# Valuing Protected Areas

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# Executive Summary

For over twenty years, the World Bank has been a major player in biodiversity conservation and remains one of the world's largest financers of biodiversity conservation projects which contribute to the goals of the Convention on Biological Diversity (CBD) and the Millennium Ecosystem Assessment (MEA) targets. The year 2010, the International Year of Biodiversity, represents an opportunity for the Bank to review its achievements in biodiversity conservation, to take stock, and to develop an ambitious scope of work for the next decade under the Bank's new Environment Strategy that is currently being developed.

The purpose of this report is to highlight the numerous values that protected areas can offer, and to detail some of the Bank's contributions to date with respect to these different dimensions of protected area management.

The report is divided into 19 sections that cover different values of protected areas. Each section includes a case study from a Bank-funded project.

- **Section 1: Categories and governance –** *A wide diversity of approaches to management and governance contributes to the strength and resilience of the global protected areas system.*
- **Section 2: Systems and connectivity –** *Protected areas are most effective as components of larger conservation systems, with connectivity enhanced by biological corridors, buffer zones and sustainable management.*
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- **Section 4: Domestic water –** *In many parts of the world adequate supplies of potable water depend on functioning natural ecosystems, often within protected areas.*
- **Section 5: Irrigation –** *Irrigated agriculture produces over a third of the global food harvest. Protected areas can secure a steady supply of good quality water, essential for successful cropping.*
- **Section 6: Hydropower –** *Hydropower, a key renewable energy source, is highly dependent on rainfall and snow melt. Protecting sustainable water supplies for electricity generation is critical for countries dependent on hydropower.*
- **Section 7: Terrestrial food security –** *In a world faced with food insecurity, protected areas have a growing role to play in sustaining supplies of wild food, providing ecosystem services (such as pollination) and protecting agro-biodiversity which provides the building blocks of food crops.*

- **Section 8: Fisheries –** *Marine and freshwater protected areas have repeatedly been shown to increase exploitable fish stocks in surrounding waters by providing secure nursery and breeding areas.*
- **Section 9: Health: medicinal plants, pharmaceutical compounds and well-being –** *Protecting areas with high biodiversity can conserve locally-important medicinal plants and also ensure resources for the pharmaceutical industry.*
- **Section 10: Mitigating natural disasters –** *Protected areas can help mitigate the impacts of natural disasters where they are linked to the loss of ecosystem integrity, a critical concern as natural disasters increase around the world.*
- **Section 11: Climate change mitigation and adaptation –** *Protected areas are highly effective tools to maintain carbon stored in oceans, forests, soils and wetlands, in order to combat climate change. They also protect ecosystem services, enabling local communities to adapt to climate change.*
- **Section 12: Cultural and spiritual values –** *Many protected areas contain sacred natural sites of great symbolic importance to particular faiths; indeed sacredness often helps preserve an intact ecosystem.*
- **Section 13: Ecotourism –** *Tourism is one of the largest industries in the world. Ecotourism is a growing sector with many people in developing countries dependent on healthy ecosystems for tourists to visit.*
- **Section 14: Indigenous peoples: cultural values, homelands –** *Indigenous people have been managing ecosystems for centuries and their territories often overlap areas of high biodiversity. The role of Indigenous people in protection and conservation of biodiversity needs to be revived, supported and valued.*
- **Section 15: Iconic and wilderness values –** *Large intact wilderness areas have enormous cultural value to many stakeholders; they also supply critical ecosystem services and protect some highly vulnerable human communities.*
- **Section 16: Materials –** *Natural ecosystems provide many raw materials for survival and livelihoods, and are particularly important for poor and subsistence communities in developing countries.*
- **Section 17: Building knowledge and education –** *Protected areas provide open-air classrooms for both students and adults.*
- **Section 18: Scientific research –** *Many breakthroughs in medicine, science and technology have been reached through detailed study of natural systems.*
- **Section 19: Political stability –** *Protected areas can help promote transboundary cooperation and rebuild security and collaboration following political tension or conflict.*

Although protected areas were established and managed primarily for biodiversity conservation, they can provide a host of other benefits, including resources that offer direct economic returns, subsistence resources, and less tangible benefits such as spiritual peace or mental well-being.

In line with its poverty alleviation mission, many projects in the Bank's biodiversity portfolio already address multiple benefits of protected areas, looking beyond biodiversity conservation.

It has been estimated that US$20 to US$28 billion is required annually to achieve an effectively-managed and ecologically-representative terrestrial protected areas system as prescribed in the work plan of the CBD. In addition, adequately protected marine reserves would cost an estimated US$23 billion per year in recurrent costs, plus some US$6 billion per year (over 30 years) in start-up costs.

In order for such investments to take place, the benefits of protected areas need to be made more explicit, and wherever possible quantified.

A proposed five-step approach is suggested in this paper:

- *Step 1*: Assessing protected area benefits – using the protected area benefits assessment tool
- *Step 2*: Evaluating benefits – using the range of valuation methods available
- *Step 3*: Identifying mechanisms to transfer benefits – notably Payment for Ecosystem Services (PES) schemes
- *Step 4*: Assessing protected area financial status, needs and sustainable financing context – notably using the Global Environment Facility (GEF) scorecard that can provide a quick snapshot of financial needs.
- *Step 5*: Decision-making and implications for management – managing protected areas for multiple benefits may require changes in management approaches, skills and capacities.

# Acronyms

| | |
|---|---|
| ARPA | Amazon Region Protected Areas Program |
| BMNP | Bale Mountains National Park |
| CABI | *Capitanía del Alto y Bajo Isozu* |
| CAPE | Cape Action Plan for the Environment |
| CBD | Convention on Biological Diversity |
| CEPF | Critical Ecosystem Partnership Fund |
| CI | Conservation International |
| COREMAP | Coral Reef Rehabilitation and Management Program |
| CWR | Crop Wild Relative |
| FAO | Food and Agriculture Organization of the United Nations |
| FFI | Flora and Fauna International |
| GEF | Global Environment Facility |
| Ha | Hectares |
| IBA | Important Bird Area |
| ICCA | Indigenous and Community Conserved Area |
| ICDP | Integrated Conservation and Development Project |
| IEDP | India Ecodevelopment Project |
| IFC | International Finance Corporation |
| INBio | National Institute for Biodiversity (INBio) (*in Costa Rica*) |
| INRENA | National Institute of Natural Resources (*in Peru*) |
| IOC | Intergovernmental Oceanographic Commission |
| IPCC | Intergovernmental Panel on Climate Change |
| IPDP | Indigenous people Development Plan |
| IUCN | International Union for the Conservation of Nature |
| MBC | Mesoamerican Biological Corridor |
| MDG | Millennium Development Goal |
| MDTP | Maloti-Drakensberg Transfrontier Project |
| MEA | Millennium Ecosystem Assessment |
| MPA | Marine Protected Area |

| | |
|---|---|
| NGO | Non-governmental Organization |
| NTFP | Non-timber Forest Product |
| PA-BAT | Protected Areas Benefits Assessment Tool |
| PES | Payment for Environmental Services |
| REDD | Reducing Emissions from Deforestation and Forest Degradation |
| SATIIM | Sarstoon-Temash Institute for Indigenous Management |
| SEED | Support to Economic Expansion and Diversification |
| SERNAP | *Servicio Nacional de Areas Protegidas* |
| SINAC | National System of Conservation Areas (*in Costa Rica*) |
| SINAP | National System of Protected Areas *(in Panama)* |
| SINANPE | National Natural Protected Areas System (*in Peru)* |
| SPAN | Strengthening Protected Areas Network |
| TCO | *Territorio de Communidad de Origin* (TCO) |
| TEEB | The Economics of Ecosystems and Biodiversity |
| TNC | The Nature Conservancy |
| TRAFFIC | The Wildlife Trade Monitoring Network |
| UNEP | United Nations Environment Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| WCF | Wild Chimpanzee Foundation |
| WDPA | World Database on Protected Areas |
| WWF | Worldwide Fund for Nature |

# Introduction

## Context

The World Bank has been actively engaged in biodiversity conservation projects for over twenty years and is one of the world's largest financers of such projects, contributing directly to the goals of the Convention on Biological Diversity (CBD) and the Millennium Ecosystem Assessment (MEA) targets. The year 2010, designated the International Year of Biodiversity, provides a suitable milestone for the Bank to look back at its achievements in biodiversity conservation, to take stock and to develop an ambitious scope of work for the next decade under the new Environment Strategy that it is developing for the end of the year. This report is a contribution to the protected areas dimension of the World Bank's work and highlights specifically the numerous values that protected areas can offer.

## Protected areas: why they are important

Protected areas—clearly defined geographical spaces, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values—remain the cornerstones of almost all national and international conservation strategies. They act as refuges for species and ecological processes that cannot survive in intensely managed landscapes and seascapes and as a rich source of species for populating the wider landscape and seascape. Their role in biodiversity conservation is all the more important in a world faced with growing pressures and threats, notably from climate change, food insecurity and rapid population growth. They also provide space for natural evolution to take place, and the biological resources for ecological restoration. Flagship protected areas also have extremely high cultural values and are as important to a nation's heritage as, say, Chartres Cathedral in France or the ruins at Machu Pichu in Peru.

Protected areas listed in the World Database on Protected Areas (WDPA) now cover around 13.9% of the world's land surface and a small but growing area of ocean. All but a tiny number were created during the twentieth century, in what is almost certainly the largest and fastest change in land management objective in recent history. There are also an extremely large, but generally unquantified, number of unofficial protected areas, community reserves, sacred natural sites and Indigenous people' lands that are managed in ways that support biodiversity and are gradually being recognized by governments. Although there are many different perceptions about protected areas and their values and benefits, overall support for protected areas remains strong. Indeed, in 2004, 188 countries that are signatories to the CBD committed to expanding the world's protected areas network,

aiming to develop and maintain a "*comprehensive, effectively managed and ecologically representative system of protected areas*".

## Protected Areas and the World Bank

The Bank's portfolio ranges from support to individual protected areas to multi-country landscape conservation programs, and embraces all International Union for the Conservation of Nature (IUCN) categories[1] and governance types, including community-led and indigenous-led initiatives.

Natural ecosystems more generally, and protected areas specifically, supply numerous goods—such as food, medicinal plants, building materials—and services, such as soil stabilization and provision of clean water.

The Millennium Ecosystem Assessment (MEA) identified four overarching categories to describe the benefits provided by ecosystems:

- **Providing** services to enable people to make a living (e.g., fisheries and forestry, both subsistence and commercial);
- **Supporting** human life (e.g., potable water and clean air);
- **Regulating** other important ecosystems (e.g., mangroves that act as a nursery for juvenile fish);
- Having **cultural** significance and providing opportunities for recreation (e.g., sacred sites and walking trails).

Increasingly, the value of such ecosystem goods and services is being recognized, both in terms of socio-economic benefits and in terms of their contribution to other aspects of human well-being, through direct and indirect use as well as non-use values. Often these benefits cannot be measured in monetary terms, including the value of protection against natural hazards or the contribution to cultural identity.

While values can be theoretical, they convert to benefits when they are received by an individual or a community. Thus, for example, the value of trees in water filtration becomes a benefit to a community that derives its clean drinking water from that source. Research suggests that for a wide range of these benefits, natural ecosystems

[1] Consistency in comparing protected areas across the World under the IUCN definition is achieved by the allocation and use of an internationally defined set of management categories, known as IUCN Protected Area Management Categories. The IUCN definition implies a common set of objectives for protected areas and the IUCN Category system in turn defines differences in management approaches. The categories include a definition outlining key aspects within the management intent of the protected area alongside an example designation. IUCN categories are not applied to protected areas established under international conventions or agreements (e.g. UNESCO World Heritage Sites).

remain the most cost-effective delivery mechanisms. In cases where particular ecosystems have unique aesthetic, cultural and spiritual values, they are literally irreplaceable.

## Assessing wider benefits of protected areas

Most protected areas were established originally to protect landscape features and/or wildlife and more recently for biodiversity conservation including genetic, species and ecosystem diversity. However, many protected areas also conserve a wide range of ecosystem services and other social, economic and cultural benefits; indeed, many could be justified in these terms alone.

To help gain a better understanding of the full range of benefits available, the Worldwide Fund for Nature (WWF) has developed a typology of benefits for its Protected Areas Benefits Assessment Tool (PA-BAT) as part of the *Arguments for Protection* series which was supported by the World Bank. This report draws on this typology to look at 19 ways in which protected area projects in the World Bank portfolio provide social, economic and cultural benefits to local communities and wider human society. Each section covers one of the following themes and includes a case study from a Bank-funded project:

- **Biodiversity protection**: the first priority of protected areas is the conservation of biodiversity, particularly when those areas contain rare, endangered or endemic species, or under-represented habitats such as grasslands or freshwater areas. Section 1 provides an introduction to protected areas and sections 2 and 3 describe their connectivity and biodiversity benefits.
- **Water**: natural vegetation in protected areas can help to maintain water quality and in some circumstances can also help increase the quantity of water available (i.e. through filtration, groundwater renewal and maintenance of natural flows). Water from protected areas is important for non-commercial uses, such as subsistence agriculture, drinking, washing and/or cooking, and for commercial uses including large-scale irrigation, waterways, bottling plants, hydro-electric power or as a source of municipal drinking water. Sections 4, 5 and 6 describe the drinking water, irrigation and hydropower benefits of protected areas.
- **Food**: protected areas can provide a variety of food including wild food plants, wild game, and fish (either directly or through the contribution to fish stocks by protecting spawning areas). Traditional agricultural systems and associated agro-biodiversity is increasingly being conserved in protected landscapes, and protected areas can be important for the conservation of locally adapted crops and/or agriculture practices. Some protected areas are also important for livestock grazing and fodder collection, where this is an integral part of their conservation management. Sections 7 and 8 describe the food, agro-biodiversity and fisheries benefits of protected areas.

