Extract from:

Area-based conservation as a key tool for delivering SDGs

SDG 6: Clean water and sanitation

Summary for policy makers

Half a million children still die every year as a result of contaminated water and three-quarters of a billion people around the world lack even basic water services. Climate and other environmental changes are disrupting water supplies and reducing water security in many countries.

Protected and conserved areas can help in several ways, by:

- Improving the **quality of water** flowing out of catchments, through judicious protection of forests, grasslands and wetland areas that provide natural filtering services, thus reducing the costs of water purification.
- Increasing the **quantity of water** available in the case of some ecosystems, particularly tropical mountain cloud forests and Andean paramos vegetation, creating water towers that already supply many cities around the world.
- **Storing water** in soils and vegetation to regulate water flow and thus smooth over peaks and troughs in water supply.
- **Sensitive restoration** for instance by removal of exotic species with high transpiration rates.

Careful planning is needed to identify and protect critical water-related ecosystems, forests, grasslands, wetlands and riparian zones, in both protected areas and OECMs. These need to be under management that avoids disturbance so stricter categories of protection are needed here. Other approaches beyond protected areas and OECMs, such as reduced grazing regimes and promoting aquifer recharge, also have important roles to play in improving overall water security and addressing SDG 6.

What is the challenge?

Despite impressive efforts to address global childhood mortality rates, there were still half a million deaths of under-fives due to diarrhoea in 2015.[1] Diarrhoea is caused by a variety of disease organisms including bacteria and amoeba, and is closely linked to inadequacies in water, sanitation and hygiene,[2] particularly in low to middle income countries. In particular, it is caused by drinking water and infant formula contaminated with human or animal waste, from contaminated wells or in *ad hoc* unregulated settlements.[3] Even with decades of effort, 29 per cent of the global population still do not have access to safely managed drinking water services, 785 million people still lack even a basic drinking water service as do a third of primary schools, and three billion people do not have basic handwashing facilities at home.[4]

Many water supplies are also contaminated with a range of other pollutants, particularly agrochemicals (pesticides and fertilisers), heavy metals and industrial waste products. For instance, the use of synthetic nitrogen fertilisers has grown nine-fold since the 1960s and is projected to increase 40-50 per cent more in the next 50 years. Increasing fertiliser use, livestock production and fossil fuel burning have raised nitrate levels above safe thresholds for human and ecosystem health,[5] including in drinking water.[6] Total global leaching and runoff of nitrogen is estimated at 32.6 million tons per year, mostly from agriculture.[7] Phosphate use has tripled,[8] and is also a significant pollutant.[9] Pesticides, herbicides and fungicides enter freshwater systems and have harmful impacts on biodiversity,[10] including at concentrations that current legislation in many countries deem safe,[11] and exposure to pesticides has a variety of impacts on human health.[12]

Furthermore, the planet is facing increasing levels of water stress. 1.7 billion people already live in river basins where water use exceeds natural replenishment.[13] Up to 4 billion people already experience severe water stress for at least one month a year.[14] Agriculture is impacted as well, with 71 per cent of the world's irrigated area experiencing periodic water shortages.[15] A combination of population growth, increased per capita water use (and waste), loss of water retention in wetlands and the disrupting impacts of climate change all contribute to declining water security. In the last century, water consumption increased six-fold, double the rate of population growth,[16] largely due to agricultural use.[17, 18] Water demand will soon exceed reliable supplies at a global scale,[19, 20, 21] with hotspots and critical areas of shortage emerging.[22] Poor planning, and "water grabbing" is leading to tensions within[23] and between[24] countries that share water resources, although the extent to which this risks open conflict is the object of much debate.[25, 26] Over 680 water treaties have been signed since 1820, and the number is increasing,[27] in attempts to defuse international tensions.

SDG 6 attempts to address all of these issues, albeit sometimes obliquely. The overall aims are to "*Ensure availability and sustainable management of water and sanitation for all*", which provides a very wide remit. Target 6.1 aims to "*achieve universal and equitable access to safe and affordable drinking water for all*", Target 6.5 to "*implement integrated water resources management at all levels, including through transboundary cooperation as appropriate*" and Target 6.6 to "*protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes*". This last has a 2020 deadline and may be revised in line with negotiations in the Convention on Biological Diversity. Other targets look at sanitation, pollution control and efficiency, largely beyond our remit here, although indicator 6.3.2 is for a "*proportion of bodies of water with good ambient water quality*".

