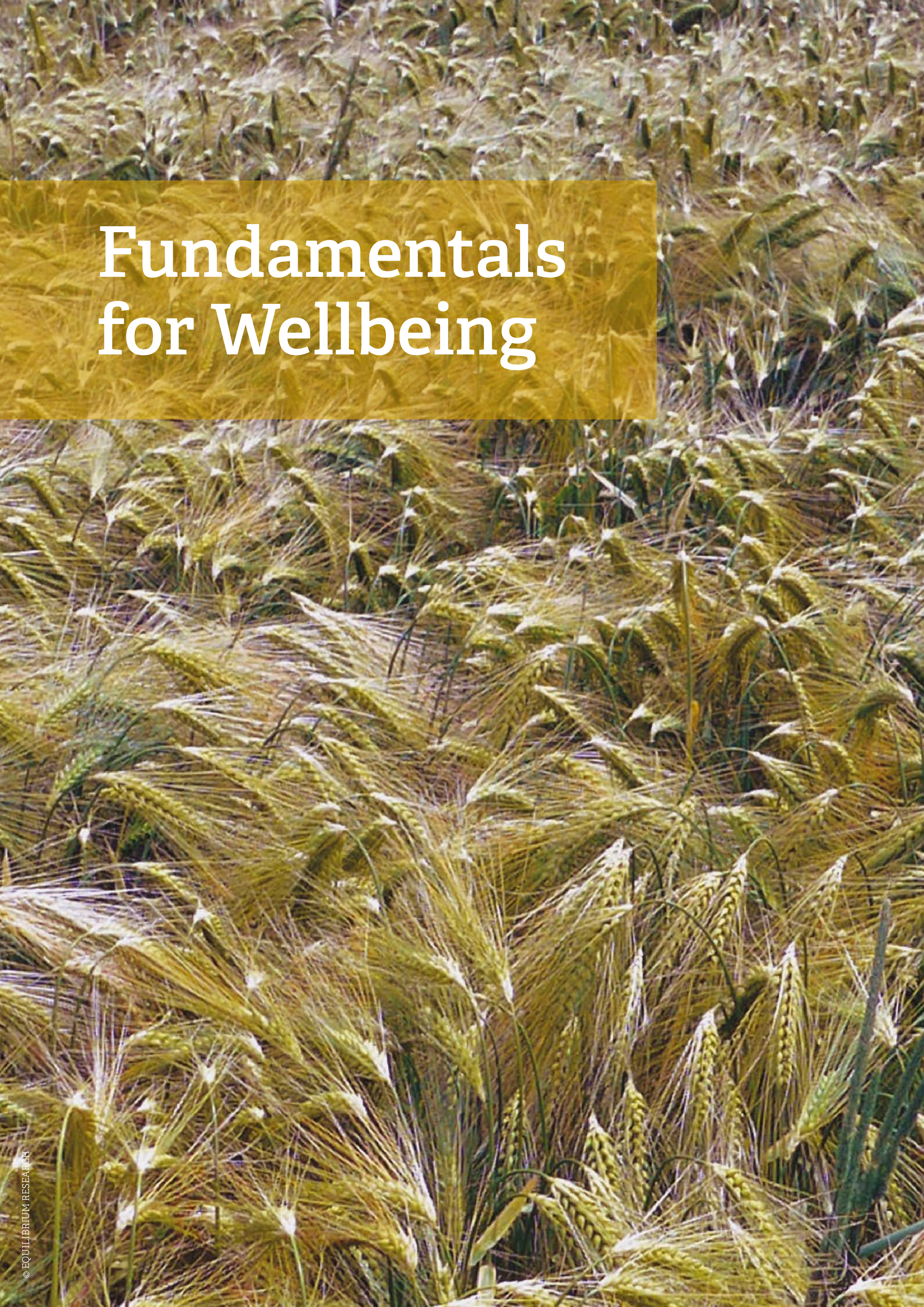
Extract from:

BUILDING ON NATURE

Area-based conservation as a key tool for delivering SDGs

Fundamentals for Wellbeing



SDG 2: Zero hunger

Summary for policy makers

There is currently enough food to feed the whole world, although unequal distribution means a billion people go hungry. Food security will decline as population grows and productivity fails to keep pace. Farming has become more productive but less sustainable. Problems include agrochemical pollution, land degradation, loss of pollinators, a declining genetic base, overfishing, food waste, climate change and a shift to inefficient foodstuffs, primarily meat. Local food security is threatened in many countries by loss of livelihoods for small farmers. These all impact negatively on many other SDGs. Effective area-based conservation offers a range of approaches to boost food security in line with SDG 2 by:

- Maintaining populations of species collected from the wild, particularly fish
- Supplying ecosystem services such as water for agriculture
- Regulating water flows to avoid floods and various forms of disaster risk reduction
- Conserving wild species supportive of agriculture such as pollinators and pest predators
- Stabilising and rebuilding soil and associated beneficial soil organisms in protected landscapes
- Conserving crop and livestock wild relatives needed for breeding programmes
- Maintaining cultural ecosystems with traditional agriculture and grazing
- Integrating these benefits into national and global strategies means building links with relevant UN bodies, donor agencies, government policy makers and agribusiness companies.