- **Health and recreation**: protected areas are increasingly being recognized as important places to promote physical and mental health and also as major recreational resources. Health values can also be derived directly from medicinal resources from within protected areas (e.g. medicinal herbs) for local use or for the pharmaceutical industry. Sections 9 and 13 describe the medicinal plants, health and ecotourism benefits of protected areas.
- **Disaster mitigation**: protected areas can help mitigate natural disasters by, for example, soil stabilization (e.g. preventing avalanches, landslides and erosion); flood prevention (e.g. mitigation in small watersheds, flood plains and wetland protection); and coastal protection (e.g. mangroves, sand dunes or coral reefs as storm and surge barriers). Section 10 describes the disaster mitigation benefits of protected areas.
- **Climate change mitigation and adaptation**: protected areas can play a role in both sequestering carbon and ameliorating local impacts attributable to climate change. Section 11 describes benefits of protected areas with respect to addressing climate change.
- **Cultural and spiritual values**: many of the world's oldest protected areas were set aside for their cultural or historical values. They can contain important archaeological sites and historic buildings, sacred natural sites, and protect pilgrimage routes and traditional land use systems. Protected areas can also provide a legal mechanism to support the rights of indigenous groups to own and manage the land of their ancestors. Section 12 describes the spiritual and cultural benefits of protected areas. Section 14 considers protected areas and Indigenous people and Section 15 looks at iconic and wilderness values.
- **Materials**: in many protected areas, or specific zones within them, it is legal to harvest a whole range of natural products including non-timber forest products (NTFPs) such as resin or rubber, fuelwood, coral, shells and grass. Many communities around the world depend upon such materials for their subsistence and livelihoods. Section 16 describes the role of protected areas in providing such benefits.
- **Knowledge**: protected areas can be used for education, ecological research and monitoring. Many sites play a vital role in providing base-line environmental conditions for research and an outdoor classroom for both children and adults. Sections 17 and 18 describe the benefits of protected areas for knowledge and research.
- **Political stability**: natural resources are often at the root of conflicts, especially when they are shared across borders. To help remedy or avoid these conflicts, transboundary protected areas can promote transborder collaboration and joint approaches to managing these resources. Section 19 describes the benefits of these "Parks for Peace" in improving political collaboration.

## Categories and governance

*A wide diversity of approaches to management and governance contributes to the strength and resilience of the global protected areas system.*

**CASE STUDY**

### Regularizing land tenure and equitable access to land in Panama

Panama has the highest per capita income in Central America, but many people remain poor, particularly in rural areas and among the 200,000 or so Indigenous people. As a first step in improving livelihoods for the rural poor, the Bank supported a project designed to contribute to regularizing land tenure while addressing environmental and human rights issues by building and consolidating the National System of Protected Areas (SINAP). The project also supported contributing to the recognition of three Indigenous people' territories.
Indigenous people

A comprehensive, holistic approach is being adopted including land titling, natural resource conservation and management, land administration services and indigenous rights. The land titling, in particular, is being used to spread information about environmentally sustainable land management and to ensure stakeholder input (from government experts, NGOs and other stakeholders) into formulating policy. From a conservation perspective, this includes working with 20 existing protected areas and five officially proposed protected areas to ensure that land titling processes enhance rather than undermine conservation status. The steps involved range from dispute resolution, through physical demarcation of protected areas to production of management plans.

The term "protected area" does not describe a single management or ownership model: protected areas include a wide variety of management approaches, ranging from strict reserves that ban or carefully limit human access, through national parks and wildlife reserves, to protected cultural landscapes or seascapes that include settled human communities going about their everyday lives. Traditional management systems may in some cases be the reason why the area was established and their retention is a key part of management.

When it comes to who owns or takes decisions about the protected area, options vary from State-run national parks through private reserves to Indigenous and Community Conserved Areas (ICCAs) that are managed and often created by traditional owners. A growing number of protected areas are also co-managed by several stakeholder groups, at least to some extent, and protected area managers are increasingly collaborating across national borders. The Bank portfolio includes

examples of all six categories of protected area defined by IUCN and areas under various governance arrangements.

The shifting paradigm in protection is reflected within the donor community, with protected area support increasingly aimed also at private landowners, indigenous communities and innovative co-management approaches. In Brazil, for example, the Alliance for the Conservation of the Atlantic Rainforest has drawn on support from the Critical Ecosystem Partnership Fund (CEPF) to create new private reserves and improve management in some existing reserves. Also in Brazil, Bank funding has supported private reserves in the Central and Sierra do Mar conservation corridors. In Belize, the International Finance Corporation (IFC) has assisted private landowners to create ecotourism ventures linked to wildlife reserves on private land.

Similarly, in the Seychelles Islands, the Improving Management in NGO and Privately-Owned Islands Project has helped build management capacity in privately-owned reserves in a number of islands, including Cousine Island. Although only 26 hectares (ha) in size, Cousine, which is managed by the NGO Nature Seychelles, contains five land bird species endemic to the Seychelles, plus the world's largest breeding colony of wedge-tailed shearwaters (*Puffinus pacificus*) along with many other seabirds, and is a globally important breeding site for the hawksbill turtle (*Eretmochelys imbriacata*). Tourist visitation helps to support conservation activities but tourist access is limited to ten visitors at a time because of the island's fragile habitat.

Targeted support can also help to protect Indigenous people' rights to land and water, sometimes linked to improved ecosystem protection. The Indigenous Management of Protected Areas project in Peru has helped to develop an effective co-management model involving local indigenous communities. A National Protected Areas Management Committee has been formed along with community organizations to set up a series of economic projects in buffer zones, to provide more sustainable livelihood options which reduce pressures on the protected areas. Communal reserves have been established: an agreed compromise between the desires of Indigenous people for land title and the fact that Peruvian legislation does not permit legal recognition of indigenous territories. Indigenous people representatives participate in surveillance committees to provide additional security and training for management, and participatory monitoring and evaluation.

## Systems and connectivity

*Protected areas are most effective as components of larger conservation systems, with connectivity enhanced by biological corridors, buffer zones and sustainable management.*

**CASE STUDY**

### Mesoamerican Biological Corridor

The Mesoamerican Biological Corridor (MBC) was first conceived in 1992, as a seven-nation conservation project, stretching through Central America from Mexico to Colombia, characterized by a mosaic of protected areas and sustainable development to conserve the unique biodiversity of the region. It was one of the first projects of such a scale to look carefully at issues of connectivity and innovative approaches. Four main categories of land were proposed: core zones, buffer zones, corridor (connectivity) zones and multiple use zones. The MBC includes tropical forests, pine savannahs, montane forests and coastal wetlands, and has become a unique focus for transboundary conservation.

The Bank has been actively involved in supporting various national projects within the MBC in Guatemala, Honduras, Mexico, Nicaragua and Panama. In Nicaragua a US$30.5 million Integrated Conservation and Development Project (ICDP) was designed to improve agriculture on the Pacific coast and reduce expansion of the agricultural frontier into the Atlantic forests. A complementary US$7.1 million GEF grant addressed the incremental costs of managing three protected areas: Cerro Silva Reserve, Wawashan Natural Reserve and Cayos Miskitos Biological Reserve. The latter protects breeding grounds for five turtle species. Part of the funding has been used to help Indigenous people in the region gain formal title to their land, and thus security of tenure.

In Honduras and Nicaragua, the Bank has also been supporting development of the Corazón Transfrontier Biosphere Reserve Project. Activities include addressing land tenure issues, developing protected areas, and community-based natural resource management, to complete another section of the MBC. In Panama, formal agreements with Indigenous people are protecting key biodiversity lands and helping to create sustainable livelihood options in buffer zones and corridors, especially for Indigenous people.

Most protected areas do not work as isolated entities, separated from the rest of nature; apart from a few very large reserves, their plant and animal populations are not sizeable enough to be genetically viable in the long term and are vulnerable to sudden disruptions such as outbreaks of disease or poaching. The theory of island biogeography suggests that the larger the "island" (e.g., protected area) the more

species are likely to occur. Many of the wider ecosystem services supplied by well-managed protected areas also operate at a large scale.

Scientists have recognized for years that protected areas only function well if they are extremely large, or if they are connected to other similar habitats as part of a coherent network through management systems that maintain a natural enough habitat to allow passage for wild species. Although conservation planners often talk about "landscapes", the need for connectivity is equally important in many freshwater and marine systems. The principles of connectivity conservation become even more crucial when climate change is taken into account, as larger areas of healthy ecosystems are more likely to be resilient to the impacts of climate change.

The setting aside of protected areas large enough to function as complete ecosystems is no longer an option in most countries. Furthermore, land and water outside protected areas is increasingly under pressure so, for instance, it is common to see agriculture taking place intensively right up to the boundary of a protected area. Conservation scientists and protected area planners therefore increasingly have to look at ways of linking protected areas and other compatible land uses to allow them to *function* as if they were larger areas. In practical terms, interventions focus on a number of key areas:

- Setting up or protecting buffer zones of protected areas
- Maintaining connectivity through biological corridors
- Promoting biodiversity-friendly management outside protected areas
- Conflict resolution to address long-standing tensions relating to wildlife and land management

**Buffer zones**: Numerous Bank and GEF projects have supported Integrated Conservation and Development Projects (ICDPs) to provide alternative livelihoods for local communities and reduce the pressure on protected area resources. In Senegal, the Bank has been supporting the development of sustainable timber production in 300,000 ha of forest that act as a buffer zone to the Niokolo-Koba National Park and World Heritage site, an important area of gallery forests on the Gambia River with high wildlife values, including Derby's eland (*Taurotragus derbianus*), the largest of the antelopes. The project aims to protect the national park through increasing local benefits from the buffer zone; much of the fuelwood produced will be sold to cities. Similarly, in the buffer zone of the Maya Biosphere Reserve in Guatemala, high-value organically grown spices are supplying the export market. In Mexico, a slightly different approach is being trialled, using Payment for Environmental Services (PES) schemes through the Environmental Services Project to augment and diversify revenues to protected areas and buffer

zone communities. Payments for water services, carbon sequestration and biodiversity values are being used to promote effective management in 200,000 ha of protected area buffer zones. PES schemes are considered when areas meet at least two of the following criteria: (1) existing natural protected areas; (2) priority terrestrial ecoregions; (3) Important Bird Areas (IBAs); or (4) Ramsar (The Convention on Wetlands of International Importance, called the Ramsar Convention) wetland sites.

**Biological corridors:** As noted above, the Mesoamerican Biological Corridor is one of the world's most ambitious corridor programs. Elsewhere, Bank projects have promoted national approaches to link protected areas within production landscapes. In Georgia, for instance, both GEF and CEPF projects have promoted policy reforms and community management to maintain wildlife corridors in the Eastern Caucasus Mountains, linking a number of protected areas including Tusheti and Vashlovani National Parks.

Part of the challenge involves helping authorities and communities to think on a **larger scale and a longer time-scale**. The Pu Luong – Cuc Phuong protected areas in Vietnam contain globally important examples of karst limestone, along with the largest area of pristine lowland forest in northern Vietnam. Flora and Fauna International (FFI), an international NGO, worked with government agencies and local communities to strengthen management of existing protected areas and create one additional reserve. The project also developed a Regional Landscape Plan that explored new opportunities, including the potential for local communes to enact their own conservation decrees and the possibility of conservation stewardship agreements with communities, thus greatly expanding the total land managed for conservation.

In Kenya, **direct payments** are being trialled as financial incentives to maintain a key migration corridor through pastoralist lands to Nairobi National Park. The Maasai traditionally used the land south of the park to graze their livestock but in recent years many parcels of land have been sold off for agriculture and urban development. The park, which is very close to the capital city and popular with tourists, only remains ecologically viable because larger animals such as wildebeest can migrate between the park and the wider landscape: a wholly isolated protected area could not maintain many of its wildlife values. GEF funding is now providing wildlife conservation leasing to Maasai communities through The Wildlife Foundation, at US$4/acre/year, to maintain wildlife habitat in the buffer zone. Given that most recipients are investing this income in medical facilities or children's education, the fund is also providing long-term benefits for the community.

As human activities expand and natural habitats decrease, tensions sometimes emerge related to **human-wildlife conflicts and the costs of protected areas**. Several Bank projects in Africa are addressing this conflict directly through facilitated conflict resolution and improved land management. In Ghana, for example, the Bank has supported conflict resolution approaches around protected areas, buffer zones and biological corridors. Similarly, in Mali the Mali Rangelands Conservation Project is implementing measures to reduce conflict between elephants and humans.

## Biodiversity Conservation

*An ecologically-representative, diversified and well-managed protected areas system is the most effective way to safeguard biodiversity.*

**CASE STUDY**

### Cape Action Plan for the Environment (CAPE), South Africa

The Cape Floral Kingdom in South Africa is a unique center of plant diversity, one of six recognized floral kingdoms, and the only one found within a single country. While much of the landscape has been modified or altered by agriculture, large areas of native fynbos remain to provide the basis for successful conservation initiatives. For both economic and social reasons, it is not possible to buy enough land to address all biodiversity conservation needs. Instead the CAPE program has encouraged partnerships between government agencies and civil society to ensure protection of all floral communities and to manage large landscape corridors stretching from the mountains to the sea.

The Kogelberg Biosphere Reserve, for example, harbors amazing plant diversity, including 77 known endemic species, and is made up of a core nature reserve, buffered by a variety of private reserves, a botanic garden, the Palmiet estuary and other habitat, with a transition zone comprising farms, plantations, settlements and industrial areas. A management board includes all statutory and key NGO agencies and management is from the bottom up. Similarly, the Gouritz Initiative is linking conservation efforts in existing nature reserves and private holdings to create a wider conservation landscape, with projects including eradication of invasive plants, research on leopards, an initiative to promote more sustainable ostrich farming, and biodiversity conservation in local vineyards.

The project was developed through a two-year participatory planning process, involving a wide cross-section of society and comprehensive conservation ecoregional planning with identified targets for biodiversity and ecosystem processes. The project has been able to mainstream biodiversity priorities into local and regional planning, with government agencies, NGOs and the private sector working towards common goals.

The world is currently experiencing unprecedented biodiversity loss. The 2009 update of the IUCN Red List of Threatened Species estimates that 17,291 species out of 47,677 so far assessed are threatened with extinction, including 30% of amphibians. At least 1 in 8 birds, 1 in 4 mammals and 1 in 3 freshwater fish are listed as threatened; in addition, 70% of the world's coral reefs are either threatened or destroyed. Threats include habitat loss and fragmentation, over-exploitation, pollution, the impact of introduced or invasive species, and climate change.