How can effective area-based conservation help?

There is recognition that meeting SDG 6 will require ecosystem approaches to management and a new emphasis on stewardship.[28] Well-managed natural ecosystems, including those under different

area-based conservation arrangements, almost always produce cleaner water than other ecosystems, in certain specific cases they also produce more water, and importantly many ecosystems help to store water and smooth out flow to improve water security during times of low rainfall.[29]

Improved water quality. Water flowing from natural forest catchments and from many wetlands is cleaner than water flowing through agricultural land, industrial areas or urban settlements.[30] In part, this is simply because there are less pollutants to leach into water in a forest or natural grassland, but is also partly due to the ability of natural systems to neutralise some pollutants, through uptake in plants, natural breakdown systems, etc.[31] The filtering effect is not perfect, the resilient *Giardia* parasitic microorganisms will pass through natural ecosystems into water supplies. But hundreds of municipalities around the world, large and small, have recognised the increased water quality provided by natural ecosystems and draw on these for their water supply, radically reducing the need for artificial treatment.

A third of the world's largest hundred cities draw a substantial proportion of their drinking water from forest protected areas, including Mumbai, Jakarta, Tokyo, New York, Caracas, Abidjan, Cape Town, Sydney and Melbourne.[32] Many of the relevant water authorities are fully aware of the important role played by the protected areas and cooperate actively with managers. In Melbourne, for example, there is a long history of cooperation between water authorities and the managers of national parks supplying water to the city, such as Yarra Ranges National Park and Kinglake National Park.[33] At the same time, there is recognition that in other areas of the water catchment where logging has taken place, water supply is diminished.[34] Other municipalities are unaware of the link between ecosystem integrity and water supply, or take the ecosystem services for granted, or have failed to prevent degradation and loss in the areas and thus have lost some of the water services as well. There is currently a major REDD+ supported forest restoration project in the Chyulu Hills National Park, Kenya,[35] because the hills supply water to the city of Mombasa and forests have been degraded by illegal settlement, charcoal making and cattle grazing.

Increasing water availability. In addition to water quality, certain ecosystems also increase the quantity of water flowing from the catchment. Tropical cloud forests and the Andean *paramos* ecosystem in particular boost net water flow.[36] In the former cases, specially evolved plants high on the mountains or plateaus "scavenge" water from clouds and mist by condensing droplets on leaves, from where they eventually trickle to the ground and enter the water flowing downhill. Tegucigalpa in Honduras received 40 per cent of its drinking water from cloud forest in La Tigra National Park.[37] This is by no means rare; also in Latin America, Quito in Ecuador (from cloud forest in Antisana and Cayambe-Coca protected areas) and Bogotá in Colombia (from *paramos* in Chingaza National Park) gain the majority of their drinking water from natural ecosystems inside protected areas.[38] Many of these ecosystems are in the mountains, where they are exposed to constant mist, cloud and often high precipitation rates, and have become known as "water towers" in consequence. Recognition of the importance of water towers probably came first from Latin America but is now a feature of water planning throughout the world.[39]

Increasing water security: Just as important as net amount of water is its availability throughout the year. Climate change in practice also means climate uncertainty, with increasing fluctuation in precipitation patterns; countries that could previously predict rainfall patterns through the year are now experiencing unexpected droughts or floods. From the perspective of water supply, it is important that water arriving during wet periods is retained long enough to maintain supplies during dry periods, the principle behind reservoirs and other water storage systems. Protected areas and OECMs can help, by retaining water in soils and natural vegetation and regulating water flows; conversely ecosystem degradation often has the effect of decreasing such storage capacity and therefore decreasing overall water security, with the risk of flash floods and water shortages.

Cloud forest
Colombia

Any healthy natural forested or grassland ecosystem will provide the services described above. But protected areas have a key role to play in that they come with a certain amount of long-term security, management systems in place and staff who are aware of and supportive of ecosystem services. Alongside protected areas, OECMs seem to be ideally suited as water towers or water filters, and the recognition of areas particularly for their role in water security is likely to increase over the next few years. Many protected areas have been established to protect watersheds and important wetland ecosystems.