What is the challenge?

Since 1945, global food production has kept pace with human population growth through a mixture of increased productivity[1] and the conversion of natural ecosystems to crop or livestock production.[2] The conversion of natural ecosystems has also been a major cause of biodiversity loss.[3] Productivity gains have been greatest in cereals, oilseeds, fruits and vegetables, with an estimated 47 per cent increase from 1985-2005 due to higher yielding varieties, less crop failure, and multiple annual cropping.[4] Cropland increased only 2.4 per cent over this period.[5] Sadly, a combination of poverty, poor food distribution, food waste, agricultural inefficiency and the politics of agribusiness mean that 800 million people still go hungry.[6] The second sustainable development goal needs to start by looking at equitability of access to food,[7] with close links to SDG 10.

But achieving longer term food security, which lies at the heart of SDG 2, is more complicated. Several challenges come together.[8] Aspects of agricultural intensification have ecological and health impacts that threaten to undermine food production. These impact negatively on other SDGs, particularly those addressing clean water (SDG 6), climate (SDG 13) and life in water and on land (SDGs 14 and 15). Projections on rising population and future agricultural productivity also suggest there could be real food shortages within a few decades,[9] and need for further land conversion.[10] Farming has become more productive but less sustainable,[11] and is exceeding planetary boundaries for stressors such as nitrogen levels.[12] We risk undermining our own food production systems just when we need them more than ever, and causing a lot of collateral damage in the process.

Fertilisers boost crop yields, but inefficient use[13] creates air and water pollution. Surface and groundwater are affected along with marine areas, where over 500 eutrophication dead zones are now known.[14] Nitrous oxide is an increasingly important greenhouse gas, with emissions largely from agriculture.[15] Reactive nitrogen from our own activity exceeds that from natural processes.[16] Environmental impacts of pesticides are often underestimated,[17] especially in the tropics,[18] with concerns about serious declines in insects.[19] German researchers measured a 76 per cent decline in flying insect biomass in 63 nature reserves over 27 years.[20] This has knock-on impacts on food production. The total economic value of pollination worldwide is estimated at US$165 billion annually,[21] but in parts of China farmers now pollinate fruit trees by hand due to the loss of insects.[22] Use continues to increase, and many farmers feel trapped into a cycle of ever increasing applications.[23] Herbicide-resistant genetically modified crops receive 56 per cent of total glyphosate use[24] and increased herbicide tolerance means that farmers are likely to increase the application rates even more.[25] At least 20 per cent of irrigated lands are believed to be impacted by salinisation from poorly designed irrigation schemes, with some estimates putting the figure much higher.[26] Researchers suggest that half of all arable land will be affected by 2050.[27]

About 75 per cent of crop genetic diversity was lost in the 20th century due to abandonment of traditional landraces.[28] While modern crop varieties are often more productive, their narrow genetic base reduces their ability to react to environmental change. Further, many crop wild relatives (CWR), which form genetic resources for breeding, are threatened,[29] and 70 per cent of important CWR need protection.[30] Pests and disease continue to take a heavy toll on crops worldwide,[31] with problems increasing due to climate change, which amongst other things helps pests and pathogens spread to new areas.[32]

Around 1.3 billion people live on degrading agricultural land.[33] The *Status of the World's Soil Resources* report identified: "*the risk that the degradation of soils will strongly impact ecosystem services and in turn production if soil sustainable management practices are not adopted*".[34] The Economics of Land Degradation Initiative estimated that loss of ecosystem services due to land degradation cost US$6.3-10.6 trillion annually; 10-17 per cent of the world's GDP.[35]

In the oceans, 33 per cent of marine fish stocks were harvested at unsustainable levels in 2015,[36] while ocean acidification has increased by 30 per cent since the start

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Grazing in Armenia privately protected area.

of the Industrial Revolution, with profound implications on marine life.[37]

Paradoxically, both food demand and waste are increasing with growth of population and average income.[38] One-third of food is estimated to be wasted, equivalent to food grown on an area larger than China, with a cumulative carbon footprint of 3.3 Gt of CO_2 equivalent/year, making food waste the world's third largest carbon emitter.[39] Dietary change is driving agricultural expansion as consumers demand land-intensive food, particularly processed foods and meat.[40] Demand for meat and livestock feed is expected to rise by almost 50 per cent by 2050.[41] Nutrition from meat requires about five times more land than plant-based equivalents,[42] with beef needing a massive 28 times more land and 11 times more irrigation water than livestock such as pigs and poultry.[43]

