impacts, interagency coordination is essential to ensure ecologically-resilient livelihoods and communities. Regulatory programs administered by agencies with interrelated or overlapping mandates (such as an oil leasing agency and a forestry department charged with stewardship of adjoining pieces of land) can be used as a starting point for encouraging regulatory actors to collaborate to find solutions to common or cross-cutting problems.[78] In addition, a framework of environmental information collection improves decision-making by building up a publicly available record on what worked and what did not. This allows for adaptive management and planning on a larger scale than a single project- or resource-specific issue, as officials and the public are able to evaluate new proposals by referring to a wider administrative and regulatory history.

Options to improve coordination may be available under **existing** institutional structures, which can be strengthened by new authorities or legislative initiatives. Such options for policymakers to improve coordination within existing regulatory systems include:

- Appoint inter-agency contact persons (liaisons) to coordinate on cross-cutting climate change adaptation issues
- Assign responsibility to each line ministry to consider climate change in activities and programs (e.g., through use of environmental impact assessment (EIA) and strategic environmental assessment (SEA))
- Establish regional coordinating bodies that streamline existing legal authorities and regulatory institutions

Policymakers could also establish **new** structures, organizations, or agencies to improve coordinated planning on climate adaptation, such as a:

- Climate Change Service (a non-regulatory and information-focused service that maintains early warning systems, provides reports on indicators for resource users, maintains easy-to-use, publicly accessible database of raw data, records, reports, and other publications)
- Minister of Climate Change (a ministry position with a public figurehead that has regulatory responsibilities and establishes adaptation as top government priority)
- Committee on Climate Change + Adaptation Sub-committee (a separate group that ensures greater independence although with some

[78] Arlene Kwasniak, *Environmental Assessment, Overlap, Duplication, Harmonization, Equivalency, and Substitution: Interpretation, Misinterpretation, and a Path Forward,* 20 J. Envtl. L. & Practice 1 (2009).

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CROSS-CUTTING issues are ones that affects many different sectors or agencies.

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Photo credit: Amelia Wells

Figure 7.2 Integrated Planning for a Different Future Tropical glaciers in Peru's Andes could be gone by mid-century. Loss of this vital water source impacts multiple sectors and populations and will require a unified regional response.

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STRATEGIC ENVIRONMENTAL ASSESSMENTS integrate environmental consid-erations into policies, plans, regulations, and legislation, as opposed to traditional environmental assessments, which are project-specific.

loss of democratic accountability that develops recommendations and may oversee a program of work carried out by other agencies or industry actors)

- International Adaptation Secretariat (e.g., a treaty organization to facilitate cooperation on adaptation strategies across national boundaries)

Laws that require a **strategic environmental assessment** (SEA) are powerful tools for coordinating climate change adaptation efforts. SEA helps integrate environmental considerations into policies, plans, regulations, legislation, and programs and helps evaluate how those considerations link with economic and social concerns. By guiding the development of high-level government planning and activities, SEA can complement and enhance a project-specific environmental impact assessment (EIA) by ensuring that project proposals are set within a fully integrated national-level impacts analysis.[79] SEA uses a range of analytical

[79] *See generally* Organization for Economic Co-operation and Development (OECD), Applying Strategic Environmental Assessment: Good Practice

and participatory approaches that can be adapted to a country's governance context and needs.[80] SEAs are meant to close gaps in legal frameworks by providing environmental analysis of a country's existing development plans and by establishing procedures for assessing the impact of climate change on higher-level government actions. Kenya defines SEA as "the process of subjecting public policy, programmes and plans to tests for compliance with sound environmental management."[81]

In Bhutan, an assessment of the capacity of its national legal frameworks to confront climate change might take place under the Regulation on Strategic Environmental Assessments (RSEA), which requires that "cumulative and large scale environmental effects are taken into consideration" in government policy making.[82] These effects are "built up incrementally over periods of time, result from the addition and interaction of multiple activities and stresses, and are pervasive, cutting across policy sectors and ecological boundaries."[83] By undertaking SEA, a government gains a holistic view of its capacity to preserve and enhance the biodiversity of its natural resources under future climate change scenarios.

General environmental framework laws can enable cross-scale, "diagonal" governance through information dissemination. Liberian law establishes a national monitoring system involving relevant government authorities "that provides regular reports for polluting facilities, industries and activities in Liberia."[84] In general, the environmental authority is to "enter into consultation with other State Agencies in the region and develop Action Plans for the co-operation and harmonization of the management of shared natural resources."[85] The law also establishes the environmental agency as a "clearinghouse" of environmental conventions and agreements and as such must "coordinate activities related to these instruments in Line Ministries, State agencies and non-governmental organizations."[86] Implementing these programs is a continuing challenge for Liberia.

Guidance for Development Co-operation (2006), *available at* http://www.oecd.org/dataoecd/4/21/37353858.pdf.

[80] *Id*. at 24-25 (2006).

[81] Environmental (Impact Assessment and Audit) Regulations art. 2 (Legal Notice No. 101, Kenya Gazette Supp. No. 56, June 13, 2003) (Kenya).

[82] Regulation on Strategic Environmental Assessments art. 1.2 (2000) (Bhutan).

[83] *Id*. art. 3.2.

[84] Environment Protection and Management Law of the Republic of Liberia, art. 34 (approved Nov. 26, 2002).

[85] *Id.* art. 98.

[86] *Id.* art. 99(3).

Box 7.1. Developing a Multi-Agency Adaptive Aquatic Species Program in Vietnam

Vietnam provides one example of a forward-looking attempt at integrated, holistic management of resources that can be built upon in responding to climate change. In May 2008, Vietnam's prime minister issued a decision "Approving the Scheme on the Protection of Endangered Precious and Rare Aquatic Species to 2015, and Vision to 2020" (the "Scheme").[1] Importantly for long-term adaptive management, the preamble of the decision requires that "protection of endangered, aquatic species must be based on a regularly-updated foundation," and calls for the fisheries sector to be developed sustainably. The Scheme's objective is to limit threats to aquatic species "in a community-participatory approach."

During 2008-2010, the Scheme established a database system that lists precious and rare aquatic species and information about them. The Scheme also created a system of "operation zones" of protection in inland water reserves for threatened, endemic aquatic species. These zones are to be "buil[t] on an experimental basis" and they are region-specific. For example, eel species, especially Anguilla marmorata located in the lower stretches of the Ba and Huong Rivers, are managed under a special plan.

The Ministry of Agriculture and Rural Development and provincial/municipal People's Councils are responsible for implementation, with funding provided by the central government. During 2011-2015, the goals include, for example, setting up annual programs to monitor changes in rare aquatic species in all catchment basins, establishing fifteen zones under local management, and setting up a roadmap for a responsible system of fishing and trade governed by the rule of law.

Importantly, the Scheme is not a law itself. Rather, it implements several regulatory programs through a long-term, master project that consists of many smaller, more specific targets that all operate to achieve a final result. Each provincial agency implements the Scheme following its existing legal authorizations, which are interpreted broadly enough to allow for participation in the management project. In other words, the Scheme grows out of and synthesizes the existing laws.

This is an example of how a government can avoid the "stove piping" effect caused by fragmented regulatory authorities. ("Stove piping" occurs when separate but related regulatory processes go forward without coordination between them.) Here, a centralized program authorizes the relevant

[1] Information in this paragraph derives from Prime Minister's Decision 485/QD-TTg, Official Gazette Issue Nos. 03-04, at 30-34 (May 2, 2008) (Vietnam).

agencies at each level of government to coordinate activities to implement a single, overarching management scheme for aquatic resources. While the results of this arrangement are still forthcoming, this may be an important model for integrated policies to respond to climate change, given the need to coordinate actions among the many agencies that will likely develop adaptation strategies for complex climate change problems such as sea level rise.

Photo credit: TU Dang Trung, Institute for Strategy and Policy on Natural Resources and Environment, Vietnam

Figure 7.3 Adapting with Ecological Sensitivity The Tam Giang-Cau Hai lagoon in the Huong River Basin is a World Heritage Site and also home to thousands of impoverished fishing and farming communities. The lagoon is highly vulnerable to climate change impacts like salinity intrusion and increased erosion. However, an anti-salinity weir to protect aquaculture is fragmenting freshwater habitat.[1] Vietnam's new plan to coordinate management of aquatic species may improve adaptation decision-making in the future.

[1] *See* Netherlands Climate Assistance Program (NCAP), Climate Change Impacts in Huong River Basin and Adaptation in its Coastal District Phu Vang (2005), *available at* http://www.nlcap.net/fileadmin/NCAP/Countries/Vietnam/NCAP_work-plan_Vietnam_summary.01.300106.pdf; WikiADAPT, Methodology of the Vietnam NCAP Project, http://wikiadapt.org/index.php?title=Methodology_of_Vietnam_NCAP_Project (last visited July 16, 2010).

7.2 Incorporating Adaptation Strategies across Sectors using Environmental Impact Assessment (EIA) Laws

Key Point: Environmental Impact Assessments (EIA) can guide decision making on projects impacting natural resources that are likely to be affected by climate change. An EIA system that captures and accounts for climate change in economic development and natural resources decision making should use an impacts analysis that considers: (1) the viability and cost of a project under a range of climate scenarios; and (2) the impact of the project on an environment undergoing climate change.

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MAIN-STREAMING means to make something a regular part of a process.

ENVIRONMENTAL IMPACT ASSESSMENTS analyze the environmental consequences of carrying out a proposed activity or plan.

EXOGENOUS changes are those caused by factors not within the control of local actors. The effects of climate change are exogenous to local natural resource management decisions, but they still must be considered.

Climate change is a stressor that cuts across multiple sectors. It is therefore important to consider the effect of climate change on projects and activities that may lie outside the context of biodiversity protection and natural resources management but that nonetheless impact natural resources. These include large infrastructure projects such as dams and highways, commercial development projects, mining operations, residential subdivisions, agricultural practices, and many others. A key tool for "**mainstreaming**" climate change planning (making it a systematic part of the process of developing these types of projects) is through **environmental impact assessment** (EIA). Climate change information may be necessary in order to make an environmentally sound decision about a proposed project or policy, and therefore a strong legal argument can be made that the information must be included in the EIA. A useful model for making climate change issues a part of an EIA may be found in guidance issued by the U.S. government on how to consider projected climate change effects for EIAs under the National Environmental Policy Act.[87] Guidance materials on how to undertake a Vulnerability Assessment of proposed actions may also prove helpful in analyzing how climate change considerations can be integrated into the EIA. (See box on this topic at Chapter 1.1).

In order for EIAs prepared under these laws to include climate change impacts on the environment, the legal language must be broadly interpreted to allow for consideration of **exogenous** changes in the environment (i.e., those changes not brought about by the project itself or by other human activities in the region). Many countries' EIA laws are broad enough to include consideration of climate change, but this power may be underutilized or not well understood. Guidance documents from agencies charged with overseeing the implementation of an EIA law can direct those undertaking EIA to include climate change in their analysis, as the U.S. Council on Environmental Quality did in 2009.

[87] Memorandum for Heads of Federal Departments and Agencies from Nancy Sutley, Chair, U.S. Council on Environmental Quality, "Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions" (Feb. 18, 2010), *available at* http://ceq.hss.doe.gov/nepa/regs/Consideration_of_Effects_of_GHG_Draft_NEPA_Guidance_FINAL_02182010.pdf.

Box 7.2. EIA for Biodiversity and Climate Change

Requirements to undertake EIAs are included in treaties on both climate change and biodiversity protection.

- The U.N. Framework Convention on Climate Change (UNFCCC) calls on parties to "[t]ake climate change considerations into account . . . in their relevant social, economic and environmental policies and actions," including the use of EIA to reduce "adverse impacts on the economy, on public health and on the quality of the environment."[1]
- Article 14 of the 1992 Convention on Biological Diversity states that contracting parties "shall [i]ntroduce appropriate procedures requiring environmental impact assessment of [their] proposed projects, that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects."[2]
- The U.N. Convention on the Law of the Sea and the U.N Convention to Combat Desertification contain similar provisions.[3]
- The *Paris Declaration on Aid Effectiveness* states that EIA should be used in "addressing implications of global environmental issues such as climate change, desertification and loss of biodiversity," and calls on donor agencies and partner countries to "develop and apply common approaches for 'strategic environmental assessment' at the sector and national levels."[4]

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[1] U.N. Framework Convention on Climate Change, art. 4(1)(f), *opened for signature* May 9, 1992, 1771 U.N.T.S. 165, 171 (entered into force Mar. 21, 1994).

[2] Convention on Biological Diversity, art. 14(1)(a), *opened for signature* June 5, 1992, 1760 U.N.T.S. 143, 151 (entered into force Dec. 29, 1993).

[3] U.N. Convention on the Law of the Sea, art. 206, *opened for signature* Dec. 10, 1982, 1833 U.N.T.S 397, 481 (entered into force Nov. 16, 1994); U.N. Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, art. 10(4), *opened for signature* Oct. 14, 1994, 1954 U.N.T.S. 108, 117 (entered into force Dec. 26, 1996).

[4] OECD, Paris Declaration on Aid Effectiveness arts. 40 and 41 (adopted Mar. 2, 2005), *available at* http://www.oecd.org/dataoecd/11/41/34428351.pdf.

Box 7.3. Opportunities to Consider Climate Change in Bhutan's EIA Law

Practitioners will need to closely examine EIA laws to identify opportunities to include and respond to the effects of climate change on major projects. For example, Annex 3 of Bhutan's Regulation for the Environmental Clearance of Projects of 2002 requires all Environmental Clearances (EC, Bhutan's term for EIA) to consider the "potential environmental, economical and social impacts of the proposal."[1] Although it does not mention climate change specifically, the requirement to look at "potential" impacts of a project could be sufficient to include the consideration of climate change impacts in the EC. Further, this law requires ECs to describe the "existing environment" in order to establish a baseline against which the project's impacts and mitigation measures can be assessed.[2] As discussed above, identifying baselines is an essential step in adaptive governance. On the other hand, establishing a baseline based only on the "existing environment", without regard to how that environment may have already changed and how it will change under future climatic scenarios, may not give decision makers a full understanding of the environmental context of projects in the longer term.

Other requirements in Bhutan's law may also be used to enable consideration of climate change effects. Impact assessment must include "direct and indirect potential environmental impacts from all aspects of the project" as well as "long-term impacts for all phases of the project . . . and cumulative impacts of the project, any other projects, and other work or activity in the immediate surroundings and region."[3] The shear breadth of this language may be sufficient to incorporate relevant effects of climate change on project viability, cost, or impact within the EC analysis. However, officials may still be inclined to read this language narrowly as only requiring cumulative impacts of other human activity in the region, and not necessarily or expressly calling on project proponents to take a hard look at the synergies between project activities and climate change. Bhutan's law might also be interpreted to require evaluation of long-term climate change effects through its provisions on mitigation measures, which must be implemented "prior to or when appropriate in relation to environmental impacts."[4] This "schedule" introduces a temporal element into impact analysis and mitigation, and could be read as providing the implicit authority to recognize and mandate adjustments in response to a project's changing ecological context.

[1] Regulation for the Environmental Clearance of Projects, annx. 3 (2002) (Bhutan) (emphasis added).
[2] *Id.* § 7.
[3] *Id.* § 8.
[4] *Id.* § 9.

The definition of the "environment" itself may determine whether the scope of an EIA analysis is broad enough to include climate change as a factor for consideration. Generally, most definitions in national laws are quite broad. The Nigerian EIA law, for example, defines "environment" as "the components of the Earth, and includes land, water and air, including all the layers of the atmosphere; all organic and inorganic matter and living organisms; and the interacting natural systems that include [the above] components."[88] An "environmental effect" means "any change the project may cause to the environment, whether such change occurs within or outside Nigeria, and includes any effect of any such change on health and socio-economic conditions."[89] This definition provides significant authority to consider the effects of climate change on projects for which an EIA is required. However, specific guidance on the consideration of climate change impacts will be important to ensure those preparing the EIA actually do consider climate change. The authority to do something is often very different from a willingness to actually do it.

EIA laws frequently require analysis of four types of impacts, which can be used to consider the effects of climate change on most major projects affecting biodiversity or natural resources.

- **Indirect (or "secondary") impacts**
  Example: Farmers increase their use of pesticides in agriculture to deal with an increase in weeds caused by climate-induced shift in species range. This has the secondary effect of increasing toxic farm runoff into nearby water bodies.

- **Long-term impacts**
  Example: A dam is built to generate hydroelectric power eliminating a migratory route for fish. Twenty years later, climate change has altered the regional water cycle so much that there is no longer enough water in the reservoir to generate power, and the dam is abandoned.

- **Cumulative impacts**
  Example: Sea walls are built to protect cities along a country's coast from sea level rise due to climate change. This has the effect of severing a large percentage of the country's coastal habitats from inland habitats.

- **Irreversible impacts**
  Example: A mine is opened and operated in high-elevation core habitat for a rare mountain species. Climate change has pushed that species up the mountain and out of lower-elevation areas. The mining activity renders the remaining habitat unsuitable and the species goes extinct.

[88] Nigeria, Decree No. 86 of 10 Dec. 1992, art. 63(1) (Supplement to Official Gazette Extraordinary No. 73 Vol. 79, 31st December 1992—Part A A979).
[89] *Id.* art. 63(1).

Adaptive management done properly is more rigorous, involves heightened procedural requirements, and demands more follow-through, accountability, and enforcement than traditional management frameworks. Laws to guide adaptive management should be detailed and clearly written; they should impose mandatory requirements for implementation and compliance; and they should provide enforceable disincentives and other penalties when procedures are not followed.

There is nothing contradictory about developing adaptive management protocols and also imposing strict legal and procedural safeguards. However, the increased discretion required for adaptive management presents challenges to developing enforceable standards and regulations.[90] These may include:

- Local non-environmental interests may be in a better position to influence decentralized or discretionary management programs
- There is a risk of political deal making in the absence of clear, enforceable external standards, raising "rule of law" concerns that the laws will not be applied equally
- Courts may have difficulty adjudicating disputes involving "adjustable" substantive and procedural rules or open-ended timetables
- Regulated entities may not cooperate in undertaking new management burdens and may engage in "stonewalling, strategic bargaining, dilatory tactics, and other forms of unilaterally imposed transaction costs"[91]

These concerns will be most acute when adaptive management is attempted through unenforceable policies or management plans that lack the force of law. Where procedures and substantive rules for adaptive management are built into the law itself, are legally enforceable, and are subject to oversight, adaptive management programs can achieve more

[90] *See* Bruce Pardy, *The Pardy-Ruhl Dialogue on Ecosystem Management Part V: Discretion, Complex-Adaptive Problem Solving and the Rule of Law*, 25 Pace Envtl. L. Rev. 341 (2008)
[91] Bradley C. Karkkainen, *Adaptive Ecosystem Management and Regulatory Penalty Defaults: Toward A Bounded Pragmatism*, 87 Minn. L. Rev. 943, 961-65 (2003).

resilient outcomes for ecosystems and people. This chapter discusses the role of law in assuring accountability for management decisions within a flexible, adaptive management framework.

8.1 Setting and Enforcing Climate-resilient Management Objectives

Key Point: Adaptive management helps identify and improve the best management strategies to reach ultimate objectives for a resource or ecosystem. The flexibility designed into adaptive management, however, should not carry over completely into the process for setting those ultimate objectives. Defining and modifying ultimate goals requires a different set of procedures that are more stringent than those governing adjustments in how those goals should be achieved.

This section provides several options for setting objectives for biodiversity management in the face of unpredictable ecosystem changes due to climate change. Adaptive legal frameworks may require a graduated system of checks-and-balances that intensifies for decisions that change ultimate goals rather than shift the methods of achieving them. To illustrate, if managers wish to restore a rare bird to fifty percent of its baseline population in a protected area within a given time period, it may be appropriate to use adaptive management techniques to determine the best management approach for achieving this target. But would it be appropriate for a regulatory framework to delegate to the managing official the power to adjust the target based on a scientific claim that the species cannot be restored to the target level due to a change in the local climate?

The problem is that external stresses like climate change affect ecosystems and biodiversity in ways that are outside the control of the local managing authority. While some flexibility to adjust targets is likely necessary given the broad impacts of climate change, decisions to change a substantive management or restoration goal are of a different order than decisions to adjust the methods by which a fixed goal is reached. Two possible approaches could provide some measure of accountability in determining, enforcing, and modifying conservation goals and benchmarks for a natural resource.

One approach is to incorporate the concept of **resilience** (discussed above in Chapter 4.2) as a broad legal standard against which to review individual decisions affecting the ultimate status of an ecosystem. Rather than a rigid test, the question of what constitutes acceptable management policies to achieve resilient

THRESHOLDS are defined points that, when crossed, requires actions or responses.

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ecosystems might turn on the analysis and balancing of several different factors:

- The values and services provided by the resource in its prior state
- The values and services provided by the resource in its anticipated future state
- The uniqueness of the resource
- The cost of restoring the resource to its prior state.[92]

This approach recognizes that when dealing with potential climate change impacts, managers will need to make decisions about which species or ecosystem goods or services should be given priority protections. But it also provides a test against which those decisions can be evaluated. The test is flexible because it requires a case-by-case analysis, but it is enforceable because decisions can be evaluated to determine whether they have the effect of enhancing or weakening the resilience of the ecosystem. For example, decisions about whether to restore a degraded coastal wetland can be evaluated by an assessment of the future anticipated state of the wetland given sea level rise, salinity intrusion, and other effects of climate change. The resilience test may then be applied to support a determination that resources should be invested in preparing areas farther inland to become new coastal wetlands rather than attempting to restore wetlands at the current coastline.

A second approach is to set **thresholds** for indicators of ecological functionality that automatically trigger remedial or contingency actions when they are crossed. For example, thresholds might be set for:

- Population limits for migratory species or other keystone species below which the major ecological functions they serve are impaired
- Measures of ecosystem services such as water filtration, biodiversity levels, or storm-buffering capacity
- Losses of endemic species compared to non-native species as a percentage of total population numbers, biomass, or other suitable proxy in a defined area

The purpose of these types of thresholds is to automatically trigger regulatory actions. They reflect the fact that climate change may force changes in management strategy, but they also limit the discretion of managers to a pre-determined set of actions or new authorities. When they are designed to ensure ecological integrity and not just the bare survival of individual species, they have been called "thresholds of abundance."[93]

Adjustment of ultimate objectives or redefinition of thresholds should not happen without significant input by the public and stakeholders through a deliberative process in which the scientific and policy bases for the adjustment are

[92] Alyson C. Flournoy, *Protecting a Natural Resource Legacy While Promoting Resilience: Can it be Done?*, 87 Neb. L. Rev. 1008, 1030-32 (2009).

[93] Robert L. Fischman and Jeffrey B. Hyman, *The Legal Challenge of Protecting Animal Migrations as Phenomena of Abundance*, 28 Va. Envtl. L. J. 173, 189-205 (2010).

laid out for debate and possible rebuttal. Though courts may not be competent to assess the scientific merits of this type of decision, they should be able to review the record to determine if public participation and scientific assessment procedures have been followed and the managing authority has rationally and thoroughly considered all the evidence before it.

8.2 Options for Insulating Flexibility Mechanisms from Misuse

Key Point: Policymakers can give on-the-ground managers and resource users flexibility without sacrificing environmental protections or procedural safeguards. Climate change calls for laws that meet biodiversity-sustaining benchmarks over the long term while retaining flexibility in the means used to meet these benchmarks.

