Seminar

7

Ecosystem Services: Forecasting and Next Steps

Speaker

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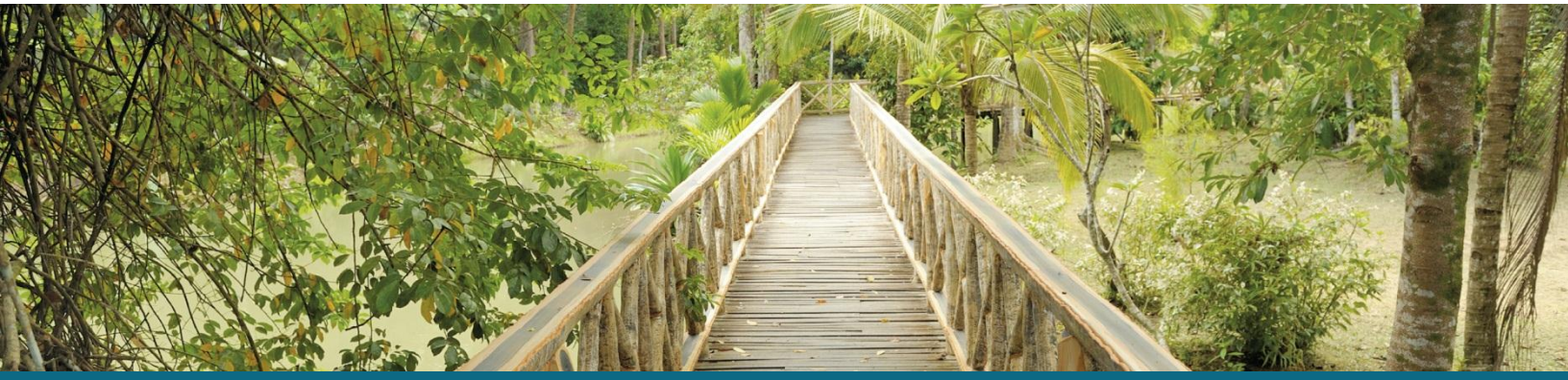

GORDON AND BETTY MOORE FOUNDATION

The Nuts and Bolts of an Ecosystem Services Approach

by Janet Ranganathan, World Resources Institute

INTRODUCTION

The Moore Foundation and World Resources Institute share similar missions, both of which emphasize the concept of sustainable use of ecosystems by humans. However, translating sustainable use of ecosystems into operational terms is challenging. Use of what, by whom, with what trade-offs, where, when, and to whom? The 2005 Millennium Ecosystem Assessment (the Assessment) provided a framework that can help answer these and other questions. The Assessment was a global audit of the world's ecosystems four years in the making, commissioned by the United Nations Environment Programme in partnership with over 1,300 experts worldwide from 95 countries. What made the Assessment especially unique was that it assessed the condition of ecosystems on the basis of the services and benefits they provide to humans. In choosing to focus on ecosystem services rather than biodiversity, the Assessment helped advance the concept of ecosystem services in three important ways:

1) By including public and private decision makers, the Assessment moved awareness of ecosystem services beyond the scientific community. And the Assessment's findings—that nearly two thirds of ecosystem services assessed were degraded, putting at risk business and economic development goals—helped catapult the concept of ecosystem services on to the agenda of business and governments.
2) By providing a robust conceptual framework for understanding the links between conservation and economic goals the Assessment provided an approach to reconcile the agendas of the development and conservation communities (Figure 22: Millennium Ecosystem Assessment conceptual framework). The framework is versatile in its application—those working in the economic development community can start with the elements of human well-being in the framework, such as health or food, and make the connections to ecosystem services. The environmental conservation community, on the other hand, can start with an analysis of biodiversity and ecosystems and assess their relevance to economic development goals in terms of dependence and impacts.
3) By providing a robust conceptual framework for understanding the links between conservation and economic goals the Assessment provided an approach to reconcile the agendas of the development and conservation communities (Figure 22: Millennium Ecosystem Assessment conceptual framework). The framework is versatile in its application—those working in the economic development community can start with the elements of human well-being in the framework, such as health or food, and make the connections to ecosystem services. The environmental conservation community, on the other hand, can start with an analysis of biodiversity and ecosystems and assess their relevance to economic development goals in terms of dependence and impacts.

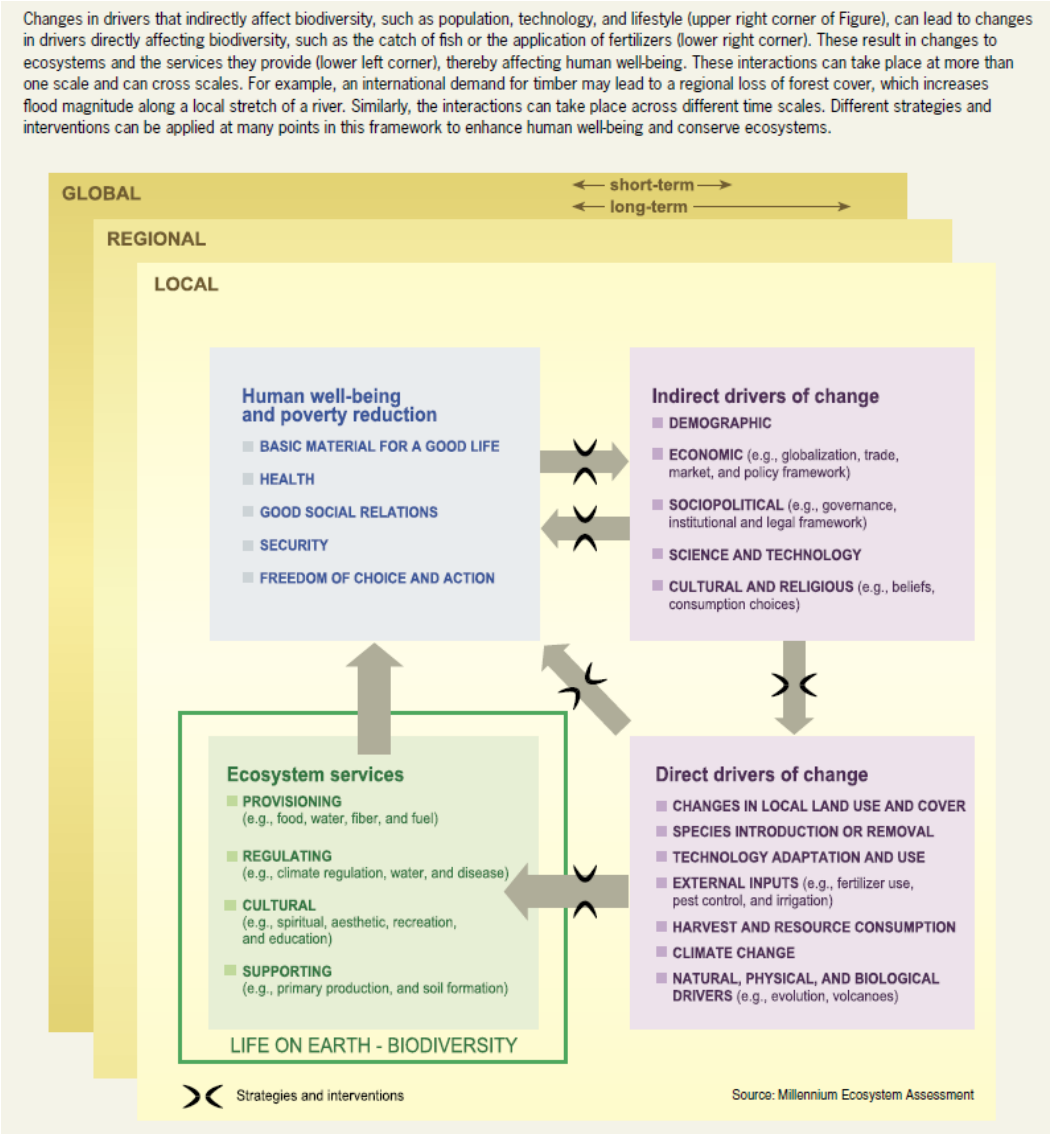

Figure 22: Millennium Ecosystem Assessment conceptual framework of interactions*. Framework represents interactions between biodiversity, ecosystem services, human well-being, and drivers of change.*

WHAT IS AN ECOSYSTEM SERVICES-BASED APPROACH?