Many of the most critically threatened terrestrial habitats and species occur in the tropics, especially the tropical rainforests of Central and South America, Africa, and South and Southeast Asia. A recent study to map the total human impact on the world's oceans found that no area is unaffected by human influence and that a large fraction (41%) is heavily affected by human activities, including fishing, coastal development and pollution from shipping.

Protected areas are the cornerstones of biodiversity conservation. It is increasingly recognised that successful conservation requires a well designed, spacious and effective protected area system, embedded in a wider landscape and seascape where the needs of wild plant and animal species are taken into account. Protected areas offer unique opportunities for species and ecological processes that cannot survive or function in managed landscapes and seascapes. They provide space for evolution and a benchmark for future restoration. Protected areas are often the only remaining natural or semi-natural areas in countries or regions, and significant numbers of species can only be found within their boundaries. Protected areas can provide high levels of protection for range- restricted and endemic species; conservation of habitat fragments of importance for migratory species such as birds; and conservation of particular aspects of species' life-cycles through time-limited interventions such as temporary fishing exclusions. Lastly, protected landscapes, seascapes and extractive reserves also create places to experiment with sustainable natural resource management within biodiversity conservation strategies.

World Bank and GEF funding has supported establishment of new protected areas and strengthened management of a wide range of existing reserves. Prior to Bank engagement, Namibia had already made an important commitment to conservation through designation of 13.8% of its territory into 20 major State protected areas (the country also includes many private reserves and community conservancies). The Strengthening Protected Areas Network (SPAN) project was a multi-year effort to strengthen management of the system, concentrating on improving the legal and policy framework, building institutional capacity and testing new management approaches in pilot sites. Designation of a new protected area, Sperrgebeit National Park, in the Succulent Karoo Hotspot, brought protected area coverage up to 17% of the country's total area. The 2.6 million ha park includes land that has remained virtually untouched for centuries and is a refuge for nearly 25% of Namibia's plants. The CEPF supported the Namibia Nature Foundation to develop management and tourism plans for this remarkable arid region.

Protected area projects cover a wide range of habitats from lowland rainforests to boreal and temperate woodlands, savannahs and temperate grasslands, mountain ranges, drylands and deserts, and freshwater, costal and marine ecosystems. Sev-

eral projects have been designed to promote protection of charismatic and key flagship species. Projects in Uganda and the Democratic Republic of Congo are affording improved protection for mountain gorillas, while Bank projects in Bhutan, Cambodia, China, India, Indonesia, Lao PDR and Vietnam have improved management of key tiger habitat. Less well-known threatened species, such as Buton macaques (*Macaca ochreata brunnescens*), Sulawesi tarsiers (*Tarsius spectrum*) and the Caerulean paradise flycatcher (*Eutrichomyias rowleyi*) have benefited from GEF medium-sized projects to improve management of critical forests on the offshore islands of Sulawesi .

*In many parts of the world adequate supplies of potable water depend on functioning natural ecosystems.*

**CASE STUDY**

### Making watershed conservation pay to ensure quality water supply in Costa Rica

Located between the Atlantic and Pacific oceans, the small country of Costa Rica is a major biodiversity hotspot, with more than 500,000 plant and animal species. Costa Rica is also a world leader in the development and application of innovative market-based instruments for environmental management.

The government-led Payment for Environmental Services Program (PES) rewards forest owners for the environmental services their forests provide, such as watershed protection, carbon sequestration, landscape beauty and biodiversity protection. PES schemes in the country have been implemented since 1997, with a total investment to date of well over US$100 million. Over 80% of payments go towards conservation; the scheme provides resources for the national park system and works with private landowners to support the creation of biological corridors and protection of strategic water catchments, or focuses work in areas with high poverty levels. By 2005, 451,420 ha had been protected as part of the scheme and the program had made payments to more than 4,400 farmers and forest owners.

The World Bank has been a major supporter of the development of the PES program in Costa Rica. The latest support package, which began in 2006, provides a loan of US$30 million and a US$10 million GEF grant to strengthen the existing PES program and improve participation of smallholders. The project is also supporting the introduction of a new water tariff and the creation of a Biodiversity Conservation Trust Fund.

Water is a renewable natural resource, but inefficient water use, population growth and increasing demands for water all mean that the provision of adequate, safe supplies of water remains a major source of concern, and international and national tension. As urbanization continues, these problems are likely to become more intense. In the last century the world population tripled, but human water consumption multiplied six-fold. One in five people in the developing world lives without a reliable water supply, and the situation is likely to get worse as climate change exacerbates water stress.

Forests and freshwater systems help to protect the quality of water resources. Ecosystem protection can help to regulate, and in some cases increase, water flow.

Mountain cloud forests, for instance, can capture fog or wind-driven precipitation, and add it to the water budget. In many situations the economic benefits from provision of ecosystem services can more than justify the costs of conservation and sustainable management of natural ecosystems. It has been estimated that the value of ecosystem services in terms of water regulation and supply alone is worth US$2.3 trillion globally; in reality, very little of this potential value is spent on ensuring this ecosystem function.

In 2003, a survey carried out for the World Bank and WWF found that around a third (33 out of 105) of the world's largest cities obtain a significant proportion of their drinking water directly from protected areas. At least five other cities in the survey obtained water from sources that originate in distant watersheds that also include protected areas; and at least eight more obtain water from forests that are managed in a way that gives priority to their role in providing water.

Many protected areas originally protected for scenic or wildlife values are now also seen to be vital for their watershed benefits. Kerinci Seblat National Park in Indonesia, for example, protects the head waters of two of Sumatra's major rivers, the Musi and the Batanghari, which provide downstream water supplies for major cities such as Jambi, Padang and Palembang as well as millions of ha of irrigated farmlands. The cloud forests of La Tigra National Park in Honduras provide more than 40% of the annual water supply to the capital city, Tegucigalpa, while about 80% of Quito's 1.5 million residents receive drinking water from two protected areas.

This link between habitat protection and the provision of safe water supplies has been recognized in several Bank projects. In Chile, public-private partnerships are protecting forests covering some 12,000 ha around the capital, Santiago. These high altitude forests are under threat from urban spread, fire and overgrazing, but are also responsible for the provision of some 20% of Santiago's potable water. In Haiti, the Forest and Parks Protection Technical Assistance Project has provided support to the La Visite and Pic Macaya National Parks which respectively contribute to the city water supplies of Port au Prince and Les Cayes.

The importance of protected areas in providing quality water is now well documented but few countries have successfully introduced schemes to provide PES to protected areas and catchment landowners. The Bank has thus played a leading role in the development or implementation of PES systems in Costa Rica (see case study), Colombia, the Dominican Republic, Ecuador, El Salvador, Guatemala, Mexico and Nicaragua.

*Irrigated agriculture produces over a third of the global food harvest. Protected areas can secure a steady supply of good quality water, essential for successful cropping.*

CASE STUDY

### Protected areas support irrigated agriculture in some of Madagascar's poorest regions

Madagascar's unique biodiversity has attracted scientists and nature lovers for decades. About 75% of the population depends primarily on agriculture, with rice by far the main staple crop, accounting for 70% of total farm output. Madagascar uses irrigation in 40% of crops, as opposed to only 6% of crops on average elsewhere in sub-Saharan Africa.

Environmental degradation is the leading factor affecting irrigated agriculture in Madagascar. A Bank study showed that the economic benefits of conservation and sustainable management of 2.2 million ha of forests and protected areas far outweigh the costs forgone in agricultural production, with 50% of benefits from watershed protection to maintain water flow and reduced sedimentation in downstream smallholder rice fields. The study contributed to a government decision to expand the protected area system, with additional support for establishment and management of protected areas coming from Bank and GEF funds. The Bank is also supporting a US$5.44 million Irrigation and Watershed Management Project for Madagascar, which is improving water quality for irrigated agriculture through protection of critical upstream resources. The project aims to achieve a 15% increase in vegetation cover to help secure water resources in four priority watersheds:

1. The rice-producing region of Marovoay plains, located downstream of the Ankarafantsika National Park;
2. The Itasy Region, located around Lac Itasy;
3. The Andapa basin bordered in the north-east by Marojejy National Park and in the south-east by Anjananaribe South Special Natural Reserve;
4. The Lac Alaotra watershed, a Ramsar site, which serves about 80,000 ha of rice farms, of which 30,000 ha are developed to date.

Agriculture is the largest user of fresh water globally. Irrigation is a vital element for agriculture, with irrigated crops yielding up to 400% more than rain fed crops. As food insecurity continues to grow and climate instability looms, the importance of irrigated agriculture is growing: by 2030, irrigated crop production is expected to grow by 80% in order to meet global demand.

Ecosystems play a key role in directly providing a reliable source of water, in various river systems and wetlands, and in securing water quality, notably by reducing sedimentation and salinization. The link between water supply upstream and water availability for various uses downstream, including for irrigation, is increasingly being recognized. In the Dominican Republic the Madre de las Aguas Conservation Area protects the source of 17 rivers that provide numerous ecosystem services, notably irrigation, to over half of the country's population. In Venezuela, it has been estimated that about 20% of irrigated lands are dependent on protected areas for irrigation water, and that protected areas contribute to increasing the lifespan of irrigation schemes by 10–30%, saving a total of US$30 million. In Sulawesi, Indonesia, the Dumoga-Bone National Park was established to protect a major Bank-funded irrigation project.

The Bank's agriculture development strategy recognizes the need for broader river basin management and an integrated watershed approach to management of water resources. Thus, the Natural Resources Management and Poverty Reduction Project in Armenia is implementing an integrated project which includes forest protection upstream—wise management of water resources—and working with communities downstream to engage in better irrigation practices.

*Hydropower is a key renewable energy source which is highly dependent on rainfall and snow melt. Protecting sustainable water supplies for electricity generation is critical for countries dependent on hydropower.*

**CASE STUDY**

### Creating national wealth in Lao PDR through hydropower

Lao PDR is a country endowed with lush forests and rich natural resources but the country is one of the poorest on the planet, and remains highly dependent on foreign aid. Today the government is focusing on generating income through the sale of hydropower, already the second largest export and the first source of foreign income.

The mountainous terrain and forests of the Annamite chain are ideally suited for producing hydro-electricity. The Nam Theun 2 Hydropower Project in Central Lao is expected to supply enough electricity both for domestic use and for export to Thailand, generating an estimated US$30 million per year during the first ten years, rising substantially to US$110 million between 2020 and 2034. However, its development will inundate 450 square kilometres of the Nakai Plateau. To offset this impact, a Bank loan for the environment will provide an unprecedented level of support for conservation.

Upstream of the Nam Theun hydropower plant, extending over 400,000 ha, Nakai Nam Theun is the largest protected area in Lao PDR, and an important bird area with 403 species of birds and many rare mammals, including the recently discovered Saola (Pseudoryx nghetinhensis), the Large Antlered Muntjac (*Muntiacus vuquangensis*), and the Annamite Striped Rabbit (*Nesolagus timminsi*). Recognizing the watershed value of Nakai Nam Theun, the hydropower company has agreed to fund the management of the protected area and adjacent forest corridors for a total of 30 years, with a payment of US$1 million per year.

Many countries have invested in hydropower as a sustainable power source (hydropower provides 80% of Brazil's and 92% of Nepal's electricity generation). It is the third largest source of energy worldwide, providing approximately 20% of global energy; and it is the largest source of renewable energy. With increased efforts to reduce greenhouse gas emissions, hydropower is expected to increase further. Since 2003, the Bank has approved a total of 67 hydropower projects, amounting to US$3.7 billion in contributions. Hydropower schemes include both large-scale infrastructure and dams, and smaller "run of the river" schemes where natural changes in elevation from fast flowing rivers are used to generate electricity, such

as in the Chacabuquito project on Chile's Aconcagua River, funded through the Bank's Prototype Carbon Fund.

Many of the world's so-called "water towers" are found in protected areas, such as Nakai Nam Theun. A review of the Mekong region, found that *"over 40 major existing and proposed hydropower projects are linked to protected areas"*. The interplay between the hydrological cycle and forests is complex and depends on a range of factors, including the quality of soil, the type of forest, the scale of climatic factors such as rainfall. Forests and diverse habitats help to control water runoff by absorbing a large amount of precipitation and releasing it gradually into the water cycle. In this way they help to maintain a regular river flow. By maintaining soil structure, forest cover also reduces the amount of sediment carried into the river, which can ultimately affect dams. Haiti's Peligre Dam, for example, has lost half of its potential because of damage from sediment.

Hydropower is dependent on precipitation and snow or glacier melt, both of which are being affected by climate change. An unreliable or erratic source of water can make hydropower less effective and efficient, and affect the income generation potential of these schemes. The Bank's Biocarbon Fund is supporting a project in Brazil to restore over 5,000 ha with native trees in an area around four hydropower reservoirs in the State of Sao Paulo, and to establish this zone as a conservation area to secure the services provided by forests for hydropower generation. Many of Colombia's parks situated in the Andes above 4,000 metres, such as the Los Nevados Natural National Park, provide an important water service downstream, notably to hydropower plants in a country that counts on this source of energy for over 60% of its power supply. Accordingly the Bank is supporting an Integrated National Adaptation Program that includes a component to protect the Amoya watershed in the Las Hermosas massif so as to ensure hydropower generation.

Watershed services are hard to quantify. However, in Costa Rica each ha of forest is estimated to be worth between US$40–100 for the service provided in protecting watersheds and in Peru, 60% of the hydroelectricity produced comes from rivers in protected areas, a service estimated at US$320 million.

*In a world faced with food insecurity, protected areas have a growing role to play in sustaining supplies of wild food, providing ecosystem services (such as pollination) and protecting agro-biodiversity which provides the building blocks of food crops.*

**CASE STUDY**

### Conserving fruit tree genetic diversity in Central Asia

The wild relatives and ancient forms of domesticated crop plants are not spread evenly across the world, but are concentrated in relatively small, isolated regions often referred to as centers of origin and diversity. The region of *Central Asia and North West India* (e.g. Uzbekistan, Kazakhstan, Kyrgyzstan and India) is recognised as one of the world's eight main centers of agricultural diversity, with 42 domesticated species originating in this region, particularly wheat species, rye, many herbaceous legumes, and seed-sown root crops and fruits.