Chapter 8.1 looked at ways of setting targets for resource management that are adaptable to climate change. This section looks at how best to maximize beneficial, on-the-ground flexibility within a framework of long-term goal setting and accountability. Mechanisms for flexibility are critical to adaptive management. Flexibility in the law, however, must be carefully defined. "Flexibility" does not mean managers and local stakeholders receive a blank check to go back on previously-agreed commitments. Some examples of legal flexibility to support adaptive management without sacrificing accountability may include the following:

- Allowing managers to use their expert judgment to make policy adjustments on issues that have been deemed from the start to fall within the managers' discretion
- Setting standards individually by region based on local conditions and climate impacts
- Requiring deference to agency expertise for the judicial review of decisions that require a high level of ecological or scientific expertise
- Providing authority to adjust terms and conditions of resource use permits and authorizations to reflect changing ecological conditions
- Using existing legal tools and doctrines such as
    - Guidance on appropriate use of "enforcement discretion" (the right of government to choose not to prosecute an individual)
    - Administrative waivers (an agreement to waive compliance with specific regulatory requirements in exchange for achieving the same or better result by a different means), or
    - Out-of-court settlements to drop criminal or civil charges for environmental violations in exchange for the violator's commitment to perform conservation actions that go beyond what is required by current law

This last category of options must be used cautiously, of course, to avoid undermining enforcement efforts. Despite that caveat, management officials may be able to find opportunities to work with private actors to achieve conservation results that are better than what could be done under the strict letter of the law. Because climate adaptation is not yet included in most regulatory requirements, these opportunities may be particularly useful for testing innovative adaptation measures.

Example: Vietnam's "Second National Strategy and Action Plan for Disaster Mitigation and Management in Vietnam – 2001-2020" provides an example of how flexibility can be incorporated into natural resource management by tailoring programs to local conditions.[94] Each region of the country is charged with carrying out activities to mitigate natural disasters, but the Plan allows each region to develop strategies that are sensitive to its geographical and ecological context. For example, in some coastal regions the Plan calls for strengthening dike systems, reforesting mangroves, and protecting forests. The Eastern Coast and Islands apply the approach "Proactiveness in disaster prevention, and adaptation for development," while the Mekong River Delta applies the approach "living with flooding."[95] The flexibility in this approach comes through the recognition that ecological and geographical contexts have different needs and requirements. Similarly, a "one-size-fits-all" approach will not be appropriate for all resource managers in a country to confront climate change impacts.

In order to ensure accountability, it is critical that institutions and programs are in place to provide general oversight of these tools for management flexibility and discretion and to provide protections from potential misuse or malfeasance. These protective mechanisms may include:

- Judicial oversight to ensure agencies comply with basic regulatory or legal requirements (including judicial power to remand a case to the agency to make adjustments)
- Procedural rules that tie discretionary power to make adjustments in management to specific reference points or benchmarks based on high-quality monitoring and data collection
- Third-party independent audits of management programs
- Internal control officers within agencies or ministries
- Administrative, civil, and criminal penalties for officials who violate regulatory safeguards, accept bribes, or engage in other forms of corruption
- Remedial training programs for neglectful or unskilled managers
- Capacity-building exercises, workshops, and seminars for officials

The discretion to adapt management strategies in response to climate change can be limited through many types of binding and enforceable "hard law" tools to ensure adaptive measures do not infringe basic rights, produce inequitable results, or provide a cover for corrupt or abusive practices.

[94] Prime Minister's Decision 172/2007/ND-CP (2007) (Vietnam).
[95] National Strategy Decision 172/2007/ND-CP (2007) (Vietnam).

Box 8.1. Clear Legal Drafting Is Essential for Adaptation Policies

Drafting and enacting precise legal language is difficult. But the risk of overly broad or vague laws and regulatory programs is that they are much more likely to be misused and fail their intended purpose. Laws related to adaptation efforts are no different. The following example comes from a legislative proposal to establish a mixed-use, public-private refuge in a coastal area to protect leatherback sea turtles in response to climate change and other human-caused impacts. While its aims may have been well-intentioned, several provisions in the bill are vaguely worded and pose significant risks to the future of the management program.[1] Below are several of these "red flag" provisions and explanations of how imprecise or overly broad legislative language can create potentially troublesome outcomes:

"Direct collaboration between the public authorities and the private owners is intended . . . [J]oint management, carrying due respect for current guidelines . . . ."

Red Flag: "Joint management" can be an effective means of collaboration between private stakeholders and officials. But without a backstop of mandatory protections, this could give landowners or developers the power to veto government regulations that they do not like. Moreover, the phrase, "due respect for current guidelines," is so vague that it may neither adequately protect the turtles from exploitation nor property owners from capricious government actions.

"The [management plan] shall be developed jointly by [the ministry] and the association constituted exclusively by the owners of the land included in the limits established for the Refuge . . . ."

Red Flag: Limiting the development of the plan to only the ministry and the property owners is too narrow. Left out of the development are interested stakeholders such as tour operators dependent on the turtles, environmentalists, scientists, and others in the community. Moreover, without a wider stakeholder input, the legislation puts a small group of local landowners in too great a position of control over the fate of a critically endangered, internationally protected species.

"[Lands] shall remain in the Refuge for equal and consecutive periods of ten years . . . these periods [will be renewed] automatically, as long as the public objective motivating the creation of this Refuge is maintained."

Red Flag: This clause allows for the dissolution of the Refuge after a ten-year period. The renewal of the Refuge program is only automatic as long as a vaguely defined "public objective motivating the creation of this Refuge is maintained." This opens the door for Refuge opponents to argue that climate change has rendered the refuge unsuitable for turtles and therefore that the public objective is no longer valid. While periodic review of resource management and protection is essential for adaptive management, this provision sets an arbitrary date and imprecise renewal requirements that may make it possible for opponents to halt the program.

These examples demonstrate the importance of good legislative drafting. Close attention to exact language is needed to prevent flexibility and collaboration from undermining environmental protections and stakeholder rights and safeguards.

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[1] An English language version of the draft law can be found at http://www.leatherback.org/pages/Law Project17383/LawProject17383_071909.pdf (last visited Nov. 19, 2009).

In addition to administrative frameworks for adaptive management, there are other legal authorities that can be used to increase the resilience of ecosystems to climate change. This chapter looks at the role of constitutional provisions guaranteeing substantive and procedural rights. It also examines how courts can facilitate adaptive, collaborative governance through judicial procedure and standards of review. The constitutional rights this chapter will analyze are:

- The substantive right to a clean and healthy environment
- The substantive right to private property
- The procedural rights of access to information and the courts

The constitutions of many countries provide a right to a healthy environment (or a right to life that is interpreted to include the right to live in a healthy environment) and guarantee rights to ownership or use of private property. They may also impose a duty upon government to protect the environment for its citizens. These rights or duties provide powerful legal tools to push governments to take measures to protect resources from climate change. *First*, they can be used defensively, or restrictively, to protect against government encroachment upon an enforceable right (e.g., halting government authorizations for a development project that threatens resources).[96] *Second*, they can be used affirmatively, or constructively, to compel government to take action to protect a right (e.g., stopping a private polluting enterprise from discharging into a protected area).[97] *Third*, and perhaps most importantly in the context of climate change and other emerging environmental stressors, a broad constitutional provision like the ones examined in this chapter "can provide a 'safety net' for resolving environmental problems that existing legislative and regulatory frameworks do not address."[98] Other legal options for protecting ecosystems may be available as well, such as the public trust doctrine[99] or private causes of action for nuisance or trespass to stop activities that are maladaptive to climate change and that cause damage to privately-owned lands, resources, or habitat.[100]

[96] United Nations Environment Programme et al., Constitutional Environmental Law: Giving Force to Fundamental Principles in Africa 1 (2d ed. 2007).
[97] *Id.*
[98] *Id.* at 2.
[99] *See* Robin Kundis Craig, *Adapting to Climate Change: The Potential Role of State Common-Law Public Trust Doctrines,* 34 Vt. L. Rev. 781 (2010).
[100] *See* Christine A. Klein, *The New Nuisance: An Antidote to Wetland Loss, Sprawl, and Global Warming*, 48 B.C. L. Rev. 1155, 1225-29 (2007).

9.1 The Right to a Clean and Healthy Environment

Key Point: In countries that recognize a constitutional right to a clean and healthy environment (or a constitutional "right to life" that is interpreted to include the right to live in a healthy environment), courts may have a stronger role in halting activities or behaviors that are maladaptive to climate change. Courts may even be able to mandate affirmative adaptation measures when government fails to act.

If the right to a "clean and healthy environment" is interpreted to include ecological "balance" or "stability," then courts may be able to require governments to take adaptation actions that build social or ecosystem resilience to climate change impacts. Practitioners will need to explore how their countries' constitutions define rights and duties related to the environment and whether these rights are enforceable in court.

examples

The Namibian Constitution requires the government to take action for the "maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future."[101] This provision, emphasizing "ecological processes," "sustainability," and "future" Namibians, provides several "hooks" on which to hang a legal claim to compel climate adaptation activities to build ecosystem resilience for the future. Statutory enforcement provisions are a key next step.

The three East African Community countries, Kenya, Tanzania, and Uganda, each recognize rights in the environment that are privately enforceable through court action.[102] Uganda's Constitution is the most comprehensive and provides "The State shall protect important natural resources … on behalf of the people of Uganda."[103] Uganda's Constitution also articulates national principles and policy objectives such as balancing the interests of present and future generations through sustainable development, developing clean energy policies, and ensuring preservation of biodiversity through parks and reserves. Each of these elements of Uganda's constitutional rights framework provides legal authority to spur adaptation policies.

Courts are able to apply these types of constitutional provisions in powerful ways. For example, in *Rural Litigation & Entitlement Kendra v. Uttar Pradesh*, the Indian Supreme Court construed the right to a healthy environment to include an entitlement to "ecological balance" and ordered the cessation of an unauthorized mining operation despite the lack of a direct impact on human health.[104] In the Hungarian Protected Forests Case, the Constitutional Court struck down a law as unconstitutional that would have redesignated protected areas as private lands for agricultural development, declaring

[101] Const. art. 95, ch. 11, §(l) (1978) (Namibia).

[102] Patricia Kameri-Mbote and Collins Odote, *Courts as Champions of Sustainable Development: Lessons from East Africa*, 10 Sustainable Development L. & Pol'y 31, 32 (2009).

[103] Const., directive XIII (1995) (Uganda).

[104] A.I.R. 1985 S.C. 652, 656; A.I.R. 1988 S.C. 2187 (S. Ct.) (India).

Box 9.1. Constitutional Law and Climate Change in Ecuador

Few countries have constitutional provisions explicitly dealing with climate change, but in 2008 the people of Ecuador voted to adopt a new constitution that contains detailed provisions related to environmental rights, biodiversity, and climate change. The 2008 Constitution recognizes the right of every Ecuadorian to live in an environment that is "healthy and ecologically balanced."[1] The protection of the environment, the conservation of ecosystems and biodiversity, and the integrity of the country's genetic heritage are considered of public interest.[2] Nature itself has a right to have its processes and integrity kept intact – "Pacha Mama [Nature] . . . is entitled to full respect in its existence and maintenance and regeneration of its vital cycles, structure, functions and evolutionary processes."[3] By highlighting the importance of ecological processes, these provisions may allow for adaptation and evolution in natural systems over time, while providing legal authority to protect such processes from undue or preventable degradation.

Duties to Adapt

Ecuador's Constitutional provisions on environmental and natural resource planning provide explicit authority for climate change adaptation. The Constitution requires the government to protect forests and vulnerable populations, which provides the state authority to undertake adaptive measures for biodiversity conservation in response to climate change.[4] The state is also responsible for establishing a system to prevent and manage natural disasters and risks. Among the highest priorities for Ecuador, a coastal mountainous country, is the need to preserve soil and prevent erosion.[5] *(box continued on next page...)*

[1] *See* Const. art. 14 (2008) (Ecuador).
[2] *Id.*
[3] *Id.* art. 71.
[4] *Id.* art. 414.
[5] *Id.* art. 409.

that citizens have a right to the "highest possible level of physical and spiritual health."[105] Constitutional environmental rights cases often involve tradeoffs between immediate economic interests (in this case, new agricultural lands) and long-term ecological health (such as protected forests or the environment). Because constitutional rights extend theoretically to perpetuity, they are

[105] Magyar Közlöny Case No. 1994/No.55, p. 1919 (Hungarian Constitutional Court, 1994).

(...box continued from previous page)

Ecosystem Approach

In affected areas, the Constitution obligates the government to forest and reforest the land using native species and to lend support to farmers to prevent soil loss.[6] Further, the government must guarantee the conservation and management of water resources, guided by human and ecosystem needs.[7] Ecuador guards protected areas and guarantees the protection of biodiversity and ecosystems.[8] The government's responsibility over the country's biodiversity is informed by the principle of intergenerational justice, or the duty to consider past and future generations in actions it takes.[9]

Collaboration with Communities

The state is to regulate the conservation, management and use of fragile ecosystems, including cloud forests, mangroves, and marine areas.[10] However, the Constitution also provides that the responsibility for such environmental management will be decentralized.[11] Ecuador guarantees the active and permanent participation by all persons, communities, and groups in the planning, execution, and control of actions that affect their environment.[12] The Constitution empowers natural and legal persons with the right to protect nature and promote respect for ecosystems, and it grants any natural or legal person or group, without prejudice to any direct interests, *locus standi*, or standing to challenge actions, in environmental matters.[13]

Despite the strong wording of these provisions, it is too soon to know how they will be implemented, enforced, and interpreted.

[6] *Id.* art. 410.
[7] *Id.* art. 411.
[8] *Id.* art. 397 (4).
[9] *Id.* art. 400.
[10] *Id.* art. 406.
[11] *Id.* art. 399.
[12] *Id.* art. 395 (3).
[13] *Id.* art. 71.

powerful tools to force consideration of long-term climate impacts to a country's natural resources and, at least within some legal systems, to require the consideration of those impacts even when pitted against the prospect of immediate human economic gain.

The public trust doctrine similarly emphasizes the obligation of the government to maintain publicly-owned resources for future generations. This may be an effective doctrine to drive climate-adaptive resource laws and policies.[106]

[106] *See* M.C. Mehta v. Kamal Nath et al., 1 S. Ct. 388, ¶ 32 (writ petition before the Supreme Court of India Dec. 13, 1996) ("Thus, the public trust is more than an affirmation of State power to use public property for public purposes. It is an affirmation of the duty of the State to protect the people's common heritage of streams,

(For more on the role of the public trust doctrine in adaptation on private lands, see Section 13.4.)

In some countries, constitutional rights to a healthy environment have a "horizontal" operation, imposing legal duties on private actors.[107] For example, Bhutan recognizes a constitutional right to a healthy environment through a provision stating that, "Every Bhutanese is a trustee of the Kingdom's natural resources and environment for the benefit of the present and future generations and it is the fundamental duty of every citizen to contribute to the protection of the natural environment . . . ."[108] Further, the Royal Government "shall protect, conserve and improve the pristine environment and safeguard the biodiversity of the country" as well as "[s]ecure ecologically balanced sustainable development while promoting justifiable economic and social development."[109] The emphasis on "trusteeship" and individual duties in Bhutan's Constitution could encourage citizens and the Government to take into account the effects of climate change when carrying out activities that might affect the environment.

Such provisions might be used to stop private economic development projects that are maladaptive to climate change even if the government is not directly involved. The Supreme Court of Chile in Pedro Flores v. Corporación del Cobre, Codelco, Division Salvador enjoined a mining company from further depositing copper tailings onto beaches after it was shown the practice was causing a massive die-off of marine life. The court relied on Articles 19 (providing the right to live in an unpolluted environment) and 20 (authorizing actions to enforce Article 19) of the Chilean Constitution for authority.[110] The mining company was a private actor, but the court used constitutional guarantees to a healthy environment to halt actions that were clearly harmful. A similar logic may be used to stop private actions that will increase the vulnerability of natural resources to climate change in the long term (e.g., logging on a timber concession that exposes a downstream community to risks of landslides in the event of extreme weather events).

lakes, marshlands and tidelands . . . .") (quoting Nat'l Audobon Soc'y v. Superior Court of Alpine County, 33 Cal. 3d 419, 441 (Cal. 1983) (U.S.A.)).

[107] United Nations Environment Programme et al., Constitutional Environmental Law: Giving Force to Fundamental Principles in Africa 29 (2d ed. 2007).

[108] Const. art. 5(1) (2008) (Bhutan).

[109] *Id.* art. 5(2)(a) and (c).

[110] ROL.12.753FS.641 (Supreme Court of Chile, 1988).

9.2 Private Property Rights: Opportunities and Obstacles for Adaptation

Key Point: Private property rights must be respected and need not pose an obstacle to adaptation measures. They may provide an incentive for adaptive measures if owners believe they have a long-term stake in the well-being of their land. However, reasonable public measures to conserve biodiversity on private lands are important for adaptation and do not necessarily constitute an unconstitutional taking of private property.

Private property rights present both opportunities and challenges in implementing adaptation policies for natural resources. Expropriation of property can be so costly as to preclude the use of privately-owned property areas to accomplish conservation aims. This problem is significant in an era of climate change, in which the shifting ranges and habitats will bring many species onto private lands, where conservation measures traditionally have been very weak.[111] Property rights may pose an obstacle to more innovative or far-reaching conservation measures necessary to protect biodiversity and natural resources from the effects of climate change. However, private lands conservation – carried out through collaboration with landowners – is a potent method of extending sound resource management beyond public lands.[112] (See Chapter 13 on the use of adaptive management in private lands conservation.)

Practitioners must look at the body of law on property issues within their own countries to determine whether constitutionally protected private property rights will pose an obstacle to climate change adaptation actions. One recent Ugandan case provides support for the view that decisive action to protect ecosystems on private lands does not necessarily rise to the level of an unconstitutional "taking" of that property. In *Nyakana v. NEMA*, the Constitutional Court of Uganda dismissed a petition on behalf of a landowner who alleged his property had been taken unconstitutionally when the National Environmental Management Authority (NEMA) demolished a house he was constructing within wetlands after he failed to obey a restoration order.[113] The petition relied in part on Article 26 of Uganda's Constitution, which forbids compulsory deprivation of property except (1) in service of public purposes and (2) under a law providing for fair compensation and an opportunity to be heard. The court found authority for the agency's actions under Uganda's National Environment Management Act, which restricts any use of wetlands without prior approval of the agency. The court agreed with the reasoning of the respondents that "[w]hat was taken away from him was misuse of the land and this was done to protect the environment."[114] A concurring judge noted, "[S]uch wetlands could not be granted to private individuals/entities because the State holds such natural resources in trust for

[111] Kathy J. Willis and Shonil A. Bhagwat, *Biodiversity and Climate Change*, 326 Sci. Mag. 806, 807 (2009).

[112] *See* Envtl. L. Inst., Legal Tools and Incentives for Private Lands Conservation in Latin America: Building Models for Success (2003).

[113] Const. Pet. No. 03/05 (Const. Ct. of Uganda Nov. 9, 2009).

[114] *Id.* at 14.

the citizenry and they must be preserved for the public benefit . . . ."[115]

This ruling provides important precedent in Uganda that private property rights do not trump constitutional and legislative mandates to protect the environment. This will provide Uganda's NEMA with more flexibility to confront environmental challenges arising from climate change impacts. The determination that a particular private land use threatens ecological values held in trust for the public may be found sufficient to justify governmental restrictions on those private actions without expropriation or compensation.

Private property rights need not be in tension with strong environmental governance. Indeed, sophisticated use of private rights can be used to motivate private actors' engagement in management programs. For example, Project Elé, an effort sponsored by the Argentinean government to save the blue-fronted parrot while maintaining a healthy export market, achieved meaningful private engagement by limiting the right to collect the bird to local landowners contingent on their participation in a management plan for the bird.[116]

Figure 9.1 The Dambo wetlands in Uganda[1]

[1] Photo: Dambo Wetlands Research Project, http://www.geog.utah.edu/dambo/index.html (last visited July 14, 2011), funded by NSF Geography & Regional Science Grants No. 0620142 and 0620206.

[115] *Id.* at 14 (Byamugisha, J., concurring).

[116] Jorge Rabinovich, *Parrots, Precaution, and Project Elé: Management in the Face of Multiple Uncertainties, in* Biodiversity and the Precautionary Principle 177, 184 (Barney Dickson and Rosie Cooney eds. 2005).

9.3 Procedural Rights: Access to Information, Public Participation, and Citizen Enforcement Power

Key Point: The rights to obtain information about and to participate in resource decision making are essential for climate adaptation planning. Informed participation by civil society actors such as non-governmental organizations, businesses, and academic institutions can help facilitate holistic, cross-sector, multi-stakeholder, ecosystem-level thinking about resource management.

CIVIL SOCIETY groups can play an important coordinating and connecting role in carrying out complex climate adaptive strategies.

terms on page

Civil society actors generally work with many different government bodies, private sector actors, funding institutions, and local community groups, and their activities encompass both science and policy. These groups can play an important coordinating and connecting role in carrying out complex climate adaptive strategies.[117] They and others with interests in adaptive resource management, such as businesses and local communities, can be given institutionalized legitimacy through laws that encourage a strong role in adaptive governance.[118] The ability of these groups to act in this role, however, depends upon the strength of a country's laws allowing the public to obtain access to government information, participate in development decisions, and enforce legal requirements when the government fails to act.

There are a number of legal instruments or methods that can confer upon these groups legal status that will enhance their ability to participate in climate change adaptation. Some examples include:

- Constitutional or statutory rights to obtain information held by the government (e.g., Liberia's Environment Protection and Management Law §105 (2002) provides for freedom of access to information regarding the "development and management of the environment and natural resources;" in the United States, the Freedom of Information Act (FOIA) allows individuals to request and obtain information held by government agencies)
- Constitutional or statutory rights to go to court on behalf of environmental interests and protections
- Consultation requirements with respect to the development of new legislation
- Statutory rights to participate in planning, management, and regulatory decisions (e.g., Liberia's Environment Protection and Management Law (2002) §§11 - 21 requires a "scoping process" that ensures public participation in environmental impact assessments and requires the environmental agency to disseminate the proposed environmental impact statement to, and invite comment from, those most likely to be affected by the project. In addition, under Section

[117] Cassandra Brooke, *Conservation and Adaptation to Climate Change*, 22 Conservation Bio. 1471 (2008).
[118] Harry Blair, *Participation and Accountability at the Periphery: Democratic Local Governance in Six Countries*, 28 World Development 21 (2000).

20, at least one person based in or living within the area affected by the proposed project must be included on the committee reviewing the EIS)

- Autonomous rights to control resources in decentralized or federal systems or on indigenous or native lands[119]

examples

In general, most countries' laws require or allow public participation, but enforcement of those provisions is not fully guaranteed through the use of administrative appeals, judicial power to set aside unlawful action, or other compliance mechanisms. In the Dominican Republic, the environmental ministry is encouraged but not mandated to include civil society and community organizations in environmental plans, programs, and projects.[120] The requirement is vaguely worded and there is no established penalty for excluding these groups from decision making. In Vietnam, the strategic environmental assessment law provides: "Organizations and individuals shall have the rights to submit their requests and recommendations of environmental protection to the agencies that are responsible for establishing the review councils, and the . . . [councils] shall have responsibility to consider these requests and recommendations prior to their conclusions and decisions made."[121] However, like the Dominican Republic law above, this law does not clearly specify the consequences of failure to follow its mandate. The lack of defined remedies for violations can weaken or even eliminate meaningful public participation.

[119] For information about public access and tools to improve the ability of stakeholders to influence government decision-making see Access Initiative, www.accessinitiative.org (last visited Dec. 18, 2010).
[120] Gen. Law on the Environment 64-00 §18(11) (2000) (Dominican Republic).

[121] Law on Environment Protection art. 17(5) (2005) (Vietnam).

9.4 Problems with Standing to Bring Climate Change Court Cases

Key Point: Courts can play a stronger role driving climate adaptation policies in jurisdictions that provide civil society actors access to courts through broad doctrines of "standing" and "legal interests."

In additional to participation in adaptation programs at the administrative level, citizens' groups and civil society have an oversight and enforcement role to play through the use of the court system. An independent judiciary with power to hear complaints brought by private groups, businesses, or citizens can review resource management decisions that may be maladaptive to climate change. In order to obtain this review, however, such groups must have standing, or the right to be heard in court.

STANDING is a doctrine that generally limits courts' jurisdiction to actual disputes between parties.

terms on page ......