An ecosystem services approach, as discussed in this paper, focuses on the linkages between ecosystems and economic development goals (nature for people's sake). It targets the "sweet spot" where conservation and economic development goals intersect (see Figure 23).

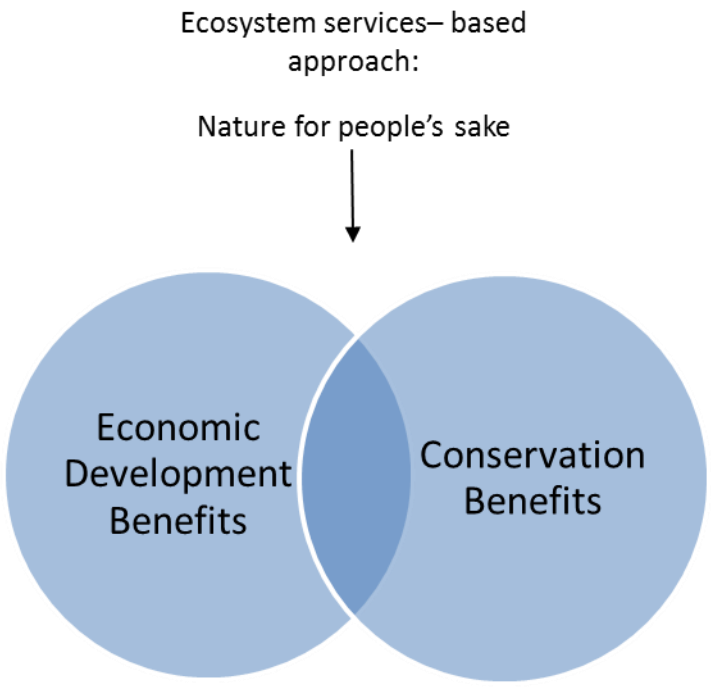

Figure 23: An ecosystem services approach.

Given the resource demands of a growing global middle class that is expected to triple from 1.8 billion (2009-10) to 4.8 billion (2030), making the case for conserving nature for nature's sake will likely be an increasingly hard sell to decision-makers preoccupied with more pressing goals, such as poverty reduction, energy security, access to freshwater, and food security. An ecosystem services–based approach can show how investing in the restoration, maintenance, and enhancement of ecosystem services can help achieve economic development benefits.

In doing so, it can help provide conservation practitioners with access to economic development funds from international donors and national governments, which are typically greater than those available for biodiversity or conservation. It can incorporate a variety of tools and policies; for example, ecosystem service dependency and impact assessments, trade-off analysis, valuations, and payments for ecosystem services. And it can be integrated into existing decision processes, such as environmental impact assessments (EIAs), cost-benefit analyses, economic assessments, environmental management systems, and national economic accounts.

Drawing on experience collaborating with government agencies and businesses such as the United Nations Poverty and Environment Initiative, the U.S. Department of Agriculture, partners in Belize, and the World Business Council for Sustainable Development, WRI has identified three broad applications of an ecosystem services–based approach:

1) Making the case for investing in ecosystems to achieve economic development goals
2) Advancing policies and incentives for sustaining ecosystems
3) Providing a systematic way of managing ecosystem service trade-offs

ECOSYSTEM SERVICES-BASED APPROACHES IN PRACTICE

The following examples in Table 1, from the work of WRI and others, each illustrate one or more of the three applications of an ecosystem services–based approach. Additional information is available in Appendix 1.

Table 1: Examples of ecosystem services based approaches.

	Making the case	Advancing policies, markets, & governance reforms	Providing systematic management of trade-offs
Sebago Lake, Maine, United States Natural water filtration provided by forests has long ensured clean water for the water district of Portland, Maine. Expanding development now threatens water quality and may cause Portland to lose its EPA-issued filtration waiver. An estimated US $101 million would be needed for a filtration plant to ensure water quality. Conversely, a comparatively small US $33.6 million investment in restoring the upstream ecosystem will maintain water quality while helping to preserve the area's natural assets.	✓	✓	
Humber Estuary, United Kingdom Maintaining aging traditional flood defenses along the Humber Estuary in the United Kingdom will cost an estimated US $101 million. But restoring intertidal habitat spaces and moving "hard" defenses further inland through a process known as managed realignment, drops the cost of coastal protection to US $64 million.	✓		
Tualatin River, Oregon, United States Clean Water Services, a wastewater and stormwater utility in Washington County, Oregon, implemented an ecosystem services approach to help meet temperature requirements for wastewater discharge. Rather than installing a new chiller (at an estimated 20-year cost of US $101-$255 million), the utility opted to manage temperatures by establishing riparian forests that would provide shade, and to augment stream flows with releases of water from upstream reservoirs. The alternative plan saved US $50.5 million.	✓		
Agroforestry in Niger Niger was a country ravaged by deforestation and desertification, brought about in large part by the clearing of land for crops. Tree regeneration has transformed heavily cropped and degraded savannas into fertile land densely studded with trees, shrubs, and crops. When planted with crops, trees act as windbreaks to counter erosion, increase soil fertility by providing enriching mulch and fixing nitrogen in root systems, and provide a valuable source of wood and fodder. Soil fertility and crop harvests have risen, spurring better diets, improved nutrition, higher incomes, and increased capacity to cope with drought.	✓	✓	
Conservancies in Namibia Under apartheid-era law, game animals were declared protected, state-owned assets, so those who inhabited communal areas had little incentive to join in conservation efforts. The 1996 Nature Conservation Act enabled the establishment of conservancies within the state's communal lands. The conservancies gave local communities guaranteed rights to benefit from the land, while decentralizing land management and putting it into the hands of the people on whom it has the biggest impact. The conservancy program now includes more than 14 million hectares in 64 registered conservancies, covering 17.6% of the country.	✓	✓	

	Making the case	Advancing policies, markets, & governance reforms	Providing systematic management of trade-offs
Corporate Ecosystem Services Review (ESR) The corporate ESR helps managers develop strategies to manage business risks and opportunities arising from a company's dependence and impact on ecosystems. Over 200 companies have used it. For example, Mondi was spurred by its corporate ESR results to increase invasive species clearing by 30%, thereby protecting water sources and generating revenues from biomass fuel.	✓	✓	✓
Shrimp Aquaculture, Tha Po Village, Thailand The proliferation of shrimp farms in Southeast Asia has driven widespread conversion of mangrove forests. A study of mangrove conversion near Tha Po village in Thailand showed that when non-marketed ecosystem services (such as coastline protection and spawning ground for wild fish) are considered in an economic analysis, intact mangroves have a net present value of US $35,696 per hectare. Using a similar calculation and including the costs of subsidies, pollution, and restoration, the net present value of shrimp farms was found to be **negative** US $5,443 per hectare.	✓		
International Finance Corporation (IFC) Performance Standards During a recent review of its Environmental and Social Performance Standards, the IFC incorporated ecosystem services into Performance Standard 6. As a result, all new IFC investments are required to maintain the benefits arising from ecosystem services and to include systematic screening for ecosystem services risks and impacts. Additionally potential impacts on ecosystem services must be addressed in mitigation plans and compensation rules.			✓
Quito, Ecuador, Water Fund In 2000, Quito, Ecuador, established a water fund to protect upstream lands in order to maintain water flows and water quality. The fund has a regular cash flow from payments from the local water utility, hydroelectric company, and businesses (most notably a brewer). Interest income generated by the fund is used to finance forest and watershed restoration projects. By late 2010, the fund was responsible for more than 5,000 acres of restored land and over 2 million trees planted.	✓	✓	
Allegheny Energy, Canaan Valley, West Virginia, United States Allegheny Power used an ecosystem services–based approach to value its 4,800-hectare Canaan Valley property in West Virginia. Traditional valuation appraised the property at US $16 million, but when the company commissioned a valuation of the site's ecosystem service benefits, the new appraisal came in at US $33 million. Allegheny Power subsequently sold the property for US $16 million to the U.S. government, which merged it with an existing wildlife refuge. The company thus secured several million dollars in tax savings by taking advantage of "bargain sale" provisions in the federal tax code.	✓		
Coral Reef Valuation in Belize Belize's coral reefs are under threat from warming oceans, overfishing, pollution, and poorly regulated coastal development. But recently, influenced by an economic valuation of the reefs, the government has taken several important steps to protect them, including tightening a number of critical fishing regulations. Additionally, after a container ship ran aground on a reef, the government sued for damages on the basis of the reef's economic value. The favorable ruling was eventually overturned, but the case nonetheless represents a turning point in the government's approach to conserving reef ecosystems.	✓	✓	

WHAT ARE KEY BARRIERS TO SCALING AN ECOSYSTEM SERVICES-BASED APPROACH?