The Tien Shan Mountains in Central Asia include ecosystems ranging from high mountains to steppes, dry arid lands and deserts. A biodiversity hotspot, the mountain's wild-fruit forests include the wild ancestors of cultivated fruit-bearing species such as apple, pear, pistachio, almond and walnut. More than 100 species of wild progenitors of 24 fruit trees grow here and are the source of a unique gene pool. However, these forests are subject to numerous threats such as illegal logging and firewood collection, overgrazing and fire.

A GEF-funded tri-national transboundary conservation project in the West Tien Shan helped maintain important juniper and walnut forests, as well as the gene pool of native apple trees. Management was strengthened in four protected areas: Besh-Aral (Kyrgyz Republic), Sary-Chelek (Kyrgyz Republic), Aksu-Dzhabagly (Kazakhstan) and Chatkal (Uzbekistan), through a mix of investments in capacity building, community awareness, development activities, and research and monitoring. The US$10.15 million GEF grant also helped the three countries strengthen and coordinate national policies, legal frameworks and institutional development in the area of biodiversity conservation. A follow-up project is under preparation to replicate lessons learned and to improve biodiversity conservation and protection of forest habitats in the Tien Shan region of Kazakhstan and Kyrgyzstan.

The global target to abolish hunger remains unachieved: according to the latest data from the Food and Agriculture Organization (FAO) of the United Nations, 1.02 billion people are still undernourished. An estimated 150 million people rely directly on wild species for food. In India, for example, 50 million people (more than the entire population of Spain) are estimated to be directly dependent on

forest products for their subsistence. In southern Africa alone the value of wild resource consumption is estimated at US$800 million per year.

Increasing agricultural production remains the primary strategy for ensuring food security worldwide. The Green Revolution of the 1950s spread new high yielding, disease- and pest-resistant varieties across the developing world. Today, just nine crops (wheat, rice, maize, barley, sorghum/millet, potato, sweet potato/yam, sugar cane and soybean) account for over 75% of the plant kingdom's contribution to human dietary energy. As a consequence, as the variety of our food staples has decreased, so has the genetic diversity of our crops. For example, an estimated 72% of all known pear species are native to Asia where land development is threatening indigenous species, and some species, like *Pyrus koehnei,* are facing extinction.

Genetic variation allows species to adapt to changing environmental conditions and to new pests and diseases. Landraces—domesticated animals or plants adapted to the natural and cultural environment in which they live—and Crop Wild Relatives (CWRs) serve as the world's repositories of crop genetic diversity and represent a vital source of genes for future food security. It was estimated in the 1990s that the introduction of new genes from CWRs contributes approximately US$20 billion towards increased crop yields per year in the US alone and US$115 billion worldwide. Crops have thus been improved even more by the use of landraces, but breeders use these so routinely that no quantitative data exists on their level of use and economic value. These sources of genetic material are likely to become even more important in the face of climate change.

Many protected areas can **maintain stocks** of wild food for both humans and livestock, particularly where such protected areas are zoned for appropriate use. For example, the Bedouins living in and around the Dana Biosphere Reserve in Jordan (which includes the 31,000 ha Dana Wildlands Nature Reserve) have for centuries allowed their livestock to roam freely, grazing on juniper and herbs; however, pressure from a growing human and livestock population has resulted in soil erosion and environmental degradation in the reserve. Through the Bank, the Royal Society for the Conservation of Nature received GEF support to manage the reserve to promote livelihood options for the community that were compatible with the Reserve's environmental protection. The Reserve is now zoned with areas allocated for grazing and recreation, leaving the more fragile areas strictly protected. Village orchards conserve traditional varieties of fruit trees. Enterprises such as fruit drying and processing, honey, medicinal and culinary herb production, and tourism services are creating new jobs and generating income.

Protected areas can also **conserve agro-biodiversity** both within natural ecosystems as CWRs and in culturally-derived ecosystems, where areas of traditional agriculture protect landraces. The Millennium Ecosystem Assessment (MEA) found that over 45% of existing protected areas worldwide had more than 30% of their area under some form of agriculture. For example, the Camili biosphere reserve in Turkey which lies in the Caucasus biodiversity hotspot includes agricultural lands and walnut forests. It lies in one of the 122 Important Plant Areas defined in Turkey and retains important populations of the Caucasus bee, a wild race of honey bee. A World Bank/GEF project in Turkey also supported the *In-situ* Conservation of Genetic Diversity Project, which helped protect genetic resources and wild relatives of important cereal crops and forest tree species. Gene Management Zones were introduced in three locations including the Kazdagi National Park, which is rich in fruit progenitor, nut, ornamental and forest species.

Protected areas also provide **services that are vital to food production** such as pollination. The annual value of pollination has been estimated at between US$120 billion and US$200 billion globally. Some estimates suggest that over 75% of crops rely on pollination by animal vectors. However, as the distance between agricultural fields and natural habitats increase, these vital pollinators decrease in quantity.

*Marine protected areas (MPAs) have repeatedly been shown to increase exploitable fish stocks in surrounding waters by providing secure nursery and breeding areas.*

CASE STUDY

### Protection and sustainable management of Samoa's fisheries

Fisheries are a critical element of Samoa's economy, contributing approximately 58% of export earnings in 2005. About 70–75% of the island's families are engaged in subsistence fishing. With more than 900 species of fish recorded, 52 hard coral genera and two species of turtle—green turtle (*Chelonia mydas*) and hawksbill turtle (*Eretmochelys imbriacata*)—Samoan waters are exceptionally rich in marine biodiversity. The island's mangroves are a vital breeding, feeding and spawning ground for several fish species.

Climate change, however, poses a significant threat to Samoa's fishers. Low-lying Pacific islands have already been affected, with changes in ocean temperatures favouring exotic species, particularly the crown-of-thorns starfish (*Acanthaster planci*), which preys on reef coral polyps. Powerful cyclones and ocean acidification are devastating coral gardens. Traditional fishing practices under the stewardship of local village authorities used to be more sustainable and based on indigenous knowledge about species, with practices evolving in synchrony with marine life. Seasonal "no take zones" were declared and enforced through taboos and fines. More recently, competition from larger fishing fleets has resulted in tensions developing between top-down approaches and traditional practices, with the latter being replaced by unsustainable and destructive practices such as the use of poison and, to a lesser degree, explosives.

A GEF project implemented by IUCN promoted better protection and sustainable use of Samoa's coastal marine resources in two districts: Aleipata and Safata. The project's objective was to empower local communities "*to effectively protect and manage the critical and threatened biological diversity of coral reef, mangrove and lagoon environments and help them achieve sustainable use of marine resources.*" Two marine protected areas (MPAs) were established totalling 9,000 ha; community-developed management plans were drawn up for the MPAs and ecotourism capacity was strengthened as an alternative to over-fishing. To secure sustainability, the project emphasized the need for local ownership, while also working closely with government authorities.

Close to 1 billion people depend on fish as their primary source of protein. In 2006, fish provided more than 2.9 billion people with at least 15% of their average per capita animal protein intake, and world exports of fish and fishery products

totalled US$85.9 billion (more than the combined export value of rice, coffee, sugar and tea).

Both inland aquatic ecosystems and marine ecosystems are important to fisheries. Inland aquatic ecosystems only cover about 1% of total land surface, but they are highly productive, being home to about 100,000 aquatic species, including 40% of all fish species. Marine ecosystems can be coastal areas or open water areas. Many fish need different habitats at different stages in their life cycle. For example, mangroves are particularly important as breeding and spawning grounds and they can also help to protect fish from predators. Mangrove loss, therefore, also impacts on coastal and marine fisheries.

Many marine systems are extremely productive but biomass of the ocean's valuable fish (in particular cod, tuna, grouper and sharks) is estimated to have dropped by a staggering 90% from pre-industrial levels. Furthermore, FAO estimates that 25% of the world's major fisheries are overfished, and 40% are fully fished. This unsustainable harvesting has come about because of exploding demand, fishery subsidies, improved technology and the fact that since most of the world's oceans and seas fall outside of local and national jurisdictions, it is difficult to monitor harvests and ensure compliance. Particular habitat and locations may also be impacted by specific threats, including pollution from agriculture, changes in water acidity levels, changes in water temperatures, and oil exploration.

The areas under protection in the marine environment remains low. Nevertheless marine protected areas play an important role in conservation and sustainable use: they can help fish stocks to replenish and restock waters beyond the MPA boundaries; they help conserve important habitats for aquatic life; they promote development of natural biological communities; and they are generally more resilient to threats such as climate change. Analysis of costs and benefits for marine protected areas (MPAs) in Cape Province, South Africa, for example, found benefits outweighing costs. A recent review of 112 independent studies in 80 different MPAs found that population densities were 91% higher, biomass was 192% higher and average organism size and diversity were 20–30% higher in MPAs compared to areas without protection, usually after as little as 1–3 years of being declared a protected area. MPAs are also one of the most effective means of preserving coral.

In terms of socio-economic benefits, it has been estimated that the setting aside of 20% of total fishing area for protection would create a global annual economic loss of US$270 million but that this would be offset by economic gains of US$70–80 billion per year and the creation of 1 million jobs through restored fisheries. If

ecosystem services are included, the value of this benefit could reach as much as US$4.5–6.7 trillion a year.

The Bank has been supporting marine conservation projects from the Caribbean and Mesoamerican Barrier Reef to coral reef protection and more sustainable fisheries in Indonesia and Vietnam. In Vietnam's Hon Mun Marine Protected Area, GEF funding supported the involvement of local communities in collaborative management of the reserve, development of village micro-credit programs to support alternative income-generating activities and institutional capacity building within the Ministry of Fisheries.

In Indonesia, fisheries are a major source of food and income to about 65,000 coastal villages. In 1998, with Bank and GEF funding, the government of Indonesia initiated a multi-donor, 15-year Coral Reef Rehabilitation and Management Program (COREMAP) to improve management of coral reef ecosystems in pilot sites. The first phase worked with local communities in pilot sites in Sulawesi and Papua, including the Taka Bone Rata National Park, to develop reef management plans and more sustainable livelihoods. The project also launched an ambitious campaign to raise public awareness, notably through multi-media campaigns, and to monitor and control compliance in order to curb destructive practices. Lessons from the first phase of COREMAP have been replicated into an expansion of the program throughout eastern Indonesia and are feeding into development of the Coral Triangle Initiative, an ambitious multi-country, multi-donor effort to protect coral reefs and promote more sustainable fisheries in the world's richest marine ecosystems.

## Health: medicinal plants, pharmaceutical compounds and well-being

*Protecting areas with high biodiversity can conserve locally-important medicinal plants and also ensure resources for pharmaceutical research.*

**CASE STUDY**

### Conserving traditional herbal medicines in Bale Mountains National Park, Ethiopia

The 247,100 ha Bale Mountains National Park (BMNP) in Ethiopia supports a wide range of habitats, including the largest tract of Afro-alpine vegetation in continental Africa, and the largest remaining intact forest block in the country. The park supports high levels of species richness and endemism, including the Simien fox (*Canis simensis*), mountain nyala (*Tragelaphus buxtoni*) and the giant mole-rat (*Tachyoryctes macrocephalus*).

In Africa up to 80% of the population uses traditional medicines for their primary health care and the forests of the Bale Mountains are used for gathering plant species to manage human ailments. The total value of unprocessed medicinal plants in Ethiopia has been estimated to be US$35 million annually. A recent assessment of the importance of the country's protected area system estimated the value of medicinal plants in Bale Mountains to be US$869,792 a year. More than 340 medicinal plants are recognized in BMNP and 95% of households around BMNP use medicinal plants to treat common ailments and for pre- and post-natal care. Four native plants are collected in large quantities: *Hagenia abyssinica*, *Thymus schimperi*, *Senna italica* and *Embelia schimperi*.

The sustainability of these medicinal plants is threatened by agricultural encroachment, livestock grazing and wood collection. Many of the native medicinal plant species are considered threatened. A Bank/GEF project helped to promote conservation and sustainable use of medicinal plants in Ethiopia. In BMNP, funding supported the costs of education and mass awareness campaigns, local training and pilot cultivation trials in village gardens. The Bank has also helped support:

- Socio-economic surveys to identify which villages were harvesting medicinal plants from the protected area to inform the designation of use zones;
- Development of guidelines for sustainable harvesting; and
- Development of tree nurseries and medicinal gardens in five *woredas* (districts) under the management of communities and traditional healers. Herbalists in five woredas established medicinal gardens as field gene banks and nurseries for native medicinal plants to reduce collection from the wild and restock degraded forests.

More species of medicinal plants are harvested than of any other product from the natural world, and over a quarter of all known plants have been used medicinally at some period. Locally collected native herbs and other plant species are the basis of traditional medicines which are a major resource for meeting primary health care needs in much of Asia, Latin America and Africa. Medicinal plants are also increasingly traded internationally, with a market estimated to be worth more than US$50 billion annually. However, as populations grow and natural resources are depleted, over-exploitation of medicinal plants is of growing concern. According to research by WWF and The Wildlife Trade Monitoring Network (TRAFFIC), about 15,000 of the estimated 50,000–70,000 plant species used for medicine, cosmetics or dietary supplements are threatened.

Loss and destruction of natural habitats and traditional knowledge are threatening future health solutions for both traditional and so-called western medicine, as new medicinal uses of plants and animals are being discovered all the time, particularly by the pharmaceuticals trade. The marine environment is an especially rich source of chemicals for new medical drugs: in the last 25 years more than 2,500 different chemical compounds have been found in marine plants and animals, and clinical trials are underway for some 30 possible treatments derived from marine products just for cancer. Forests are also important repositories of medicinal compounds from wild organisms, yet fewer than 5% of tropical plant species have been examined for their medicinal value. With the global pharmaceutical market worth many billions of dollars and forecast to reach US$1,043.4 billion by 2012, the potential loss of compounds for research and development should be a far more powerful argument for conservation than is currently the case.