Strategic planning of new area-based conservation initiatives to protect critical natural ecosystems will be important to ensure adequate water supplies for sustainable cities (see SDG 11). Most existing cities have established water supplies; they may be facing pressures due to population growth or climate change, but the basic system is in place. The focus in the future will increasingly be on new cities, or rapidly expanding cities. Africa, for example, is experiencing the highest rate of urbanisation in the world, moving from an overwhelmingly rural society to one in which over a third of its 1.1 billion inhabitants already live in urban areas. This is expected to triple to 1.34 billion by 2050. In 1960, there were only five cities in sub-Saharan Africa with over half a million inhabitants, but by 2015 there were 84, including megacities like Lagos with over 13 million inhabitants. By 2030, there will probably be over 140.[40] Some 17 per cent of city dwellers in sub-Saharan Africa still lack access to treated water, and numbers could increase as councils struggle to keep up with a booming population.[41] China has also created an unprecedented number of cities in the last few years, and water resources are becoming increasingly scarce.[42] Working with these municipalities to identify where and how effective area-based conservation can best support water supplies is an important priority for the future.

Approaches that support SDG 6

Many protected areas and OECMs help to protect water sources and thus support important aspects of SDG 6. Some types of area-based conservation have special roles to play and there are associated conservation tools that can act as support. These are outlined below:

Protected areas

- **IUCN category I-IV and category VI protected areas:** Conserving a pristine water supply implies an ecosystem in good condition and without major disturbance. This means in practice stricter protection than in many protected landscapes (IUCN category V), which often contain farms and settlements. Mount Kenya National Park, Aberdare National Park and Aberdare Forest Reserve near Nairobi provide critical water supplies to the capital city.

OECMs

- **Watershed protection areas:** Existing watershed protection areas outside protected areas may well be suitable sites for OECMs if they protect significant biodiversity, or other ways of formally recognising their role in water services, which in turn means that their emphasis on other values such as biodiversity conservation may increase.
- **Areas of high biodiversity value with reduced grazing regimes managed for conservation:** Identifying such areas in the wider landscape can help to retain vegetation and thus absorb additional water during periods of heavy rainfall, reducing runoff problems but also smoothing out water supply through the year.

Key complementary approaches

These may be applied in protected areas, or OECMs, or in other effective area-based strategies.

- **Systematic conservation planning:** Systematic planning to support conservation will play a critical role in terms of determining where areas of natural ecosystem important for water supply are located and including them within overall land-use planning. Protected watersheds may be quite remote from the recipient population; the Chyulu Hills National Park in Kenya provides water for Mombasa, 250 km away on the coast.
- **Restoration:** Restoration is important in many places where degradation or land use change have already undermined water services; cities like Malaga and New York have already shown that strategic restoration initiatives can be successful in rebuilding important water services (in these cases respectively flood control and drinking water supply).
- **Payment for Ecosystem Services (PES):** Schemes have proved particularly suitable for water services in that they have two of the essential ingredients needed for success: a clearly identifiable buyer (a water company or council) and seller (communities managing an area of natural ecosystem providing water).[43] Quito, the capital of Ecuador, has long benefitted from a PES scheme for water with two protected areas nearby, as has New York.
- **Protected riparian zones:** Setting aside riparian zones along rivers, streams and around lakes can help ameliorate water surges, maintain water quality and retain water within catchments to increase overall water security.

Case study

Maintaining and managing wetlands for fresh water supply and biodiversity

Walthamstow Reservoirs and Wetlands, the UK

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Co-benefit SDGs

Ellie Davey (IEEP) with review by **Mathew Frith** (London Wildlife Trust) and **Kirsty Halford** (Thames Water).

Background: Walthamstow Wetlands, in north London, is the largest urban wetland nature reserve in Europe. The wetland is a partnership project between London Borough of Waltham Forest, Thames Water and London Wildlife Trust, funded by the National Heritage Lottery Fund.

The 221-hectare site hosts ten artificial freshwater reservoirs, which were constructed on the existing marshland adjoining the River Lee, to meet London's growing water demands from the mid-19th century. The Walthamstow Reservoirs form part of the Lee Valley Reservoir Chain, which since passing from public to private ownership in 1989 are now managed by Thames Water Utilities Ltd.[44] The Reservoirs continue to provide potable water to 3.5 million customers in London. In 2017, most of the site was opened to the public as Walthamstow Wetlands.

Walthamstow Reservoirs are a Site of Special Scientific Importance (SSSI) within the UK, and as an internationally important wetland habitat, they became designated as part of

the Lee Valley Special Protection Area and Ramsar site in 2000.