In the approximately seven years since the release of the Millennium Ecosystem Assessment, the ecosystem services approach has begun to make its way into the language and practices of development organizations, business and financial institutions, and governments. But there is still a long way to go. Governments in particular are lagging in embracing methodologies that demonstrate the real value of the resources they govern. And while awareness and use of the ecosystem services concept is increasing, a steady stream of news reports and findings from more recent assessments suggest that the overall trends documented in the Assessment have not changed significantly. Global ecosystem degradation continues to endanger economic development goals. Forests continue to be cleared and degraded, overfishing is still widespread, the march of increasing water scarcity continues onward, and food production remains a major source of environmental degradation.

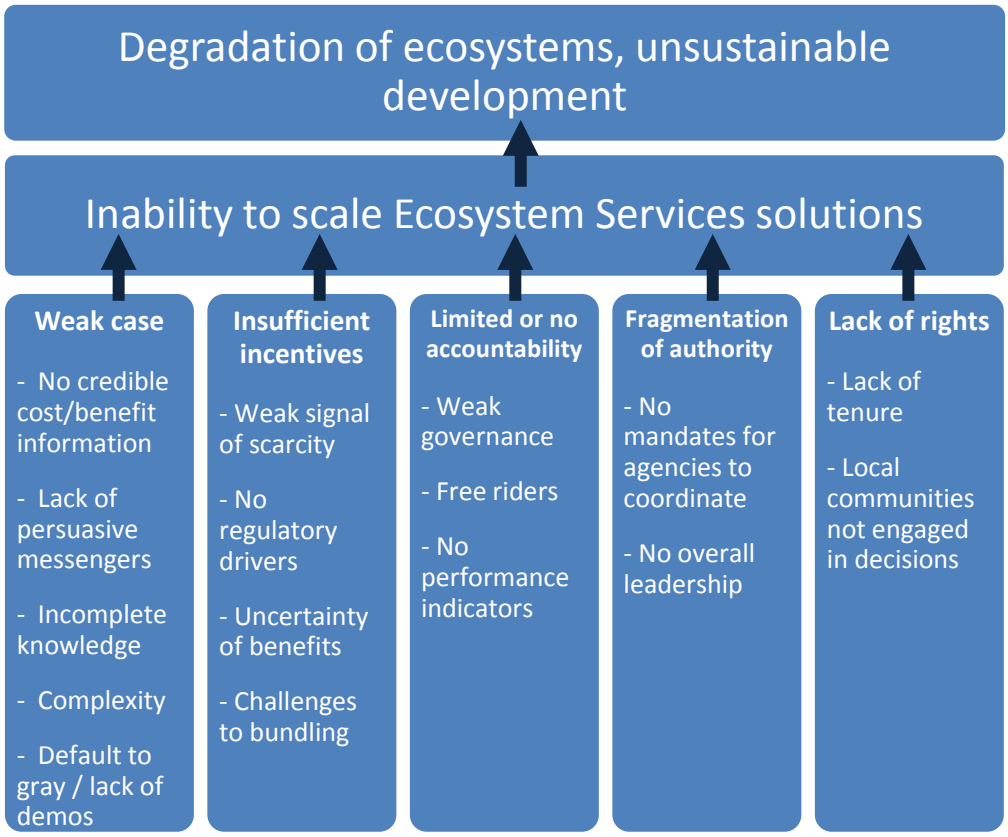

Figure 24: Barriers to scaling ecosystem services based solutions (not exhaustive).

WRI has identified five key barriers to scaling up ecosystem services–based approaches (see Figure 24) (Irwin and Ranganathan 2007).

1) **A weak case for investing in ecosystems to achieve economic development benefits.**
   - *No credible cost-benefit information.* Given the limited experience with investing in ecosystem services, there is still a dearth of quantitative data about the costs and benefits of investing in natural capital versus alternative options. Even with this information, there are limitations to the cost-benefit approach in identifying ecosystem service trade-offs in decision-making.
   - *Lack of persuasive messengers.* The current champions for investing in ecosystems as solutions to economic development issues are primarily within academia and conservation non-governmental organizations (NGOs). More champions are needed within mainstream government agencies/ministries, companies, and investors.

- *Incomplete knowledge.* Our knowledge of the flow of ecosystem services due to specific ecosystem management practices is incomplete. More investment is needed in measuring and monitoring ecosystem services — and decision-making processes should be closely tied to any changes and growth in knowledge. If policy and practice get too far ahead of the science, it could eventually contribute to a backlash or default in credibility. Knowledge, policy, and practice must co-evolve.
- *Complexity.* Managing for ecosystem services can be complex. For instance, the mechanisms for generating ecosystem services–related credits or receiving payments can be convoluted and unwieldy for many businesses and landowners. Investment screening tools have been developed to identify dependencies on ecosystem services and the risks of disruption of those services, as well as the potential benefits of restoring such services. But these tools are not widely applied because they are too complicated and not yet sufficiently user-friendly or well-adapted to real-world situations.
- *Default to gray.* Local governments and many other decision-makers still tend to default to non-ecosystem-based solutions for their development needs (e.g., water supply, shoreline protection, flood mitigation, food security). Such default to "gray" solutions (human-made solutions typically involving technology, concrete, and/or steel) instead of "green" solutions could be out of habit, old administrative requirements, a predilection for "engineered" solutions by decision-makers trained in engineering (the "engineers conundrum"), a belief that gray options are economically superior to green ones, and/or a belief that gray options give greater performance certainty and thereby greater regulatory compliance certainty.
- *Lack of successful demonstrations.* There are still relatively few large-scale "success stories" with hard data on the costs, benefits, and political economy dynamics that led to investments in ecosystems. We need more iconic examples to raise awareness, provide insights, and inspire replication.

2) **Insufficient incentives:** regulations and markets need to explicitly value ecosystem services in order to provide increased incentives for investing in their protection and restoration.
   - *Weak signals of scarcity.* Many entities (e.g., cities, nations, companies) currently enjoy the benefits of ecosystem services for free. Absent a strong physical or regulatory signal of immediate scarcity, why would any of those entities start paying for those services or adopt policies that put restrictions on the use of those services, or activities that lead to their loss?
   - *Insufficient regulatory drivers.* Investment in ecosystems to deliver needed services has occurred in situations where there is government regulation requiring the service to be maintained at a sufficient level or quality. The investments currently being undertaken in Sebago Lake and the Crooked River watershed, for example, are motivated by the need to maintain an EPA-regulated filtration waiver. Similarly, the often-cited investments by New York City in source water protection in the Catskills were motivated by drinking water standards. The Willamette Partnership riparian restoration investment (temperature trading) was underpinned by requirements under the Clean Water Act and the Endangered Species Act (for salmon). In some places such policy or regulatory drivers are absent and in others the ecosystem services movement arguably has not sufficiently leveraged existing laws to push for ecosystem-based solutions.
   - *Uncertainty of benefits.* Natural ecosystems are unpredictable, and there is uncertainty about the level and extent of ecosystem services that will be provided by a given investment in natural capital. Risk factors are also uncertain. Practitioners need better tools for accounting for and, when possible, for offsetting the elements of uncertainty in their ecosystem services–based solutions.
   - *Challenges to bundling services.* Multiple revenue streams are often needed to trigger the protection and restoration of ecosystem services, yet obstacles remain for efficiently rewarding investments that generate a range of types of ecosystem services

3) **Limited or no accountability:** people are not held accountable for ecosystem degradation and adverse impacts on the flow of ecosystem services.
   - *Weak governance and/or lack of capacity.* In some countries, poorly developed, decentralized institutional mechanisms for ensuring full participation, transparency, and accountability in decision-making related to the management of ecosystem services undermine equitable benefit-sharing arrangements.
   - *Free riders.* Ecosystems and their services can have multiple beneficiaries. For instance, in the example of the Quito water fund, the erosion control afforded by riparian forests benefits nearby farmers as well as downstream municipal water treatment plants, hydroelectric facilities, and breweries, to name a few. But the brewery would not be willing

to finance riparian restoration on its own, since the treatment plant and power company also benefit from the reduced river siltation. Why should the brewery pay when the others would benefit without paying?
- *No performance indicators.* Decision-makers and resource users are not held accountable to performance standards for protecting or restoring ecosystem services.