The doctrine of *locus standi,* or standing, generally provides that only parties with real grievances that can be redressed through adjudication should have their cases heard in court. In many cases, climate impacts may be difficult to quantify, located in the future, or suffered by a great many people to the same degree. Nonetheless, if the concerns of communities or organizations about climate change that prompted a lawsuit are valid, and the legal footing of the case is otherwise sound, then the doctrine of standing should not be used to block a potentially powerful judicial role.

examples

As articulated in an important Bangladeshi case, that country's doctrine of standing provides, "If [the citizen-applicant or the indigenous and native association] espouses a public cause involving public wrong or public injury, he need not be personally affected. The public wrong or injury is very much a primary concern of the Supreme Court which in the scheme of our Constitution is a constitutional vehicle for exercising the judicial power of the people."[122] This doctrine is likely broad enough for a wide range of citizen suit actions.

In the United States, a narrower interpretation of standing requires persons bringing a lawsuit – the plaintiffs – to show, among other things, an injury that is concrete and particularized as well as actual or imminent, not conjectural or hypothetical. This high bar to meet the standing requirement has forced many groups to spend extra time and money to establish the right to be in court to pursue legal claims related to climate change.[123] The U.S. House of Representatives attempted to strengthen the basis for legal standing due to climate change "injury" through legislative findings in the American Clean Energy and Security Act of 2009. The bill, which was not passed into law, stated,

> That many of these effects and risks of future effects of global warming are widely shared does not minimize the adverse effects individual persons have suffered, will suffer, and are at risk of suffering because of global

[122] Dr. Mohiuddin Farooque v. Bangladesh et al., Civil Appeal No. 24 of 1995, 17 B.L.D. (AD) 1997, vol. XVII, pp. 1-33, 1 BLC (AD) (1996) pp. 189-219 (High Court of Bangladesh).

[123] *See* Center for Biological Diversity v. Department of the Interior, 563 F.3d 466 (D.C. Cir. 2009) (USA) (finding only limited standing to pursue "procedural injury" claims and no standing to pursue substantive claims related to climate change because petitioners could only show their climate injury "may" occur and was not "actual or imminent").

> warming. That some of the adverse and potentially catastrophic effects of global warming are at risk of occurring and not a certainty does not negate the harm persons suffer from actions that increase the likelihood, extent, and severity of such future impacts.[124]

These legislative findings emphasize that climate change causes injury; that an increase in the risk of injury is itself a form of injury; and that injury to many people is not "injury to none." In the U.S. legal system, language such as this that is inserted into climate change legislation can influence a court's analysis of whether a party has legal standing to be in court in cases related to climate change.

[124] H.R. 2454, 111th Cong. § 311 (proposed Clean Air Act § 701(a)(4)-(5) (2009) (U.S.A.)).

9.5 Using Courts to Foster Adaptive and Collaborative Resource Management

Key Point: Though it may be beyond the power or expertise of a court to adjudicate complicated scientific disputes, it is within a court's powers to determine whether procedural requirements, including those governing effective adaptive management, are being met.

Adaptive management poses special problems for courts that have power to review agency decisions on climate change. Agency decisions related to large-scale, long-term ecosystem management, made under conditions of scientific uncertainty, are difficult for courts to effectively review. Officials and managers implementing long-term adaptive management frameworks require broad discretion to review and adjust strategies without the constant threat of litigation. But this discretion makes it difficult to determine whether adaptive management is achieving long-term conservation targets. One way to provide some oversight over these discretionary decisions is to ensure that they are adequately supported by the scientific data and available information.

One approach is for NGOs, businesses, and other non-government entities with an interest in sustainable management of natural resources to target litigation efforts toward an improved learning function within resource agencies.[125] The questions that could be useful to bring before courts to answer might include:

- Is the agency using or ignoring data collected through monitoring efforts?
- Has the agency complied with periodic review schedules?
- Has the agency considered and addressed all relevant concerns of stakeholders, including scientific experts?

Australia's state-level courts have heard four cases involving questions of climate adaptation in relation to coastal development. In each case, the future, long-term impacts of climate change were determined to be relevant to regulatory decisions and judicially cognizable in evaluating the validity of the regulatory determination.[126]

examples

- **Aldous v. Greater Taree City Council**[127]: The requirement to consider ecologically sustainable land development includes a requirement to consider coastal erosion caused by climate change.
- **Gippsland Coastal Board v. South Gippsland Shire Council**[128]: The court applied the precautionary

[125] *See* Holly Doremus, *Precaution, Science, and Learning While Doing in Natural Resource Management*, 82 Wash. L. Rev. 547, 573-79 (2007) (comparing *Ecology Ctr. v. Austin*, 430 F.3d 1057 (9th Cir. 2005) (U.S.A.) and *Sierra Club v. Marita*, 46 F.3d 606 (7th Cir. 1995) (U.S.A.)).

[126] Case examples taken from Columbia Law School, Center for Climate Change Law, Michael B. Gerrard and Jerry Chen, Non-U.S. Climate Change Litigation Chart (last updated May 10, 2010), *available at* http://www.law.columbia.edu/null/download?&exclusive=filemgr.download&file_id=163021.

[127] [2009] NCWELC 17 (Land and Envt. Ct. of New South Wales 2009) (Aust.).

[128] [2008] VCAT 1545 (Victorian Civil and Administrative Tribunal 2008) (Aust.).

Box 9.2. Tailoring Courtroom Rules to Community Needs in Kenya

Court procedures can contribute to a collaborative learning culture in resource management. The National Environmental Tribunal in Kenya was established to provide appellate review of licensing decisions by the National Environmental Management Authority. The Tribunal regularly hears cases related to EIA licensing, which under Kenyan law has strong public participation requirements. Members of the community are often called upon to provide testimony in these cases.

In traditional courtroom proceedings, rules for witnesses might require that they be absent from the courtroom during other testimony, to prevent the chance for collusive lying between witnesses. But the Tribunal has not adhered to such strict evidentiary requirements because its members want to ensure that members of the community affected by a project under review have access to information that is presented in the proceedings. Community participants are encouraged to remain in the courtroom throughout the hearing, even though they may serve as witnesses, so that they have an opportunity to learn about the larger issues in the case. The Tribunal decided that it is more important to foster a learning environment around an environmental controversy, and that it could rely on other safeguards to determine if a witness is trustworthy. This is one simple way courts can foster learning among the community within the environmental regulatory process.[1]

[1] Adapted from Jane Dwasi, Judge, Kenyan Nat'l Envtl. Tribunal, Presentation to the Environmental Law Institute., Kenya's Experience with Environmental Impact Assessment as a Tool for Sustainable Development: Opportunities and Challenges (Nov. 10, 2009).

Figure 9.2 Squeezing Coastal Habitat Coastal development is at risk from sea level rise in Australia, along with coastal habitat already squeezed by development.

Photo credit: Tinni Choudhury

principle to determine that climate change created a foreseeable risk that a residential development site would be inundated, and it overturned the municipal permit.

- **Northcape Properties v. District Council of Yorke Peninsula**[129]: The court held that a city's refusal to allow development of coastal areas was justified on the basis of projected sea level rise over the next 100 years.
- **Charles & Howard Pty Ltd v. Redland Shire Council**[130]: The court upheld an order to move a proposed dwelling to an area less vulnerable to tidal inundation from climate change.

[129] [2008] SASC 57 (South Aust. Supreme Ct.) (Aust.).
[130] [2007] QCA 200 (Queensland Planning and Envt. Court) (Aust.).

Part 3: Implementing Adaptive Rules and Policies in Four Areas of Natural Resource Management

Part 2 analyzed broad design principles for biodiversity management programs and other high-level legal provisions for adaptation to climate change. Legal frameworks contain many more elements affecting resource management: implementing regulations, management plans, permits, leases, customary practices and rules of conduct, private property relations, contracts, memoranda of understanding, and others. In each of these legal tools and practices, climate change may arise as an important consideration, and the statutory law governing the resource in question may not provide a clear method for addressing slimate change considerations. This Part, like Part 2, will use principles of adaptive, ecosystem-based management to develop options that can help stake-holders and communities develop and implement adaptive rules and policies. However, unlike Part 2, this Part explores mechanisms to enable adaptive management in several applied examples of resource use or protection.

This Part looks at four natural resource management practices where the methods of adaptive management can be used to respond to climate change:

- Permitting, licensing, and concessions for natural resource access and extraction
- Community-based natural resource management
- Protected areas on public lands and waters
- Private lands conservation

This Part is intended to operate on two levels: First, it provides guidance to legal and regulatory actors seeking to adapt resource management policies to climate change in the absence of clear statutory programs or other high-level mandates. Second, for those who are designing higher-level legislation and policy for climate adaptation, this Part can be used to flesh out important on-the-ground considerations that will help inform future legal and policy development on climate change adaptation at the national and international levels.

In many countries, the current permitting practices and laws governing access and extraction rights for natural resources may hinder the capacity to adapt to potential climate change impacts. This chapter provides options for improving these practices and laws. By viewing permits as adaptive management tools, managers can monitor, assess, and modify programs to protect resources that are affected by climate change.

For example, the use of leases to allow international agribusiness firms long-term access to fertile cropland is a growing practice in some developing countries. Though potentially beneficial for food security, governments often sign these contracts for very long periods – between 40 and 99 years. The leases contain few environmental requirements or conditions. They may lack clear means or standards for auditing, reviewing, adjusting, or cancelling the lease.[131] Thus, if an area becomes less suitable to crop agriculture as the region becomes drier, the permit holder may continue to demand irrigation water as a right, even though this leaves less water for other uses. This chapter looks at how permitting and licensing practices for commercial-scale access and extraction of natural resources can be made more adaptive to the effects of climate change.

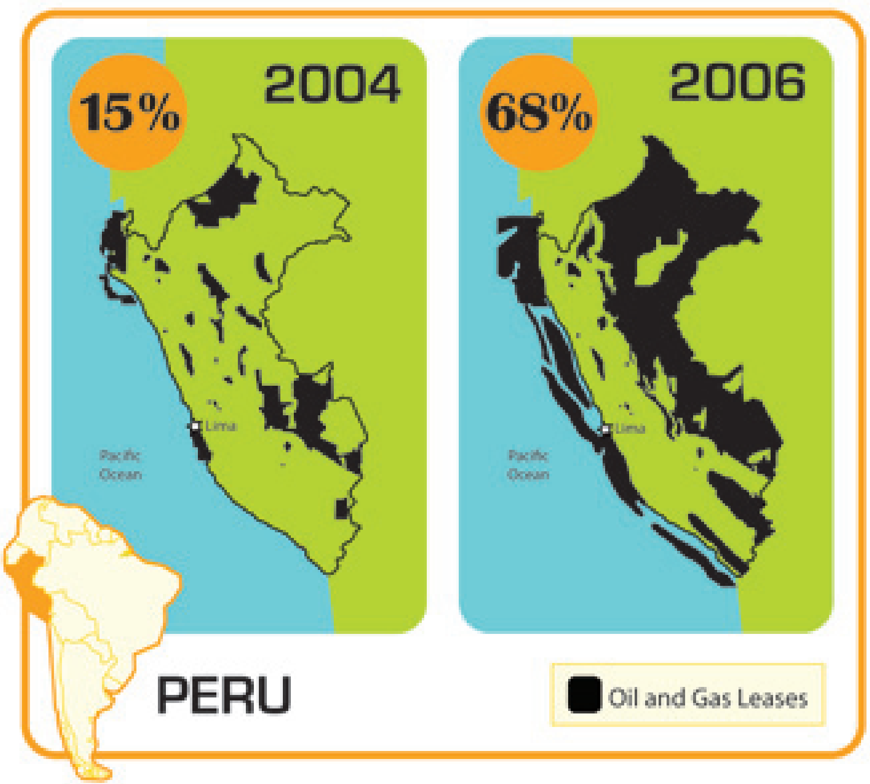

Figure 10.1 Integrating Extraction and Biodiversity Adaptation Expansion of oil and gas leasing over two years in Peru. Laws governing where, when, and how petroleum may be extracted have enormous impacts on the surrounding ecosystems and communities.

[131] *See* Stephanie McCrummen, *The Ultimate Crop Rotation*, Wash. Post, Nov. 23, 2009, at A1.

10.1 Establishing the Legal Entitlement: A privilege or a right?

Key Point: Natural resource permits that can be modified or terminated based on periodic assessments of ecological conditions, including how a resource is affected by climate change, can help promote adaptive management.

Those with significant economic interests in a permit or concession understandably need some predictability and certainty in knowing what they can and cannot do with respect to particular resources. Adaptive management can weaken that certainty. On the other hand, officials must also be able to modify the terms of permits in response to changing conditions. Thus, a balance must be struck between providing clear terms and conditions for the permit holder and allowing flexibility for the government to require modifications to adapt to changing circumstances. Brazil's permitting regime, for example, enables government officials to auction off timber rights within some sections of the country's rainforest, but the winners of such bids do not receive title to the land or the right to extract any resource other than timber.[132] The degree of legal entitlement authorized might depend on whether the permitting government views resource use as a **right** or a **privilege**. In general, a right gives the resource user an absolute interest. A privilege gives a resource user a conditioned interest, which can be subject to requirements that can foster adaptive management.

[132] Larry Rohter, *Brazil Gambles on Monitoring of Amazon Loggers*, N.Y. Times, Jan. 14, 2007, at A11.

10.2 Authority to Evaluate and Adjust Permits: Reopener Clauses

Key Point: Policymakers can improve their evaluations of the impacts of natural resource permits on the environment by setting out specific procedural and substantive requirements governing when and how a permit can be "reopened" or modified. Permitting regulations can provide a procedural framework detailing who conducts permit evaluations and at what intervals.

Climate change may have such a severe impact in some areas that a resource agency may need to suspend or modify previously-issued permits in order to reevaluate impacts or halt further degradation. This authority can be written into the permit itself or in the regulations governing the permit. There are two ways in which the authority to reevaluate the permit can be invoked:

- **Triggering event:** an occurrence of a specific event that directs the permit holders or government officials to respond in a prescribed manner
- **Temporal restriction:** passage of a defined period of time, or the arrival of a specified date, that prompts a prearranged response

These provisions are called **reopener clauses**. Reopener clauses do not terminate a permit, but rather provide periodic opportunities for study and reconsideration of the permitted activity's impact on the environment in light of changing circumstances. Both triggering events and temporal restrictions can be used in a reopener clause so long as they are used to encourage evaluation, review, and adjustment throughout the permit's lifetime.

For major development projects with significant economic benefits, it may not be realistic to expect officials to halt a previously authorized activity outright. In this circumstance, changing conditions might trigger a reopener that requires **mitigation** measures rather than a change the permitted activity itself. For example, the permit holder might be required to identify and set aside a greater amount of reserve land relative to the size of an (unexpected) ecological impact that occurs or is observed after a project is approved. Or the government might be required to remove land it was considering for future leasing from the leasing pool.

Determining the appropriate length of time between permit evaluations depends on the type of resource being used, the rate of use or extraction, the regional impacts of climate change, and the overall objectives of the resource management program.

terms on page

REOPENER-CLAUSES allow parties to reconsider earlier permit decisions when certain defined circumstances occur.

MITIGATION measures are conditions placed on an authorized activity to reduce the environmental impact of that activity.

examples

- Ecuador employs a time-based reopener clause in its permitting regime for petroleum extraction by private industries.[133] Companies may obtain a twenty-four year concession for oil extraction, which only may be renewed upon a determination that the permitted activity continues to be in the "public interest."[134]
- Madagascar grants forty-year mining permits, but the permit holder must undergo a mid-point evaluation and consent to revisions and modifications to the permit.[135]
- Uganda's 2003 mining law requires those holding exploration licenses and mining licenses to carry out an annual environmental audit.[136]

[133] Kristen Hite, *Back to the Basics: Improved Property Rights Can Help Save Ecuador's Rainforests*, 16 Geo. Int'l Envtl. L. Rev. 763, 781 (2004).
[134] *Id.*
[135] Kai Batla (Pty) Ltd., http://www.kaibatla.co.za/madagascar.htm (last visited Sept. 11, 2009); *see also* Decree Nº 7802/2000 of 24 July 2000 in accordance with Act 99-022 (Aug. 19, 1999) of the Mining Act and Decree No. 2000-170 of Mar. 15, 2000 (Madagascar) (authorizing a permitting scheme in which periodic evaluations are encouraged to foster improved resource management strategies).
[136] Mining Act § 108(3) (2003) (Uganda).

10.3 Flexibility to Allow Permit Holders to Adapt to Climate Change

Key Point: Permits whose terms can be adjusted to respond to changing ecological conditions can help resource-dependent communities adapt to the effects of climate change without undue suffering. However, such flexibility should not be allowed to undermine basic protections for biodiversity.

A permitting program that places overly strict restrictions on resource access can jeopardize resource users' livelihoods in the face of radically altered or diminished resources, or it could lead people to ignore the rules. Flexible permitting provides adaptive capacity to resource users by allowing shifts in use to the least vulnerable resources or migration to more fertile areas. For example, assume that a rural community resides near a protected area with a large lake located inside of it. The herders depend for water on a smaller lake located outside the park's boundaries. Climate-induced drought in the region dries up the smaller lake, forcing the herders to go in search of a new water supply. This situation poses a number of hard questions:

- Should the herders be allowed access to the lake inside the protected area?
- Can access be provided on a limited basis without opening up demands for more permanent access rights?
- Can conditions be imposed on the herders so that damage to the protected area is minimized?

These problems might be addressable through a flexible system of temporary permits. A temporary permit could provide:

> If the permit holder can demonstrate that the resource is substantially impaired as a result of changes in ecological conditions beyond the permit holder's power to control, including but not limited to those resulting from global climate change, the permit process can be reopened to consider allowing access to [a resource] of comparable value on a limited basis and conditioned on appropriate mitigation measures.

One concern with this approach is the possibility that resource users will seek to maximize their use of temporary permits, thus making what should be an exceptional circumstance into a routine occurrence and putting undue stress on the ecosystem. Policymakers must evaluate the needs of resource users and ecosystems, as well as governance capacities, before implementing this type of permitting regime in order to strike a workable balance between conservation and the protection of human livelihoods.

example

In Bolivia, the management and administration of protected areas has an objective of "ensuring effective participation and ownership of regional and local population" and "developing capacity in the local and regional level" to advance the management and conservation of such lands.[137] Bolivia's framework law mandates the

[137] Supreme Decree No. 24,781, art. 3.3-5 (1997) (Bolivia).

Box 10.1. Managing Climate Impacts on Forests and Logging Practices in Madagascar

Due to decades of deforestation, Madagascar retains only fifteen percent of its original forests.[1] With the exception of slash and burn practices (or tavy), the country's most significant cause of deforestation is the harvesting of commercially valuable trees, such as rosewoods, palissanders, and ebonies.[2] In recent years, Madagascar has experienced an increase in floods, cyclones, and severe droughts—events likely to become more frequent and more intense as a result of climate change.[3] An increase in cyclone activity may enable loggers to exploit a provision in the country's forestry law authorizing salvage timber operations.

The Malagasy government legalized the export of lumber felled during natural disasters in 2004 and expanded the scope of this activity in September 2009.[4] However, scientists have demonstrated that "downed and damaged trees play an important role in forest recovery and ecosystem resilience."[5] Policies that allow removal of felled timber may lead to an "eliminat[ion] of leaf and woody biomass, decrease [in] evapotransporation . . . and damage [to] many soil and organic structures created by disturbance."[6] In addition to the ecological concerns of extracting downed timber, after Cyclone Gafilo hit in 2004, loggers were alleged to have gathered illegally-extracted commercially-valuable tree species that were still standing.[7]

Madagascar's case demonstrates that lifting export bans in the aftermath of natural disasters can open forests to overexploitation.[8] A projected increase in the number of high-intensity cyclones from climate change indicates the need for close monitoring of salvage timber operations. Permits authorizing some level of salvage logging may be appropriate, but they should not be used to enable practices that increase the forest ecosystem's vulnerability to climate change.

[1] Conservation Int'l, Harnessing Nature as a Solution to Climate Change in Madagascar (Dec. 2008) [hereinafter Harnessing Nature].
[2] Derek Schuurman and Porter P. Lowry II, *The Madagascar Rosewood Massacre*, 4 Madagascar Conservation & Dev. 98, 99 (2009).
[3] Harnessing Nature.
[4] Rowan Moore Gerety, *Major International Banks, Shipping Companies and Consumers Play Key Role in Madagascar's Logging Crisis*, Wild Madagascar (Dec. 16, 2009) [hereinafter *Logging Crisis*].
[5] Sarah Cooper-Ellis et al., *Forest Response to Catastrophic Wind: Results for an Experimental Hurricane*, 80 Ecology 2683, 2693 (1999).
[6] *Id.*
[7] Global Witness and Environmental Investigation Agency, Inc., Investigation into the Illegal Felling, Transport and Export of Precious Wood in SAVA Region Madagascar 5 (2009).
[8] *Logging Crisis.*

involvement of public and private entities, including indigenous groups, in the management of protected areas.[138] These goals are demonstrated by the inclusion of local communities and governments in virtually all aspects of the Protected Areas Regulation. In exceptional cases, the National Government may issue a Supreme Decree to permit the use of natural resources within a protected area for a "national interest." However, any such activity must comply with other requirements in environmental legislation and regulations, including the completion of a monitoring plan and mitigation actions. If the permitted use threatens the conservation objectives of a protected area, it can only be authorized through a National Act.[139] These rules can be used to provide relief to climate-stressed communities without sacrificing core conservation objectives in protected areas.

[138] Environmental Law No. 1333 art. 62 (1992) (Bolivia).
[139] Supreme Decree No. 24,781, art. 33 (Bolivia).

10.4 Including Stakeholder Input in Permitting Processes

Key Point: The list of stakeholders with interests in a resource is much broader than the group of people who own or directly use that resource. Including all relevant individuals, organizations, and entities in resource planning and management improves learning, coordination, and management outcomes. This builds adaptive capacity for climate change by creating a broader set of perspectives on all issues pertaining to the resource.

Increased stakeholder participation in resource governance improves the capacity of the system to adapt and respond to climate change. Identifying all stakeholders in biodiversity adaptation is not always easy and requires some investigation, but they may include:

- Community members
- Environmental organizations
- Resource extraction companies
- Local or indigenous resource users
- Scientific researchers and organizations
- Tourism operators
- Religious organizations
- Officials from other agencies or government levels
- International organizations and other civil society institutions
- Trade organizations

Project designers and resource managers might consider creating a **stakeholder group** and giving its members a significant role in ecosystem management, subject to appropriate oversight and accountability mechanisms. The stakeholder group would then be able to set conservation and use goals, develop a plan for implementation, and enforce rules. While minimum environmental protections must be maintained, trust in the integrity of the process is essential for collaboration to work. In Trinidad and Tobago, for example, co-management of reefs was undermined as the local coral reef users came to believe that they were being denied access to information and shut out of the high-level regulatory decision making process by government officials and regulated fisheries. This in turn led to a breakdown in trust in the shared management process.[140]

[140] *See* W. Neil Adger, Katrina Brown, and Emma L. Tompkins, *The Political Economy of Cross-Scale Networks in Resource Co-Management,* 10 Ecology & Soc'y 9 (2005).

terms on page

STAKEHOLDERS are any persons or organizations that has an interest in a natural resource. Interests can be economic, aesthetic, scientific, cultural, religious, or otherwise.