Sustainability challenge: Walthamstow Wetlands requires active management in order to protect the wetland ecosystem and its capacity to purify and maintain water quality.

Thames Water needs to maintain the drinking water quality and supply, and to meet this the reservoirs must be regularly dredged in accordance with a quota. This is important so that the reservoirs do not accumulate excessive sedimentation and maintain an operational reservoir depth.

As a consequence of the above, the reserve underwent a major restoration project in 2014-2017. The dredging produced 9,000 m^3 of excess sediment, which was placed behind 619 metres of reedbed retention structures alongside the reservoirs, creating 1.8 hectares of new reedbed habitat.

Business case: The restoration work of Walthamstow Wetlands has been mutually beneficial for Thames Water and their conservation efforts with regards to water management. The dredging of the reservoirs produced 9,000 m^3 of sediment, which, due to low levels of contaminants, was categorised as non-hazardous waste, which is not suitable for agricultural use. The disposal of this volume of sediment was estimated to cost £1 million in landfill tax, in addition to the carbon cost attached to transporting the material off-site.[45] However, since the sediment was used to establish new reed bed habitats and extend the wetland (confined to the older reservoirs due to their design), Thames Water was spared these costs, and found a sustainable and cost-effective solution to the requirement to dredge the reservoirs. The reservoir where most of the dredging took place is where the backwash from the Water Treatment process comes out.

Key benefits: Securing access to good quality freshwater for Londoners is the key sustainability benefit the Walthamstow Wetlands nature reserve aims to deliver. Healthy wetland ecosystems provide valuable benefits in their capacity to improve water quality. Wetland vegetation and marshland function as natural filtration systems, removing sediment and contaminants such as pollutants and nutrients from water. The removal of sediment in 2017 has ensured that the reservoirs remain operational to provide clean drinking water to 3.5 million Londoners. The creation of these wetland habitats also reduces the frequency of dredging requirements for Thames Water in the future and improves the purification capacity of the wetlands. Furthermore, the extension of the new reed bed habitats performs a key regulatory service in absorbing nutrients, and so increases its filtration capacity further.

The enhancement of the wetlands as a protected area has created an internationally important urban site for biodiversity. The combination of careful reservoir management and habitat restoration means that the site supports 54 rare and vulnerable wetland bird populations, thus fulfilling the aims of the EU Birds Directive. The site qualifies as a Special Protected Area due to the presence of migratory bird species like bittern (*Botaurus stellaris*), northern shoveler (*Anas clypeata*) and gadwall (*A. strepera*). The wetlands also provide breeding and roosting grounds for a range of birds, such as great crested grebe (*Podiceps cristatus*), tufted duck (*Aythya fuligula*), pochard (*A. ferina*), coot (*Fulica atra*) and great cormorant (*Phalacrocorax carbo*), and is one of the UK's major heronries (*Ardea cinerea*).[46]

Furthermore, the creation of additional reedbed habitats provides new areas of shallow water, which has benefitted different species. These buffer zones provide protection and cover for amphibians and water vole populations from predators, and nesting sites for wading bird species. Birds of prey have also been drawn to the site, sightings of sparrowhawk (*Accipter nisus*), kestrel (*Falco tinnunculus*) and osprey (*Pandion haliaetus*) have risen since the completion of the project.[47] Peregrine falcons (F. *peregrinus*) now breed on site, one of less than 15 sites in London.

Since being open to public access in 2017, the wetlands have received over 550,000 visitors, providing benefits to human health, wellbeing and recreation.[48] Access to blue and green spaces supports active lifestyles, good mental wellbeing, cleaner air quality and improved

social cohesion. There are woodland pathways, bike trails, a refurbished bird hide, an education centre and historic industrial buildings on site. London Wildlife Trust delivers community engagement activities, volunteering opportunities, educational workshops and ecological surveying to involve members of the local community in the conservation efforts onsite.[49] The site is also home to a successful and well-established recreational fishery, the largest in London. The fisheries are run by Thames Water and provide both coarse and fly fisheries. Fish species such as carp (*Cyprinus carpio*), bream (*Abramis brama*), trout and pike (*Esox lucius*) thrive here, attracting anglers from across the country.[50]

Conservation solution: Since the major enhancement project opening in 2017, the Walthamstow Wetlands' ability to provide fresh water seems to be on a sustainable footing. Main ongoing issues with the reserve are linked to managing the use of the site as a recreation area vis-à-vis the conservation of biodiversity, in other words mitigating delivering benefits to SDG 11 and SDG 15.