4) **Fragmentation of authority:** weak leadership and insufficient institutional mandates with respect to integrating a consideration of ecosystem services into decision-making and managing trade-offs.
   - *No mandate for entities that manage ecosystems to coordinate.* Many ecosystem services are generated over a large landscape that has multiple owners. Coordinating land management practices in order to ensure sustainability and the provision of desired services is often difficult with many different owners.
   - *No overall leadership.* There is a need for more charismatic champions of sustainably managing ecosystems for the sake of ecosystem services. The ecosystem services movement currently lacks institutional support at the local, national, and international levels; while networks and forums to enable collaboration are emerging, more cooperative action is needed.

5) **Lack of rights:** communities are not engaged.
   - *Lack of tenure and property rights.* In many countries, a lack of clear property rights impedes the ability of individuals or local communities that manage ecosystems to control access to and use of these ecosystems and to benefit from their improved management. Without this ability to benefit from management of an ecosystem, the incentive for sustainable management diminishes.
   - *Local communities not engaged in decisions.* Local communities continue to face problems in accessing information, and suffer inadequate provisions for full, equitable, and representative participation.

The most relevant barriers vary from case to case depending on the nature of the ecosystem services, geography, and other issues. For example, in the case of Niger's agro-ecosystems, the most significant barriers to restoring ecosystem services were related to lack of tenure, lack of community engagement, and rural producers' lack of management rights to trees on their farms. These factors, in combination with poor permitting systems and marketing constraints, prevented rural producers from capturing the full economic benefits of farmer-managed natural regeneration. In the case of the adoption of green infrastructure solutions for protecting water supplies for the city of Portland, Maine, key barriers were related to the need for credible cost-benefit information, a tendency by decision-makers to default to gray solutions, uncertainty of benefits, and lack of persuasive messengers.

WHAT ARE PROMISING OPPORTUNITIES FOR SCALING UP ECOSYSTEM SERVICES-BASED SOLUTIONS?

National and local governments are important targets of influence for scaling up ecosystem services–based solutions. Governments at the national and local levels are well-positioned to reform policies, enact regulations, improve governance, strengthen institutions, increase accountability, and otherwise establish more favorable enabling conditions for sustaining ecosystem services. Businesses, development agencies, NGOs and civil society, and the media should be viewed as means to ultimately influence decision-makers in government.

In terms of engaging national governments, WRI has found that it is more effective to make specific links between ecosystem services and their existing priorities, rather than advocating for them to generally adopt ecosystem services as a decision-making framework. A number of current national government priorities depend on ecosystem services. These include food security, climate adaptation, and access to freshwater.

The protection, management, or restoration of ecosystem services could be part of a cost-effective response to addressing these challenges. In addition, the incorporation of ecosystem services in the IFC's performance standards represents an opportunity to scale up an ecosystem services approach within the financial community.

There are now dozens of international and regional initiatives aimed at improving food security and nutrition through increased investments in agricultural development. In response to increasing risks of water scarcity, multiple initiatives and programs are emerging to invest in improving water supplies. Food and water security are increasingly being targeted in development assistance programs, in response to increasing political pressures and widespread recognition of the growing threats associated with burgeoning demand and constrained supplies and access to food and clean water. Issues of food and water security are often compounded by climate change, and efforts to improve food and water security through ecosystem services–based solutions can also contribute to climate change mitigation, adaptation, and increased resiliency, and interventions piloted by the Vulnerability and Adaptation Initiative. The ecosystem-based approach to improving food and water security can also be positively linked to protection of forests.

WHAT TYPES OF POLICY INTERVENTIONS CAN BE USED TO INFLUENCE THE FLOW OF ECOSYSTEM SERVICES?

Types of policies for sustaining ecosystem services extend beyond the often-cited payments for ecosystem services (e.g., carbon markets for forests). A growing list of innovations in other policy arenas show promise for sustaining ecosystem services (see Table 2). These can be broadly categorized as:

- national and subnational policies
- economic and fiscal incentives
- sector policies
- governance

Table 2: Policy options for sustaining ecosystem services. *For additional information, including potential value for sustaining ecosystem services, challenges in design and implementation, and examples of experience, please refer to Appendix 2.*

Policy Category	Policy Options
National and sub-national policies	• Establish protected areas • Mainstream ecosystem services into economic and development planning • Include investments in ecosystem services in government budgeting
Economic and fiscal incentives	• Use tax deductions and credits to encourage investment in and purchase of ecosystem services • Establish fees for use of resources or services • Use taxes or other public funds to pay to maintain regulating and cultural services • Reduce perverse subsidies • Set limits and establish trading systems for use of ecosystems and their services • Fund valuation of ecosystem services and research into improving valuation methods • Use procurement policies to focus demand on products and services that conserve ecosystem services • Support wetland banking schemes
Sector policies	• Include ecosystem services in sector policies and strategic environmental assessments • Set targets to encourage use of renewable energy • Require ecosystem management best practices in granting licenses or concessions • Use zoning or easements to keep land available for priority ecosystem services • Use regulatory ecosystem services such as natural hazard protection or water filtration instead of built structures • Establish certification schemes that encourage best management practices • Introduce education or extension programs on good practices • Develop and encourage use of products and methods that reduce dependence and impact on ecosystem services
Governance	• Clarify or strengthen local community rights to use and manage ecosystem services • Develop and use private- and public-sector indicators for ecosystem services • Establish processes to work across levels of government, from local to national • Ensure public access to information and participation

Some interventions fit into more than one category. For example, conservation easements can be viewed both as an economic incentive and as a sector policy. The appropriateness of a policy for any given situation will depend on a number of factors, such as political buy-in, presence of existing legal authority, and institutional capacity.

On a cautionary note, despite over a decade of experience of creating policy interventions to protect and sustain ecosystems and their services, there have been few evaluations of the effectiveness of these solutions in regard to meeting their conservation or socioeconomic goals. And there has been almost no effort to assess the cost-effectiveness of such policy interventions (Ferraro et al. 2011).

Given that much uncertainty remains about how ecosystems function, it is critical to design robust monitoring as part of an adaptive management approach. This turns the management of ecosystem services into a series of experiments. It tests hypotheses about how the components of an ecosystem function and interact. Based on monitoring, policies and management practices can be continually adjusted and course corrections made to ensure they achieve their goals.

CONCLUSIONS

Over the past 50 years, economic development policies have too often unwittingly diminished nature's capacity to provide the goods and services people depend on. As a result, 15 ecosystem services have been degraded globally in the past 50 years, while another 5, such as water regulation and the supply of timber, hang in the balance. This decline in ecosystem services is jeopardizing the attainment of economic development goals that depend on ecosystem services, such as food and freshwater security.

If the world is to sustainably feed and provide freshwater to nine billion people in 2050 *and* successfully navigate ecological tipping points in the face of climate change, we will need to change the way we use and manage ecosystems. And we will need to ensure that economic development decisions explicitly take ecosystem services into account and reduce trade-offs across services.