Box 10.2. Informal Stakeholder Networks Can Improve Management

Outside of formally-constituted stakeholder groups such as fishery or forestry councils, **informal networks** of stakeholders or community members can supply new ideas and information, which in turn allows the formal resource governance structure to respond more quickly to changes in the environment caused by climate change.[1] Because an informal network does not have authority to take action on its own, officials may consider setting up "pathways" of information exchange so that new concerns, ideas, and proposed solutions raised informally can reach the regulatory process more quickly.[2]

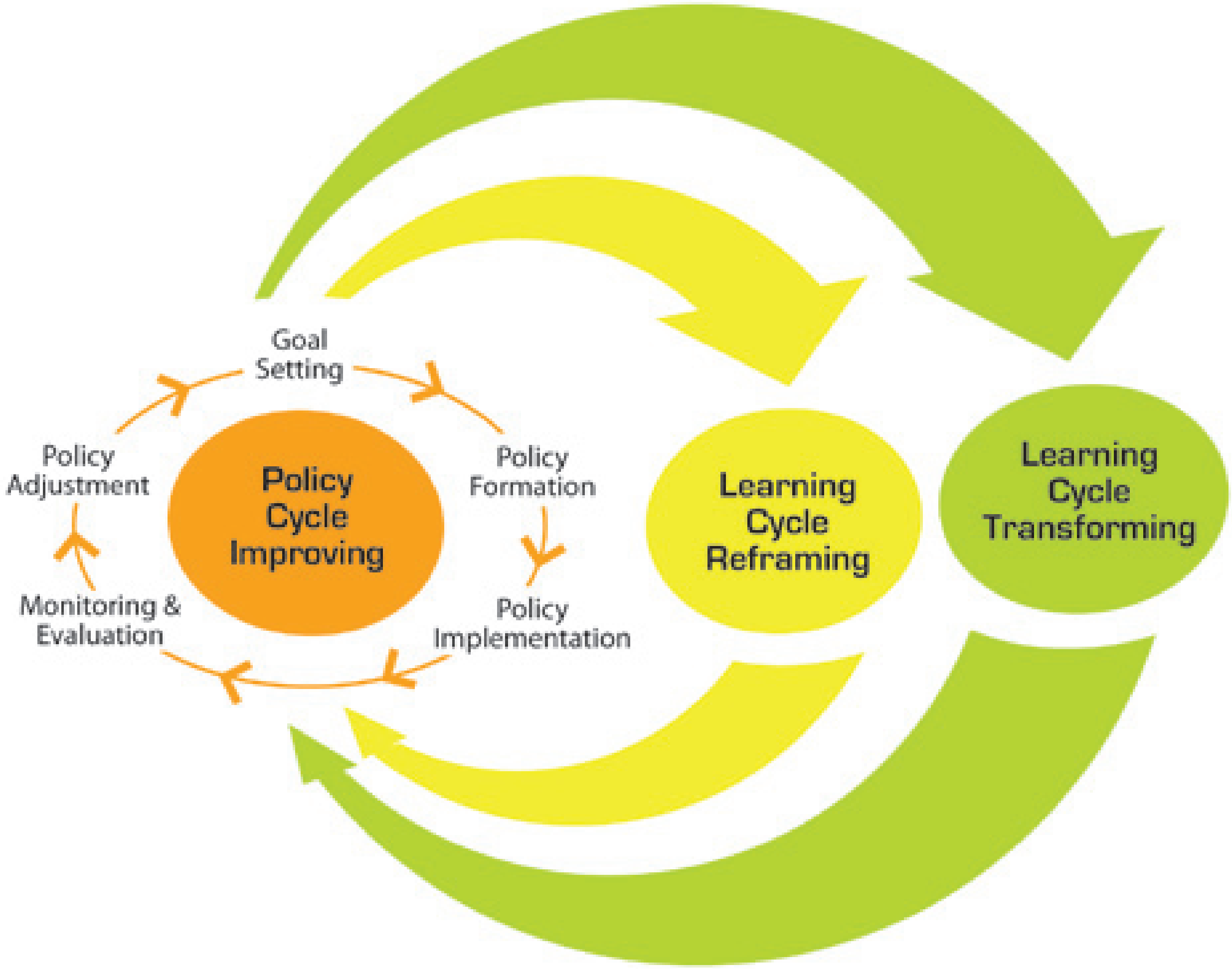

Figure 10.2 "Triple-loop" Adaptive Cycles Fully-adaptive governance is a "triple-loop." Adaptive management cycles take place within larger learning cycles of "reframing" and "transformation" that go on outside the formal regulatory process.

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[1] Reprinted from Global Envtl. Change, Vol. 19, Claudia Pahl-Wostl, *A Conceptual Framework for Analysing Adaptive Capacity and Multi-level Learning Processes in Resource Governance Regimes*, Page 361 (2009), with permission from Elsevier.
[2] *Id.* at 359, 361 (2009).

example

The Seychelles' National Plan of Action for shark fisheries (NPOA) contains a detailed stakeholder analysis in order to identify the entire community of people who have an interest in the sharks. It includes not just the resource users themselves, but sports fisherfolk, environmental NGOs, tourism operators, and even the general public of the Seychelles. Everyone is given a seat at the table, but direct resource users receive a higher status. Primary resource users receive preferential consideration through direct one-on-one interviews and consultations, while lower-level stakeholders participate less extensively.[141] Everyone is given a seat at the table, but direct resource users receive a higher status. Resource planners will need to determine whether a similar system makes sense for them.

[141] Sharks NPOA, *supra* note 54, at 49-52.

Box 10.3. Fisherfolk Close the Arctic Fishery in Response to Climate Change

When stakeholders are brought together to manage a resource, they are often capable of making surprisingly farsighted decisions to protect it. In recent years, it has become clear that the Arctic marine ecosystem faces devastating impacts from climate change. In response to the need to protect fishery resources in the Arctic, the U.S. Northern Pacific Fisheries Management Council took action. The Council, a legally empowered governing body composed of fishing industry representatives and other stakeholders, voted unanimously in February 2009 to close the entire Arctic area to commercial fishing.[1] This decision was only possible because the stakeholders, including the fisherfolk, understood that climate change required them to act together to set aside their short-term interests to ensure long-term sustainability. "This proactive decision by the council removes one source of additional stress, giving the Arctic, its peoples and animals a better chance to adapt to the changes [brought by climate change]."[2]

[1] *See* North Pacific Fisheries Management Council, Fishery Management Plan for Fish Resource of the Arctic Management Area 61 (August 2009), *available at* http://www.alaskafisheries.noaa.gov/npfmc/fmp/arctic/ArcticFMP.pdf.

[2] Allison Winter, *Federal Council Approves Plan to Protect Upper Arctic*, Energy & Environment News, Feb. 5, 2009.

10.5 Ensuring Compliance with Monitoring and Reporting Requirements

Key Point: Monitoring and reporting by permit holders, with proper oversight, can provide important information about how climate change is affecting an ecosystem.

Monitoring and reporting requirements are an essential aspect of an adaptive management approach to resource extraction. The Convention on Biological Diversity recommends, "[I]t is necessary for the management to monitor the effects of [resource] use and allow adjustment of the use as appropriate . . . .[I]t is preferable to use all sources of information about a resource when deciding how it can be used."[142] Ecological monitoring can be assigned to several different parties: the permit holder, government officials, or third parties such as an academic institution (see Chapter 5.3 on deciding who does the monitoring). Because institutional knowledge is so important for long-term adaptation, monitoring and reporting systems should be maintained despite changes in the ownership or control of land and resources.

Once monitoring requirements have been built into permitting, the question becomes how to ensure they are implemented, complied with, and enforced to achieve accurate and useful reporting of information. Governments can provide assistance in setting up and maintaining monitoring and feedback systems.[143] Beyond funding and other technical support, there are several mechanisms that can help ensure monitoring requirements are complied with and enforced, such as: 1) conditioning future permits on compliance with the current permit monitoring requirements; 2) requiring public disclosure statements; 3) requiring periodic reporting on monitoring efforts; 4) posting monitoring information online that can be accessed by the public; 5) authorizing citizen suits for filing false information and failing to report; and 6) using fees to support monitoring by independent third parties.

Examples of ways to ensure effective monitoring include:

- **Auditing** ensures the ecological information reported by the permitted entity is accurate. Uganda, for example, requires that between one and three years after an EIA project has been initiated, an environmental audit be performed to ensure compliance with "predictions" made in the EIA and to mitigate any unanticipated effects.[144] In the Dominican Republic, the Environmental Ministry (SEMARENA) is authorized to perform an environmental evaluation to ensure compliance with the terms of a license by comparing self-monitoring reports to the environmental audit performed by the agency.[145] The timing of audits should be randomized and without notice—this will prevent "gaming" of the system by only fulfilling the requirements around the time an audit is scheduled. Performing

[142] CBD Secretariat, Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity 11 (2004).
[143] *Id.* at 12.
[144] Environmental Impact Assessment Regulations 1998, No. 13, arts. 31-33 (Statutory Instruments Supp. to the Uganda Gazette No. 28 volume XCI dated 8th May, 1998) (Uganda).
[145] Resolution No. 06/2004, § 46 (Dominican Republic).

Box 10.4. Adaptive Capacities in Bolivia's Forest Laws

In Bolivia, forests are governed by a system that could, if effectively implemented, provide important adaptive measures for climate change. Four are worth highlighting here. First, forests are governed according to the principle of "*en dubio pro forest*" ("when in doubt, favor the forest"), meaning that when there is evidence that a forest management practice or omission could seriously or irrevocably damage an ecosystem, "or any of its elements," forestry managers "cannot fail" to take precautionary measures to prevent or mitigate these effects.[1] Further, forest concessionaires are "obligated" to protect all natural resources, *including biodiversity*, within their permit areas, under penalty of revocation. Loggers may not export species when logging could accelerate a species into "threatened" status.[2] Each of these precautionary elements provides managers with robust authority to take early action with respect to climate change impacts on the forest ecosystem. *(box continued on next page...)*

[1] Forestry Law No. 1700 arts. 9, 12 (1996) (Bolivia) [hereinafter Forestry Law]; Supreme Decree No. 24,453, art. 25 (1996) (Bolivia) [hereinafter Supreme Decree].
[2] Supreme Decree, art. 8.II.

audits at random intervals also optimizes the limited resources of auditors.

- **Incentives** in the form of rewards for those who report that a permit holder has falsified or provided inaccurate monitoring data. This can be accomplished by extending existing whistleblower rewards to include monitoring violations, such as those Bhutan offers for reporting general forestry or wildlife-related offenses.[146]
- **Bonding** is another cost-effective means of ensuring compliance with monitoring requirements. In the Dominican Republic, the environmental ministry imposes a performance bond of ten percent of the value of a project to ensure compliance with project requirements over the long term.[147] With respect to monitoring, a performance bond could be required for resolving uncertainties identified at the outset of resource use or development. As uncertainties are resolved through the effective (and verified) monitoring effort of the resource user, the bond can be incrementally returned to the user.[148] Large bond requirements, however, will be most appropriate for large-scale resource users with substantial financial reserves, such as multinational companies.

[146] Forest and Nature Conservation Rules § 89 (2006) (Bhutan).

[147] Resolution No. 06/2004, § 47 (Dominican Republic).
[148] *See* Alejandro E. Camacho, *Can Regulation Evolve? Lessons from a Study in Maladaptive Management*, 55 U.C.L.A. L. Rev. 293, 357 (2009).

(...box continued from previous page)

Second, forest concessionaires are required to produce and implement long-term, sustainable Forest Management Plans (Planes Generales de Manejo Forestal—PGMF), to be updated every five years,[3] and Forestry Operational Plans (*Planes Operativos Anuales Forestales*—POAF), to be submitted annually. The PGMFs are to be drafted by a forest professional held civilly and criminally responsible for the accurateness and completeness of the plans.[4] The management plans must include forest inventories, species mapping, and estimates of potential output volumes.[5] If the forest management plan is approved, a POAF must then be submitted annually for approval by the Forestry Superintendence. Both land use plans and forest management plans are binding once approved.[6] These planning requirements do not expressly require adaptive management. Nonetheless, the requirement to undertake species inventories and mapping is essential to a better understanding of how the ecosystem may change under use and how it is being affected by climate change.

Third, Bolivian forestry concession rules use structural incentives to encourage long-term planning. They impose a 20-year felling period within 40-year forest concession periods, and area-based fees rather than volume-based taxes.[7] The 20-year felling period means only about five percent of the total forest area may be logged every year, and the longer, 40-year concession period encourages more long-term forestry management practices. The fee schedule is designed to discourage selective harvesting of valuable species.[8] The concessionaire's stake in the long-term health of the forest may encourage consideration of how climate change will affect the forest plot.

Finally, forest lands in Bolivia can be "immobilized," or closed, to harvesting. Lands qualifying for closure to harvesting include those that have forestry potential but warrant further study of factors such as customary rights, conservation status, and major risk factors and limitations.[9] The power to close lands temporarily for further study may provide a powerful adaptation measure that can be used to assess climate change impacts and develop response strategies prior to opening lands to extractive activities.

Bolivia's forest laws provide the legal tools for adaptive management of forests in response to climate change. Implementing them, however, will require resources, trained personnel, and long-term commitment by the government.

[3] Forestry Law, arts. 27, 30.
[4] *Id*. arts. 27, 30.
[5] Supreme Decree, art. 69.
[6] *Id.* art. 6.
[7] Forestry Law, arts. 29, 33, 36.
[8] Arnoldo Contreras-Hermosilla and María Teresa Vargas Ríos, Forest Trends and CIFOR, Social, Environmental and Economic Dimensions of Forest Policy Reforms in Bolivia 13 (2002) *available at* http://www.cifor.cgiar.org/publications/pdf_files/Books/BoliviaEnglish.pdf.
[9] Supreme Decree, arts. 55-58.

Community-based natural resource management ("community management") can provide valuable adaptation benefits for biodiversity. Community management shifts on-the-ground decision making from centralized bureaucracies into the control of local managers and stakeholders who may be better able to respond quickly to changing conditions and new information.[149] Local and indigenous communities and other small-scale resource user groups are closely dependent on local ecosystem services. They have always confronted and adapted to localized ecological complexity. Climate change intensifies that complexity by amplifying variability and uncertainty, but because impacts are localized, solutions must also be context-specific. Engaging and collaborating with local communities is critical to adaptation, and traditional knowledge and customary rules for resource use are an invaluable starting point for developing locally-sensitive policies, strategies, and rules. The parties to the CBD recognize, "In many societies traditional and local knowledge has led to much use of biological diversity being sustainable over long time-periods without detriment to the environment or resource."[150]

In addition to fully devolved community management, this chapter will look at several methods for engaging the public and communities in climate change adaptation. While there are many adaptation benefits from community management, this chapter will also explore policy concerns that may need to be addressed.

[149] *See* Daniel J. Klooster, *Toward Adaptive Community Forestry Management: Integrating Local Forest Knowledge with Scientific Forestry*, 78 Econ. Geog. 43 (2002).
[150] CBD Secretariat, Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity 11(2004).

11.1 Community Management: The Basics

Key Point: Community management can make resources more resilient to climate change while also empowering local communities and supporting local livelihoods. Where climate impacts are severe, however, central governments have an essential supportive role to play.

Community management "rests on the recognition that local communities must have direct control over the utilization and benefits of natural resources - wildlife, [forest] products - in order to value them in a sustainable manner. Community management is both a conservation and rural development strategy, involving community mobilization and organization, institutional development, comprehensive training, enterprise development, and monitoring of the natural resource base."[151] Community management empowers communities to manage their own resources in order to protect them from internal mismanagement and livelihood-degrading activities of outside individuals or entities. It provides **co-benefits** in biodiversity conservation, cultural conservation, and poverty reduction.[152]

CO-BENEFITS refer to the ability of a single policy to have positive effects in several ways.

terms on page

The benefits of community management have been observed around the world. In the South Pacific, for example, allowing local island communities to retain management control over their resources has been documented to provide social and environmental benefits:

- Localized recovery and protection for vulnerable species in Vanuatu
- Improved fishery landings in the Philippines
- Improved community decision making, support networking, political influence, and compliance and enforcement in Southeast Asia
- Development of community organizations for other endeavors in the Solway Firth
- Heightened resilience and adaptive capacity to respond to new threats in Fiji
- Health benefits in the form of secure access to marine proteins
- Integration of management across sectors, such as watersheds and waste disposal
- Cultural survival through the use of traditional management practices and ecological knowledge, such as respect for taboo areas that are closed to fishing
- More secure tenure in ownership rights and access to livelihood resources[153]

[151] Botswana CBNRM Support Programme, Community-Based Natural Resources Management in Botswana, http://www.cbnrm.bw/ (last visited March 15, 2010).
[152] Andersen, F. K. and Long, B., *An Assessment of, and Lessons Learnt from, two Pilot Community-Based Natural Resource Management Mechanisms in the Truong Son Mountains, Vietnam* [undated; on file with ELI]; WWF Greater Mekong – Vietnam Programme, Quang Nam Forest Protection Department, Pu Huong Nature Reserve and Danida, Hanoi (2006).

[153] Hugh Govan, *Overview: Reclaiming "Protected Areas" as a Livelihood Tool for Pacific Island People*, *in* Annotated Bibliography of Socio-Economic and Ecological Impacts of Marine Protected Areas in Pacific Island Countries (P. Cohen et al., eds. 2008).

Box 11.1. Community Management of Coral Reefs

Traditional management techniques used by indigenous communities could be effective at reducing local stresses on coral ecosystems, allowing them a better chance to adapt to climate change. **Periodic closure** is a dynamic cycle of opening and closing harvesting within prescribed areas employed in Kakarotan, Indonesia and Muluk Village, Papua New Guinea (PNG).[1] In both cases, the biomass and average size of fishes were greater inside the periodic closure areas compared to control sites.[2] Another study comparing reef conservation at four national parks, four co-managed reserves, and three traditionally managed areas in Indonesia and PNG found that the size and biomass of fish were higher inside the traditionally managed areas.[3] Evidence suggests the indigenous communities are more sensitive to climatic shifts. In Kakarotan, a reef area was closed for an entire year coinciding with a severe El Niño bleaching event.[4] By studying these areas, policymakers can improve understanding of the socio-economic conditions needed to support localized adaptive management.

[1] G.R. Almany et al., *Periodic Closures as Adaptive Coral Reef Management in the Indo-Pacific*, 11 Ecology and Society 32 (2005).
[2] *Id.* at 37.
[3] T.R. McClanahan et al., *A Comparison of Marine Protected Areas and Alternative Approaches to Coral-Reef Management*, 16 Current Biology 1408 (2006).
[4] Almany et al., at 35.

Generally, communities are thought to use common pool resources sustainably when social rules exist that establish clear geographic boundaries, limits to usage type, and appropriate consequences for overuse.[154]

example

Hybrid public-private systems have developed in Nepal in which individuals lease plots of public land for 25 and 40 years, respectively, for restricted use. These arrangements have proven successful for restoring degraded land because they provide more secure tenure. Strong land tenure is essential for reducing vulnerability to climate change by ensuring access to the forest's resources and giving local people a stake in the resilience of their forest.[155] To date, Nepal's rules have been based on local institutional understandings and are not grounded in official laws or policies.[156] Developing such laws and policies may be the next step for the Nepalese government to further reduce vulnerability.

[154] James Sanderson et al., *Escaping the Minimalist Trap: Design and Implementation of Large-Scale Biodiversity Corridors, in* Connectivity Conservation 638 (Kevin. R. Crooks and M. Sanjayan eds. 2006).
[155] Bharat K. Pokharel and Sarah Byrne, Climate Change Mitigation and Adaptation Strategies in Nepal's Forest Sector: How Can Rural Communities Benefit, NSCFP Discussion Paper No. 7, at 29 (2009).
[156] Peter Glück et al., *Governance and Policies for Adaptation, in* Adaptation of Forests and People to Climate Change: A Global Assessment Report, IUFRO World Series vol. 22, at 198-99 (Risto Seppälä et al. eds. 2009).

11.2 Promoting Community Awareness about Climate Change

Key Point: Communities informed about the measures others have taken to respond to climate change impacts similar to those that they face are more likely to accept the need for and to develop their own adaptation measures.

Engaging the public at the community level allows planners, policymakers, and managers to determine local attitudes about climate change impacts: provide educational opportunities, awareness, and outreach; and build a stronger sense of solidarity across levels of governance. Involvement in adaptation activities allows participants to "own" both the problem and its solution through informed engagement.

Public outreach can inform officials about local attitudes toward climate change. In some cases, officials will find that communities are responding to changes they are already seeing, such as increased variability in weather, which are often good proxies for future climate change. Identifying responses to the immediate variability, therefore, often serves as a first step toward responding to the longer-term changes. In other cases, the population may not recognize particular ecological impacts as being caused by climate change. For example, a survey of coffee farmers in rural regions of Mexico, Guatemala, and Honduras revealed key community attitudes demonstrating an indifference or a feeling of powerlessness that should be considered by planners, resource managers, and others who are developing adaptation strategies. The survey showed that:

- Changes in climate such as temperature increases and longer dry periods had been noted by local farmers, but the farmers did not prioritize them or develop responses. Farmers were more concerned with market forces than with climate change impacts, because the former were perceived as either more pressing or within their power to influence. One smallholder farmer in Guatemala said, "*I'm not very worried about the climate, although it does affect my harvests, because it is beyond my control*."
- The study found a lack of initiative, both in smallholder farmers and at regional and national levels of government, to focus on environmental impacts in the coffee-growing industry and their effect on farmers' profits. There was a lack of communication among farmers and between farmers and the national government, including information about technological advancements and climate change impacts in the region.[157]

Resource users have shown that they do indeed have control over many aspects of environmental management that can reduce their vulnerability to climate change and support ecologically sustainable livelihoods. In some areas, people may be unaware that climate change is responsible for changes in their environment, or they may not believe that climate change is actually

[157] H. Eakin et al., *Market Shocks and Climate Variability: The Coffee Crisis in Mexico, Guatemala, and Honduras*, 25 Mountain Research and Development 204 (2005).

occurring or that they may not believe they have any power over its effects.[158] Governments and civil society can reach out and inform these populations about the impact climate change likely will have in their region, and identify constructive methods of responding and adapting to those changes.

Methods of responding to a sense of climate helplessness within a community include:

- Establishing and promoting local organizations, associations, or committees to share ideas and experiences
- Establishing and promoting local environmental planning initiatives to give communities empowerment and control over resources
- Establishing community-to-community networks of information exchange (research shows people are much more likely to heed the advice of peers than that of authority figures)

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PEER-TO-PEER NETWORKS draw on the expertise of those in similar situations, rather than the expertise of those who are regarded as having superior status or authority.

[158] For a collection of African perspectives on climate change, see Africa Talks Climate, http://africatalksclimate.com/ (last visited August 20, 2010).

11.3 Using Local Knowledge of Climate and Adaptation Strategies

Key Point: Traditional and indigenous knowledge can provide cultural continuity in times of great change and invaluable information on effective strategies for adapting to climate changes that can be shared with other regions and communities.

Traditional and indigenous knowledge is an invaluable source of information on climate change and locally appropriate methods of adapting. This knowledge includes the ability to interpret meteorological and climatic phenomena, manage ecological relations between society and nature, and adapt to environmental and social change.[159] Surveys, interviews, and other methods of gaining information about ecological conditions from local residents complement scientific data and enhance adaptation efforts.[160] People living close to managed resources will be able to provide researchers and managers with first-person perceptions of changes in their environment over time.[161] Biologists in Alaska, for example, found that traditional Inupiat knowledge about the Arctic provided hypotheses that could be tested, laying the foundation for collaborative research on subsistence resources.[162]

In order to ensure respect for, the appropriate use of, and, in some cases, compensation for access to local knowledge, countries could establish legal programs and other safeguards so that the benefits of local knowledge do not flow only to outside managers or researchers. The following considerations should be kept in mind:

- Indigenous people have been adversely affected by expropriation of their knowledge and the failure to obtain voluntary, prior, informed consent for its use
- Agreements can be negotiated to ensure that benefits from advances in climate adaptation resulting from the use of local knowledge are shared with the indigenous people who provided the information
- Traditional knowledge has value (economic, aesthetic, and spiritual) apart from its use for climate adaptation or other scientific or policy purposes, and these other values should be respected by outside users, researchers, and officials

With the informed consent and cooperation of local or indigenous people, researchers can work toward identifying two key types of information that may be useful in developing methods for adapting to climate impacts.