There were concerns that public access and increased footfall on site would be harmful to the fragile wetland ecosystem and biodiversity. For example, the refurbishment of the bird hide will likely increase the footfall of people in this location close to the bird habitats, and this will need to be managed with regard to bird sensitivities. Therefore, precautionary measures based on the advice of environmental authorities were integrated into the design to mitigate disturbance to rare and vulnerable bird species with the seasonal closure of pathways to divert the public away from breeding and refuge areas. The vulnerability and importance of this balance is communicated to the public through liaison with on-site rangers, sessions at an interactive educational centre, and various walks and talks.

To ensure that these measures are effective, London Wildlife Trust has completed several annual Bird Monitoring reports, documenting changes in bird population and distribution across the site.[51]

The site will also be assessed and reviewed on a 5-yearly basis by SPA (Special Protected Area) Review, which will monitor populations of bird species to assess the success of the conservation efforts.

Lessons learned: The synergy of benefits delivered across SDGs 6, 11 and 15 demonstrates how wetland conservation and restoration efforts in Walthamstow are effective solutions to deliver benefits for multiple SDGs.

Securing regional water supply through protected areas restoration

Network of nature reserves surrounding greater Cape Town, South Africa

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Co-benefit SDGs

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"*An investment of R372 million (US$25.5 million) in ecosystem restoration will generate annual water gains of 55 billion liters (55 million m³) a year within five years compared to business-as-usual — equivalent to one-sixth of the city's current supply needs — increasing to 100 billion liters a year (100 million m³) within 30 years. Water gains are achieved at one-tenth the unit cost of alternative supply options.*"[52]

Background: The mountainous water catchments of the Western Cape province are often called "water factories", as they provide 57 per cent of the water resources for South Africa. The Western Cape Water Supply System supplying water to Greater Cape Town, consisting of dams and aquifers connected through a network of pipelines, originates in these water factories.

The continued provision of water from the Western Cape's catchments relies on maintaining a healthy network of protected areas that cover over 90 per cent of the province's catchment areas.

These protected areas were originally designated for their critical biodiversity values as representative of the Cape Floral region, a biodiversity hotspot with over 9,600 plant species, 70 per cent of which are found nowhere else in the world.

Many of the protected areas, including Hottentots-Holland, Limietberg and Jonkershoek Nature Reserves, that are critical to the Greater Cape town region's water supply, are threatened by alien invasive species that harm the native fynbos vegetation, cause increased fire intensity that destroys the native seed bank, and consume significantly more water than the native vegetation each year.

Sustainability challenge: Water security is a major concern for the City of Cape Town, which faced the possibility of running out of water following a three-year drought between 2015 and 2018. The day the taps run dry, dubbed "Day Zero", was narrowly avoided but the threat remains. Cape Town's population is growing fast, at a rate of about 2.6 per cent a year, while climate models show decreased rainfall accompanied with increased temperatures in the future, increasing the risk of water shortages.

Case study

Cape Town's water demand is predicted to outstrip current supply by 2021. Current forecasts suggest that an additional 300-350 million litres (0.3-0.35 million m^3) of water a day will be needed by 2028 to ensure supply meets demand. Over R8 billion (US$540 million) in public funding is being considered to increase the water supply through investments in deep aquifer drilling, seawater desalination, water reuse and increased surface water storage to meet the required demand.

Conservation solution: Improving the ecological condition of the source water protected areas is a cost-effective and critical step to address regional water needs.

Over two-thirds of the sub-catchments supplying the Western Cape Water Supply System (WCWSS) are affected by alien plant invasions, reducing the amount of water that reaches the rivers and dams that feed the region. Invasive woody plant species, such as pine, Australian acacia, and eucalyptus, that have come to dominate in these source catchments, have higher evapotranspiration rates and use up to 20 per cent more water than the region's native fynbos vegetation. This leads to attendant decreases in surface water runoff as well as a reduction in infiltration or deep percolation to aquifers. Because woody invasive trees have deeper rooting systems than herbaceous land cover, they are also able to access and extract more groundwater even in times of low rainfall, allowing their growth cycles to persist.