An ecosystem services approach can help in three ways. First, it can help make the case for investing in the restoration, maintenance, and enhancement of ecosystem services to attain economic development goals. Second, it can build support for policies, markets, and governance reforms that sustain ecosystem services. Third, by systematically assessing the dependence and effect of any decision, plan, or policy on ecosystem services, decision-makers can proactively identify and manage ecosystem trade-offs.

National governments should be an important target for advancing an ecosystem services approach. Progress can be made on a number of priorities on the political agenda, such as food and water security and climate change, by advancing investments in ecosystems.

Markets for, or more specifically payments for, ecosystems' regulating services, such as carbon sequestration and water filtration, have become popular in recent years. But payments for ecosystem services are not the only mechanism for aligning economic incentives with sustaining ecosystem services. Others include subsidies, policies, land-use zoning, and governance reforms.

APPENDIX 1: CASE STUDIES OF ECOSYSTEM SERVICES–BASED SOLUTIONS

Sebago Lake, Portland, Maine, United States: Protecting Forests to Protect Water

WRI and its partners identified Sebago Lake as a promising opportunity to make the case for investing in forest protection on the basis of preserving freshwater supplies. Sebago Lake and the Crooked River watershed supply water to the Portland Water District — 25 million gallons of water to nearly 200,000 people on a daily basis. On the basis of the natural water filtration services provided by upstream forests, Portland Water District has an EPA Clean Water Act exemption for water filtration requirements. But with expanding development and deforestation, the waiver is in danger. Loss of the waiver would cost the city around US $101 million in upgrades and new water treatment infrastructure.

Using an ecosystem services approach, WRI has demonstrated that a comparatively small investment of around US $33.6 million in restoration, through afforestation and reforestation, the establishment of conservation easements, and other measures, will ensure high water quality for years to come while helping to preserve the area's natural assets. WRI is continuing to help make the case to beneficiaries for investing in maintenance and restoration of the Crooked River watershed. Barriers that are being addressed include expanding the traditional engineering analysis of alternative water treatment options to include ecosystem approaches, addressing ecological risks such as fires and disease, and securing political support and funding to cover the costs of watershed conservation measures.

Humber Estuary, United Kingdom: Cost-Effective Coastal Flood Protection

Much of the aging flood defense infrastructure along the English coastline is nearing the end of its effectiveness, and the need for significant investment looms in the near future. Given concerns about sea-level rise and increasing severity and frequency of storms, planners are considering alternative options such as managed realignment, which allows for the restoration of intertidal habitat space by moving hard sea defense farther inward. A recent study found that in many scenarios, managed realignment is more economically efficient than maintaining the current approach over a 25-year period —– US $64 million versus US $101 million (Turner et al. 2007).

Tualatin River, Oregon, United States: Reducing Thermal Pollution Costs

When Clean Water Services, a wastewater and stormwater utility in Washington County, Oregon, was faced with the prospect of installing a new water chiller in order to meet a temperature requirement for its wastewater discharges, it selected an ecosystem services–based solution. The 20-year cost estimate for installing and operating a man-made chiller came in at US $101-$255 million (Cochran and Roll 2008). Instead, Clean Water Services developed a plan to reduce costs by US $50.5 million by establishing riparian forests that would provide shade to water upstream of the wastewater facilities, and to augment stream flows with releases of water from upstream reservoirs. In 2004, the Oregon Department of Environmental Quality approved the plan, the first of its kind in the United States. Since 2005, more than a half-million native trees and shrubs have been planted.

Agroforestry in Niger: More Trees, More Grain

Agroforestry, the integration of trees into food crop landscapes to maintain a green cover year-round, was a traditional African farming practice until the arrival of colonial influence and the mindset that trees and crops should be separated. Trees were removed from vast expanses of land across Africa, and creeping desertification ensued (Ranganathan and Hanson 2011).

Over the past 20 years, however, development agencies and NGOs have led tree regeneration and planting efforts in Niger, transforming heavily cropped and degraded savannas into fertile land densely studded with trees, shrubs, and crops. The movement grew after pilot projects demonstrated that when planted with crops, trees act as windbreaks to counter erosion, increase soil fertility by providing enriching mulch and fixing nitrogen in root systems, and provide a valuable source of wood and fodder. For good measure, they also sequester carbon dioxide from the atmosphere. The scale of the change is impressive, affecting more than 5 million hectares of land — an area about the size of Costa Rica (Tappan 2007).

By 2007, between a quarter and a half of the country's farmers were involved, and about 4.5 million people were reaping the benefits (Reij 2008). Soil fertility and crop harvests have risen, spurring better diets, improved nutrition, higher incomes, and increased capacity to cope with drought (see Figure A1). And with farmers producing more fuel wood, Niger's previously shrinking forests have been spared further destruction.

A combination of factors underpinned Niger's transformation, but three stand out:

1) Investment in simple, low-cost techniques for managing the natural regeneration of on-farm trees and shrubs, alongside improved soil and water conservation techniques (World Vision Australia 2010)
2) A shift away from forest protection as the State's exclusive responsibility to expanded farmer support and use of farmer-to-farmer visits to spread improved practices (World Resources Institute et al. 2008.)
3) Tree tenure reform. In post-colonial Niger, the government claimed ownership of forests and strictly controlled the harvesting of trees. Farmers were fined or even imprisoned for harvesting trees without a permit or for simply lopping branches. But between 1998 and 2004, government tenure reforms relaxed the rules, tipping the balance toward farmer self-interest in regenerating and managing trees on their land.

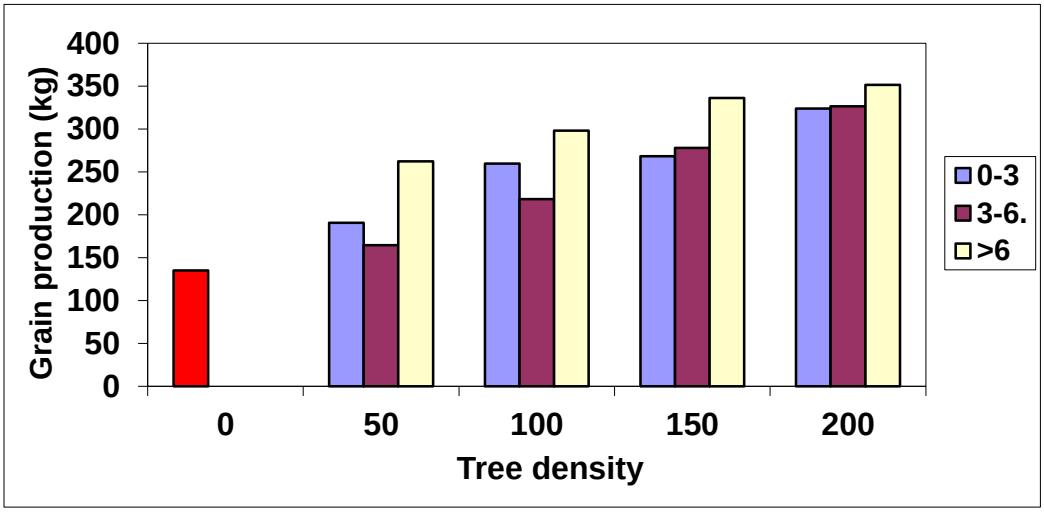

Figure A1: More trees, more grain. *Source: M. Larwanou, 2011, African Forest Forum.*

Agroforestry has potential well beyond Niger. Similar initiatives for farmer-managed natural regeneration are now underway in Zambia, Malawi, and Burkina Faso, suggesting that agroforestry may be applicable to a broad range of food crop systems in Africa. To be successful, however, these need to be accompanied by the kind of governance reforms embarked on in Niger, blanket extension efforts, and strong buy-in from farmers (Garrity et al. 2010; Hertsgaard 2011).

Note: The full case study that this summary is drawn from is available in *World Resources 2008: Roots of Resilience — Growing the Wealth of the Poor* (World Resources Institute et al. 2008).

Conservancies in Namibia: Supporting Income and Increased Wildlife Abundance

In the early 1980s, Namibia's rich natural assets were under serious threat. Ecosystems in the north were rapidly deteriorating; drought-prone land was severely overused, poaching of elephant ivory and rhino horn was rampant, and wildlife populations plummeted (World Resources Institute et al. 2005).