(1) The historic trends of the climate of a region and its effect on ecology

example In Bolivia, the National Climate Change Program was set up to identify climate change

[159] Int'l Council for Science, Science, Traditional Knowledge, and Sustainable Development 9 (2002).
[160] Programa Nacional de Cambios Climacticos, Republica de Bolivia, Vulanerabilidad y Adaptacion al Cambio Climactico en Bolivia 4 (2006) [hereinafter PNCC Adaptacion].
[161] *See, e.g.*, Kenneth R. Young and Jennifer K. Lipton, *Adaptive Governance and Climate Change in the Tropical Highlands of Western South America*, 78 Climate Change 63 (2006).
[162] George Noongwook, the Native Village of Savoonga, the Native Village of Gambell, Henry P. Huntington, and John C. George, *Traditional Knowledge of the Bowhead Whale* (Balaena mysticetus) *around St. Lawrence Island, Alaska*, 60 Arctic 47 (2007).

vulnerability in indigenous communities living in dry mountain lands. The Program's goal was to analyze climate change effects in the region and work towards creating adaptive strategies.[163] The Program found that indigenous communities in Bolivia had recorded changes in the climate by observing alterations in animal behaviors and plants over multi-year periods. From these observations, the communities predicted how their food, resources, and farming patterns would be affected. Fifty percent of the population identified drought as a major issue, as opposed to only thirty percent ten years earlier.

(2) Local methods for adapting or coping with those changes that have been effective in the past

example

The remote village of Quezungal in Honduras was one of only a few communities that did not lose its entire crop to Hurricane Mitch in 1998. Researchers found that the Quezungal people's use of traditional farming methods, such as inter-planting crops with trees to prevent soil erosion and pruning vegetation to reduce water use, provided protection against the effects of the hurricane. In contrast, farming practices taught in agriculture colleges and practiced in neighboring regions were based on methods suited for the plains areas but not for the Honduran terrain, making the crops vulnerable to failure from a single severe weather event. The Quezungal method is being promoted around the country through the Watershed Protection Program set up by the Honduran government and the U.N. Food and Agriculture Organization.[164]

Figure 11.1 The Lakota Winter Counts Indigenous peoples in the Great Plains of North America used bison hides to track major events in the community's life. Often these pictograms show responses to weather events, allowing contemporary tribal communities to develop strategies for climate change rooted in a community's own history.[1] Similar cultural resources can support climate adaptation measures in other regions.

[1] Courtesy, National Museum of the American Indian, Smithsonian Institution (S02791). Photo by Carmelo Guadagno.

[163] PNCC Adaptacion, *supra* note 160.

[164] *See* IUCN, Vision for Water and Nature: A World Strategy for Conservation and Sustainable Management of Natural Resources 79 (2000).

11.4 Policy Concerns Surrounding Community-Based Management

Key Point: Before carrying out a community-based climate adaptation program, policymakers must determine that the right social and political conditions exist for the transfer or devolution of power to local communities.

> *Rather than enfranchising local people under democratic decentralization, choosing nondemocratic authorities may—as under the colonial policies of "indirect rule" and "association"—subject local people to arbitrary authority without representation, rights, or recourse.*[165]

Decentralization of resource management authority has taken place in many countries. As the previous sections demonstrate, local control and management of common-pool or collectively-owned natural resources can be highly adaptive to changing ecological conditions. Localized management regimes can be tailored more closely to a particular ecological region or context (though this is not always the case).[166] As such, allowing for the continued existence of these regimes, fostering their growth, and providing support for them (for example, by mediating conflicts arising from the in-migration of new groups) are all steps governments and NGOs can take to build adaptive capacity for climate change among natural resource users.

Caution and strategic planning, however, are important to ensure the effective and democratic transfer of natural resource management to the community level. There are many potential policy issues and problems that may arise when natural resource management is handed to local-level systems of government. Some of the issues that need to be considered and addressed include:

- Partial transfers of power that create regulatory confusion or fail to sufficiently devolve power to local communities (see Figure 11.2)
- Elected local leaders who may feel greater political pressure than those in the centralized ministries to allow unsustainable resource use in response to scarcity or crisis
- A lack of accountability by newly empowered local agencies' lack of accountability to community members and to centralized government ministries
- Methods for ensuring the secure transfer of authority to local officials through constitutional guarantees and for limiting ministerial discretion in carrying out transfers of authority
- The proper role of agency discretion and institutional choices given considerations of scale and capacity
- Use of customary institutions and authorities that may be inequitable to one or more demographics (for example, entrenchment of male-dominated hierarchies)

[165] Jesse C. Ribot, Democratic Decentralization of Natural Resources: Institutionalizing Popular Participation 12 (World Resources Inst. 2002).
[166] Bradley C. Karkkainen, *Collaborative Ecosystem Governance: Scale, Complexity, and Dynamism*, 21 Va. Envtl. L.J. 189, 206-08 (2002).

- Protections for marginal groups such as ethnic or religious minorities, at the local level
- Elite capture and patronage (elites taking resources for themselves or their relatives), which leaves other community members with fewer resources and hinders democratic governance
- The presence and authority of a strong central government as a backstop for environmental protections if local governance fails
- Reliance on privatization of natural resource management as an inadequate substitute for true devolution of power to local communities
- Effective enforcement of minimal environmental standards[167]

These issues, especially those related to the need for checks and balances at the local level or through complementary or "backstop" authority at a centralized level,

[167] Jesse C. Ribot, Waiting for Democracy: The Politics of Choice in Natural Resources Decentralization (World Resources Inst. 2004).

Box 11.2. Elinor Ostrom's Eight Design Principles for Common Pool Resource Management

Elinor Ostrom was awarded the Nobel Prize in economic sciences in 2009 for her life's work on common property ownership. Her eight 'design principles' for successful common pool resource governance are useful to keep in mind when transferring authority for resource management to the local level:

1. Clearly-defined boundaries on who has the right to use the resource as well as the boundaries of the resource itself
2. Rules regarding the appropriation of common resources that are adapted to local conditions
3. Collective-choice arrangements that allow most resource appropriators to participate in the decision making process
4. Effective monitoring by monitors who are part of or accountable to the appropriators
5. A scale of graduated sanctions for resource appropriators who violate community rules
6. Cheap and easy-access mechanisms for conflict resolution
7. Self-determination of the community that is recognized by higher-level authorities
8. For large-scale resources: organization in the form of multiple layers of nested enterprises and local community pool resources at the base level.[1]

[1] Elinor Ostrom, Governing the Commons: The Evolution of Institutions for Collective Action (1990).

Figure 11.2. Possible Delegation between Local and Central Authorities

Decisions for Local Authorities	Decisions to be made Jointly	Decisions for Central Authorities
Timing of opening of season for hunting, fishing, or gathering of resources	Distribution of resources among user groups	Enforcement of constitutional rights and protections
Permitted harvesting techniques, including types of technology used and timing of harvests	Assessments of equity and democratic representation in local management processes	Enforcement of other human rights (e.g., gender and racial equality)
Setting access fees and small civil penalties	Public participation and transparency requirements	Use of force to secure control of resources
Monitoring of compliance and ecological indicators	Total amount of resources allowed to be extracted	Compliance with international treaty obligations
Establishment of temporary protected areas to allow resource replenishment	Budgetary and financial choices, especially with respect to grant projects or private sector initiatives	Decisions with respect to migrant human populations
Traditional, customary, or religious practices or rituals governing resource use or access	Decisions on exploitation of sensitive, threatened, or endangered species	Decisions on national policies to address global environmental problems

suggest a continuing role for central governments. In countries with decentralized resource management, the central ministries must play supportive roles in implementation of customary or village level regimes. They must also play an active regulatory role on questions that are uniquely within the central government's competency.

Legal frameworks for climate-adaptive community management should address two equally compelling policy concerns:

1. Adaptive regimes must provide local or community resource managers with the discretion and flexibility to make quick decisions about resources under changing ecological conditions without burdensome regulatory requirements, intrusion by central officials, or constant judicial intervention; but

2. Ensuring resource managers adhere to the rule of law requires checks and balances to determine whether they are providing equitable access to resources both within and between communities, transparency and public participation in decision making, and recourse to those who believe themselves aggrieved by a local authority's decision.

To address these two policy concerns, it may help to categorize types of resource management decisions. Three categories of decisions can be identified: (1) those choices that are properly within the discretion of local resource managers; (2) those choices that require decentralized and centralized authorities to work together; and (3) those choices that are most appropriately resolved by national-level authorities. An illustrative list is presented in Figure 11.2; however, the assignment of responsibilities is highly context-specific, and depends on local laws, policies, and social conditions. (Caution: This approach may be inappropriate in the case of lands or resources over which an indigenous people hold sovereign powers; in such cases decentralization is often not a question of strategy, but a matter of rights.)

11.5 Case Study: Adaptive Community Management in Mali

Key Point: Local or indigenous resource management may already be highly adaptive to changing ecological conditions at local to regional scales. Investigation of these practices is a necessary first step to developing and implementing climate adaptation policies.

The communities in Mali's Inner Niger Delta area of the African Sahel provide a useful case study in resource management structures that can adapt to changing ecological conditions.[168] Because of the severe climatic shifts that occurred in this region over the twentieth century and the effective management responses organized by the region's communities, important lessons may be drawn for climate-adaptive community management elsewhere.[169] An additional lesson is that traditional legal safeguards to protect customary rules and norms, as embodied in Article 8(j) of the Convention on Biological Diversity, can be an important part of legal adaptation strategies.

Researchers in Mali identified three basic levels of governance where "collective action problems" were addressed: the village, inter-village relationships, and the regional level.

The Village Level

Adaptive common pool resource management at the village level included:

- Flexible rules on timing of access to a resource, techniques used for harvesting, and who may have access
- Enforcement bodies that monitor a resource area and apprehend rule breakers
- Fines or other penalties that are negotiable depending on the severity of the offense and the attitude of the rule breaker
- Community-based institutions (for example, an assembly of all heads of households) that have power to modify rules or practices

An example of the adaptive capacity of these village-level structures is demonstrated in one village's management of a 110-hectare forest along the Tarabé River. Since the 1970s, this small forest has become highly productive through the stringent management of access and tree cutting. Ultimate decision making authority rests with the village chief, but he rarely acts without the consensus of the household heads. The choice of opening date is seasonal, depending on the rate at which flooding recedes from the area and opens up a passageway for access. For one month before the opening date, the village hires a guard to prevent unauthorized entry.

Adaptation to at least some climate change effects is possible in this regime, because there exists a relatively simple

[168] Information in this section is adapted from Charles E. Benjamin, *From Action Spaces to Polycentric Governance: Livelihoods and Natural Resource Institutions in Mali* (submitted to *Africa J. of the Int'l African Inst.* Sept. 12, 2009; on file with ELI).
[169] This case study helps us understand the range of management activities, structures, and protocols that may be in place in local or indigenous communities. It is not intended to suggest there is any "typical" village or social arrangement for which adaptive community management works better than others. These rules and institutions are highly localized and are not necessarily appropriate for exporting to other regions.

and consensus-based decision making process that allows the village to modify the opening date of access each year, which may fluctuate based on environmental conditions. Further, enforcement of the rules is possible through (1) a respected traditional regime and (2) a paid guard.

The Inter-village Level

Structures at the inter-village level for adaptive governance of common pool resources in Mali include:

"Polycentric" resource control and access regimes

In the Sahel region, waters and fisheries are often "owned" by different entities, as are the riverbeds and the underwater vegetation along those riverbeds. Aquatic grasses may be owned separately from the land upon which they grow. This system recognizes multiple use ownership rights over the same area of land or water. Research is needed as to how and why the ownership rules developed this way. It can be speculated, however, that multiple use ownership may prevent any single entity from acting unilaterally on a resource without the input of other interested parties.

Special authority for resource decisions vested in persons who do not draw their authority from any one village's hierarchy

In some cases, management control of a resource can be distinct from the ownership of the land or water where that resource is located. In the village of Badiari, management of forest resources is undertaken by the Beme, a community forest association made up of all male villagers between the ages of 15 and 55 and under the control of a Beme chief, while agricultural decisions are made by the village chief in consultation with household heads. In the same region, decisions on the opening date of the fishing season are made by "shaman-like water chiefs . . . whose residence has little relation to the territories in which the fishing spots are located." This structure for resource governance may allow for a diffusion of power among multiple authorities in a given area so that no one person or group is able to control all resources, encouraging consensus-building in decisions.

Joint policing of resource use through inter-village institutions

As with village-level resource management, at the inter-village level there must be a method of enforcement for resource use rules. In the Inner Niger Delta, once the water chiefs have declared a fishery open, a group of "police" called walangari governs the fishing activities. The walangari are selected by councils from each of the participating villages. On location, they self-organize by seniority and possess delegated authority over all fisherfolk regardless of village of origin. By selecting those charged with enforcing the rules from the ranks of all villages that wish to fish, the walangari possess legitimacy to ensure compliance with the rules.

The Regional Level

At the regional level, climate change may cause larger-scale conflicts over resources that may strain the capacity for community resource management to resolve. Therefore, there may be a greater role for central governments to support adaptive community management institutions that mediate resource conflicts and respond to changing ecological conditions. These institutions may include:

Longstanding conventions between outside resource users who traditionally pass through an area and local villagers

These conventions may be expanded to address new issues arising from the migration of new groups of people. Examples of these types of conventions in Mali include those that ban certain unsustainable technologies for resource extraction (e.g., a ban on the use of highly efficient "pound nets" that are recognized to cause fishery depletion) and a ban on agricultural cultivation in those areas known to be traditional corridors for herd migration, including areas set aside for herder encampments. The permanent settlement of persons displaced by climate change may prove a more difficult situation for the traditional structure to accommodate, and government interventions to address that issue may become more necessary.

Activities that help outside resource users, such as herders, fisherfolk, and other outside migrants, learn about and comply with local rules governing resource use

Migrating populations may come from distant regions and have no familiarity with local rules (unlike pastoralist populations who have an historical presence in an area). Likewise, the resident population of resource users may respond inhospitably to outsiders not familiar with their customs. The supportive activities for government might include:

- Educating newcomers to the local customs, preventing resource conflicts before they arise
- Organizing meetings between resident and outsider groups at which new conventions and agreements can be reached regarding resource use
- Intervening in disputes to prevent violence, adjudicate fair resolutions, and ensure local customs are upheld to the extent practicable under changed or degrading ecological conditions

Relaxation of local rules for migrant populations during periods of hardship

The Malian villages relax certain rules to the benefit of outsider populations during "hardship" periods. These periods can result from climate-driven events, such as extreme flooding or drought. Some villages, for example, have opened up access to non-timber forest products such as famine foods (crops that can withstand harsh conditions and provide enough nutrition for survival). Outside officials and NGOs may have a role to play in mediating special resource privileges between outside groups and resident populations.

Chapter 12 Protected Areas on Public Lands and Waters

LANDSCAPE-LEVEL or seascape-level habitat protection integrates core habitats, corridors, and mixed-use or human-occupied areas into an overarching regional management strategy.

terms on page

Climate change poses a challenge for existing protected areas (both land-based and marine) and the design and establishment of new ones.[170] Most protected areas continue to be "managed" primarily by sealing their borders to development and allowing nature to "run its course."[171] Climate change calls into question whether a small reserve area can be set aside while the rest of the landscape is fragmented and degraded by human development.[172] When climate conditions exceed the range that species can tolerate, species will likely attempt to move to a new location.[173] The varying paces at which species will be able to seek out more suitable habitat, if at all, will create new species community compositions and novel habitat arrangements.[174]

At the same time, people seeking relief from the impacts of climate change will put increasing pressure on officials to open up protected areas for settlement and use of resources (see Chapter 10.3). Ecosystems' complex, nonlinear, and unpredictable responses to climate change, and human needs to adapt, strongly point to the need for a **landscape-level approach** to protected areas. This approach brings core habitats, corridors, and mixed-use or human-occupied areas under various levels of protection, in order to give species a wide range of choices for movement,[175] while also accommodating human development needs.[176] Ultimately, the end goal is not to conserve species communities as they exist today, but to conserve "centers of evolution" and pathways of migration in and by which new ecosystems can form and reassemble.[177]

It is not possible, however, to place under full public protection all of

[170] Patty Glick et al., Nat'l Wildlife Fed., A New Era for Conservation: Review of Climate Change Adaptation Literature 14-15 (2009).
[171] P. Bernier and D. Schoene, *Adapting Forests and their Management to Climate Change: An Overview, in* Unasylva 231/232 vol. 60, at 7 (A. Perlis ed. 2009).
[172] J.J. Hopkins et al., Conserving Biodiversity in a Changing Climate: Guidance on Building Capacity to Adapt 15 (2007).
[173] Patty Glick et al., *supra* note 170, at 15; Reed F. Noss, *Beyond Kyoto: Forest Management in a Time of Rapid Climate Change,* 15 Conservation Bio. 578, 580 (2001).
[174] David Welch, *What Should Protected Areas Managers do in the Face of Climate Change*, 22 George Wright Forum 75, 79 (2005).
[175] S. Mansourian et al., *The Role of Forest Protected Areas in Adaptation to Climate Change, in* Unasylva 231/232 vol. 60, at 63 (A. Perlis ed. 2009).
[176] *See* Nigel Dudley and Sue Stolton, *Ecological and Socio-economic Benefits of Protected Areas in Dealing with Climate Change, in* Buying Time: A Users' Manual for Building Resistance and Resilience to Climate Change in Natural Systems 217, 218 (Lara Hansen et al., 2003), *available at* http://www.panda.org/about_our_earth/all_publications/?8678/BUYING-TIME-A-Users-Manual-for-Building-Resistance-and-Resilience-to-Climate-Change-in-Natural-Systems.
[177] P. Kareiva and M. Marvier, *Conserving Biodiversity Coldspots*, 91 Am. Sci. 344 (2003).

the areas needed to help species' adapt to climate change without causing serious social and political destabilization. Three points emerge:

- Public protected area networks need to be reconfigured to maximize climate resilience using limited public resources
- Conservation and habitat restoration on private lands is essential
- Coordination of private and public efforts will maximize the adaptation benefits of both

A landscape-level approach to habitat conservation encompasses fully protected areas (such as wildlife reserves or wildernesses) as well as human uses that take place between those areas. Appropriately managed **matrix lands** (those lands outside of the protected areas) can enhance connectivity between reserves without necessarily requiring the removal of human communities and activities.[178] As climate change shifts habitat conditions, matrix lands may replace protected areas as primary habitat. Approaching habitat protections from the perspective of matrix management builds the adaptive capacity of ecosystems and biodiversity as well as human communities who rely on natural resources for livelihoods and economic development.[179]

This chapter covers the following topics:

- Building climate resilience into the design of protected areas
- Improving connectivity between protected areas
- Aligning community roles and benefit sharing with adaptation
- Creating transboundary and international protected areas networks
- Translocating species: legal and policy considerations

[178] G.P. Von Maltitz et al., Adapting Conservation Strategies to Accommodate Impacts of Climate Change in Southern Africa, S. Africa AIACC Working Paper No. 35, at 20 (2006); Paul F. Donald and Andy D. Evans, *Habitat Connectivity and Matrix Restoration: the Wider Implications of Agri-Environment Schemes*, 43 J. Applied Ecology 209, 214 (2006).

[179] Lee Hannah et al., *Climate Change-Integrated Conservation Strategies,* 11 Global Ecology & Biogeography 485 (2002).

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MATRIX LANDS generally refer to those areas outside formally protected zones.

12.1 Building Climate Resilience into the Design of Protected Areas

Key Point: Policymakers need to be strategic in selecting areas for conservation, preservation, or restoration. The areas chosen should be part of a comprehensively-designed protected areas network that is ecologically sensitive and attuned to the impacts of climate change on individual species and habitat types.

BIOCLIMATIC MODELING uses information about species and climate trends to develop projections of how species will move and interact under future climate scenarios.

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Adding lands to the existing system of protected areas has been identified as the chief policy objective in adapting biodiversity conservation to climate change.[180] Policymakers should seek to design protected area networks to anticipate those sites that will remain or become viable centers of evolution and conduits to facilitate species' range shifts under a plausible range of long-term climate scenarios.[181] The emerging field and improving technology of regional and local **bioclimatic modeling** can help policymakers determine where these sites are located (See Box 12.1).[182] Meanwhile, ecological science already provides many ideas for priorities in designing future protected areas:

- **Tailor restoration targets to future conditions, not historic ones:** Well-intentioned restoration efforts will fail if they do not consider the impacts of climate change on the viability of the site selected for restoration or the objectives of the restoration.[183] Valuable and limited community, agency, and NGO resources will be squandered on projects that may fail because they did not account for future conditions at the site (e.g., mangrove restoration in areas that will be inundated by sea level rise).
- **Protect the ecosystem and its functions:** Species-specific conservation strategies may shortchange the larger goal of protecting whole ecosystems and the functions that build resilience in the system to climate change.[184] Any one species is part of a thriving network of relationships. Protecting the whole system rather than just one component of it ensures the largest number of species is protected. In some cases, conservation of a keystone species will provide valuable protected space for an entire ecosystem. For example, African elephants require large areas to move, so conservation strategies for them necessarily protect many other species as well.[185]

[180] Alison Campbell et al., UNEP World Conservation Monitoring Centre, The Linkages between Biodiversity and Climate Change Mitigation 30 (2008).
[181] Ad Hoc Technical Advisory Group on Biodiversity and Adaptation to Climate Change, Guidance for Promoting Synergy Among Activities Addressing Biological Diversity, Desertification, Land Degradation and Climate Change, CBD Technical Series No. 25, at 8 (2006); Alison Campbell et al., *supra* note 180, at 31.
[182] *See* Bastian Bomhard and Guy Midgley, IUCN World Commission on Protected Areas, Securing Protected Areas in the Face of Global Change: Lessons Learned from the South African Cape Floristic Region: A Report by the Ecosystems, Protected Areas and People Project 31 (2005).
[183] *See* J.P. McCarty and J.B. Zedler, *Restoration, Ecosystem*, *in* The Earth System: Biological and Ecological Dimensions of Global Environmental Change 532 (H.A. Mooney and J.G. Canadell eds. vol. 2, 2002).
[184] W.J. Junk, *Long-term Environmental Trends and the Future of Tropical Wetlands*, 29 Envtl. Conservation 414 (2002).
[185] *See* P.J. Stephenson, WWF Species Action Plan: African Elephant 2007-2011 (2007), *available at* http://assets.panda.org/downloads/wwf_sap_african_elephants_final_june_2007v1_1.pdf.

Box 12.1. Using Bioclimatic Modeling to Site Protected Areas

Bioclimatic modeling is an effective tool to inform the selection of locations for protected areas that will provide the most ecological resilience to climate change. Bioclimatic models combine location- and species-specific information with climate change scenarios to project the rates, magnitudes, and directions of the responses of different species and regions to climate change. These models can be useful in helping to design a network of protected areas and connectivity measures that can adapt to climate change.[1] Some regional modeling tools are already available for conservation planners. These include:

SERVIR is a regional visualization and monitoring system for Central America and Africa focused on improved scientific knowledge and decision making. SERVIR addresses the nine societal benefit areas of the Global Earth Observation System of Systems (GEOSS): disasters, ecosystems, biodiversity, weather, water, climate, health, agriculture and energy. http://www.servir.net.

The Climate Change Explorer Tool (CCE) provides users with an analytical foundation from which to explore the climate variables relevant to their particular adaptation decisions. The approach links vulnerability, monitoring, and projecting climate hazards with planning adaptation processes. CCE provides an interface for downloading, managing, and visualizing scaled-down model outputs. http://wikiadapt.org/index.php?title=The_Climate_Change_Explorer_Tool. *(box continued on page 122...)*

[1] Lee Hannah et al., *Conservation of Biology in a Changing Climate*, 16 Conservation Bio. 264, 266 (2002); Bastian Bomhard and Guy Midgley, IUCN World Commission on Protected Areas, Securing Protected Areas in the Face of Global Change: Lessons Learned from the South African Cape Floristic Region: A Report by the Ecosystems, Protected Areas and People Project 31 (2005).