Several Millennium Development Goals (MDGs) relate to health,[2] but the role that natural ecosystems and protected areas can play in delivering these goals is often overlooked. Bank projects are helping to link conservation goals with human health in many protected areas across the world. The Bank's Grants Facility for Indigenous people—established in 2002 at the request of indigenous leaders—has helped support Colombia's Siona and Cofa people in the Department of Putumayo—the site of Colombia's most recently designated protected area, the Alto Orito Ingi-Ande Medicinal Plants Sanctuary. The Sanctuary was proposed by the local indigenous people to strengthen and restore their traditional culture including use of the yoco liana (*Paullinia yoco*), one of the most highly regarded medicinal plants in the north-western Amazon.

[2] Including MDG 4 on child mortality; 5 on maternal health; 6 on HIV/AIDS, malaria and other diseases and 8 on access to affordable essential medicines

Conservation of medicinal plants around national parks and in small community-managed reserves has also been supported in Ethiopia (see case study), Jordan and Sri Lanka. In Sri Lanka dependency on ayurvedic (traditional) medicine is high, particularly among the rural poor. There are about 15,000 ayurvedic practitioners (compared to about 11,000 Western-trained practitioners) using some 1,500 plants of medicinal value, 190 of which are endemic to Sri Lanka. By the 1990s a combination of habitat destruction, poor forestry practice and over-harvesting had put many medical plant species at risk, with 80 considered "endangered". A Bank/GEF project increased awareness of the potential for conserving and using medicinal plants more sustainably, both in the wild and through cultivation, and provided knowledge and tools for effective conservation. Medicinal Plant Conservation Areas were established in and around protected areas, with the full participation of local villagers.

Protected areas can also provide attractive conditions for people to exercise and in many places offer rare access to safe and controlled environments. Health specialists are increasingly recognising these benefits and working with conservation professionals to encourage positive links between protected areas and health pursuits. National policies linking health with the natural environment and protected areas are being introduced in many developed countries, including Australia, Canada, the UK and the US, as one way of encouraging people to take exercise and improve their health.

## Mitigating Natural Disasters

*Natural disasters are increasing around the world, often linked to the loss of ecosystem integrity. Protected areas can help mitigate the impacts of natural disasters.*

**CASE STUDY**

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In 2008 at least 36 million people around the world were displaced by natural disasters such as landslides, floods, severe hurricanes or cyclones, forest fires, earthquakes etc. Natural disasters seem to be increasing. A study by the insurance

company Munich Re focused on major natural disasters and found that between 1950 and 1959 there were 20 major natural disasters, leading to US$38 billion in economic losses (at 1998 values) while between 1990 and 1999 there were 82 such events, with estimated losses of US$535 billion (four times more events but at 14 times the cost). Climate-related disasters, mainly floods and droughts, killed 225,800 people in 2008, up from an annual average of 66,000 during the previous eight years. The death toll, costs and political consequences associated with disasters are rising all the time; around the world more people are affected by disasters than by wars.

A significant factor affecting the impact of disasters on humans is the increasing trend, pushed by population growth, to live in precarious conditions: in floodplains, downstream of heavily eroded slopes, close to fire-prone forests, too close to an exposed coastline. In 2005, the Bank undertook a global analysis of disaster hotspots and found that 3.4 billion people, over half of the planet's population, are exposed to at least one hazard.

Some areas are more likely to face natural disasters because of environmental degradation. The impact of Hurricane Jeanne in 2004, for example, was felt very differently in the two neighbouring Caribbean countries of Haiti and the Dominican Republic: in Haiti, which has lost most of its forest cover, 3,000 lives were lost; in the Dominican Republic, which maintains good forest and a protected area coverage of 24.5%, 24 lives were lost.

Responses to natural disasters are always high on the political and humanitarian agendas. Many such responses involve expensive technical fixes. Yet natural and healthy ecosystems can provide cost-effective solutions, providing protection against some disasters and reducing the impacts of others. Forests can protect against floods, avalanches, heavy storms, desertification, droughts and landslides; wetlands can mitigate flooding; and coral reefs play an important role in protection against storm surges, tsunamis and flooding events. Ecosystems that are functioning and diverse are more resilient to various hazards. The average global value of wetlands for flood control and storm mitigation has been estimated at US$464 per ha, per year (in 2000 figures).

Protected areas can play several roles in preventing or mitigating the impact of natural hazards (see Table 1) by:

1. Maintaining natural ecosystems, notably coastal mangroves, coral reefs, floodplains and forests. In Argentina, the Bank is supporting a Flood Protection Program which includes the protection of forest areas as a natural and low-

**TABLE 1** **Role of protected areas in disaster mitigation**

| Event | Role of protected areas |
|---|---|
| Flooding | • providing space for floodwaters to go without causing major damage<br>• absorbing the impacts of floods with natural vegetation |
| Landslide | • stabilizing soil<br>• packing snow<br>• slowing the movement and extent of damage |
| Storm surge, tsunamis, erosion | • corals and mangroves can create a natural barrier to the force of waves<br>• roots stabilize wetlands |
| Droughts and desertification | • reducing pressure (particularly grazing pressure) thus reducing desert formation<br>• maintaining populations of drought resistant plants to serve as food during droughts |
| Fires | • limiting encroachment into the most fire-prone areas<br>• maintaining traditional management systems that have controlled fire<br>• protecting intact natural systems that are better able to withstand fire |
| Hurricanes and typhoons | • mitigating floods and landslides<br>• directly buffering communities against impacts of storm events (e.g. storm surge) |
| Earthquakes | • prevention or mitigation of associated hazards including particularly landslides and rock falls<br>• providing zoning controls to prevent settlement in the most earthquake prone areas |

cost flood protection system. China and Vietnam set national afforestation/reforestation targets in response to severe flooding events, with Bank support directed both to afforestation and protected areas; even if flooding events continue, forests may reduce their intensity. Similarly in Vietnam, those coastal areas where mangrove protection and reforestation projects were implemented were relatively unharmed during typhoon Wukong in comparison to neighbouring provinces.

2. Maintaining traditional cultural ecosystems that are adapted to local weather conditions and extreme weather events, such as agroforestry systems, terraced crop-growing and fruit-tree forests in arid lands. In the Mexican part of the Mesoamerican Biological Corridor, the Bank has supported a project that explored economically viable alternatives for local populations in the areas linking the protected areas along this corridor through managed ecosystems with native trees, including agroforestry.
3. Providing opportunities for active or passive restoration of degraded ecosystems. For example, in the mountainous country of Ethiopia, where less than

3% of the native forests remain untouched, the Bank-funded Humbo project has supported forest restoration to reduce soil loss, erosion and downstream flooding. Already more than 2,700 ha have been restored and protected.

4. Helping recovery from major disasters. In Aceh, Indonesia, where a Multi Donor Trust Fund is supporting a range of post-tsunami projects, the Bank's Forests and Environment Project is helping protect the environmental services provided by the Leuser and Ulu Masen forest ecosystems. The project will strengthen management in the protected areas and protect them from illegal logging during the reconstruction process to protect water services and biodiversity.

## Climate Change Mitigation and Adaptation

*Protected areas are highly effective tools to maintain carbon stored in oceans, forests, soils and wetlands, in order to combat climate change. They also protect ecosystem services enabling local communities to adapt to climate change.*

CASE STUDY

### Amazon: protecting the world's largest rainforest and its valuable store of carbon

In 1992 the world was called to action at what was then the largest-ever meeting about the environment: The Earth Summit. The meeting was appropriately convened in Brazil, the country with the world's largest tropical rainforest and the world's largest river system. Then, as today, Brazil's forests were ailing, with the loss of up to 1,700,000 ha each year throughout the 1990s. In 1998, recognizing the biodiversity importance of the country's forests and their role as territories of indigenous communities, the government of Brazil pledged to ensure protection of its natural wealth by tripling the coverage of its protected areas. Five years later, a coalition of donors, including the World Bank, rallied together to fund what became known as the Amazon Region Protected Areas Program (ARPA). This ambitious twelve-year (2003–2015) program aims to create a mosaic of 41 million ha of protected areas across the Amazon basin through a mix of strengthening existing protected areas (12.5 million ha) and establishing new protected areas (28.5 million ha). ARPA was established to protect the region's rich Amazon biodiversity but the mosaic of state, provincial, private and indigenous reserves also contributes to both global and Brazilian efforts to combat climate change through reduced deforestation. The estimated carbon stock within ARPA is 4.5 billion tons, with potential reductions in emissions estimated at 1.8 billion tons.

Currently 51% of the remaining forests in the Brazilian Amazon are protected. Appreciation of their value is further increased with improved understanding of the pivotal role that these forests play in mitigating climate change, not only locally but also much further afield. Reductions in total evapotranspiration rates from deforestation in the Amazon, coupled with atmospheric heating, may be changing moisture cycles and deep convection in the atmosphere, with an impact on the whole of South America's climate. Furthermore, recent research suggests that the impact may also be felt in Europe and Asia, with changes affecting the North Atlantic and European storm tracks, leading to substantial cooling in southern Europe and warming across parts of Asia in winter.

The growing threat of climate change adds new complexity to all the other pressures experienced by natural ecosystems. The most recent Global Environment

Outlook published by the United Nations Environment Programme (UNEP) estimated that a temperature rise of 2°C by 2050 would cause extinction of 15–37% of species and taxa in the study regions. If global average temperatures were to increase by more than 3.5°C, the models published by the United Nations Framework Convention on Climate Change (UNFCCC) Intergovernmental Panel on Climate Change (IPCC) predict 40–70% of species assessed going extinct. Yet, at current rates of greenhouse gas emissions we are heading for a rise of 4°C by 2100.

There is a positive feedback loop between climate change and environment: climate change impacts on biodiversity and the environment, and the latter impact on climate change. Terrestrial ecosystems are estimated to store over 2,000 gigatons (Gt) of carbon (see Table 2). Healthy forests, oceans and wetlands hold carbon stocks and can help sequester carbon, playing an important climate change mitigation role. Wetlands hold an approximate 33% of the planet's carbon. Peat lands are estimated to store twice the carbon present in the world's forest biomass, although they only cover 3% of the planet. Marine and coastal ecosystems are estimated to capture up to 0.2 Gt per year.

Natural ecosystems can also help communities to ***adapt*** to climate change through the provision of ecosystems goods, such as medicinal plants, food and income in times of stress, and ecosystem services, such as flood control and soil stabilization.

**TABLE 2** **Carbon stored by biome**

| Biome | Gt Carbon |
|---|---|
| Tropical and subtropical forests | 547.8 |
| Tropical and subtropical grasslands, savannas, shrublands | 285.3 |
| Deserts and dry shrubland | 178.0 |
| Temperate grasslands, savannas and shrublands | 183.7 |
| Temperate forest | 314.9 |
| Boreal forest | 384.2 |
| Tundra | 155.4 |
| Total | 2049.3 |

Natural ecosystems are increasingly recognized for their value in climate change response strategies; and protected areas are recognized as the most effective means of maintaining forest cover, securing existing carbon stocks and continuing to sequester carbon. A recent Bank study, for example, indicates that protected areas and indigenous reserves are more successful at preserving forests and their carbon stocks than non-protected areas. By virtue of their legal recognition and manage-

ment arrangements, protected areas help secure carbon stocks more permanently than ecosystems outside their perimeter.

**Mitigation.** Protected areas globally are estimated to hold 312 Gt of carbon or at least 15% of terrestrial carbon storage. In Peru, for example, the total value of protected areas as a carbon sink has been estimated at US$127 million per year at a price of US$3.5 dollars per ton. Effective management of existing protected areas increases in importance when the need to maintain existing carbon stocks is taken into account. Indeed, poor management of protected areas can rapidly turn carbon stocks into carbon sources with deforestation leading to increased release of carbon dioxide and degradation of wetlands leading to increased release of methane.

In Senegal, the Bank is supporting a highly successful project to reduce emissions from inefficient fuel-burning while creating a sustainable forestry operation in a 300,000 ha buffer zone of the Niakolo-Koba National Park, linking climate change mitigation and biodiversity conservation. Up to 20% of carbon emissions comes from forests, so many countries and institutions are already investing in payments for Reducing Emissions from Deforestation and Forest Degradation (REDD). In Indonesia, a detailed economic study suggested that the Leuser National Park could generate an additional US$2 billion over 30 years in carbon revenues if the forests were retained. The Bank's BioCarbon Fund currently supports three REDD projects in Colombia, Honduras and Madagascar, including protected areas and adjacent forests.

**Adaptation**. Protected areas also play an important role in adaptation to climate change (ecosystem-based adaptation) as they can contribute to helping populations adapt to the impacts of climate change, such as flooding, desertification or landslides. Many of these examples are discussed in other sections of this paper. Ecosystems that are biologically diverse, functional and dynamic will be more resilient to climate change than disturbed or degraded systems and, therefore, better able to provide important ecosystem goods and services.

*Many protected areas contain sacred natural sites of great symbolic importance to particular faiths; indeed sacredness often helps preserve an intact ecosystem.*

**CASE STUDY**

### Lake Hövsgöl, Mongolia – Reviving traditional Buddhist nature rituals around a sacred lake

Mongolia has a long history of conserving nature through honoring land and water spirits. Lake Hövsgöl is Mongolia's largest lake, lying at 1,700 meters above sea level at the southern edge of the taiga forests. The Hövsgöl National Park was declared in 1992 and has been formally nominated as a UNESCO natural World Heritage site. Lake Hövsgöl has been regarded as an important sacred site for centuries, one of around 600 in the country, initially by the shamanistic traditions and since the 16th century also by Buddhists. Manifestations of its religious significance include rituals honoring spirits of the water which, since the arrival of Buddhism, have been codified through development of religious scriptures (*sutras*) that are chanted in ceremonies and stress the inter-dependence of all life.