Under apartheid-era law, game animals were declared to be protected, state-owned assets, and those who inhabited communal areas had little incentive to join in conservation efforts (World Wildlife Fund and Rossing Foundation 2004). But in the mid-1980s, conservationists and others began to push for more user rights. Finally, in 1996, the Nature Conservation Act enabled the establishment of conservancies within the state's communal lands. The state devolved limited wildlife rights (including hunting, capture, culling, and sale of huntable game) to conservancy communities. To qualify, applicant communities

had to elect a representative committee, negotiate a legal constitution, prove the ability to manage funds, and produce an acceptable plan for equitable distribution of wildlife-related benefits (Long 2004). Once approved, registered conservancies acquired rights to a sustainable wildlife quota.

The conservancies gave local communities guaranteed rights to benefit from the land, while decentralizing land management and putting it into the hands of the people on whom it has the biggest impact. Previously, wild predators imposed significant costs on rural herding communities, but with the introduction of conservancies, local people could benefit from wildlife. The conservancy program now includes more than 14 million hectares in 64 registered conservancies, covering 17.6% of the country (Weaver 2011). Thirty-one of the conservancies are adjacent to national parks or key corridors between the parks, and have benefited the parks by reducing poaching and promoting compatible land nearby. As of May 2011, the conservancy program in Namibia had generated over US $28 million in cumulative economic benefits since the program was launched in the mid-1990s (Weaver 2011).

Note: The full case study that this summary is drawn from is available in *World Resources 2005: The Wealth of the Poor – Managing Ecosystems to Fight Poverty* (World Resources Institute et al. 2005).

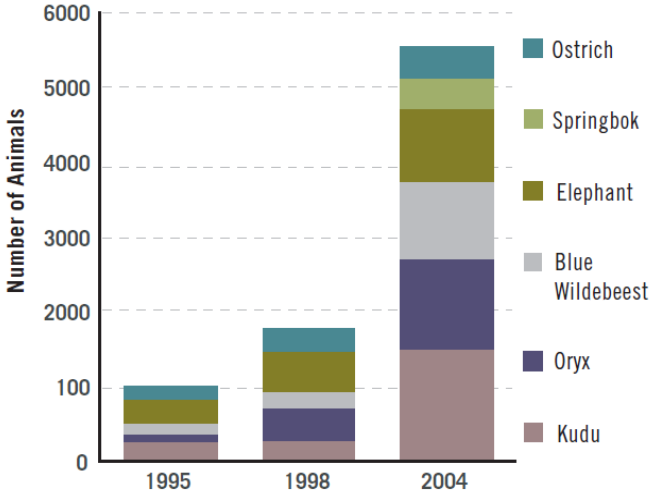

Figure A2: Wildlife recovery in Nyae Nyae Conservancy. *Source: World Resources Institute et al. (2005).*

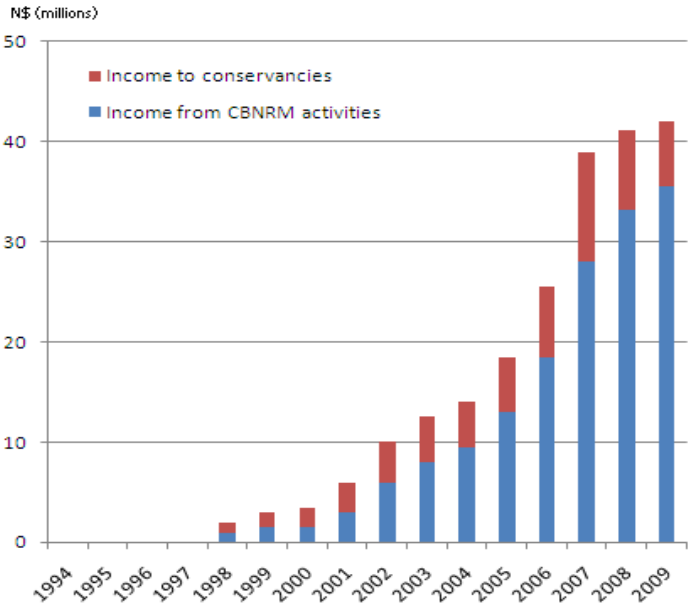

Figure A3: Income from Namibian conservancies. *Source: Chris Weaver, WWF/Namibia.*

Corporate Ecosystem Services Review: Assessing Business Risks and Opportunities from Dependence and Impacts on Ecosystem Services

In partnership with the Meridian Institute and World Business Council for Sustainable Development, the World Resources Institute developed the Corporate Ecosystem Services Review (Corporate ESR) (Hanson et al. 2008). The Corporate ESR is a structured methodology that helps managers proactively develop strategies to manage business risks and opportunities arising from a company's dependence and impact on ecosystems. Since it was launched in 2008, over 300 companies have used it, with several striking successes that have benefited both the companies and the ecosystems their profits depend on.

For example, Alcoa protected its license to operate at a Canadian aluminum smelter by investing in ecosystems to reduce noise and protect the water catchment. European paper company Mondi was spurred by its Corporate ESR results to increase invasive species clearing by 30%, thereby protecting water sources and generating revenues from biomass fuel. The business community is developing a stronger understanding of the linkages between environmental benefits and profits, and ecosystem services practitioners can provide the tools businesses need to make sound decisions.

An Economic Analysis of the Impacts of Shrimp Farms on Ecosystem Services and People

The expansion of shrimp aquaculture, particularly in Southeast Asia and Central America, has increased profits for a few growers while supplying the global marketplace with low-cost shrimp. Unfortunately for many coastal communities in Southeast Asia, the proliferation of shrimp farms has driven widespread destruction and conversion of mangrove forests (Stevenson 1997).

A study of mangrove conversion near Tha Po village in Thailand compared the economic returns from shrimp farms with those from sustainably managed mangroves (Sathirathai and Barbier 2001). Conversion of mangroves to shrimp farms appears the economically sound choice when only the values of the shrimp harvest and forest products are considered in the economic analyses (a net present economic value of US $8,340 per hectare as aquaculture space, versus US $823 per hectare as intact mangroves). However, if the value of non-marketed ecosystem services from mangroves (such as coastline protection and spawning ground for wild fish) is considered, the intact mangroves become the more sound development choice (US $35,696 per hectare). Under a similar calculation, the net present value of shrimp farms was found to be negative US $5,443 per hectare — this is taking into account the traditional "value" of the shrimp farm, minus the cost of subsidies, pollution, and restoration. Managing trade-offs becomes much more clear-cut when the ecosystem services approach is applied.

People in Tha Po village and other poor coastal communities where mangrove conversion is occurring bear most of the costs associated with diminished ecosystem services, including lost forest resources, reduced coastline protection from storms, lower fishery yields, and water quality degradation from aquaculture pollution. Yet they receive few of the benefits, which primarily accrue to shrimp aquaculture operators and distant consumers who enjoy subsidized shrimp. If residents had been involved in the decision and provided with information about their use of ecosystem services in a cost-benefit analysis, might a more equitable and economically sound decision have been made?

The International Finance Corporation: Incorporating Ecosystem Services in Investment Safeguards

The International Finance Corporation's (IFC) Performance Standards define clients' roles and responsibilities for managing their projects and the requirements for receiving and retaining IFC support (International Finance Corporation 2012). During a recent review of its Environmental and Social Performance Standards, the IFC incorporated ecosystem services into Performance Standard 6. As a result, all new IFC investments are required to maintain the benefits arising from ecosystem services and to include systematic screening for ecosystem services risks and impacts. Potential impacts on ecosystem services need to be addressed in mitigation plans and compensation rules. This is potentially a significant ecosystem services–based success outcome, if adequately implemented, for the following reasons:

- It will affect the IFC's investment portfolio (US $18 billion in 2010), as well as the practices of investment partners within government and the private sector.
- The World Bank is looking at the IFC policies as it updates its own safeguards.
- The 60+ Equator Principle banks are expected to link their own performance standards to those of the IFC.
- Banks in China and Brazil may use the IFC's policies as they develop their own standards.
- Most OECD export credit agencies have linked their standards to the IFC.