- **Protect heterogeneous habitat areas:** As species try to keep up with climate change, they will seek out new habitat with similar conditions or that provide other advantages, given the environmental changes taking place. To support the development of robust, vibrant natural communities, governments should protect and foster heterogeneous landscapes, or complex and variable systems, with a diversity of options for species to use. This is bet hedging: without knowing exactly what changes will occur or the conditions that will prove beneficial, protecting a variety of types of habitats increases the likelihood of safeguarding critical areas for species conservation.[186]

[186] *See* IPCC, Working Group II, Climate Change 2001: Impacts, Adaptation, and Vulnerability ¶ 19.3.3.3 (2001) (noting the importance of protecting areas where different ecosystem types meet).

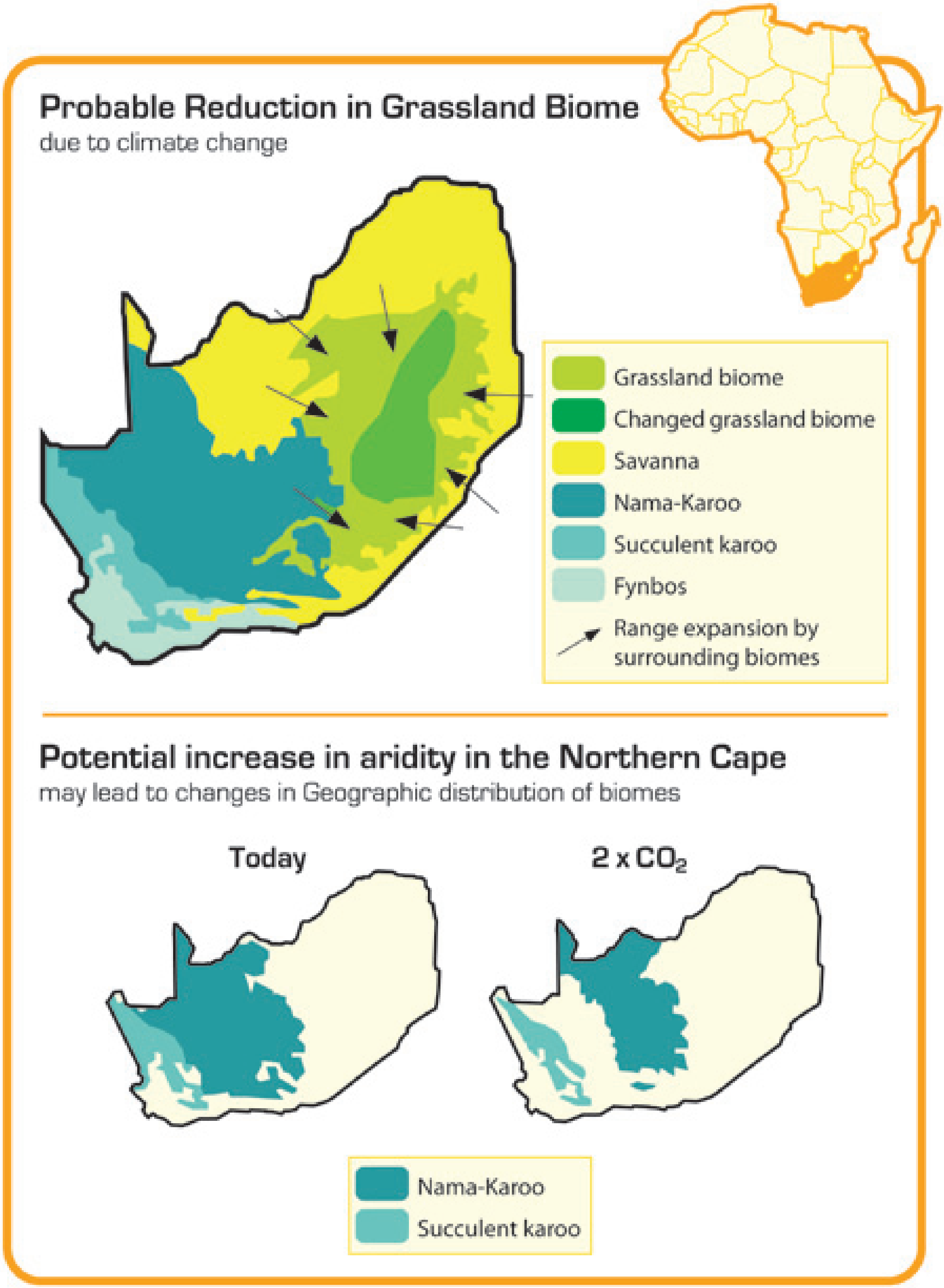

Figure 12.1 Bioclimatic Modeling in South Africa Climate impacts to grassland ecosystem in the Cape floristic region of South Africa.[1]

[1] Dep't of Environmental Affairs and Tourism of South Africa, State of the Environment-South Africa: Terrestrial Ecosystems: Impact Part 2 (1999), *available at* http://www.grida.no/publications/vg/africa/page/3120.aspx.

(box continued from page 120...)

The World Bank Climate Change Knowledge Portal provides quick and readily-accessible global climate and climate-related data to the development community. The site allows users to access data such as the outputs from climate models, historical climate observations, natural disaster data, crop yield projections and socio-economic data at any point on the globe. http://sdwebx.worldbank.org/climateportal/.

The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) is developing a global and regional adaptation support platform called Climate Impacts: Global and Regional Adaptation Support Platform (CI:grasp). www.ci-grasp.org.

While these models have potential, they also have significant limitations and should be used with caution.[2] Planners using bioclimatic models also need to consider changes in human activities and work with urban planners and developers to plan protected areas and migration pathways. For example, modeling in Madagascar projected that under future climate change scenarios, the most effective locations for protected areas overlap with locations where rice farming would be most productive.[3] This knowledge may allow planners to negotiate a balance of uses in an area prior to the period when that area will come under the most stress.

[2] Lee Hannah et al., *Climate Change-Integrated Conservation Strategies*, 11 Global Ecology & Biogeography 485, 487 (2002); Philip E. Hulme, *Adapting to Climate Change: Is There Scope for Ecological Management in the Face of a Global Threat?*, 42 J. Applied Ecology 784, 788 (2005).
[3] Lee Hannah et al., *Climate Change Adaptation for Conservation in Madagascar*, 4 Bio. Lett. 590 (2008).

- **Preserve and enhance access to "climatic refuges":** These are areas that, due to their location or inherent stability, are expected to change the least in response to climate change. Conserving these areas provides protection for species and ecosystems that have the best chance of weathering global climate change.[187]

Policies and legal authorities governing how and where protected areas are created must be informed by a consideration of how climate change will affect their ecological goals. Given the high degree of species movement anticipated from climate change, some biodiversity conservationists have proposed that conservation officials be given the legal authority to modify the location of existing protected areas as bioclimatic conditions change.[188] The process of selecting areas for protection may need to become more dynamic than in the past. However, there are two concerns with protected areas whose boundaries are overly flexible or that shift. First, this may be politically impossible to carry out in practice. The administrative requirements of decommissioning and establishing new protected areas across a coun-

[187] Stacey Combes, *Protecting Freshwater Ecosystems in the Face of Global Climate Change, in* Buying Time, *supra* note 176, at 177, 199-200.
[188] G.P. Von Maltitz et al., Adapting Conservation Strategies to Accommodate Impacts of Climate Change in Southern Africa, S. Africa AIACC Working Paper No. 35, at 11-12 (2006).

try as the climate changes would be burdensome, and the costs of buying out landowners or moving existing human populations would be high. Moreover, there are high levels of uncertainty associated with fluctuating protected area status. Second, discretionary ministerial authority to shift protected area boundaries poses a risk of abuse. For example, protected areas may be decommissioned to make way for development rather than to establish new, more climate-resilient areas elsewhere.[189] Any proposals to adopt such a scheme would require significant transparency in the process of selecting sites and the ability of stakeholders and authorities to detect and halt fraud and abuse.

One method of achieving some flexibility is to provide for the creation of temporary protected areas in anticipation of establishing more permanent ones. Madagascar's regulations on establishing protected areas authorize the use of temporary protected areas to avoid resource degradation during the lengthy administrative process for permanently creating a new area.[190] Such authorities could be reinterpreted or adapted to allow for creation of temporary reserves or special scientific evaluation areas to determine whether an area is likely to provide significant biodiversity or ecosystem benefits over the long term and in the face of climate change. Of course, due consideration for land rights or tenure in this process is essential. Temporary protected areas (zakazniks) were also introduced successfully in the Soviet Union to protect critical habitat of migratory species such as the Saiga Antelope (Saiga tatarica) during reproductive phases such as rut and calving seasons. Such measures could also be useful in adapting to climate change more generally, beyond migratory species.[191]

[189] *See, e.g.*, *Uganda: Gov't to Give Away Nine More Forests,* July 16, 2007, http://www.illegal-logging.info/item_single.php?it_id=1896&it=news (last visited Dec. 17, 2009) (quoting official claiming Uganda's forest law permits decommissioning of forests at the request of local communities for land development).
[190] Decree no. 2005-848 art. 14 (2005) (Madagascar).

[191] *See* I.J. Gordon et al., *The Management of Wild Large Herbivores to Meet Economic, Conservation and Environmental Objectives,* 41 J. Appl. Ecol. 1021 (2004)

12.2 Improving Connectivity between Protected Areas

Key Point: Improved connectivity between core protected areas will allow species to shift their ranges in response to future climate conditions. Effective mechanisms to improve this connectivity combine land use controls with partnership opportunities, engagement with communities and stakeholders, revenue sharing, and other incentives for landowners to participate voluntarily in conservation efforts.

Policymakers can design protected areas networks to provide as many species as possible with the ability to shift their ranges to lands that will be more suitable for them under future climate conditions.[192] **Connectivity** between protected habitats is generally improved through the use of (1) corridors, (2) stepping stones, and (3) buffer zones.[193]

- **Corridors:** Corridors provide routes for species movement between core habitat areas. They may be formally protected and publicly owned, or they may go across private lands protected through partnerships with or incentives provided to the property owner.[194] For climate change, corridors are essential to allow species to migrate and establish new ranges when prior habitat areas are made unsuitable.[195]
- **Stepping Stones:** These serve the same function as corridors, but take the form of "islands" of suitable habitat that span an unsuitable landscape, "connecting" two or more protected areas. Because they require less land, stepping stones may be desirable for conserving species that are highly mobile, such as many birds, or that disperse widely and easily, such as plants that use airborne seed dispersion strategies.[196]
- **Buffer Zones:** Buffer zones are areas adjacent to protected habitat that serve two functions. Not only do buffer zones protect core habitat from outside encroachment, but when they are managed to allow species to shift onto them, they

[192] Secretariat of the Convention on Biological Diversity, Making Protected Areas Relevant: A Guide to Integrating Protected Areas into Wider Landscapes, Seascapes, and Sectoral Plans and Strategies, CBD Technical Series No. 44, Appendix 12, at 85 (2010) [hereinafter Making Protected Areas Relevant].

[193] Ad hoc Technical Expert Group on Biological Diversity and Climate Change, Interlinkages between Biological Diversity and Climate Change: Advice on Integration of Biodiversity Consideration into Implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol, CBD Technical Series No. 10, at 77, 82 (October 2003).

[194] Nigel Dudley, IUCN, Guidelines for Applying Protected Area Management Categories 37 (2008).

[195] *See* James Sanderson et al., *Escaping the Minimalist Trap: Design and Implementation of Large-Scale Biodiversity Corridors, in* Connectivity Conservation 627 (Kevin. R. Crooks and M. Sanjayan eds. 2006).

[196] Reed F. Noss, *Beyond Kyoto: Forest Management in a Time of Rapid Climate Change,* 15 Conservation Bio. 578, 584 (2001); N.M. Haddad, *Finding the Corridor More Traveled*, 105 Proc. Nat'l Acad. Sci. 19,569 (2008); Alison Campbell et al., UNEP World Conservation Monitoring Centre, The Linkages between Biodiversity and Climate Change Mitigation 34 (2008).

terms on page

CONNECTIVITY refers to the degree to which species are able to move from one area to another with minimum disturbance or interference from human activities.

provide a valuable function for climate adaptation.[197]

These mechanisms will need to be designed within a legal framework of land tenure and water rights, zoning and planning requirements, rules governing expropriation, and other laws. Governments can also use laws authorizing private lands conservation to strategically target conservation in such areas. Connectivity mechanisms can be integrated into resource management laws in a number of sectors. When changing or drafting these laws or requirements to facilitate connectivity between protected areas, practitioners should consider the following factors:

- Existing land ownership, use, and planning laws that may conflict with or may be used to help connect protected areas (e.g., zoning requirements to maintain green space)
- Existing aquaculture, agriculture, and forestry laws and regulations that may affect how protected areas can be connected (e.g., requirements to leave riparian zones along streams and rivers)
- Restrictive effects of land categorization on habitat connectivity (e.g., ensuring commercial development zones do not fragment key habitat areas)
- The potential for using existing frameworks for national protected areas for system-level planning that includes consideration of connectivity between areas
- Ensuring resource users and communities have a right to participate in or make decisions related to connectivity, including both rights and responsibilities
- Ensuring that legal authorities to create connectivity between protected areas integrate community needs such as poverty reduction, socio-economic development, and financial incentives into the planning process

example Under Peru's law governing conservation easements, a provision to give priority to private conservation areas located within buffer zones around or within public protected areas could be used to strategically direct the formation of conservation areas along biological corridors where species are expected to migrate or resettle as a result of climate change.[198] (See more on private areas conservation in Chapter 13.)

[197] Sanderson et al., *supra* note 154, at 628; J.J. Hopkins et al., *supra* note 172, at 12.

[198] Envtl. L. Inst., Legal Tools and Incentives for Private Lands Conservation in Latin America: Building Models for Success 169 (2003).

12.3 Aligning Community Roles and Benefit Sharing with Adaptation

Key Point: It is possible to both conserve ecosystems and support local communities that depend on resources from those ecosystems. Climate change makes this approach a necessity because much larger areas of land and water must be sustainably managed to support the movement and dispersal of species, and it is neither possible nor desirable to remove human settlements from all areas where habitat conservation is needed.

If the size of areas under management for conservation needs to grow to give ecosystems the best chance to adapt to climate change, this should not happen at the expense of communities, indigenous groups or other populations who are frequently impoverished or who rely on local resources and ecosystem services for livelihoods. These communities are already highly vulnerable to climate change, and establishing new protected areas without regard to their welfare is not acceptable conservation policy.[199] Historically, preserves, refuges, and similar protected areas in the developing world have often been set aside without sufficient recognition of, or provision for, indigenous peoples' aboriginal and other legal rights to continue to gather, fish, and hunt within these areas.[200] Many policymakers and conservationists now understand it is essential to provide for these rights, develop co-managed or wholly community-managed protected areas, and share revenues and other benefits, recognizing that the interests of all involved are often compatible.[201] (See Chapter 11 for information on adaptation and community-based natural resources management.)

Key legal and policy questions for community engagement in protected areas include:

- **Management responsibility and functions:** Are local communities given management responsibility?
- **Management accountability:** Do communities have a role in determining the outcome of management decisions?
- **Negotiation to determine management roles:** Is there a process for negotiation between government authorities and communities?
- **Benefit sharing:** Do communities have a right to share economic benefits of a protected area, either in cash (such as entrance fee revenues) or in-kind (such as the use of timber)?
- **Rights to access resources:** Do communities retain rights to access natural resources in protected areas or in their buffer zones? May

[199] *See* Mark Dowie, *Conservation Refugees: When Protecting Nature Means Kicking People Out, in* The Future of Nature: Writing on a Human Ecology 65 (Barry Lopez ed. 2007).
[200] For a history of expropriative conservation in Tanzania, for example, see Greg Goldstein, Note, *The Legal System and Wildlife Conservation: History and the Law's Effect on Indigenous People and Community Conservation in Tanzania*, 17 Geo. Int'l Envtl. L. Rev. 481 (2005).

[201] Making Protected Areas Relevant, *supra* note 192, at 29-31. See *id.* appx. 9 for a chart of protected-area governance categories.

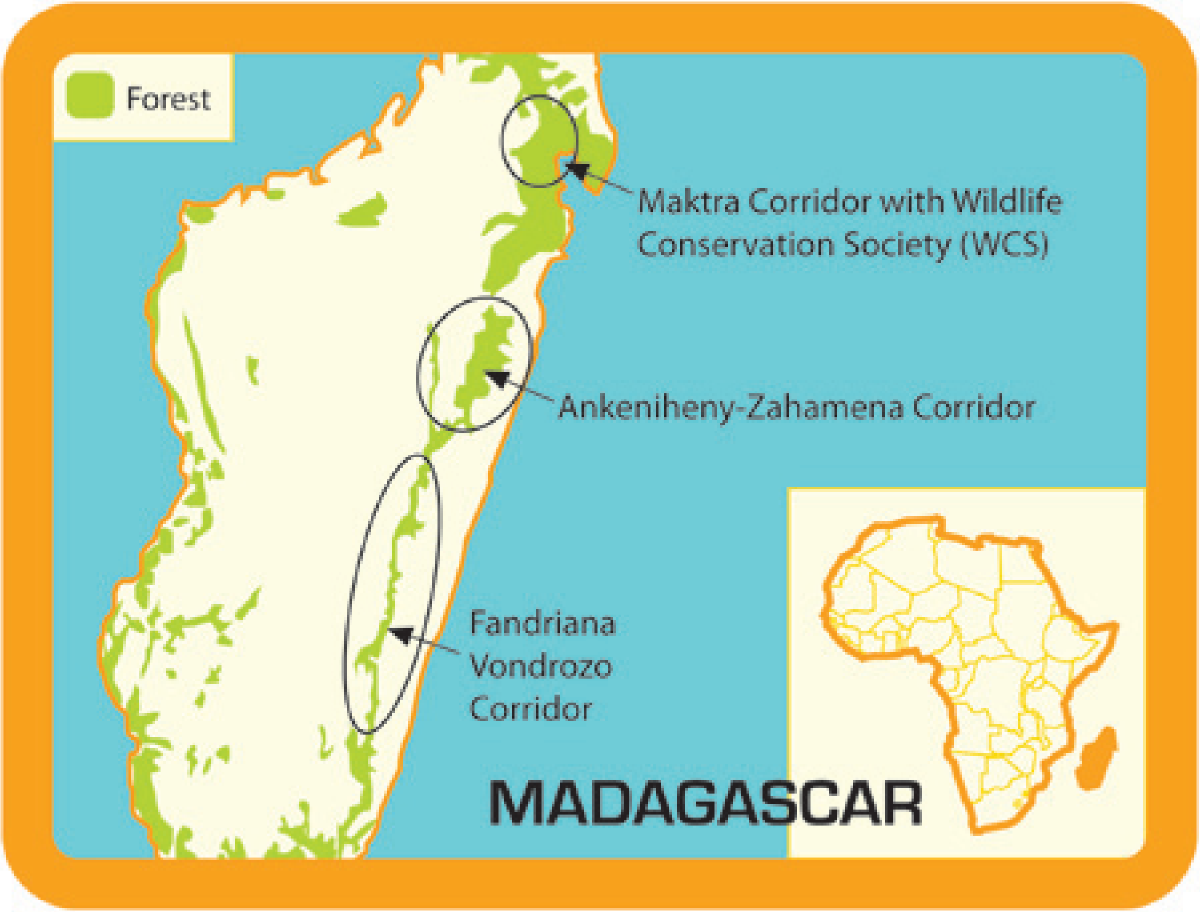

Figure 12.2 Integrating Biodiversity Adaptation with Community Needs High-priority conservation zones in Madagascar where Conservation International is partnering with local communities.[1]

[1] © Conservation International Foundation; www.conservation.org.

communities access rights directly or as a benefit in exchange for management functions?

- **Agreement/contract setting out terms and conditions:** Does the law or regulation provide for a formal agreement between government authorities and communities for protected areas management, benefit sharing, and access rights?[202]

[202] *See* Tran Thi Huong Trang, Review of the Regulatory Framework Governing Community Management of Protected Areas (PAs) in Vietnam 8-9 (2007, unpublished; on file with ELI).

example

In Madagascar, local communities are given both responsibilities and incentives to actively participate in the management of local protected areas. Madagascar's protected areas management policy is to dedicate exactly half of park revenues to promote the development of local communities around the park. Giving the local community a direct financial stake in the park's success helps prevent poaching, illegal logging, and other activities that reduce ecosystem resilience.

12.4 Creating Transboundary and International Protected Areas Networks

Key Point: Management strategies that cross political borders are needed to identify, monitor, and jointly manage species and habitats vulnerable to climate change.

Climate-resilient biodiversity corridors will often need to cross international or other political boundaries.[203] New efforts to "make protected areas relevant" now focus on creating systems of protected areas large enough to accommodate species' range shifts in response to climate change.[204] International networks are currently being developed in the Albertine Rift, the Andes, the Apennines, the Austrian Alps, the Rocky Mountains, the Western Ghats, the Caribbean, and elsewhere.[205]

Joint **transboundary management** of protected areas facilitates adaptive measures for climate change by providing a framework within which information about local changes can be conveyed to other conservation planners. Equity issues may arise in partnerships between countries with markedly different capacities to adapt to climate change.[206]

[203] Lee Hannah et al., *Conservation of Biology in a Changing Climate*, 16 Conservation Bio. 264, 267 (2002).
[204] Making Protected Areas Relevant, *supra* note 192.

[205] Martin F. Price and Graham R. Neville, *Designing Strategies to Increase the Resilience of Alpine/Montane Systems to Climate Change*, *in* Buying Time, *supra* note 176, at 73, 82.
[206] Lee Hannah et al., *Protected Area Needs in a Changing Climate*, 5 Front Ecol. Envt. 131, 137 (2007).

Box 12.2. Major International Conventions and Programs on Protected Areas

Policymakers may wish to assess current programs and other efforts taking place at the international level as a starting point for transboundary initiatives.[1] Some of these efforts include:

- The Convention on Migratory Species (CMS) and its daughter agreements, such as the African-Eurasian Waterbirds Agreement.
- UNESCO World Network of Biosphere Reserves (WNBR)
- The World Heritage Convention (WHC)
- UNESCO Man and the Biosphere Program
- Convention on Biological Diversity's Program of Work on Protected Areas (PoWPA)

[1] A database of international obligations on protected areas is at UNEP and IUCN, TEMATEA, Protected Areas, http://www.tematea.org/?q=node/6618 (last visited December 28, 2010). *See also* Arie Trouborst, *International Nature Conservation Law and the Adaptation of Biodiversity to Climate Change: A Mismatch*, 21 J. Envtl. L. 419 (2009).

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TRANS-BOUNDARY PROTECTED AREAS are conservation areas that cross international borders.

A strong legal framework for international collaboration on transboundary protected areas might include:

- Methods of inspection, verification, and reporting
- Mechanisms for compliance and enforcement of commitments
- Dispute resolution processes
- Financing agreements (especially between countries with significant differences in management capacity)

Another concern is minimizing disturbance of human livelihoods in transboundary areas. Several transboundary parks have been criticized for excluding local stakeholders from decision-making processes and forcing the relocation of residents.[207] An alternative model to the transboundary park system is the Transfrontier Conservation Area (TFCA). TFCAs are managed areas that cut across the border between two or more countries. They encompass one or more protected areas surrounded by community- or individually-owned land that is managed for sustainable use of natural resources. TFCAs have the potential to bring multiple simultaneous benefits. They extend the model of community-based natural resource management across national boundaries, particularly in situations where a local community or ethnic group is situated on both sides of an international border. TFCAs can also improve connectivity, open economic opportunities through tourism, decrease cultural isolation, and lay the groundwork for further regional cooperation.

example

The *Protocol on Conservation and Sustainable Use of Biological and Landscape Diversity* signed between the Carpathian countries in Eastern Europe in 2003 is a model for regional cooperation in building a resilient protected areas network.[208] This agreement calls on the parties to, among other things, "harmonise and coordinate their efforts and cooperate on [protecting] habitats, and securing their continuity and connectivity."[209] These efforts at coordination include "establishing an ecological network in the Carpathians, composed of protected areas and other areas significant for biological and landscape diversity;"[210] "facilitat[ing] cooperation under the Carpathian Network of Protected Areas" (established by the Conference of the Parties); [211] enhancing "conservation . . . in areas outside of protected areas . . . , improving and ensuring connectivity between existing protected areas and other areas and habitats significant for . . . diversity"[212]; "encourag[ing] the expansion of existing transboundary protected areas or creation of new transboundary

[207] Simon M. Munthali, *Transfrontier Conservation Areas: Integrating Biodiversity and Poverty Alleviation in Southern Africa,* 31 Nat. Resources Forum 51, 54-55 (2007).