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In response to the increasing threats, a broad coalition of partners from conservation and government to business communities[1] came together under the auspices of the Greater Cape Town Water Fund Steering Committee, with an aim to identify solutions and work together to improve water security. The Committee commissioned studies to evaluate the impact of nature-based solutions on water supply (see below), beginning with targeted removals of alien plant invasions, and to determine whether investing at scale in catchment restoration would be cost competitive with other supply-side solutions. As a result, the Greater Cape Town Water Fund will be the catalyst for the funding and implementation of catchment restoration that will help secure the future of Greater Cape Town's water supply, with protected areas as one of the key focus areas.

Business case: One of the supporting analyses modelled a 30-year period, discounting both costs and water gains at 6 per cent for surface water sub-catchments. Seven of the twenty-four sub-catchments in the Western Cape area, comprising a total of 54,300 hectares, were identified as priorities for restoration. Results show that investing R372 million in the restoration of these areas (US$25.5 million; discounted present value) will generate expected annual water gains of 100 billion litres (100 million m^3) within thirty years compared to the business as usual scenario. Importantly, invasive alien plant removal alone would yield up to an additional 55 billion litres (55 million m^3) within six years. Approximately 350 job opportunities will be created in the first six years of implementation, as removing alien plant invasions is very labour intensive.

Catchment restoration, including the restoration of protected areas, was estimated to be significantly more cost-effective than other water augmentation solutions for the greater Cape Town Area, supplying water

[1] The Nature Conservancy, National Department of Water and Sanitation, National Department of Environmental Affairs (Environmental Programmes), Provincial Department of Environmental Affairs and Development Planning, City of Cape Town, SANBI, CapeNature, Coca-Cola Peninsula Beverages, Nedbank, Remgro Ltd and WWF.

at more than one-tenth the unit cost of alternative options.

Restoration of the water catchment and its protected areas was estimated to produce greater water yields than all other supply options except desalination, which is far more costly. The results of catchment restoration programmes are also expected to be realised quickly, with improved supply showing as soon as the first winter rains. Furthermore, catchment restoration produces water yield gains into perpetuity if areas cleared of invasive alien plants are maintained.

In addition to restoration focused on the removal of invasive plant species, additional benefits to water security could also be gained through wetland restoration. Four wetlands in the WCWSS — Upper Riviersonderend, Du Toits, Olifants and Zuurvlak — have been identified as of strategic importance for Greater Cape Town water supply by applying a set of criteria considering their position in the catchments and their hydrological and geomorphological characteristics. A preliminary analysis of the water storage and nutrient removal services provided by these four wetlands, based on avoided replacement costs for water storage and treatment costs with a 30-year time horizon and 6 per cent discount rate, estimated that wetland rehabilitation would generate values of R280,000-R560,000 per year in water storage provided by all four wetlands and R472,000-R937,000 per year in nutrient removal by the Zuurvlak wetland, for a combined net economic benefit estimated at R0.81-R1.35 million/year.

Lessons learned: Protected areas form the backbone of water security for the Greater Cape Town water supply. Restoring the native vegetation and ecological function across these protected areas is a cost effective solution for improving water availability in the region. Clearing invasive plants – the main activity of the water fund – not only reduces a major threat to the biodiversity of the Cape Floral region, but also restores the full capacities of the "water factories" of WCWSS.

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Next steps: The near-term priorities for improving the water security conserving biodiversity and for the Greater Cape Town Water Fund will be focused on strategic removal of invasive alien plants and the maintenance of restored native vegetation. Over time, the Water Fund plans to deploy a wider range of ecological interventions in WCWSS source water areas. These proposed interventions include riparian restoration, the restoration and protection of wetlands, and agricultural land use improvements. Implementation of a broader set of ecological infrastructure interventions will continue the collaborative science-based approach.

The Water Fund will use its strategic plan to guide implementation and associated monitoring and evaluation, in partnership with the landowners and land managers of the priority sub-catchments. Putting the strategic plan in place will include building the institutional capacity of the Greater Cape Town Water Fund to lead or support restoration efforts and creating a sustainable funding mechanism to help maintain the catchments.