Quito, Ecuador: Water Fund

In 2000, Quito, Ecuador, established a water fund to protect upstream lands in order to maintain water flows and water quality. The fund was conceptualized and promoted by The Nature Conservancy (TNC), and started with about US $21,000 from TNC, USAID, and others (Porras and Neves 2006). Regular cash began flowing in with consumption-based payments from the local water utility, hydroelectric company, and businesses (most notably a brewer). Interest income generated by the fund is now used to finance forest and watershed restoration projects. By late 2010, the fund was responsible for more than 5,000 acres of restored land and over 2 million trees planted (Whelan 2010).

Allegheny Energy, Canaan Valley, West Virginia

The U.S.-based electric utility Allegheny Power took an innovative ecosystem services–based approach when it embarked on divesting its 4,800-hectare Canaan Valley property in West Virginia (Bayon 2002). Traditional approaches appraised the property, with its pristine forests, marshes, and abundant wildlife, at US $16 million. Believing the property was worth more, the company commissioned an economic valuation of the environmental benefits provided by the site. The new appraisal came in at US $33 million. Allegheny Power subsequently sold the property for the original US $16 million value to the U.S. government, which merged it with an existing wildlife refuge. But by taking advantage of "bargain sale" provisions in the federal tax code, the company was able to claim a charitable contribution of the remaining US $17 million value, thereby securing several million dollars in tax savings (Powicki 2002).

Coral Reefs in Belize

Belize is home to some of the Caribbean's largest, most stunning, and most valuable coral reefs. Reef ecosystems provide significant value to Belize's economy, through fishing, shore protection, tourism, and other services. But the reefs are under threat from warming oceans, overfishing, pollution, and poorly regulated coastal development. WRI, along with other NGOs, has worked to provide policy-makers with better information on the full value of the ecosystem services the reefs provide.

Over the past 18 months, influenced by WRI's *Coastal Capital: Belize,* an economic valuation of the nation's coral reefs, the government of Belize took momentous steps to protect this unique ecosystem (Cooper et al. 2009). For example, after the container ship *Westerhaven* ran aground on a reef in January 2009, the government decided to sue for damages, something that had not occurred with past groundings. The suit was premised on the foregone economic contribution of the damaged reef's ecosystem services, a first-of-its-kind approach in Belize history. In a landmark decision, the Belizean Supreme Court ruled in April 2010 that the ship's owners must pay the government approximately US $6 million in damages. Although the ruling was subsequently overturned on appeal, it represents a turning point in the government's approach to reef conservation.

In addition to this lawsuit, the government tightened a number of fishing regulations, including restricting the size limit of Nassau groupers and banning the harvest of parrotfish; mandating that all fish fillets brought to landing sites retain a skin patch, facilitating species identification for law enforcement; and banning spearfishing within marine protected areas. These outcomes, especially the ecosystem services–based fine, are landmarks for Belize and the Caribbean region, and perhaps for other reef-rich areas, as well. They should help relieve threats to the Mesoamerican Reef, which underpins a significant portion of Belize's GDP. For example, coral reef– and mangrove-associated tourism contribute 12% to 15% of Belize's GDP. Reefs and mangroves also protect coastal properties from erosion and wave-induced damage, providing an estimated US $231 million to US $347 million in avoided damages per year —20% of Belize's annual GDP.

APPENDIX 2: POLICY OPTIONS FOR SUSTAINING ECOSYSTEM SERVICES.

Table A1. Policy Options for Sustaining Ecosystem Services. *Source: Ranganathan et al. (2008).*

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
National and Subnational Policies			
Mainstream ecosystem services into economic and development planning	Addresses indirect drivers of ecosystem change over the longer term by including ecosystem services in poverty reduction strategies, national economic and development plans, or country assistance strategies	Overcoming separate agency mandates, integrating different skills and perspectives, aligning with other policies such as financial and economic incentives	Tanzania's 2005 National Strategy for Growth and Reduction of Poverty explicitly recognizes many of the drivers of ecosystem service degradation as impediments to poverty reduction. The strategy sets goals to address these drivers, establishes a set of poverty-environment indicators, and includes 15 environmental targets (Assey et al. 2007). Regreening of Niger: see Appendix 1.
Include investments in ecosystem services in government budgeting	Makes the crucial link between policies focused on ecosystem services and providing funds to carry them out	Improving ability to value and integrate ecosystem services in cost-benefit analyses and identifying specific investments to sustain them	The U.K. Treasury drew on the Millennium Ecosystem Assessment in preparing its comprehensive spending review of government funding. Notes that the Assessment is relevant to achieving sustainable growth, employment, security, and equity, and that the Treasury will aim to release resources to meet environmental challenges (U.K. House of Commons Environmental Audit Committee 2007)
Establish protected areas	Helps protect ecosystems and their associated services from drivers of overexploitation and conversion	Incorporating goal of sustaining ecosystem services into site selection, linking biodiversity conservation and sustaining ecosystem service goals Including local communities, taking a landscape approach that recognizes drivers of change outside the protected area, and ensuring financial sustainability	In 1986, St. Lucia designated marine reserves with the involvement of local people and businesses, leading to regeneration of mangrove forests (WRI et al. 2000, 176–77). In 1993, Austria established 20-year contracts with all forest owners requiring them to protect the land. Financial compensation was offered to owners who lost income (Hackl and Rohrich 2001). Namibia Conservancies: see Appendix 1.

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Economic and Fiscal Incentives			
Use tax deductions and credits to encourage investment in and purchase of ecosystem services	Provides economic incentive to manage ecosystems in ways that sustain services	Avoiding equity problems or protecting one service at the expense of others	U.S. law gives landowners tax deductions for donating conservation easements, which restricts use of the property to protect associated resources (United States House 2006). Allegheny Power: see Appendix 1.
Establish fees for use of resources or services	Reduces waste of resource	Avoiding equity issues, where those with lower incomes are less able to pay, and balancing number of users	In Colombia, Cauca Valley water associations voluntarily agreed to increase user fees paid to the local utility in exchange for improved watershed management. The associations aim to improve stream flow for the benefit of agricultural producers (Food and Agriculture Organization of the United Nations 2002). Quito Water Fund: see Appendix 1.
Use taxes or other public funds to pay to maintain regulating and cultural services	Creates economic incentive to supply services that do not normally have a market value	Maintaining one service at the expense of others, avoiding creating equity issues such as loss of harvest rights or ineligibility because of lack of tenure Depending on still-emerging market infrastructure such as quantification, verification, and monitoring tools Informing public about the use of funds to provide accountability	The U.K. nitrate sensitive areas (NSA) scheme uses direct government payments to compensate farmers for adopting management practices that reduced leaching of nitrates into groundwater (IUCN 2007). A Costa Rican fund mainly from fuel tax revenues pays forest owners for watershed protection (Perrot-Maître and Davis 2001). Belize charges foreign tourists a conservation fee, which funds a trust dedicated to the sustainable management and conservation of protected areas (Conservation Finance Alliance 2003).
Reduce perverse subsidies	Removes incentive for intensive production of provisioning services at expense of other services	Overcoming vested interests in maintaining subsidies, creating mechanisms to transfer reduction in subsidies to payments to maintain regulating and cultural services	As a result of the eutrophication of waterways and threats to drinking water supply, many Asian countries have reduced fertilizer subsidies, including Pakistan (from US $178 million to US $2 million per year), Bangladesh (US $56 million to US $0), and Philippines (US $48 million to US $0) (Myers 1998).