[208] Protocol on Conservation and Sustainable Use of Biological and Landscape Diversity to the Framework Convention on the Protection and Sustainable Development of the Carpathians done in Kiev on 22 May 2003 (signed June 19, 2008).
[209] *Id.* art. 1(1).
[210] *Id.* art. 9(3).
[211] *Id*. art 14(1).
[212] *Id.* art. 15(2).

protected areas"[213]; and cooperating in the development of joint management plans, monitoring activities, scientific research, and exchange of information.[214] Each of these areas of cooperation will contribute to a stronger, more resilient protected areas network in the Carpathians. However, two areas of concern about the Protocol are that the impacts of climate change are nowhere explicitly mentioned, and that the role and rights of local communities are not clearly delineated.

[213] *Id.* art. 16(2).
[214] *Id.* arts. 17, 18, and 19.

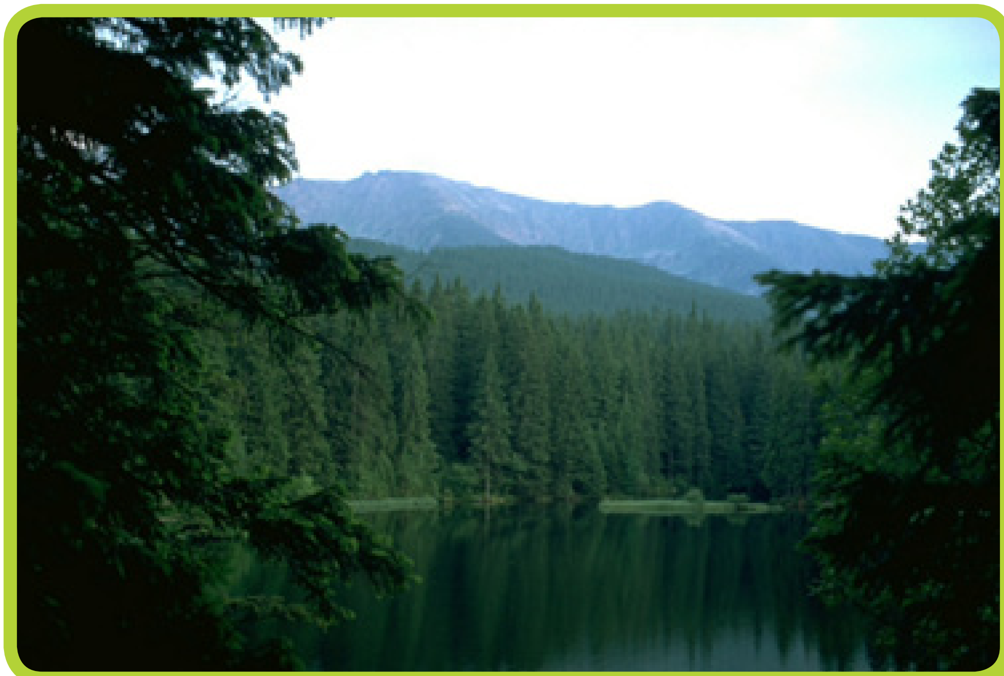

Photo credit: FAO/FO-0336/ Thomas Hofer

Figure 12.3 Eastern European Landscapes Slovakia's Tatra National Park in the Carpathians.[1]

[1] FAO, The Legal Framework for Sustainable Mountain Management: An Overview of Mountain-specific Instruments (2002), *available at* http://www.fao.org/docrep/004/y3549e/y3549e14.htm.

Figure 12.4 Mesoamerican Corridor Areas in olive green make up the Mesoamerican Biological Corridor (Graham, Global Transboundary Protected Areas Network)[1]

[1] Douglas Graham, Global Transboundary Protected Areas Network, Mesoamerican Biological Corridor: Mexico to Panama (2007).

Box 12.3. The Mesoamerican Biological Corridor[1]

By the 1990s, the rate of deforestation in Central America and Mexico put the region on track to lose almost all of its forests within a decade and a half. In response, the affected countries established the Mesoamerican Biological Corridor (MBC) with funding from the Global Environment Facility, support from a large number of partners, and coordination by the Central American Commission on Environment and Development. Implemented individually by each nation, the aim of the MBC is to combat forest conversion, recover lost forestland, protect biodiversity, and stimulate sustainable development for local people.

To achieve these goals, the project set out to strengthen existing protected areas, link them to each other, and encourage environmentally friendly economic activities, such as organic food production, ecotourism, pharmaceutical prospecting, and reforestation. The project built upon preexisting regional and national initiatives in an effort to include all national stakeholders and harmonize regional policies. Spanning 768,990 km2 from Mexico to Panama, and covering eight percent of the world's biodiversity, the MBC is a super-corridor encompassing smaller, preexisting corridors.

If successful at linking protected areas, the sheer size of the MBC is likely to provide climate adaptation benefits for the biodiversity within its borders. However, as the project was not originally conceived to deal with the impacts of climate change, its long-term utility in addressing shifting species ranges and land use is unclear. Additionally, while the project has been well received by local communities, its social and economic impact remains limited, and deforestation pressures continue.

[1] Douglas Graham, Global Transboundary Protected Areas Network, Mesoamerican Biological Corridor: Mexico to Panama (2007), *available at* http://www.tbpa.net/docs/pdfs/Meso_American_Biological_Corridor.pdf.

12.5 Translocating Species: Legal and Policy Considerations

Key Point: Translocation (also called "assisted migration") can be used to move species into habitat more suitable for future climate conditions. This should only be done with caution and with safeguards to prevent irreversible damage to the host ecosystem. Frameworks for assessment, authorization, monitoring, review, and mitigation are essential to ensure that translocations are done appropriately.

Scientists anticipate that many species will attempt to move as climate change begins to impact their current habitat.[215] But species' movements face obstacles: human infrastructure, other physical barriers, or too slow a pace of reproduction. If a species is unable to shift its range or adapt to climate change in its current location, human intervention could be the only method to prevent it from being completely eliminated in that area.[216] Conservationists are increasingly considering transporting species to new locations to protect them from climate change. This is a highly controversial technique. Proponents believe it may be the only means of saving some threatened and endangered species from climate change, while opponents see it as unproven and expensive, a drain on resources for ecosystem-based conservation, and a threat to the host ecosystems where non-native species are moved, because these species pose a risk of becoming invasive.[217]

Few countries have adequate legal frameworks for translocation. Existing biosafety, pest-control, and general wildlife laws often impose some restrictions on intentional, non-native species introductions.[218] Other laws may allow the possibility of non-native species introductions with conditions or may prohibit their entry, depending on the circumstances.[219] But these laws do not generally contemplate the ecological benefits of intentionally introducing a species to a new area in order to prevent its annihilation in its changed environment. In one Kenyan legal case, the **translocation** of the rare and endangered *hirola* antelope to a protected area was halted on the basis that the authorizing statute for wildlife protection only "entitle[s] [the Service] to conserve the wild animals in their *natural state*. It does not entitle it to translocate them" to new habitat.[220] The assumption that a species can be successfully conserved in its "natu-

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TRANSLOCATION is the activity of intentionally moving members of a species to a new area for the benefit of that species' conservation.

[215] G.P. Von Maltitz et al., Adapting Conservation Strategies to Accommodate Impacts of Climate Change in Southern Africa, S. Africa AIACC Working Paper No. 35, at 3-4 (2006).

[216] *See* Brian G. Keel, *Assisted Migration as a Conservation Strategy for Rapid Climate Change: Investigating Extended Photoperiod and Mycobiont Distributions for* Habenaria repens Nutall (Orchidaceae) *as a Case Study* 5 (dissertation submitted Antioch Univ. 2007), *available at* http://www.torreyaguardians.org/keel-assisted-mig-a.pdf.

[217] Bob Holmes, *Assisted Migration: Helping Nature to Relocate*, 196 New Sci. 46 (2007); Mark Schwartz, *Conservationists Should Not Move* Torreya taxifolia, Wild Earth (January 2005), *available at* http://www.torreyaguardians.org/schwartz.pdf.

[218] *See, e.g.*, Plant Protection Act § 3 (1937) (Uganda) (power to make rules for the prevention or spread of pests).

[219] *See, e.g.*, Plant Quarantine Act § 5 (1993) (Bhutan) ("The Royal Government instead of absolutely prohibiting the importation of any plant, pest, plant product, goods or soil may prescribe the conditions under which the import shall be permitted.").

[220] Abdikadir Sheikh Hassan et al. v. Kenya Wildlife Service, Civil Case No. 2959 (High Court of Kenya at Nairobi 1996) (emphasis in original). The injunction was later lifted, and the translocation went forward.

Box 12.4. The Contested Terminology of Moving Species

The technique of moving species to new locations to protect them from climate change is frequently called "assisted migration," but this term can cause confusion. The word "assistance" contains the assumption that humans should help species move to new areas when they are not otherwise able to move themselves. Many ecologists are concerned such movements may threaten the integrity of the host ecosystem. The terms "range shift" and "translocation" may be more precise, and are used in this section.

- **Range shifts:** This is a more inclusive term than "migration" and can be applied to the gradual movement of all life forms, including vegetation and other seemingly stationary species, in response to climate change.
- **Translocation:** The human-aided transport of individuals of a species from one location to establish a viable population in another. This term follows IUCN-published guidelines.[1]

[1] IUCN, Position Statement on Translocation of Living Organisms: Introductions, Reintroductions and Restocking 3 (1987), *available at* http://www.iucnsscrsg.org/download/IUCNPositionStatement.pdf.

ral state" is doubtful if climate change renders its current habitat unsuitable.[221]

Those considering a translocation project should undertake a thorough assessment of the ecological benefits and costs.[222] IUCN recommends considering a wide set of ecological issues before intentionally introducing a species into a new area.[223] The risks of a biological invasion should be assessed "on a site-by-site basis against the vulnerability of native populations to climate change, and the necessity and feasibility of migration to other habitats . . . [T]he risks of invasion may be so severe that allowing one sensitive species to be lost would be preferable to endangering the entire community."[224]

IUCN recommends using existing institutions governing natural resources to control intentional introductions of organisms, while also establishing new institutions and authorities to carry out beneficial translocations. Specific recommendations for developing translocation policies include:

- Subject all intentional species introductions to a permit system
- Impose penalties for violations or negligence that could result in the escape or introduction of a species harmful to the environment, including criminal penalties

[221] *See* Alejandro E. Camacho, *Assisted Migration: Redefining Nature and Natural Resource Law under Climate Change*, 27 Yale J. Reg. 171, 176 (2010) ("[A]ssisted migration is controversial because it challenges foundational tenets of conservation law and ethics that seek to preserve and restore preexisting biological systems and shield them from human interference.")
[222] J.S. McLachlan et al., *A Framework for Debate of Assisted Migration in an Era of Climate Change*, 21 Conservation Bio. 299 (2007).
[223] IUCN, *supra* note 1, Box 12.4, at 4; *see also* J.S. McLachlan et al., *A Framework for Debate of Assisted Migration in an Era of Climate Change.* 21 Conservation Bio. 299, 300-01 (2007).
[224] Stacey Combes, *Protecting Freshwater Ecosystems in the Face of Global Climate Change*, *in* Buying Time, *supra* note 176, at 199-200.

or civil liability for damages to resources or ecosystems and attendant eradication and restoration costs

- Formulate new policies on translocation of wild species for climate adaptation
- Establish specialized authorities composed of experts to advise on policy matters related to translocation and to make recommendations on specific cases of translocation when these are proposed[225]

[225] IUCN, *supra* note 1, Box 12.4, at 11.

Photo credit: TorreyaGuardians.org

Figure 12.5. The First Climate-driven Translocation? The Torreya Guardians, a U.S. NGO, are currently implementing a translocation project for Torreya taxifolia, a coniferous tree existing in small pockets at the edge of its climatic range in the state of Florida. The Guardians are relocating torreya seedlings to cooler, wetter habitat believed to have been within the torreya's historical range prior to the last glacial period.[1] This torreya seedling was translocated 600 kilometers north of existing habitat.[2] Advocates argue that the U.S. Fish & Wildlife Service should define "native habitat" for purposes of endangered species restoration by reference to deep historical baselines going back to the last ice age.[3]

[1] Torreya Guardians, Efforts to Save *Torreya taxifolia*, http://www.torreyaguardians.org/save.html (last visited Nov. 25, 2009).
[2] Torreya Guardians, Waynseville Rewilding, http://www.torreyaguardians.org/waynesville-rewilding.html (last visited Dec. 18, 2010).
[3] Letter from Connie Barlow to Jessica Hellmann et al. regarding "Assisted Migration and the USF&WS management plans for endangered species" (May 13, 2010), *available at* http://www.torreyaguardians.org/barlow-leopoldreport.pdf.

Chapter 13 Private Lands Conservation

Private lands conservation is still growing as a tool for conservation in much of the developing world. The expansion of Western systems of land registration and private ownership of property pose policy challenges with respect to community rights and land tenure that cannot be addressed here. However, they also provide opportunities for private conservation efforts. This is especially important for climate adaptation efforts to protect biodiversity. In order to facilitate species' range shifts and reduce habitat fragmentation caused by climate change, management efforts must reach beyond core protected areas to include non-public lands. Engaging private landowners is therefore essential to increasing habitat connectivity over the whole landscape. Further, many landowners are responsible biodiversity stewards who understand the ecosystem and who are likely to voluntarily participate in projects to adapt to climate change.

Private conservation efforts utilize a variety of legal tools. These may include:

- Land ownership by NGOs
- Formally declared private reserves
- Ecological easements created under the civil code or by common law
- Independent or "in gross" conservation easements that benefit the public good
- The right of "usufructo" or "comodato" (i.e., the right to continue using areas in a way that is compatible with conservation objectives)
- Land donations to protected area networks
- Conditional gifts or bequests
- Land trusts and limited development efforts
- Transfer of urban development rights
- Informal private reserves[226]

This chapter will look at how private initiatives and public laws that operate on private lands can help build networks of protected areas that are

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[226] Envtl. L. Inst. (ELI), Legal Tools and Incentives for Private Lands Conservation in Latin America: Building Models for Success 14 (2003).

resilient in the face of climate change. It will also explore options for making these devices themselves more resilient to climate change.

13.1 Private Conservation Planning for Climate Impacts

Key Point: Laws governing private conservation areas can be used for climate adaptation. This requires analysis of adaptation potential in contract law, real property law, land tenure and registration, and estates, wills, and trusts. New laws may be necessary to provide regulatory clarity.

Climate change presents special challenges that must be considered in order to ensure long-term biodiversity protection through private conservation efforts. Private conservation easements are generally established through private agreements between a grantor (the land owner) and a grantee (a land trust or government charged with managing the easement). They may also be the result of a public-private partnership. As a first step, countries that wish to encourage private conservation areas will need to determine whether there are legal hurdles to their development, such as the restrictions that existed until recently in Latin America requiring owners to make "socio-economic use of the land."[227] Even where no direct hurdles exist, legislation authorizing the creation of private conservation easements can provide needed regulatory clarity. In Peru, for example, such areas were non-existent until the government passed the Law on National Protected Areas of 2001 (authorizing the creation of private reserves and con-

[227] *Id.* at 12.

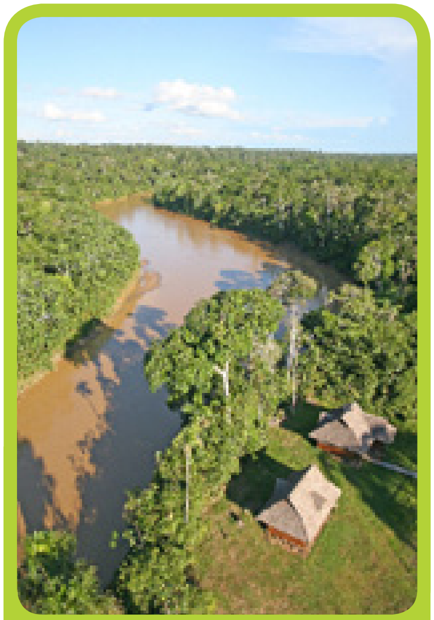

Photo credit: Joe Tobias

Figure 13.1 Private Conservation in Peru
The Los Amigos Conservation Concession.[1]

[1] Amazon Conservation Association, Conservation Concessions, http://amazon-conservation.org/ourwork/conservation.html (last visited August 19, 2010).

CONSERVATION EASEMENTS are voluntary commitments by property owners to dedicate some or all of their property to conservation purposes.

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servation concessions). Since then, two large, private conservation areas have been established: the 34,000 hectare Private Conservation Area formed by the Chongoyape campesino community (protecting the Tumbesian forest ecosystems) and the 132,832 hectare Los Amigos watershed conservation area in the Peruvian Amazon.[228]

[228] *Id*. at 167. For model legislation, see *id*. at 185.

13.2 Public Law Tools to Support Adaptation and Conservation on Private Lands

Key Point: Private lands can be used strategically to augment and advance the adaptation objectives of conservation efforts on public lands and waters.

Under many climate scenarios, species previously located within a protected area may migrate into regions beyond that area's boundaries. Climate change also means that some private lands (such as land in floodplains) will no longer be suitable for commercial or residential development, and may be best used as wetlands habitat or as a buffer from flooding. Private law tools and public-private partnerships can enhance public efforts to protect biodiversity in these circumstances and others. The following options may be considered:

Protections for buffer zones and private inholdings (privately-owned land within the boundaries of public lands): Negotiating the formation of private conservation areas in buffer zones surrounding the core protected area of a park or refuge can effectively extend the protected space without requiring the formation of entirely new government-controlled areas.[229]

Linking public protected areas by a network of conservation easement biological corridors: Conservation corridors are essential for allowing species movement over a wider geography than through single, isolated protected areas. In Bhutan, for example, protected areas are connected by twelve biological corridors covering nine percent of Bhutan's land area. Bhutan's Nature Conservation Division (NCD) has consolidated these areas into "a macro-level natural landscape called the 'Bhutan Biological Conservation Complex'" (B2C2).[230] Although the locations of these corridors were chosen in part to minimize disturbance of areas of human settlement and activity, they nonetheless include large areas of private or community-controlled land. Bhutan established rules for designating and managing corridors under the Rules on Biological Corridors (RBC), 2007, as an addendum to the general forestry regulations promulgated in 2006. Biological corridors established by the RBC are managed in a status lower than that of "protected areas," but higher than "government reserved forests."[231] Bhutan's Ministry of Agriculture has authority to declare corridors, while the Department of Forestry is authorized to develop regulations for their management.[232] Bhutan's efforts demonstrate that it is possible to use private lands to construct corridors connecting separate protected areas, so long as attention is given to the special status of those lands. Private conservation easements may be similarly linked through the coordinated efforts of multiple landowners and the government. Incentives such as tax breaks for setting aside private property for conservation purposes can substantially increase participation.

[229] ELI, *supra* note 226, at 4-5.

[230] Gov't of Bhutan, Fourth National Report to the CBD (2009).

[231] Executive Order on Management of Biological Corridors in Bhutan [undated; on file with ELI].

[232] Regulation on Biological Corridors art. 113 (2006) (Bhutan).

Community-NGO Partnerships: Conservation NGOs may have greater flexibility, adaptability, and freedom than the government to respond to changing conditions when managing areas under their control. They can also effectively partner with local communities. For example, in exchange for participation in conservation efforts along biodiversity corridors in Madagascar, Conservation International is offering local villages a range of development benefits such as technical support for agriculture, income-generating activities, infrastructure improvements, education, ecotourism development, and health services.[233] By relying on conservation groups, land trusts, and other private actors to manage conservation areas in coordination with local communities, governments can achieve three complementary policy goals: 1) reduce financial burdens on government; 2) improved adaptability in conservation area management through fewer bureaucratic hurdles; and 3) community development.

Land Swaps to Create Climate-Resilient Public Lands Networks: Land swapping is a familiar tool in natural resources law. However, regulatory authority to swap public lands for private lands has often suffered from a lack of legal clarity on its purposes and the conditions governing when it should be done.[234] New laws and regulations can guide public managers to swap lands in cases where the newly-acquired lands enhance the adaptation value of the public land network (for example, by creating a corridor on which a rare or endangered species will be able to migrate in response to climate change).[235]

Debt-for-Land Swaps: Similarly, a private person or business may owe debt to a government, or face substantial civil or administrative penalties (e.g., in the case of a business facing fines for environmental violations). In settlement negotiations with the individual or business, the government could arrange to acquire new lands for protected areas in exchange for the discharge of the debt or liability. This has been done between governments in the case of international debt,[236] but these opportunities need to be explored further in the case of private persons or businesses.

Use of Royalties to Support Conservation Areas: Leaseholders for resource extraction on government lands (such as minerals, oil and gas, timber, etc.) often provide a share of profits to the government in the form of royalties. Governments can establish funds using a share of these royalties to support conservation efforts, such as the Land and Water Conservation Fund supported

[233] Conservation Int'l, Harnessing Nature as a Solution to Climate Change in Madagascar 7 (2008).

[234] *See, e.g.*, Susan Jane M. Brown, *David and Goliath: Reformulating the Definition of 'The Public Interest' and the Future of Land Swaps after the Interstate 90 Land Exchange*, J. Envtl. L. & Litig. 235 (2000).

[235] *See* Edward J. Heisel, *Biodiversity and Federal Land Ownership: Mapping a Strategy for the Future*, 25 Ecol. L.Q. 229, 302-308 (1998).

[236] *See* Amanda Lewis, *The Evolving Process of Swapping Debt for Nature*, 10 Colorado J. Int'l Envtl. L. & Pol'y 431 (1999); Nicolas Kublicki, *The Greening of Free Trade: NAFTA, Mexican Environmental Law, and Debt Exchanges for Mexican Environmental Infrastructure Development*, 19 Columbia J. Envtl. L. 59 (1994).

by royalties from offshore drilling in the United States.[237]

In-kind Royalties in the form of Landholdings: The U.S. government has experimented in recent years with use of 'in-kind' (i.e., non-monetary) forms of payment of royalties on federal oil and gas leases. A major concern is ensuring the in-kind payment is equal to the value of the lost payment and is in the public interest.[238] Policymakers may wish to explore this option to have royalty payments (or a percentage of the payment) on government leases made through an 'in-kind' form, such as the donation of land holdings or voluntary cancellation of non-productive leases. Policymakers will need to consider whether the proposed in-kind royalty payment is equal in value to monetary payments and actually has climate adaptation value for habitat conservation.

The options listed above are only a few possible mechanisms for enhancing public biodiversity adaptation programs through private law arrangements or private-public collaborations. Other types of private methods, such as increased insurance premiums or use of "long-term insurance policies" for construction in climate-sensitive areas like coastlines and flood plains,[239] should certainly be explored as well.

[237] *See* Land and Water Conservation Fund Act of 1965; Public Law 88-578 (codified at 16 U.S.C. §§ 4601-4 et seq.) (U.S.A.). *See also* Dave Cleaves, U.S. Forest Service, Memorandum, Engaging a Climate Ready Agency 4 (July 7, 2010) (one of twelve criteria for land purchases using the LWCF is now climate adaptation benefits).

[238] *See* U.S. Gov't Accountability Office, Strategic Petroleum Reserve: Options to Improve the Cost-Effectiveness of Filling the Reserve, GAO-08-521T (February 2008).

[239] *See* Howard Kunreuther, Risk Management and Decision Processes Center, The Wharton School of the University of Pennsylvania, Long-Term Insurance and Climate Change, Working Paper # 2009-03-13, (prepared for International Seminar at the University of Innsbruck, *Adaptation to Climate Change: The Role of Insurance*, March 6-7, 2009); Environmental Defense, Blown Away: How Global Warming is Eroding the Availability of Insurance Coverage in America's Coastal States (2007).