Case study

Supplying clean drinking water to a capital city

Chingaza Reserve above Bogotá, Colombia

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Co-benefit SDGs

Nigel Dudley (Equilibrium Research and IUCN WCPA)

Background: Bogotá is the capital of Colombia, a country with a rapidly growing economy, having just emerged from decades of virtual civil war, with serious security issues remaining. Colombia has a wide range of ecosystems, including Andean mountains, dense rainforest in the Amazon, grassland and savannah within the Llanos, extensive coastal coral reefs and mangrove and offshore ecosystems. There are also large cultural landscapes, such as the coffee-growing region, recognised as a cultural World Heritage site. This variety has resulted in Colombia having some of the highest levels of biodiversity on the planet; however, much of this is under pressure from development and climate change.[53] The páramo ecosystem, a high biodiversity ecosystem endemic to the northern Andes and unusual for being found at a relatively high altitude, is of particular significance here.[54] There is also an extensive and still expanding system of protected areas. While many are managed by the central government, others are under the governance of local authorities, communities and Indigenous people.[55]

Sustainability challenge: Bogotá's rapid growth has thrown many municipal systems under strain, including the provision of clean drinking water. In 1950, the population of Bogotá was 630,315; in 2020 it is estimated at 10,978,360, an increase of over 10 million in 70 years. This trend has been accelerating; the population has increased by over a million since 2015.[56] Some 34 per cent of the Colombian population live below the poverty line,[57] and although inequality has decreased slightly, it remains stubbornly high.[58] Provision of clean water is therefore a priority; many people will be unable to buy bottled water or even have the wherewithal to boil water before drinking. At the same time, some ecosystems are under particular pressure, including the páramo, which is being converted to agriculture such as potato production, cattle ranching and for coal mining.[59] Justifying conservation in a country where many people are still poor is tricky, but much easier if conservation actions can be shown to provide direct benefits to people.

Conservation solutions: Many natural ecosystems provide pure water; some also increase net water flow. Chingaza National Park, almost on the borders of Bogotá, covers 766 km² and varies in altitude from 800 to over 4,000 metres. It contains around 40 glacial lakes and is almost entirely within the Orinoco watershed. Chingaza contains important species like tapir (*Tapirus terrestris*) and bear (*Tremarctos ornatus*). It also supports a unique flora, including bog mosses that absorb huge amounts of

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water and frailejones (*Espeletia* spp.), which have tall spikes with succulent, hairy leaves in a dense spiral pattern, which condense water droplets from the clouds and mists that habitually cloak the region. Frailejones also have low levels of transpiration of water, which increases water seeping down into the ground from the plant.[60] This combination of factors means that the native vegetation increases net water flow downstream. Lack of pollution and the existence of natural filtration processes in the ecosystem also produce very pure water, thus radically reducing the need for expensive downstream purification processes. Chuza Reservoir, with a capacity of 257 million m^3, is located inside Chingaza Park in the basin of a tributary of the River Chuza Guatiquía. This reservoir is the core element in the Bogotá Water Company's Chingaza System.[61] Chingaza contributes 80 per cent of the city's high-quality drinking water.

Sustainability measures in place: Steps have been taken to try to ensure that the source of water supply is well protected and adequately funded. The Agua Somos Water Fund has been in place since 2008 to help provide financial support for the protected area. The Fund has convened important stakeholders and has had some success in increasing awareness about water security issues, including conservation of Chingaza National Park.[62] But there is still a general lack of understanding about the role of natural ecosystems in supplying water, some donors have dropped out of the scheme. Younger people tend to understand the benefits more fully and be more willing to pay for their maintenance.[63] However, páramo continues to be destroyed both inside and outside the national park. Furthermore, climate change may well mean that there is less cloud cover in the region, which will reduce the net amount of water released from the watershed; there have already been some atypical droughts.

Business case: Bogotá gets plentiful supplies of pure water from the national park, with no other obvious sources available; serious losses from Chingaza would undermine the whole water system of the capital. A bottling plant at the edge of the park uses this water directly.

Lessons learned: There is general recognition of the importance of Chingaza as a source of water by those most closely involved, including Parques Nacionales Naturales the state protected area agency, the regional water company, and key local and international businesses. However, this understanding has not yet spread to the local

population, despite attempts at education and capacity building. In consequence, the protected area is itself not immune to continued degradation and struggles to raise funds for management.

Next steps: Further action is needed to ensure that citizens of Bogotá understand the source and fragility of their water supply, and to persuade water users that it makes financial and business sense to increase support to ensure that the water supply is not compromised or reduced.

Endnotes

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