

was created to protect the largest freshwater reserve of the country. In a region where rainfall has been reducing, this Ramsar site plays a crucial role for water supply for the city of Buba as well as contributing to local livelihoods and the survival of hundreds of plant and animal species.

Future needs: Recognising the role of protected areas

Payments for Ecosystem Services

One way to encourage more active protection of water quality and quantity through ecosystem protection is to raise awareness about the benefits of conservation and to reward those that maintain healthy ecosystems. Payment for ecosystem services (PES) schemes and more specifically Payments for Watershed Services (PWS) to compensate protected areas, communities, indigenous peoples and private landowners for maintaining forests and other water regulating habitats are already being piloted in Colombia, Ecuador, Mexico and Nicaragua. In Costa Rica the government-led PES programme rewards forest owners for ecosystem services such as watershed protection, carbon sequestration and biodiversity protection. PES schemes in Costa Rica have been implemented since 1997, with a total investment to date of over US\$100 million. More than 80% of these payments support conservation and sustainable management in national parks, biological corridors and strategic water catchments. Each hectare of forest is estimated to be worth between US\$40–100 for the service provided in protecting watersheds.

Protected areas are not a universal solution to managing water resources, but they can help to secure high quality water supplies, and to address problems of both scarcity and excess – both likely to increase as a result of climate change and increasing population. Moreover well-designed protected areas within a mosaic of other land uses can help to maintain the condition of river basins and contribute to connectivity, maintaining habitat and hydrological links and contributing to water sources in the wider basin.

To be effective in maintaining water supplies, protected areas need to be well managed, well resourced and defended by a range of stakeholders. Some water companies and government agencies already recognise the key role of protected areas in maintaining water supplies but too often these services are regarded as “free goods” and are rarely, if ever, acknowledged in national accounting.

The economic benefits from provision of ecosystem

services, however, can more than justify the costs of effective conservation and sustainable management of natural ecosystems. Although the value of ecosystem services in terms of water regulation and supply has been estimated at US\$2.3 trillion globally, very little of this potential value is spent on ensuring that these ecosystem functions are sustained.¹ Policy and management reforms are needed to ensure that protected areas are recognised and managed for their key role in maintaining vital water supplies:

1. Promote better understanding, valuation and awareness of the linkages between effectively managed protected areas and reliable water supplies in different geographical settings.
2. Establish and expand protected areas in critical watersheds, under an appropriate range of governance and management mechanisms, to maintain water supplies.
3. Improve management within protected areas to maintain water services, including enhanced protection to maintain natural vegetation cover, management of wetlands and control and management of invasive alien species.
4. Restore degraded habitats and manage wetlands within protected areas to enhance watershed functions.
5. Implement effective PES schemes to reward and fund water service provision through protected areas under a range of governance mechanisms, from state reserves to indigenous reserves and community conservation areas.

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Protected areas maintaining essential water supplies

Water is the basis of all life, yet water management remains a complex challenge; planners face problems from too much water, too little water, contaminated water and water in the wrong place at the wrong time. Any given location can suffer from all these problems, sometimes in a single year. Changing climate, environmental degradation, human population growth and concentration in urban environments, are all contributing to water shortages and increasing concern over future supplies. Protected areas already provide many communities with reliable and well-regulated sources of clean water. Yet these services are often unrecognised or under-valued. Meeting the rising demand for water will require better coordination among water utilities, planners, watershed managers, protected area agencies and communities to ensure recognition and support for intact ecosystems, including forests and wetlands, which maintain sustainable water supplies.

Protected areas: guaranteeing access to water

The provision of adequate, safe supplies of water is now a major source of concern, expense and political tension. Water regulation and supply has been estimated to be worth US\$2.3 trillion globally¹. Water is a renewable resource but poor planning, inefficient 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. One in five people in the developing world live without a reliable water supply and two billion city dwellers do not have adequate sanitation. Lack of clean water increases infant mortality and the prevalence of water-borne diseases, reducing productivity, straining health services and causing millions of deaths every year. Dirty water is one of the world's largest killers, particularly of children. A key UN Millennium Development Goal is to: *Reduce by half, by 2015, the proportion of people without sustainable access to safe drinking water*². Furthermore, water shortages undermine agricultural productivity, while excess water, as a result of storms and floods, brings a constant toll of human misery and economic costs. Unfortunately, many of the places that suffer floods also, in different seasons, undergo severe droughts, which ruin crops, kill livestock and undermine development. Protection of natural habitats to sustain availability of regular, high quality



Access to clean fresh water is a problem in many countries

water is a strong foundation for agricultural and economic development.