13.3 Mechanisms for Adapting Private Conservation Areas to Climate Change

Key Point: Contracts, charters, and agreements for private conservation areas should be drafted to ensure that conservation protections continue even if climate change causes fundamental changes in an area's ecological status.

A special set of challenges for adaptation arises in the context of private legal instruments for conservation areas. Practitioners will need to be careful in drafting the language used in these legal instruments to avoid early termination of an area's status as a result of climate change impacts, to ensure active management and restoration of conservation areas, to ensure that risks are shared equitably between parties, and to effectively fulfill larger conservation objectives. Some considerations in preparing these documents include:[240]

Set terms of years: Private reserve laws and private conservation agreements may require that a reserve or easement exist for a specified period of time. For example, in Peru, private conservation areas managed by the Institute of Natural Resources (INRENA) must exist for 10 years and are renewable.[241] Defined time periods are useful because they cannot be undercut by changes in climate. In order to ensure that easements endure beyond the initial time period, however, renewal should be cheap and easy. Other provisions for termination must be evaluated closely as well. For example, in addition to limiting conservation easements to terms of 5-20 years, Costa Rican law allows for termination of such easements upon transfer of ownership of the property.[242] This termination structure may frustrate larger-scale conservation strategies that rely on an extensive network of conservation easements.

Specific language to prevent early termination due to climate impacts: Some countries allow conservation easements to terminate if it becomes "impossible or impractical" to carry out the purposes for which an easement was created.[243] Drafters who do not want climate-induced changes to result in such terminations may wish to include a list of specified occurrences or situations that are **not** grounds for termination based on "impossibility or impracticality" under the laws governing private conservation areas.[244] For example, agreements can specifically provide that various types of climate change impacts, such as loss of a particular species or habitat type, arrival of exotic species, or dramatic changes in precipitation, are not grounds for termination of conservation easements. For private landowners who wish to retain the right to terminate an easement if extreme changes in the area's ecology occur, language can be included that would provide for renegotiation of the easement if pre-agreed thresholds are crossed.

[240] Sample easement language covering each of the following topics is provided in James L. Olmstead, *Perpetuity, Latent Ancillary Rights, and Carbon Offsets in Global Warming Era Conservation Easements*, 39 Envtl. L. Reporter 10842, 10843-46 (2009).
[241] ELI, *supra* note 226, at 186.
[242] *Id.* at 17.
[243] Nancy A. McLaughlin, *Rethinking the Perpetual Nature of Conservation Easements,* 29 Harv. Envtl. L. Rev. 421 (2005).
[244] Olmstead, *supra* note 240, at 10843 (citing Elizabeth Byers and Karin Marchetti Ponte, The Conservation Easement Handbook (2d ed. 2005)).

Standards to allow climate-sensitive changes to conservation easement management plans: It is important that management plans require monitoring and periodic reviews and allow for adjustment based on biodiversity impacts caused by climate change. This may require drafters to think about how to preserve flexibility in easement management decisions. For example, conservation easement agreements often include requirements that any change in the management of a private area must be either neutral or enhance the area's ecological values.[245] However, climate change may require amendments to a management plan that do not necessarily meet this standard. For instance, climate change-induced drought might by lead to desiccation of an evergreen forest, which is eventually destroyed by forest fire. The easement grantee may determine that the forest area can only be restored with a species of tree that is more drought-resistant. If the new species is not considered "neutral" or "ecologically valuable" under the regular language, this could hinder adaptation efforts. To avoid this problem, management plans could include language providing for third-party observers or scientific authorities to review the management changes to confirm that a management choice is the best option under prevailing ecological conditions.

Equitably allocating risks and responsibilities for restoration and remediation between parties when climate change becomes a *force majeure*: Private conservation agreements should identify the party or parties who will be responsible for restoration and remediation when damage is done to the ecological values of an easement. When extensive damage to a conservation area results from an external force like climate change, it may be unfair to place the entire burden for remediation or restoration on any one party. And if the climate impact has caused the ecosystem or natural area to cross a "tipping point," it may be impossible to restore fully the ecological community that existed up until then. In this situation, demanding that a party do so is both unfair and impossible. It may be appropriate to expressly identify severe damage to an ecosystem as a result of climate impacts as a *force majeure* or "Act of God" for which no party is liable – even though this Manual also recommends that climate change should not be allowed to automatically terminate a conservation easement. The next step, of course, is to provide shared responsibility to restore the ecosystem or develop a new set of conservation objectives.

Swapping easement land when climate change destroys all value in a private conservation area: Rather than simply terminate an easement that can no longer viable to protect ecological features due to a severe climate impact, it may be possible to make land trades. For example, the old easement property would be decommissioned and sold, and the proceeds used to purchase a new easement in an area where ecological

[245] Nancy A. McLaughlin, *Amending Perpetual Conservation Easements: A Case Study of the Myrtle Grove Controversy*, 40 U. Rich. L. Rev. 1031 (2006).

values can still be maintained. Taking this approach to private conservation areas one step further, it may be possible to create a "global warming ark"—a system of temporary protected areas on private lands that assist species migrations as necessary and then revert to non-protected status.[246] This could be useful for bird species that are already migrating further north and to higher elevations as suitable habitat shifts with climate change.[247]

[246] Olmstead, *supra* note 240, at 10846.
[247] Nathalie Poswald et al., *Potential Impacts of Climate Change on Breeding and Non-breeding Ranges and Migration Distance of European Sylvia Warblers*, 36 J. Biogeography 6 (2009).

13.4 Rolling Easements: Adapting Public Trust Doctrines to Climate Change

Key Point: Rolling easements provide a flexible way to adapt private land uses to impacts on natural resources caused by climate change.

Rolling easements prevent property owners along shorelines from erecting structures that hold back the sea from advancing landward, while allowing for other types of development (so long as they comply with other environmental and land use regulations). They can be created by clauses in deeds, statutory provisions, or judicial interpretations of existing legal rights such as the public trust doctrine. Though their original purpose was to ensure public access to the shoreline, they have valuable biodiversity adaptation benefits.[248] In the United States, rolling easements are becoming an important tool for adapting to rising sea levels.[249]

In countries where public beach access is considered a right or where the state holds sovereign ownership in submerged lands or coastlines, practitioners can investigate what steps have been taken or need to be taken to enforce that right. In common law countries, a rolling easement may be determined to exist through judicial interpretation. Generally, rolling easements can be created through legislation as well.

How they work: The boundaries of a rolling easement automatically shift inland as the sea advances, permitting wetlands and other tidal habitats to migrate inland as well. If a property owner is subject to a rolling easement, the owner must understand that the right to protect the property from the sea is limited by the state's sovereign ownership of the shifting shoreline, the right of the public to access the shore, and environmental policy considerations related to maintaining healthy coastal habitats. If the owner's house is built high enough, the owner may be able to keep using it for a time, even as the tide encroaches on parts of his property and segments become public land. If, however, the water moves far enough inland to cause the easement to shift so that it includes the land on which the house sits, the property owner may be required to move the house, abandon it, agree to conditions on future occupation of the site, or even pay rent to the state to continue using it.[250] See Figure 13.2 for an illustration of how easement borders shift landward with rising sea levels.

Legal Effect of a Rolling Easement: Lessons for Adaptation

Courts in several U.S. states have affirmed the legal validity of rolling easements, and state legislatures have codified them through specific statutory provisions. The Supreme Court of Texas has held that oceanfront easements shrink or expand as the coastline gradually shifts, with two

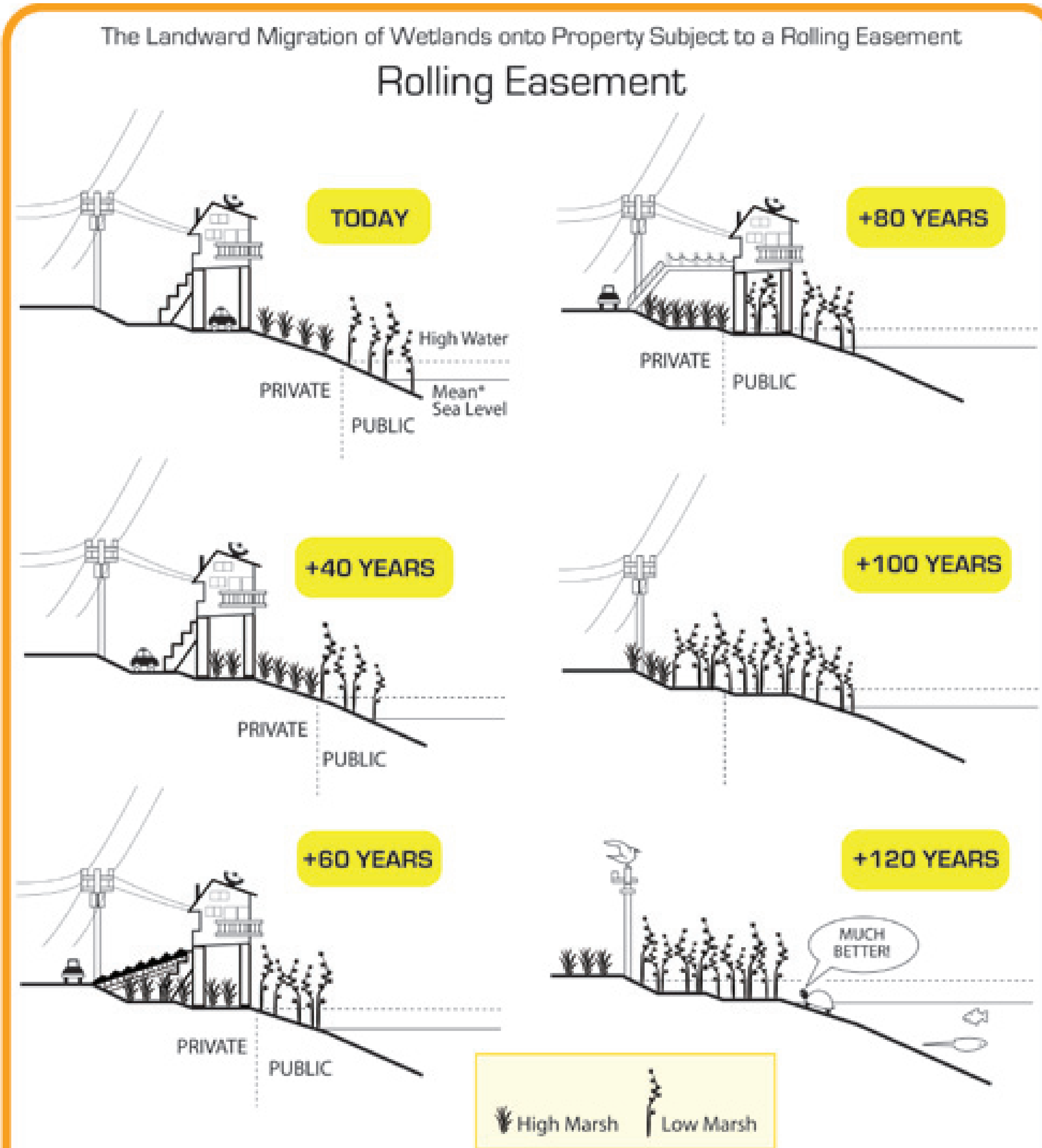
[248] *See* U.S. National Oceanic and Atmospheric Administration, Erosion Control Easements, http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_easements.html (last visited Dec. 28, 2010).

[249] James G. Titus, *Does the U.S. Government Realize that the Sea is Rising? How to Restructure Federal Programs so that Wetlands and Beaches Survive*, 30 Golden Gate U.L. Rev. 717 (2000).

[250] James G. Titus, *Rising Seas, Coastal Erosion, and the Takings Clause: How to Save Wetlands and Beaches without Hurting Property Owners*, 57 Md. L. Rev. 1279, 1316 (1998).

terms on page

ROLLING EASEMENTS refer to areas of privately-owned lands that automatically become subject to certain use restrictions based on the operation of a "natural" phenomenon, such as sea level rise.



A rolling easement allows construction near the shore, but requires the property owner to recognize nature's right of way to advance inland as sea level rises. In this case, the high marsh reaches the footprint of the house 40 years hence. Because the house is on pilings, it can still be occupied (assuming that it is hooked to a sewage treatment plant--a flooded septic system would probably fail). After 60 years, the marsh has advanced enough to require the owner to park the car along the street and construct a catwalk across the front yard. After 80 years, the march has taken over the entire yard; moreover, the footprint of the house is now seaward of mean high water and hence on public property. At this point, additional reinvestment in the property is unlikely, and the state might charge rent for continued occupation of the home. Twenty years later, the particular house has been removed, although other houses on the same street may still be occupied. Eventually, however, the entire area returns to nature.

Figure 13.2 Operation of a Rolling Easement over Time[1]

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[1] Graphic adapted from Titus, *supra* note 250, at 1316.

like a hurricane, transforms the shoreline; second, they do not automatically move onto neighboring properties.[251] In a California case, a shoreline property owner claimed that riparian property ownership includes a "'right' to construct a revetment or seawall to protect one's dwelling from destruction." The court partially rejected this claim, holding that the state's coastal authorities could impose conditions on the construction of the seawall.[252] Legislation has also been used to create rolling easements or similar restrictions on coastal development. A Texas statute concerning public beaches directs officials to "strictly and vigorously enforce the prohibition against encroachments on and interferences with the public beach easement." [253] Using this law, Texas courts have prevented people from repairing storm-damaged houses and have required others to remove structures when erosion caused a portion of the property to lie on the seaward side of the vegetation line.[254] Rhode Island's coastal management plan prohibits construction of hard structures like bulkheads or sea walls inland of coastal marshes in certain areas, in order to allow wetlands to migrate inland as sea levels rise.[255]

Several concerns must be considered and addressed before introducing rolling easements into a country's system of property law. First, few developing countries have national laws that explicitly recognize the use of traditional easements for conservation purposes, much less provide legal authority for rolling easements. While some easements have been established through creative means, often there is little potential for widespread use of easements without statutory authorization.[256] Second, relatively weak judicial systems may make it especially difficult to enforce easements, and the high cost of litigation can prevent breaches of easement agreements from being resolved.[257] Third, easements require clear land title, which is often unavailable in rural areas of developing countries where tenure is insecure or land registration systems are incomplete.[258]

New Applications: Rolling Wildlife Easements?

Rolling easements should be considered for use as a tool in pursuing other policy goals that require land use patterns to shift as ecological phenomena and other natural barriers migrate or move under changing ecological conditions.[259]

[251] Severance v. Patterson, No. 09-0387 (Tex. Nov. 5, 2010). *See also* Feinman v. State, 717 S.W.2d 106, 111 (Tex. App. 1986, writ ref'd n.r.e.) (property along the Gulf of Mexico is automatically subject to a rolling easement, as the public's guaranteed right of beach access would otherwise disappear as the shore erodes).
[252] Whalers' Village Club v. California Coastal Commission, 220 Cal. Rptr. 2 (Ct. App. 1985); *see also* Titus, *supra* note 250, at 1374-75.
[253] Tex. Nat. Res. Code Ann. § 61.011(c) (West 1978 and Supp. 1998).
[254] Arrington v. Mattox, 767 S.W.2d 957, 958 (Tex. App. 1989, writ denied).
[255] Rhode Island Coastal Resource Management Program §§ 210(B)(4), 210.3(C)(3) (1993).
[256] ELI, *supra* note 226, at 22.
[257] *Id*. at 25.
[258] *Id*.
[259] Titus, *supra* note 250, at 1313.

Box 13.1. Could Rolling Easements Save Sea Turtle Nesting Habitat?[1]

Leatherback sea turtles are threatened with extinction due to a combination of climate change impacts and patterns of human land use along beaches that provide critical nesting habitat. Globally, only 2,000 to 3,000 leatherbacks are estimated to be alive today. Twenty years ago, their population was around 90,000. The turtles are highly sensitive to climate change. They feed on coral reefs that are now dying as oceans warm (causing bleaching of the coral and an increase in disease), and they lay eggs on beaches that are now regularly flooding due to sea level rise and storm surges. Warming sands also produce more females, and very hot sands kill the eggs altogether.

These impacts are made worse by unsustainable development patterns. For example, in La Playa Grande, Costa Rica, a 50-meter stretch of beach landward of the mean high water line is publicly owned,[2] but beyond that, a strip of coastal development on a mixture of public concessions and private lands forms a man-made barrier to the coastal ecological zone. As the sea rises, nesting habitat is squeezed against the line of hotels, vacation homes, and shops. Scientists believe a protected strip of 128 meters behind the high tide line is needed to protect the turtles, but property owners have demanded compensation that the government is unable to pay.

A rolling easement might be an effective solution to this problem. The easement would have to meet the following conditions:

- Set the easement boundary immediately at 128 meters landward of the high tide line and require periodic, mandatory adjustment of this line as sea levels rise
- Prohibit property owners within the easement from undertaking repairs to properties that are damaged by storms or sea level rise
- Prohibit construction of sea walls or bulkheads to keep out rising seas
- Prohibit new construction that negatively afects turtle nesting or prevents beach migration
- Allow existing property uses to continue only so long as they remain viable without additional protective measures and do not inhibit turtle nesting

This last provision is a critical element to include in rolling easements. By allowing existing economically beneficial uses to continue, so long as they are ecologically viable, it can be used to negate claims from landowners that they should be compensated for loss of use.

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[1] *See* Lara Hansen et al., *Designing Climate-Smart Conservation: Guidance and Case Studies*, 24 Conservation Bio. 63 (2010); Elisabeth Rosenthal, *Turtles are Casualties of Warming in Costa Rica*, N.Y. Times, Nov. 14, 2009.

[2] ELI, *supra* note 226, at 113 n. 142.

Beyond its use in sea level advancement, the rolling easement mechanism could be used to adapt land use patterns to accommodate changes in biodiversity as a result of climate change. The legal rationale is that wildlife is a public trust resource and the government has an affirmative obligation to ensure that this resource is sustainably managed for future generations.[260] Rather than adjusting to rising sea levels, a rolling wildlife easement would respond to shifts in species ranges, temperature gradients, or precipitation regimes. Detailed criteria may need to be developed to determine when a shifting ecological phenomenon requires a corresponding shift in easement boundaries. Indicators that might trigger movement of an easement could include, for example:

- Presence of an indicator species in the easement area
- Thresholds based on a specified percentage of a species population or its range that has moved into an easement area
- Thresholds based on percentages of forest cover (where forest is expanding into new areas), or grasslands (where grasses are spreading)
- Changes in precipitation patterns or other hydrological indicators based on five-year seasonal averages

A conservation manager could negotiate rolling easements with landowners who own land within bioclimatic sensitive areas. An agreement might require a landowner not to take actions that would prevent species from migrating onto his land as the climate shifts, while still allowing other types of economically beneficial use of the land. The agreement might restrict actions such as clearing land or creating barriers around agricultural plantings, both of which often break up migration routes. As a shifting climate forces species further and further onto the landowner's property, a growing portion of this land would come under the state's management. Financial support such as annual payments to landowners who participate in such programs, insurance mechanisms,[261] or reducing regulatory burdens on landowners who voluntarily participate may be important to build "buy-in" for the project.[262]

Rolling easements alone can be helpful for protecting shorelines, but they are usually most effective when used in coordination with other approaches, such as setbacks, density restrictions, and other building restrictions along the shore.[263] Similarly, rolling easements for wildlife would likely be more effective if combined with other policies that limit land use or that incentivize environmentally benign activities in other ways.

[260] *See* Patrick Redmond, Note, *The Public Trust in Wildlife: Two Steps Forward, Two Steps Back*, 49 Nat. Resources J. 249 (2009).

[261] *See* Jonathan F. Tross, *Insuring against the Snail-darter: Insurance for Land Use and the Endangered Species Act,* 11 Connecticut Insurance L. J. 471 (2005).

[262] Lee Hannah et al., *Climate Change-Integrated Conservation Strategies*, 11 Global Ecology & Biogeography 485, 493 (2002).

[263] U.S. National Oceanic and Atmospheric Administration, Erosion Control Easements, http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_easements.html (last visited Dec. 1, 2009).

Glossary

CLIMATE VARIABILITY: This manual uses the term "climate change" to refer both to the increased variability of climate conditions in the short term and uni-directional shifts in climate conditions over the long term.

ADAPTATION refers to measures to respond to the effects of climate change.

VULNERABILITY refers to the level of danger climate change poses to a resource or community.

ECOSYSTEMS are a combination of the organisms and non-living elements that exist in a particular space, over a period of time. They occur at different scales, from the microorganisms in a drop of water to the size of an entire island. Humans are powerful actors within ecosystems, even if they do not always realize it.

PUBLIC PARTICIPATION refers broadly to the requirements, opportunities, and resources used to ensure all members of the public have the opportunity to learn about and influence official decision making.

DATABASES or clearinghouses refer to systems that allow people to easily locate and access documents, reports, data or other information relevant to management decisions.

CO-MANAGEMENT refers to any resource management program in which decision-making power is shared between multiple parties.

SCENARIO PLANNING is a tool to systematically compare which management options will perform the best under the widest range of plausible future conditions.

BASELINE refers to a fixed (often numerical) expression of the status of a resource.

INDICATORS, or "metrics," are measurements of a specific, narrowly defined ecological phenomenon that provides information on the status of the larger ecosystem.

EARLY WARNING SYSTEMS alert communities to a coming event, such as a typhoon or heat wave.

FRONT-LOADED DECISION MAKING sets in place a course of action that is difficult to modify or reverse when circumstances later change.

A POLICY LAG is the time between when a problem is first identified and the point at which steps are taken to address it.

CROSS-CUTTING issues are ones that affects many different sectors or agencies.

STRATEGIC ENVIRONMENTAL ASSESSMENTS integrate environmental considerations into policies, plans, regulations, and legislation, as opposed to traditional environmental assessments, which are project-specific.

MAIN-STREAMING means to make something a regular part of a process.

ENVIRONMENTAL IMPACT ASSESSMENTS analyze the environmental consequences of carrying out a proposed activity or plan.

EXOGENOUS changes are those caused by factors not within the control of local actors. The effects of climate change are exogenous to local natural resource management decisions, but they still must be considered.

THRESHOLDS are defined points that, when crossed, requires actions or responses.

CIVIL SOCIETY groups can play an important coordinating and connecting role in carrying out complex climate adaptive strategies.

STANDING is a doctrine that generally limits courts' jurisdiction to actual disputes between parties.

REOPENER CLAUSES allow parties to reconsider earlier permit decisions when certain defined circumstances occur.

MITIGATION measures are conditions placed on an authorized activity to reduce the environmental impact of that activity.

STAKEHOLDERS are any persons or organizations that has an interest in a natural resource. Interests can be economic, aesthetic, scientific, cultural, religious, or otherwise.

CO-BENEFITS refer to the ability of a single policy to have positive effects in several ways.

PEER-TO-PEER NETWORKS draw on the expertise of those in similar situations, rather than the expertise of those who are regarded as having superior status or authority.

LANDSCAPE- LEVEL or seascape-level habitat protection integrates core habitats, corridors.

MATRIX LANDS generally refer to those areas outside formally protected zones. mixed-use or human-occupied areas into an overarching regional management strategy.

BIOCLIMATIC MODELING uses information about species and climate trends to develop projections of how species will move and interact under future climate scenarios.

CONNECTIVITY refers to the degree to which species are able to move from one area to another with minimum disturbance or interference from human activities.

TRANS-BOUNDARY PROTECTED AREAS are conservation areas that cross international borders.

TRANSLOCATION is the activity of intentionally moving members of a species to a new area for the benefit of that species' conservation.

CONSERVATION EASEMENTS are voluntary commitments by property owners to dedicate some or all of their property to conservation purposes.

ROLLING EASEMENTS refer to areas of privately-owned lands that automatically become subject to certain use restrictions based on the operation of a "natural" phenomenon, such as sea level rise.

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