In 2001 the Geo-Ecology Institute of the Mongolian Academy of Sciences received a five year GEF grant to study interaction between permafrost melt, a decline in biodiversity and changes in nomadic land use patterns. Simultaneously, the Bank has been working with the Buddhist University and the Gandan Monastery of Ulaanbaatar in reviving some traditional religious practices that declined under communism. The latter includes developing documentation that helps to preserve rituals honoring spirits of the water. This documentation describes procedures for worship, necessary preparations and also the purpose of the various rituals, as well as reprinting the sutras, to provide an aid to the monks. The combined program aims to raise awareness of conservation issues among both the scientific and spiritual communities and to forge new partnerships to maintain the conservation values of the lake even as Mongolia speeds up its rate of development.

Most of the world's faiths and religions believe that the natural world reflects aspects of the divine and, to a greater or lesser extent, therefore recognize sacredness in nature. Many Asian religions and the faiths of Indigenous people explicitly designate certain natural sites as sacred and use these as places of worship, sacrifice or for particular rites of passage. Judaism, Christianity and Islam have a more complex relationship to nature because of strict teachings against idolatry, yet all these faiths have made strong statements in support of the religious base for conservation.

Natural sites regarded as sacred sites have often been very carefully protected by local communities. Many sacred natural sites have important biodiversity conservation values as well. The fact that they have been set aside from exploitation, and often carefully preserved or managed for long periods of time, means that they are often havens for wildlife. Today, however, many such sites are coming under pressure from development.

Equally, many protected areas contain sacred natural sites. In Periyar Tiger Reserve in Kerala, India, the India Eco Development Project supported capacity building to enable local ecodevelopment committees to work with some of the four million pilgrims who visit the temple located within the Reserve every year, to reduce fuelwood collection, litter and disturbance in the park, thereby protecting biodiversity and enhancing their own livelihoods. In many other protected areas, local communities continue to have access to sacred sites for visiting and ceremonies, for example sacred waterfalls in Amber National Park in Madagascar and sacred mountains in Nyika National Park in Malawi. Elsewhere, the CEPF supported biodiversity inventories in sacred groves in the south-west mountains of China, a recognized biodiversity hotspot, and enabled local communities to improve protection and management of sacred groves in the coastal forests of Kenya.

Protected areas can also provide testing grounds for sustainable management linked to religious practices. In Chiapas, Mexico, a GEF project is strengthening management in La Sepultura and El Triunfo Biosphere Reserves. It is working with indigenous and peasant communities to set up extractive reserves for non-timber forest products used by both traditional and Christian faith groups, including orchids, bromeliads, cycads and palms. In particular the project is developing links with the Lutheran Church to develop trade in certified palm products, used in Christian ceremonies during Easter. Some 300 million palms are imported into the United States every year and the project aims to introduce sustainable management principles and nurseries to ensure that trade can continue without depleting the species.

*Tourism is one of the largest industries in the world. Ecotourism is a growing sector with many people in developing countries dependent on healthy ecosystems for tourists to visit.*

CASE STUDY

### Visiting Komodo's dragons, self-financing management through tourism revenue

In one of Indonesia's driest regions, the Komodo National Park is the home of the Komodo dragon, the world's largest lizard. The Komodo monitor (*Varanus komodoensis)* can reach up to 3 meters. Tourists come from around the world for the experience of seeing this unique creature, which can be found nowhere else. The waters that make up 65% of the National Park also harbor magnificent creatures such as the blue whale (*Balaenoptera musculus),* the sperm whale (*Physeter macrocephalue),* numerous varieties of sharks, 10 species of dolphin and the elusive dugong (*Dugong dugon).* Parts of this area were first protected by the Indonesian government as early as 1938 and the park became a World Heritage site in 1992.

The World Bank, through its private sector arm, the International Finance Corporation (IFC), and with funding from the GEF, launched a private-public partnership in the park to promote high value ecotourism. The Komodo National Park Collaborative Management Initiative, a joint venture between the government, local communities, the Nature Conservancy (TNC) and a tourism operator, will aim to turn the park into a successful profit-making enterprise. The project is strengthening park management, while improving tourism facilities and securing self-financing options for the park. In order to meet standards expected by ecotourists, facilities need to be upgraded and capacity needs to be strengthened.

With over 4,000 people living in the park, communities and the local government have become engaged in setting up collaborative management arrangements and micro-credit schemes. This joint venture is expected to be making a profit by the seventh year, notably by increasing park entrance fees to US$20 with profits to be reinvested in environmental and social activities within the park perimeter. A collaborative management agreement between the joint venture, the Indonesian Conservation Department and the local government clarifies the divisions of responsibility between these three bodies in terms of conservation management, monitoring and enforcement, and sustainable livelihood activities.

Tourism is a major economic activity worth US$7,892 billion in 2008 and providing over 235 million jobs worldwide. For many countries biological wealth makes ecotourism a prime choice for income and employment generation.

Nevertheless, successful ecotourism presents certain challenges. For ecotourism to be sustainable and viable it needs to be adequately regulated and monitored to ensure that it does not cause environmental damage. Furthermore, the financial benefits of ecotourism are often accrued far from the tourist's destination, for example by package tour operators selling the product in Europe or North America. All too often limited funds reach the actual community or protected area concerned, where capacity to manage and benefit from ecotourism-related activities may be very limited.

Protected areas, such as national parks, remain key destinations for ecotourists, providing an important incentive for conservation and a potential source of revenue for both the parks and surrounding human communities. In many cases national parks have been established with the dual aim of conserving biodiversity and offering recreational value. For some destinations, such as Kenya and the Galapagos islands, nature-based tourism is by far the largest share of the tourism market (80% in Kenya) with most tourists visiting national parks. The Bank provided substantial support to the Kenya protected area system to enable the establishment of an autonomous and self-financing management authority. A GEF grant provides support to the Galapagos and several other key national parks in Ecuador.

With the aim of supporting diversification of Zambia's economy (currently heavily reliant on mining), the World Bank is providing a grant to Support to Economic Expansion and Diversification (SEED) that includes support to two protected areas (Kafue and Mosi-oa-Tunya National Parks) and aims to strengthen the ecotourism industry. Biodiversity conservation in the parks will be addressed in the framework of tourism development.

Marine protected areas often have considerable potential for ecotourism. A study from Cambridge University in the UK has demonstrated that in many cases the income generated by ecotourism can be substantially higher than that from unsustainable exploitation of natural resources. For example in the Philippines the estimated total economic value of a healthy coral reef for tourism, coastal protection and sustainable fisheries has been estimated at US$3,300 per ha versus unsustainable fishing generating US$870 per ha.

The Bank has supported conservation activities in marine protected areas from the Caribbean to Tanzania and Mozambique. In Central America, the Meso American Barrier Reef project is supporting transboundary cooperation in a chain of protected areas from Mexico to Guatemala, Belize and Honduras. The project has supported the training of fisher folk to reduce fishing pressure on marine resources and instead obtain income from ecotourism activities such as kayaking, diving, and catch and release sports fishing.

*Indigenous people have been managing ecosystems for centuries and their territories often overlap areas of high biodiversity. The role of Indigenous people in protection and conservation of biodiversity therefore needs to be revived, supported and valued.*

CASE STUDY

## Asserting indigenous rights in the Kaa-Iya del Gran Chaco National Park in Bolivia

The term "Kaa-Iya" refers to a set of minor gods who are the "owners" of natural resources and who provide the fundamental requirements for human survival, both physical and spiritual. Three indigenous groups inhabit Kaa-Iya del Gran Chaco: the Isoseño-Guarani people, a total of 10,000 inhabitants distributed in 25 communities; Chiquitanos made up of 15 communities; and the nomadic Ayoreode Groups, a Chaco-Chiquitano forest group. Since time immemorial these groups have managed their natural resources, practising sustainable agriculture, resource extraction, hunting and grazing. Now, external interests, particularly from illegal hunters, cattle ranchers and oil companies, present serious threats to their traditional way of life.

The ecosystems of the Gran Chaco, including xerophytic Chaco forest, dry deciduous forest and transitional semi-evergreen forest, are home to an estimated 1,500 plant species, and more than 500 animal species, notably the Chacoan Peccary (*Catagonus wagneri*), discovered in the 1970s, jaguars (*Panthera onca*), and the giant armadillo (*Priodontes giganteus*).

At 3.5 million ha, the Kaa-Iya National Park is Bolivia's largest protected area. It is one of the few protected areas in the world to be established and managed jointly by an indigenous community organization (the Capitanía del Alto y Bajo Isozu (CABI)) and a government protected-area agency (Servicio Nacional de Areas Protegidas (SERNAP)). In negotiations with the government, the Isozu-Guarani people were also able to negotiate their entitlement to a *Territorio de Communidad de Origin* (TCO), a 1.9 million ha buffer zone adjacent to the park.

The park benefits from a $1 million trust fund established by CABI and a consortium of petroleum companies as part of mitigation compensation negotiated for construction of gas pipelines through the park. A GEF project supports the park by providing 70% of the annual recurrent management costs, with the remainder coming from the trust fund. The TCO has benefited from a Bank allocation of $3.7 million for implementation of an Indigenous people Development Plan (IPDP) as part of the pipeline mitigation package. The park's management plan is jointly administered by the community and the government, with six different zones for the park, from a strictly protected core to an extensive extractive use zone which is reserved for use by Indigenous people.

In many places there is significant overlap between indigenous lands and protected areas: both are found in areas of high biodiversity, often in remote locations and in places with valuable natural resources. It has been estimated that traditional indigenous territories make up nearly a quarter (24%) of the earth's surface, and contain 80% of the world's ecosystems and biodiversity. Today, Indigenous people legally own an estimated 11% of the world's forest lands.

Many Indigenous people wish to retain natural or near-natural ecosystems within their territories, for practical and philosophical reasons. The establishment of indigenous and community conserved areas (ICCAs) can provide a framework for ***collaboration*** between indigenous groups and government authorities in a context of mutual respect. At the request of indigenous leaders, in 2002 the Bank established a Grants Facility for Indigenous people; by 2006 over half of the projects (52 out of 102) focused on co-management or direct participation in protected areas and buffer zone management.

Protected areas provide ***legal recognition as well as protection*** to indigenous groups. They serve to ***legitimize ancestral*** and traditional lands and approaches to land management. The Bank has supported many projects engaging indigenous communities, ranging from co-management of State national parks as at Kaa-Iya in Bolivia, to establishment and regularization of indigenous reserves. Participatory mapping in Belize's Sarstoon-Temash National Park enabled five indigenous communities to claim some of the Park's buffer zone as ancestral land. As a result, the Sarstoon-Temash Marine Management Area was established in May 2005 and is co-managed by an indigenous organization Sarstoon-Temash Institute for Indigenous Management (SATIIM), the government and coastal communities.

Similarly in Cambodia, a GEF project supported park staff and indigenous Brou, Kravet and Krueng communities to collaborate in the 350,000 ha mountainous Virachey National Park to develop and implement community resource management plans for areas overlapping the park. This support has helped indigenous communities to assert their rights in the face of powerful external timber interests.

The establishment of protected areas can also provide a framework for ***support and capacity building*** to indigenous groups. For example, in the Peruvian Amazon a Bank project with indigenous communities is providing support for: (i) participatory indigenous management of five protected areas; (ii) promoting economically, socially and environmentally sustainable investments by indigenous grassroots organizations; (iii) developing and implementing a participatory monitoring and evaluation system for the project areas and the National Natural Protected Areas System (SINANPE) as a whole; and (iv) strengthening the institutional and tech-

nical capacity of INRENA (National Institute of Natural Resources) and indigenous organizations to sustainably manage the protected areas and their resources.

In Ecuador conservation efforts focused on different management models, working with three groups of the Quichua people to protect around 250,000 ha in three community territories. Support was provided for development of management plans for all three territories, creation of a socio-environmental information center, and organization of a series of capacity building programs with the communities. Results include general agreement on a biological corridor, identified through participatory mapping exercises, and creation of a new Quichua association to help coordinate management.

## Iconic and wilderness values

*Large intact wilderness areas have enormous cultural value to many stakeholders; they also supply critical ecosystem services and protect some highly vulnerable human communities.*

**CASE STUDY**

### Otishi National Park and the Ashaninka and Machiguenga Communal Reserves, Peru

The Vilcabamba-Ambor Conservation Corridor includes some of the least-disturbed areas of the Tropical Andes biodiversity hotspot, stretching from Peru to Bolivia. The region is home to 40 different ethnic groups, many of whom have been established in the region for hundreds or thousands of years: the Machiguenga are reported to have been present for 5,000 years. Both the human communities and the ecosystem as a whole depend on maintaining large, intact areas against the triple threats of illegal logging for mahogany and other species, oil exploration and oil pipelines, and incursion by illegal coca farmers.

The Otishi National Park extends over 300,000 ha and forms the westernmost end of the conservation corridor. It was clear that creation of the Park in the wilderness area would only be acceptable if the legitimate needs of local and Indigenous people' communities were also addressed. A series of meetings and workshops were held with the Ashaninka and Machiguenga communities to address their concerns and determine and settle property rights before starting design of the protected area. The objective was to protect three key values: the watershed for several important rivers, the traditional resources and way of life for Indigenous people, and the region's unique ecosystem and biodiversity.

The result is a wilderness area with buffer zones where fishing, hunting, plant gathering and crop raising are allowed, and land that is securely under the management of traditional owners: the Otishi National Park and the Ashaninka and Machiguenga Communal Reserves. Traditional owners and park guards work together to protect against invasion. Threats remain: for example illegal logging enterprises have been offering money for mahogany and ecotourism has been introduced to provide alternative livelihoods. Nevertheless the wilderness area has been established in full cooperation with traditional owners, thus greatly strengthening its chance of long-term success.

As development expands, more-or-less intact ecosystems continue to shrink and disappear around the world. Conservation International (CI) estimates that 44% of the world's land surface is still effectively wilderness including 24 major wilderness areas, all at least a million ha in size and at least 70% intact. This wilderness area, approaching half of the world's land surface, only contains 3% of the popula-

tion. An earlier, more conservative analysis from the Sierra Club and the Bank estimated that around a third of the world (just less than 50 million square kilometers) was wilderness. Whatever the precise figure, pressures for resource extraction, particularly of timber and minerals, and for large-scale plantation agriculture continue to degrade and destroy the ecology of many wilderness areas.