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Set limits and establish trading systems for use of ecosystems and their services	Achieves more cost-effective improvements in ecosystem services than conventional regulatory approaches	Ensuring limit is stringent enough to provide an incentive to participate Allocating permits or credits in cases of unclear property rights Keeping transaction costs manageable, especially for non-point sources	In 1980, New Jersey established tradable Pinelands Development Credits to limit development in environmentally sensitive areas and allow prospective developers to trade for development rights on available land (Landell-Mills and Porras 2002). In 1999, Australia established a water transpiration credits scheme to reduce river salinity (Brand 2005). Under its National Water Initiative, Australia sets limits on water use in the Murray Darling Basin, and as of January 2007, the basin states are able to buy and sell permanent water entitlements (Parliament of Australia 2006).
Fund valuation of ecosystem services and research into improving valuation methods	Increases societal awareness of the value of ecosystem services and strengthens cost-benefit analysis for public decisions	Dealing with techniques for valuing ecosystem services that are still in their infancy Discrediting ecosystem service approach by overestimating values	A study found that Canada's Mackenzie River watershed's 17 ecosystem services were worth nearly US $450 billion undisturbed, offering a new perspective on the economic benefits and costs of a proposed gas pipeline (Canadian Parks and Wilderness Society 2007). A study found that on a single Costa Rican farm, natural pollination by insects increased coffee yields by 20% on plots that lay within a kilometer of natural forest, a service worth approximately US $60,000 (Rickets et al. 2004). Belize reef valuation: see Appendix 1
Use procurement policies to focus demand on products and services that conserve ecosystem services	Creates incentives for suppliers to adopt approaches that are ecosystem-friendly	Avoiding high transaction costs of demonstrating responsible behavior Implementing cost-effective monitoring and verification systems	The U.K. government's timber procurement policy stipulates that timber must come from legal and sustainable sources (Central Point for Expertise on Timber 2007).

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Support wetland banking schemes	Provides a way to maintain overall services provided by wetlands by requiring developers to create or restore substitute wetlands	Ensuring that substituted wetlands are of equal value to those destroyed Ensuring equity for local populations who lose services	Wetland banking schemes in California allow developers who destroy wetlands to offset the environmental damage by paying to protect a sensitive wetland in another location (Office of Policy, Economics, and Innovation and Office of Water 2005).
Sector Policies			
Include ecosystem services in sector policies and strategic environmental assessments	Goes beyond addressing the impacts of economic development to look at dependence on services Broadens the scale of analysis	Dealing with the public sector's limited experience using an ecosystem services approach in decision processes, and limited information on ecosystem services	South Africa's Working for Water program combines the social development goals of job creation and poverty relief, the agricultural goal of increasing the productivity of cleared lands, and the ecosystem rehabilitation goals of eradicating alien species and restoring stream flows (Department of Water Affairs and Forestry 2007).
Set targets to encourage the use of renewable energy	Provides incentive to replace fossil fuels with renewable sources	Using land to produce renewable energy sources such as biofuels can lead to soil erosion and degradation of ecosystem services such as water quality	Under the U.K. Renewable Transport Fuel Obligation, transport fuel suppliers must ensure that a proportion of their fuel sales are from renewable sources, as of 2008 (U.K. House of Commons Environmental Audit Committee 2007).
Require ecosystem management best practices in granting licenses or concessions	Creates incentives for managing ecosystems in ways that sustain ecosystem services	Defining and enforcing best practice standards	Cameroon's 1996 Forest Code calls for all commercial logging to be regulated under designated forest concessions. This legislation establishes rules for concession allocation and local distribution of forest revenues, as well as requirements for submitting and gaining approval for forest management plans (World Resources Institute 2007).
Use zoning or easements to keep land available for priority ecosystem services	Provides a way to maintain priority ecosystem services	Requires a legal framework to be in place and a fair political process to apply zoning	Some flood plains are zoned for uses such as recreation or agriculture rather than housing or commerce. Easements can be used to keep land available for cultural and regulatory ecosystem services.

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Use physical structures or technology to substitute for ecosystem services	Provides a substitute for degraded ecosystem services that may mimic natural design	Building structures such as seawalls to substitute for ecosystem services such as coastal protection often simply shifts the problem, distributing costs and benefits unfairly, fostering false confidence, and providing only a single benefit rather than the multiple benefits of ecosystem services.	Seattle's street edge projects mimic natural ecosystems, reducing stormwater runoff by 99%. Roof gardens also reduce runoff (Seattle Public Utilities 2007). Dikes and levees substitute for coastal protection. Seawalls avoid coastal erosion.
Use regulatory ecosystem services such as natural hazard protection or water filtration instead of built structures	Usually provides co-benefits such as carbon storage and recreation	Procuring time and funds for negotiations and continued maintenance Dealing with limited knowledge about ecosystem service flows, especially for regulating and cultural ecosystem services	New York City protected its watershed instead of building a filtration plant (U.S. Environmental Protection Agency 2007). Reforestation and conservation of mangroves in coastal areas affected by the 2004 tsunami can help prevent future damage (United Nations Environment Program World Conservation Monitoring Center 2006). Sebago Lake: see Appendix 1
Establish certification schemes that encourage best management practices	Provides those growing or harvesting timber, fish, or crops a way to learn about best management practices and to demonstrate use of the practices	Ensuring development of transparent, scientifically valid standards and their adoption Paying transaction costs that may limit participation Informing consumers	The U.S. Department of Agriculture provides farms with organic certification (U.S. Department of Agriculture 2006). The Forest Stewardship Council provides certification for sustainable timber harvesting practices (U.S. Forest Stewardship Council 2006). In the Pacific U.S. states, "salmon-safe" certifies farms and urban lands that practice fish-friendly management (IUCN 2007).
Introduce education or extension programs on good practices	Provides knowledge to those maintaining ecosystem services	Providing economic incentives for participation	The U.S. National Conservation Buffer Initiative educates farmers to control pollution by using filter strips and other measures, such as wind barriers (USDA Natural Resources Conservation Service 2007).

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Develop and encourage the use of products and methods that reduce dependence and impact on ecosystem services	Reduces degradation of ecosystem services by avoiding harmful substances or using services more efficiently	Evaluating potential negative trade-offs, such as organic agriculture potentially requiring use of more land, which could lead to further habitat conversion	Drip irrigation in Israel allows for a more efficient use of water for agriculture (Sandler 2005). Rainwater harvesting practices increase the supply of drinking water in parts of India (Center for Science and Environment India 2004). Organic agriculture reduces negative impacts on soil and water by avoiding agrochemicals.
Governance			
Clarify or strengthen local community rights to use and manage ecosystem services	Ensures the involvement of stakeholders who may depend on ecosystem services for their immediate livelihood and well-being	Identifying who represents the community, clarifying the role of traditional authorities, ensuring that women and the poor are included	Vietnam's 1994 Land Law allows organizations, households, and individuals to manage forests for long-term purposes. Some 1 million families living in upland areas manage 5 million hectares of forest. As a result of this decentralization, protected forests have increased, as have the benefits the people gain from the forests' services (Food and Agriculture Organization of the United Nations 2000). Namibia conservancies: see Appendix 1
Develop and use private- and public-sector indicators for ecosystem services	Provides information about the state of ecosystem services and shows where practices need to be changed	Obtaining funding to develop ecosystem indicators and continued funding to disseminate and use data on a regular basis	The European Union makes indicators on natural resource management publicly available online (Eurostat 2006). The Silicon Valley Environmental Partnership provides indicators and tracks local trends to foster more informed decision-making (Silicon Valley Environmental Partnership 2007). The Global Reporting Initiative standards for corporate sustainability reports require the inclusion of company water and natural resource use (Global Reporting Initiative 2007).

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Establish processes to work across levels of government, from local to national	Shifts the focus to the boundaries of ecosystem services rather than the boundaries of government jurisdictions; uses complementary authorities, skills, and resources of different levels of government	Requires transaction costs and time for building partnerships	In Samoa, 40 local communities work with national agencies to co-manage fisheries. National government provides the legal authority, research, market information, credit, and transport. Local communities have clear rights and authority to manage the local fishery under a management plan (World Resources Institute et al. 2005).
Ensure public access to information and public participation	Allows the public to hold public and private actors accountable for their actions in relation to ecosystem services	Requires investment in building the capacity of individuals, civil society, and government to produce, analyze, disseminate, and use information and to engage effectively in decision-making	Evaluation of the Brazilian ecological tax system recommends making the amounts transferred public so local governments can be held accountable for their use (World Wildlife Fund 2003).

Except where noted, examples adapted from Millennium Ecosystem Assessment 2005, 11–21.

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