River basin and water resource management, involving a mix of habitat protection and sustainable use, provides an effective solution to safeguarding water supplies and ensuring ecosystem services. Functioning natural ecosystems can help to maintain water quality, and in some circumstances can also help to regulate the seasonal quantity of water available (through maintenance of slow subsurface flows, filtration and groundwater renewal). Protected areas are one of the most effective tools for maintaining ecosystems in a natural state and thus help to maintain services vital to human welfare, especially water. Water from protected areas is important for domestic use and subsistence agriculture as well as for large-scale irrigation, industrial use, and hydroelectric power and as a source of municipal drinking water. By protecting and maintaining water sources, protected areas also support the rich diversity of aquatic species found in rivers, lakes and wetland ecosystems.

Protected areas: helping ensure adequate water supplies

Many countries are already experiencing water shortages, and water stress will be one of the key environmental challenges in coming decades. Protected areas can help to maintain clean and well-regulated water supplies³. Mountain cloud forests⁴ and *paramos* capture fog or wind-driven precipitation, as well as direct rainfall, and

add it to the water budget. The cloud forests of La Tigra National Park in Honduras provide more than 40% of the annual water supply to the capital city, Tegucigalpa⁵. Similarly cities such as Melbourne, Australia, factor management of old eucalypt forests into plans for maintaining adequate water supplies. Wetlands in protected areas, set aside from development and buffered against pollution, also provide critically important water supplies and protection from flooding for many populations.

Water availability is threatened by habitat degradation and biodiversity loss. In South Africa, for instance, invasive alien species are estimated to affect 10 million hectares (8.28% of the land area) with significant ecological and economic costs. With high evapotranspiration rates, invasive trees are an immense burden to already water-scarce regions and reduce the amount of water available to reservoirs, industry and downstream agriculture. Accordingly, large-scale programmes to clear invasives are being undertaken as part of management in many of South Africa's protected areas, providing benefits to biodiversity, water supplies and employment opportunities for poor and disenfranchised communities under the Working for Water Programme.

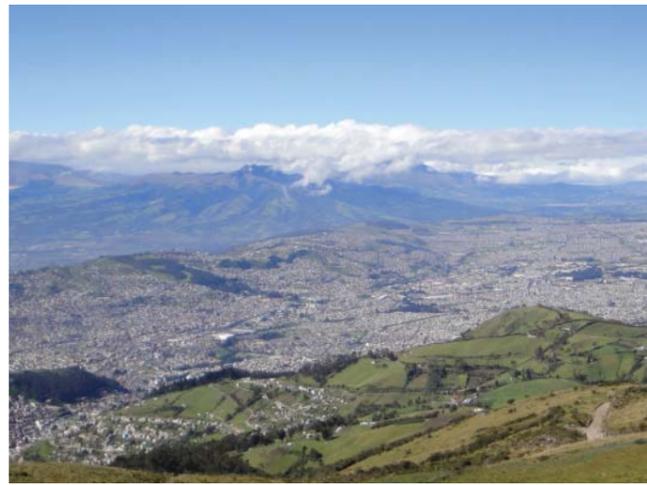
Protected areas: improving the quality of water resources

Most people drink water collected or diverted from existing freshwater sources. Until recently, the main focus of efforts to improve water supply and sanitation has been on better distribution systems, treatment plants and sewage disposal but the role of natural ecosystems in water supply and purification has not been fully appreciated nor valued. Functioning natural ecosystems within well-managed watersheds and protected areas provide efficient and cost-effective ways of supplying clean water. One third of the world's largest 100 cities, including Jakarta, Dar es Salaam, New York, and Sydney, rely on protected areas for a substantial part of their domestic water supply.⁶

High-altitude, tropical montane vegetation provides clean water supplies to major cities in Latin America. Bogotá, for instance, derives its drinking water from the

The Australian Alps Catchments

Australia is the driest permanently-inhabited continent on Earth, making water availability a key determinant of settlement, agricultural productivity and industrial development. The 11 interconnected protected areas of Australia's highest mountains, the Australian Alps, span 1.64 million hectares and conserve catchments which deliver on average 9,600 Gigalitres of high quality water annually to Australia's food bowl, the Murray-Darling Basin. This water constitutes about 30% of the total annual basin inflows; it benefits more than 2 million people, and at an estimated worth of AU\$10 billion per annum, it is of national economic significance. The high water yields, natural flow regimes and high quality water yield are directly linked to good, natural catchment condition supported by well managed protected areas.