While there is still some debate about the definition of wilderness, the term always implies that the ecosystem has remained substantially unchanged for a long period. Large protected areas can play a critical role in retaining wilderness values; setting aside large areas also protects many of the ecosystem services described in other sections, particularly watershed values.

The Bank has been working with client governments to support protection and rehabilitation efforts in many remaining wilderness areas. In Brazil, Bank and GEF support has assisted the hugely ambitious Amazon Regional Protected Areas (ARPA) program, which aims to triple the size of protected areas in the Amazon by 2012, adding 25 million ha, or an area the size of Spain. In the Western Congo Basin Moist Forest Ecoregion, the second largest tropical forest in the world, the Bank is working with partners to secure systems of protected areas together covering almost 36,000 $km^2$ of remaining forest, to provide biodiversity conservation and protect ecosystem services.

*Natural ecosystems provide many raw materials for survival and livelihoods, and are particularly important for poor and subsistence communities in developing countries.*

CASE STUDY

### Sustainable harvesting of reeds in the Lower Danube

The majestic Danube River, winding its way through 19 countries, was a source of inspiration to the musical master, Johann Strauss II. But the Danube River which inspired his masterpiece "*On the Beautiful Blue Danube*" in 1866 was quite different from the river today. Hydrological modifications (dams, dykes and weirs), pollution and excessive harvesting of natural resources have dramatically modified Europe's second largest river. Today through protection, sustainable management and restoration, the river and its wetlands are beginning to recover, and communities along the river and on its islands can make a living from sustainable harvesting of resources, notably reeds and fish.

The Bank has been engaged in a multi-stakeholder partnership (The Black Sea/Danube Strategic Partnership) since the early 1990s to reduce pollution of the river, restore its wetlands and develop economically and environmentally sustainable practices. The Wetlands Restoration and Pollution Reduction Project in Bulgaria had three components: 1) to restore two islands in the floodplain of the river; 2) to improve management of protected areas; and 3) to provide small grants to support economic activities compatible with conservation of the Danube's ecosystems and to reduce the agricultural activities which have led to excessive nutrient load. Altogether the value of the ecosystem goods and services restored under this program, including fisheries, is estimated at US$119 million per year. The project also helped to restore native reed beds, which filter pollutants and provide important habitat for nesting birds and fish. Sustainable harvesting practices have been introduced and new markets for reeds include for thatched roofs, fences, and production of eco-briquettes as alternative fuels.

An economic analysis by WWF found that the sustainable harvesting of natural resources, including NTFPs such as reeds, was more economically viable than initial plans to convert the Bulgarian Danube islands to poplar plantations. The value of the range of benefits, including reeds and other NTFPs, has been estimated to amount to at least EUR 500 (US$650) per ha per year.

Natural ecosystems provide: fodder and grazing for livestock; a wealth of timber products and NTFPs such as rubber, rattan, nuts, reeds, etc; corals and marine products for coastal communities; and building materials, both for subsistence and small-scale trading (see Table 3). These materials are for subsistence and sale,

**TABLE 3** **A typology of materials collected from natural ecosystems**

| Typology | Value | Example |
|---|---|---|
| Materials for **construction** or for physical protection (including timber, reeds, bamboo and grasses) | Housing | In Mexico's Yucatan peninsula, the value of palm thatch for roofing material is estimated at US$137 million per year. |
| Materials for **grazing** livestock (e.g. grasses, plants) | Food (livestock) | A significant percentage of India's 471 million livestock are sustained by forest grazing or fodder collected from forests. |
| **Fuels** (e.g. timber, fuelwood) | Fuel (cooking and heating) | In developing nations, an estimated 2.4 billion people—more than a third of the world population—rely on wood or other biomass fuels for cooking and heating. In a number of developed nations, timber and other wood products are also increasingly being promoted as an alternative to fossil fuels. In Switzerland, for example, biomass is seen as an important alternative source of energy; it is currently the second largest renewable source (after hydropower) and is expected to grow. |
| Materials for **handicrafts** (including grasses, reeds, seeds, wood, bamboo etc) | Income | In Namibia's Caprivi Game Reserve, one of the few sources of income for local women is through the sale of palm baskets to tourists. The raw material to make these baskets comes from well-managed palm trees in the reserve. By 2001 these producers had grown from 70 in the 1980s to more than 650. |
| Materials collected and **sold** (either as such or as inputs into other products) to provide income (including corals, sea shells, rubber, cork, honey etc) | Income | Matsutake mushrooms collected from China's Baimaxueshan Nature Reserve have helped to increase incomes 5 to 10-fold in 70 villages. Indeed, a kilogram of these mushrooms can bring more income than the average annual wage in Yunnan Province. |
| Materials with traditional, cultural or **spiritual** value | Cultural/ spiritual | In the Carpathian region NTFPs such as mushrooms, herbs and berries are extremely important culturally as well as economically. |
| **Food** (e.g.: nuts, mushrooms, honey)* | Food | In Algeria's El Kala national park, local communities engage in honey production both for local consumption and for resale. |
| **Medicine** (e.g.: plants, bark, flowers)* | Health | India and China harvest 90% and 80% respectively of their medicinal plants from the wild. |

* **Note:** materials used for food and medicine are covered in more detail in the relevant sections of this document

for direct or indirect use and for export or local use. Some of these goods enter a country's national accounts (for example, the global rattan trade estimated to be worth US$2,000 million each year), but many goods are collected simply for local subsistence by rural people.

Estimates of both the cash and subsistence value of NTFPs worldwide are as high as US$100 billion per year. In India alone, about 275 million poor rural people depend on forests for both subsistence and income which they obtain from fuelwood, fodder, timber and a range of NTFPs, such as fruits, flowers and medicinal plants.

Certain categories of protected areas (IUCN categories IV, V and VI), as well as designated zones within some parks and wildlife reserves, allow a certain amount of harvesting, under management agreements, at levels that will not negatively affect individual species or the overall ecosystem. In controlled quantities and subject to certain regulations, this collection of natural resources can be sustainable. Three elements are important in this respect: 1) assessing what is a sustainable harvest; 2) implementing arrangements to maintain sustainability; and 3) securing the overall effective management of the protected area so that its biodiversity and ecosystems are secured. Thus, in the Sultan Sazligi Game Reserve in Central Turkey reed harvesting for export generates US$1 million per year but harvesting is closely controlled to protect this wetland, which is a critical breeding ground for the vast number of migratory birds.

On the fringes of the Periyar Tiger Reserve, in India, 35,000 people depend on the reserve for natural products: 57% for fuelwood collection, 28% for grass and 13% for non-wood forest products. In order to manage this dependence on the reserve, the India Ecodevelopment Project (IEDP) has helped to establish eco-development committees and allowed thatch and firewood collection in designated areas to reduce the impact of harvesting on the protected area. The project also introduced other livelihood options for local communities, including ecotourism and organic agriculture. In Madagascar, the Biocarbon Fund is supporting activities in the Ankeniheny-Zahamena-Mantadia Biodiversity Conservation Corridor which aim to create a 420,000 ha sustainable use protected area (notably by restoring and connecting forests across three existing protected areas). The project will aim to support local communities to establish wood and fruit gardens and to improve their livelihoods through the sale of NTFPs.

*Protected areas provide open-air classrooms for both students and adults.*

CASE STUDY

## Using theatre in African protected areas to conserve critically-endangered species

The Critical Ecosystem Partnership Fund (CEFP), which is part-funded by the World Bank and GEF, has supported a unique educational project in Taï, Marahoué and Banco National Parks in Côte d'Ivoire, the Fouta Djallon region in Guinea, the Lofa-Mano-Gola forest area in Sierra Leone and around Sapo National Park in Liberia. The project aimed to bring "the life of chimpanzees" direct to the local communities living near chimpanzee populations, to increase public awareness and support for conserving this critically-endangered primate and its habitat.

Increased awareness about primates is particularly important in West Africa, where conflict and a breakdown in law enforcement have led to an increase in poaching. At the core of the project is "Nos cousins de la Forêt" (*Our Cousins from the Forest*), a play about chimpanzees and their coexistence with humans. Created by local theatre company Ymako Teatri in collaboration with Wild Chimpanzee Foundation (WCF), the play has been performed in over 50 villages located in close proximity to chimpanzee populations. The aim is to change public attitudes about eating chimpanzee meat.

The success of this novel awareness-raising approach has been studied by sociologists from the University of Abidjan and the Centre Suisse de Recherches Scientifiques. Villagers' attitudes towards eating chimpanzee meat were assessed before and after seeing the play; 112 villagers, representing 70% of those questioned, stated that chimpanzee meat was a favorite before seeing the play. After the theatre performance only 1% said they preferred chimpanzee meat. In one village, after seeing the play the chief proclaimed the chimpanzee as a totem and therefore it became taboo for the 3,000 villagers to kill these apes.

In the Taï region of Côte d'Ivoire, two school theatre groups around the Taï National Park have been trained to perform an adapted version of the play. In Banco National Park, WCF has been monitoring chimpanzee population size, behaviour and group composition; fewer hunting snares are being set up in the park than before the chimpanzee project.

In 2008 and 2009, given its success, the WCF expanded the project into Liberia working with the Liberian Theatre Group "House of Freedom" to create a new theatre piece, entitled "Chimpanzees, Our Closest Relatives". The play has been performed in 19 different towns and villages around Sapo National Park and Grebo National Forest in the east of Liberia. More than 9,000 people have had the opportunity to watch the play and two films about the chimpanzees of the Taï National Park.

Educational best practice is increasingly seeing the benefits of moving from lecture-oriented sessions where students are passive learners to hands-on experiences where students are active participants. A whole discipline has evolved around environmental education where learning is undertaken in the natural environment. This type of education encourages people to develop a bond to the natural world.

Protected areas can play a key role in environmental education, with staff and infrastructure to provide the resources for teaching and information provision. For instance, a Ghana coastal zone project worked in five priority coastal wetland sites to develop activities compatible with preserving their ecological integrity. Facilities were developed at each site to support appropriate environmental education activities and to provide resources for a non-governmental organization for schoolchildren.

In many developing countries the Bank has supported theater and mime as an effective way to spread the conservation message to local people living in and around protected areas (see above). In Southern Africa, it supported the Africa Resources Trust to establish a multinational theater troupe, which develops plays and mimes that build on local culture and experience of human-wildlife conflicts to educate about conservation and sustainable use. Community theater also helped to build support for conservation efforts on Lake Malawi and in dryland savannahs throughout southern Africa.

Education can take many forms, but it needs to be based on culturally-appropriate information. The Bank has thus been particularly active in developing local language field guides, especially for countries in Africa and Asia. The Indonesian Institute of Sciences, through the Indonesia Biodiversity Collections project, for example, helped to commission or translate 15 field guides covering plant and animal species including birds, amphibians, dragonflies, snails, bamboos, orchids and wild bananas. Working with NGOs, scientific institutions and national park authorities, the Bank has supported more than 110 field guides in local languages covering a range of flora and fauna in Africa, Asia, Eastern Europe, the Middle East and South America.

*Many breakthroughs in medicine, science and technology have been reached through detailed study of natural systems.*

**CASE STUDY**

### Monitoring and research in the Galápagos Islands

The Galápagos Islands in Ecuador epitomize the importance of natural ecosystems as the inspiration for scientific research. The islands have been called a "living museum and showcase of evolution" because of their isolation and geology. Charles Darwin's observations on the Galápagos are credited with the development and acceptance of one of the world's great scientific discoveries: that evolution occurs by the process of natural selection. The Galápagos have been a magnet for researchers ever since and in 1959, the centenary year of Charles Darwin's publication of *The Origin of Species*, the Ecuadorian government declared 97.5% of the archipelago's land area as a national park. Ten years ago the Bank supported Fundación Natura and WWF to establish monitoring and support research on the Galápagos Islands. The project established a system to monitor the impact of fishing activities and biological monitoring systems, as well as systems to monitor the impacts of tourism and the social and economic status of the local population. Although the site was put on the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage in Danger list in 2007 due to the impacts of invasive species, growing tourism and immigration, the development of long-term research and monitoring in the islands provides a good basis for understanding threats and implementing effective management. The Galápagos will remain a living laboratory for science for years to come.

To date only a small proportion of the Earth's biodiversity has been taxonomically described and little is known of the complex interactions between species or which species may have potential benefits for humankind.

The value of biodiversity and natural resources is gradually being recognized, most recently in the series of reports from The Economics of Ecosystems and Biodiversity (TEEB) project. Estimates of the global value associated with the use of plant genetic resources in food and agriculture alone vary from hundreds of millions to tens of billions of dollars per year. One estimate, for example, puts the annual value of products derived from the exploitation of plant genetic resources at US$500–800 billion.

Many protected areas have research as a major objective, both for reserve management purposes and more generally to generate scientific knowledge. Strictly protected scientific reserves (i.e. IUCN category Ia) for instance, are designated for research, as are many UNESCO Man and Biosphere Reserves that are testing and demonstrating approaches to conservation and sustainable development. Many protected areas provide opportunities for research on individual species as well as for scientists to study natural ecosystem functioning.

The Bank has supported the development of monitoring and research activities worldwide. The Bank is one of several donors to support the work of Costa Rica's National Institute for Biodiversity (INBio) and the National System of Conservation Areas (SINAC) to inventory and monitor the biological diversity of the country's conservation areas. In its more than thirteen years of intensive surveys, INBio has discovered an average of two species per day which were new to science. Many of the protected areas in Costa Rica have been used for bioprospecting (the search for wild species that contain chemicals with potential medicinal or commercial applications), and since its inception in 1989 INBio has signed 19 agreements with industry and 18 with academic institutions.

In the marine world, a Bank/GEF project in collaboration with the UNESCO Intergovernmental Oceanographic Commission (IOC) and academic institutions has supported a team of over 60 scientists to answer critical questions concerning coral reef vulnerability to human stresses (including coral bleaching and local ecological responses, coral diseases, large-scale ecological processes, recruitment and connectivity, coral restoration and remediation, and the impacts of climate change) using remote sensing and modelling and decision support. The project aims to provide coral reef resource managers with the best available scientific advice on coral reefs' response to human disturbances and climate change.

*Protected areas can help to promote transboundary cooperation and rebuild security and collaboration following political tension or conflict.*

**CASE STUDY**

### Trans-national collaboration and cooperation across boundaries in southern Africa

Transboundary conservation (e.g. cooperative management of conservation across an international boundary) represents an ideal whereby conservation can promote sustainable development and cooperation. In some cases, where countries have been actively in conflict over borders, transboundary protected areas established jointly have been used to forge a peaceful outcome and to foster improved relationships.

The World Bank's Maloti-Drakensberg Transfrontier Project (MDTP) took place in the 300 kilometer stretch of alpine and montane ecosystems along the southern, eastern and northern borders of the landlocked mountain Kingdom of Lesotho and the Republic of South Africa. Between 2002 and 2007 the MDTP received GEF funding of over US$15 million to help both conserve globally significant biodiversity and contribute to community development through nature-based tourism, improved agricultural practices, land-care strategies and PES.

Before the democratic transition of South Africa in 1994, the two countries were far less likely to cooperate due to the policies of the apartheid government of South Africa. The Maloti-Drakensberg border area was a route for armed insurgence masked by cattle rustling and other illegal activities. The MDTP project, however, has represented one of the means by which the two countries have sought to find common ground, learn from each other and discuss ways to deal with the difficulties of managing protected areas and community interactions in these remote mountain highlands.

A large number of conflicts between nation states around the world focus on the borders between countries. Border disputes often arise in relation to the control over natural resources, such as rivers (at least 261 of the world's major rivers are shared between more than one country), fertile farmland, mineral or oil resources; through disputes related to culture, religion and ethnic nationalism; or from a lack of clarity in the treaty that set up the original boundary.

Many national borders follow natural features, such as mountain ranges or river courses, and for this reason can include some of the world's most biologically rich

ecosystems. Despite the political boundaries running through these areas there are many examples worldwide of multi-national natural resource management arrangements across borders, which have either resolved conflict or averted conflict arising in the first place. For example, the Nile Basin Initiative (which the Bank has been supporting since 1997) involves collaboration among nine countries to share water resources in a sustainable and equitable way and thus help to ensure and promote regional peace and security. Increasing the level of cooperation between managers of natural resources on either side of a political border can have important conservation benefits, but experience has shown that it can have political and social benefits as well.

In recent years, politicians, conservation organizations and governments have recognised that conservation of natural resources can contribute to the achievement of multiple goals simultaneously—including security and cooperation. Parks for Peace, defined as "*transboundary protected areas that are formally dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and to the promotion of peace and cooperation*", have been established in many parts of the world, and can be effective in helping resolve boundary disputes between countries by providing a jointly controlled buffer zone where management can focus on global rather than local issues. Along part of the common border between Ecuador and Peru, for example, the Cordillera del Cóndor Transboundary Protected Area was declared to help support the resolution of a boundary dispute between the two countries.

The Bank's global reach puts it in a good position to contribute to solving resource conflicts between nations. For example, Bank and GEF funding is supporting a series of regional water resources and environment programs that focus on management of shared waters. These include programs for the Baltic Sea, Black Sea, Danube River Basin, Lake Ohrid, and Lake Victoria. In the Danube River Basin, for example, the Bank has helped three countries: in Bulgaria, the Bank has helped strengthen management of the Danube Delta Biosphere Reserve Authority; in Romania, the Bank has helped local communities and authorities in Persina Nature Park and Kalimok/Brushlen Protected Site adopt sustainable natural resource management practices; and in the Ukraine, the Danube Delta Plavni Reserve has been supported. Elsewhere, a transboundary project in the West Tien Shan has supported collaboration between three former Soviet republics: Kyrgyz Republic, Kazakhstan and Uzbekistan. Indeed, many of Bank's projects include objectives linked to solving resource conflict issues in protected areas including the Colombian National Protected Areas Conservation Trust Fund, which is supporting participatory environmental management plans that address root causes of natural resource degradation and reduce conflict over unsustainable resource exploitation.

# Conclusions

## Assessing values and benefits: many figures and multiple options

As described above, protected areas established and managed primarily for biodiversity conservation can provide a host of other benefits, including resources that provide direct economic returns, subsistence resources and less tangible benefits such as spiritual peace or mental well-being. In line with its poverty alleviation mission, many projects in the Bank's biodiversity portfolio already emphasize other benefits of protected areas beyond strict biodiversity conservation.

Benefits from protected areas can be direct and indirect. In practice, these benefits are often rather poorly defined and confused, so that for instance compensation paid to a community for loss of goods and services (an indirect benefit) is treated as being the same as benefits gained from the conservation of values that results in tourist revenue or increased fishing opportunities (a direct benefit). In this paper we discussed only direct benefits: i.e. those arising directly from the existence of the protected area itself.

The values of protected areas can be described in economic or non-economic terms. At one extreme, concrete economic benefits could be the money gained by a community from tourist lodges at the edge of a national park, while at the other extreme intangible benefits might be the spiritual well-being that people gain from the preservation of an ancient sacred site within a reserve (a value impossible to translate into conventional economic terms).

It is also important to distinguish between real and theoretical values. Many studies of ecosystem values or other kinds of benefits look at theoretical values, i.e. an estimate of the value if users were paying the market rate or paying for a substitute. This is commonly done to show the benefits of, for example, natural ecosystems buffering against climatic events such as flooding as compared to paying for replacement engineering solutions. These figures are very useful in helping to convince policy-makers and others of the value of specific ecosystem services, but they tend to be speculative with no proof that anyone is actually prepared to pay that price. Environmental services in particular are often regarded as free, or at least very cheap, goods by governments and industry. Because such values are unrecognized, where monetary benefits do arise they are rarely distributed equitably to those who are conserving the value.

## Translating values and benefits into economic terms

It has been estimated that the world spends around US$6.5 billion (2000 values) each year on the management of the existing protected areas network; but in fact a figure of more like US$20 to US$28 billion is required annually to achieve an effectively-managed and ecologically-representative terrestrial protected area system as prescribed in the CBD work plan. In addition, adequately protected marine reserves, covering some 30% of total area, would cost an estimated US$23 billion per year in recurrent costs, plus some US$6 billion per year (over 30 years) in start-up costs.

This discrepancy between actual spending and perceived need has been one of the main drivers behind the increasing number of studies to look at the economic value of protected areas. Globally, it has been estimated that ecosystems within protected areas deliver US$100 worth of services for every US$1 invested in management to maintain provision and increase delivery of ecosystem services.

Putting a price on benefits from individual protected areas is an enormous challenge, let alone calculating costs and benefits. Where studies have taken place, they tend to look at single values; research assessing multiple functions and uses, looking at the impacts of conservation management over time or looking at overall cost-benefit analysis, remain rare. Moreover, not all protected areas will provide multiple benefits or have a high economic value even though they may be important sites for biodiversity conservation. Areas that do provide multiple benefits may find that promoting some benefits can be at the cost of others; promoting ecotourism, for example, might be at the cost of some of the potential of a protected area for fisheries. The total of all benefits may therefore not be strictly cumulative. In economic terms, the total economic value of a protected area should take into account tradeoffs in benefits when calculating overall value.

In the last few years, however, a number of tools and studies have been developed which can help build a picture of the values and benefits of protected areas: first, identifying the values and benefits they provide (including identifying the beneficiaries). Second, quantifying these benefits using various economic tools already in existence (see Table 4 below); and third, a range of tools developed that can help translate these theoretical benefits into actual benefits, such as PES schemes.

**Step 1: Assessing protected area benefits: PA-BAT**

The Protected Areas Benefits Assessment Tool (PA-BAT) was developed as a simple instrument to broaden understanding of the benefits provided by any protected area. This tool is meant to serve as a checklist of the different values that a

protected area could offer and to help those using it to identify beneficiaries. The PA-BAT can also serve to record economic valuation, sustainability issues, biodiversity impacts and management responses.

**Step 2: Evaluating benefits**

There are many different valuation methods (see Table 4) applicable to different situations and values of different services. For example: food, timber and fuel wood can be valued using market prices, while water filtration and storage are more likely to be valued by assessing replacement cost, net factor income or production function. Visual aesthetics can be valued using contingent valuation, hedonic pricing or choice modelling methods.

**Step 3: Identifying mechanisms to transfer benefits**

The benefit (safe drinking water for example) provided by protected areas or healthy ecosystems has often been considered as a free good. Increasingly, however, as more benefits are explicitly being identified and quantified, payments for securing these benefits are being put in place. The Bank and others have promoted PES schemes, but these can only work when the benefit is tangible and quantifiable.

**Step 4: Assessing protected area financial status, needs and sustainable financing context**

The existing financial status of a protected area needs to be understood, from examination of management plans, work plans or budgets. The GEF has a scorecard that can provide a quick snapshot of financial needs.

**Step 5: Decision-making and implications for management**

Managing protected areas for multiple benefits brings with it additional complexities. For example, protected areas that are managed for ecotourism require careful regulations and monitoring to ensure that tourists do not negatively affect the biological diversity they came to see and experience. This may require new zoning of the protected area, new skills for protected area staff, new facilities etc.

**TABLE 4** **Valuation methods, application and limitations**

| Method | Approach | Applications | Examples | Limitation |
|---|---|---|---|---|
| Market price | Observe process directly in markets | Goods and services from protected areas that are traded in markets | Timber and fuelwood from forests; water resources | Market process can be distorted, e.g. by subsidies. Protected area services often not traded in markets |
| Replacement cost | Estimate cost of replacing environmental service with man-made service | Ecosystem services that have man-made equivalent that could be used and provides similar benefits to the environmental services | Coastal protection by mangroves, water storage and filtration in forests and wetlands | Over-estimates value if society is not prepared to pay for man-made replacement. Under-estimates value if man-made replacement does not provide all the benefits of the environmental services (i.e. biodiversity benefits) |
| Damage cost avoided | Estimate damage avoided due to ecosystem service | Ecosystems that provide protection to infrastructure and other assets | Landslide/ avalanche protection from forests, wetland protecting against floods | Difficult to relate damage levels to ecosystem services |
| Net factor income | Revenue from sales of environment-related good minus cost of other inputs | Ecosystems that provide an input in the production of a marketed good | Filtration of water by wetlands, commercial fisheries supported by nursery areas protected by coral reefs | Over-estimates ecosystem values |
| Production function | Estimate value of ecosystem service as input in production of marketed goods | Ecosystems that provide an input in the production of a marketed good | Commercial fisheries supported by nursery areas protected by coral reefs; materials used in handicraft production | Technically difficult. High data requirements |

*(continued on next page)*

**TABLE 4** **Valuation methods, application and limitations *(cont.)***

| Method | Approach | Applications | Examples | Limitation |
|---|---|---|---|---|
| Hedonic pricing | Estimate influence of environmental characteristics on price of marketed goods | Environmental characteristics that vary across goods | Air quality, scenic beauty, cultural benefits | Technically difficult. High data requirements |
| Travel cost | Travel costs to access a resource | Sites used for recreational purposes | Protected areas | Limited to recreational benefits; hard to use when trips are to multiple destinations |
| Contingent valuation | Ask respondents directly the amount of money individuals are willing to pay for a specified service | Any environmental good or service | Species loss, protected areas, air pollution, clean water | Expensive to implement |
| Choice modelling | Ask respondents their willingness to pay for their preferred environmental goods or services from a set of alternatives with particular attributes | Any environmental good or service | Species loss, protected areas, air pollution, clean water | Expensive to implement. Technically difficult. |
| Value transfer | Use values estimated at other locations | Any environmental good or service when comparison studies available | Species loss, protected areas, air pollution, clean water | Can be inaccurate, as factors vary even when contexts seem 'similar'; should be used with caution |

# Key sources


Dudley, N. (Editor) (2008); *Guidelines for Applying Protected Area Management Categories*. Gland, Switzerland: IUCN. x + 86pp.

Dudley, N. S. Stolton, A. Belokurov, L. Krueger, N. Lopoukhine, K. MacKinnon, T. Sandwith and N. Sekhran eds. (2010); *Natural Solutions: Protected Areas Helping People to Cope with Climate Change*. IUCN-WCPA, TNC, UNDP, WCS, World Bank and WWF, Gland, Switzerland.

ICEM (2003); *Lessons learned in Cambodia, Lao PDR, Thailand and Vietnam*. Review of protected areas and development in the Lower Mekong River region. Indooroopilly, Australia.

Millennium Ecosystem Assessment (2005); *Ecosystems and Human Well-being: Biodiversity Synthesis*. World Resources Institute, Washington, DC.

Red List of Threatened Species (n.d.); http://www.iucnredlist.org

Schuyt, K and L Brander (2004); *The Economic Values of the World's Wetlands*, WWF, Gland, Switzerland

Sobrevila, C. (2008); *The Role of Indigenous people in Biodiversity Conservation: The Natural But Often Forgotten Partners.* The World Bank, Washington, D.C.

Stolton S. and N. Dudley (eds.) (2010); *Arguments for Protected Areas*, Earthscan, London

Stolton, S. and Dudley, N. (2009); The Protected Areas Benefits Assessment Tool, WWF, Gland, Switzerland

www.panda.org/what_we_do/how_we_work/protected_areas/arguments_for_protection/

TEEB (2009) ; The Economics of Ecosystems and Biodiversity, Summary for Policy Makers. UNEP and EC, Nairobi and Brussels, Kenya and Belgium

World Bank (2003); *Cornerstones for Conservation: World Bank Assistance to Protected Areas*, The World Bank, Washington DC, US.

World Bank (2006); *Mountains to Coral Reefs: The World Bank and Biodiversity 1988–2005.* The World Bank, Washington, DC , US.

World Bank, GEF and UNDP (2007); *Reducing threats to protected area: Lessons from the field.* The World Bank and UNDP, Washington DC and New York, US.

World Bank (2008); *Biodiversity, Climate Change, and Adaptation Nature-Based Solutions from the World Bank Portfolio*. IBRD/The World Bank, Washington DC, US.

World Bank, (2010); *Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change*, World Bank, Washington DC, US.

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