Quito, Ecuador, protected areas supply 80% of drinking water

paramos protected in a nearby national park. Elsewhere, natural ecosystems, including wetlands and grassland, play a key role in reducing pollution levels and particulate matter in water. Wetlands can reduce high levels of nutrients, and some water plants concentrate toxic materials in their tissues, thus purifying surrounding water.⁷ For example, Florida's cypress swamps remove 98% of all nitrogen and 97% of all phosphorus from wastewater entering the wetlands.⁸ Protected areas

In many parts of the world adequate supplies of potable water depend on protected areas

- ▲ Kerinci Seblat National Park in Indonesia 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 hectares of irrigated farmlands.
- ▲ In Ecuador, about 80% of Quito's 1.5 million residents receive drinking water from two protected areas in the Andes.
- ▲ The 22,000 hectare Te Papanui Conservation Park, in New Zealand's Lammermoor Range provides the Otago region with essential water flows valued at NZ\$ 93 million for urban water supply, NZ\$12 million for irrigating 60,000 hectares of Taieri farmland and NZ\$ 31 million for hydroelectricity.
- ▲ Protected areas are particularly valuable in water resource terms where they occur upstream of large population centres in dry environments. The Cholistan Wildlife Sanctuary upstream of Karachi (population 18 million), for example, provides water services estimated at US\$ 100 million per year to the downstream population.
- ▲ The New York City watershed provides water to some nine million people through six reservoirs in the Catskills Mountains. Careful management of the landscape and protected areas provide the largest unfiltered water supply in the U.S.A., costing millions in watershed protection but avoiding billions of dollars in infrastructure costs for filtration.

also help dilute contaminants derived from upstream agriculture thus ameliorating water quality in agriculturally-dominated landscapes in the world's major river basins.⁹

Protected areas and water: contributing to food security and energy supplies

Agriculture is the largest user of freshwater globally, using as much as 50% of freshwater in many countries and up to 95% in some developing countries. Irrigated agriculture produces over a third of the global food harvest 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 increasing; by 2030, irrigated crop production is expected to expand by 80% in order to meet global demand¹⁰.

Securing water supplies in South Africa

The five main rivers of South Africa's Kruger National Park have suffered from pollution and unsustainable water use upstream, which has led to some rivers drying up completely at times of low rainfall. After implementation of a large river-related programme with major stakeholders (e.g., agriculture, forestry and mining), rivers continue to flow, water quality has improved (or in some cases declines in quality have been slowed down) and certain local rural communities have benefited, as have several aquatic species in these rivers inside and outside the park. Even though the park does not include the headwaters of these rivers, it has the stature nationally to be able to effectively influence the decisions of a range of stakeholders that operate within the watershed.

Protected areas can secure a reliable supply of water that is essential for successful crop production and food security:

- In the Dominican Republic, the Madre de las Aguas Conservation Area protects the source of 17 rivers that provide water for domestic use and irrigation to over half of the country's population.
- In Venezuela, about 20% of irrigated lands depend on protected areas for water and habitat protection. By reducing downstream sedimentation, protected forests extend the lifespan of irrigation schemes by 10–30%.
- In Sulawesi, Indonesia, the Bogani Nani Wartabone National Park was established to protect a major irrigation project designed to increase rice production.
- Ankarafantsika National Park in Madagascar protects water supplies to the rice-producing region of Marovoay plains, and the Lac Alaotra watershed, a Ramsar site, serves about 80,000 hectares of rice farms.

Hydropower is the third largest source of energy worldwide, providing approximately 20% of global energy. It is the largest source of renewable energy and

is expected to increase further with efforts to reduce greenhouse gas emissions. Hydropower already provides 80% of Brazil's and 92% of Nepal's electricity generation. As countries increase their reliance on this form of energy, protected areas have a role to play in the success and longevity of hydropower schemes:

- In the Mekong region in South-East Asia, over 40 major existing and proposed hydropower projects are linked to protected areas to help to maintain sustainable water supplies.
- The Nam Theun 2 Hydropower project in Lao PDR will supply electricity for export to Thailand. Upstream of the hydropower plant, a new protected area, Nakai Nam Theun, has been created to protect 400,000 hectares of forest and reduce sedimentation of the dam. The hydropower company will fund the management of the protected area and adjacent forest corridors for 30 years, with a budget of US\$1 million per year.
- Many of Colombia's parks situated in the Andes above 4,000 metres, such as the Los Nevados National Natural Park, safeguard water supplies to downstream hydropower plants which supply 60% of Colombia's power supply.
- In Peru, 60% of the hydroelectricity produced comes from rivers in protected areas, a service valued at US\$320 million annually.

Unfortunately the development of upstream reservoirs, irrigation dams and hydropower can reduce ecological flows and impact on biodiversity in downstream habitats. Freshwater biodiversity is particularly diverse in lowland areas, but these biomes are some of the least well represented in protected areas. Sites such as the Ramsar lowland wetlands in the Murray-Darling Basin in Australia are important for maintaining environmental flows; the protected area status of the Coorong, Lakes Alexandrina and Albert, the Gwydir wetlands and the Macquarie Marshes, has helped to buffer them from water re-allocation schemes and ensured more water devoted to biodiversity conservation. Similarly the 89,000 hectare Lagoas de Cufada natural park in southern Guinea-Bissau



Mountain lakes and wetlands provide water supplies for downstream communities