Competing land uses – including for biodiversity and ecosystem services, urbanisation,[44] infrastructure, tourism and energy[45] – reduce the area available for food.[46] Land grabbing undermines food and nutritional security as well as smallholder tenure and resource rights in poor and vulnerable communities. Climate change is expected to reduce crop yields in many countries,[47] due to both long-term shifts in climate and more incidence of extreme climate events,[48] while agriculture is also a major source of greenhouses gases.[49]

Food production is also becoming more centralised, and larger scale: traditional growers and small farmers are being pushed out of business.[50] While this might put more food into the global food market, it can undermine food security for some of the poorer members of society, who have been relying on subsistence or near subsistence living on poor land and have neither the funds nor the access to monetised food sources.

Addressing the Zero Hunger SDG therefore involves a mixture of political, technological, ecological and personal change. Reducing meat consumption is generally recognised as the quickest and most direct way of increasing food security.[51] Addressing some of the major inequalities in distribution and access to food will involve a mixture of technical advances, for example in food storage, along with political and governance changes to reduce inequality, corruption and criminality. All these are critically important but beyond our remit here. But there are many other issues, related to the long-term environmental stability of food production, access to water, maintenance of wild fish stocks and defence of the poorest and most vulnerable subsistence communities, where protected and conserved areas have a positive role to play.

How can effective area-based conservation help?

In 1996, the World Food Summit agreed that: "*Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.*"[52]

SDG 2 has several targets that relate directly to values captured by area-based conservation. Target 2.4 seeks to "*ensure sustainable food production … and … resilient agricultural practices, that help maintain ecosystems, that strengthen capacity for adaptation … and progressively improve land and soil quality*". Target 2.5 is to: "*maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species…*", while Target 2.3 has a broader social remit and relates to protection of "*small-scale food producers, in particular women, Indigenous peoples, family farmers, pastoralists and fishers*".

Protected areas and OECMs can help address hunger and strengthen food security first by maintaining wild food stocks, along with a range of ecosystem services that support the collection and cultivation of food species. More subtly, some protected and conserved areas also provide spaces in which threatened peoples and cultures can continue to access food in traditional ways.

The Food and Agriculture Organization of the United Nations (FAO) has coined the term "biodiversity for food and agriculture" (BFA) to describe the multiplicity of ways in which ecosystem services support food security, including:

- Viable populations of species collected from the wild, particularly freshwater and marine fish;
- Ecosystems supplying reliable water and various forms of disaster risk reduction;
- Wild species supportive of agriculture such as pollinators and pest predators;
- Soil and soil organisms;
- Crop and livestock wild relatives; and
- Cultural ecosystems with traditional agriculture and grazing.[53]

FAO recognises the need for conservation in addressing the SDGs, identifying enhancing soil health, restoring land, protecting water, mainstreaming biodiversity conservation and protecting ecosystem functions amongst critical steps towards achieving SDG 2.[54]

Marine protected areas, freshwater protected lakes and rivers, locally managed marine areas and other wetland areas set aside from major exploitation all play a key role in maintaining fish populations important for subsistence and commercial fishing. Effective area-based conservation approaches in wetlands create sheltered conditions that help to enhance fish breeding, prevent habitat damage and facilitate ecosystem recovery. As fish stocks build up inside reserves, juvenile and mature fish move out to populate nearby areas, where they can be fished. Reserves boost fish populations in several ways. They conserve fish of all ages; overfishing tends to remove older members of the population, but bigger fish generally produce many more eggs and are disproportionately important for breeding. Some species, especially those with no or only limited powers of movement (e.g. oysters, clams or abalones), only reproduce successfully at high population densities so need undisturbed habitat. Reserves also ensure that species are protected at vulnerable stages of their life cycle, particularly in fish nurseries and spawning grounds.[55] A review of 112 independent studies in 80 different MPAs found strikingly higher fish populations inside the reserves compared with surrounding areas,[56] and well-managed MPAs were shown to be highly beneficial in replenishing fished populations.[57]

The role of ecosystems in supplying reliable freshwater for agriculture is discussed under SDG 6. The stable ecosystems within protected areas and OECMs also help to reduce the impacts of several climate-related disasters that can disrupt food supplies, including reducing erosion, sandstorms and desertification in drylands,[58] and reducing flood events through maintenance of natural floodplains and the buffering effect of riparian vegetation.[59]

A third critical agricultural benefit is in maintaining populations of supportive wild species: particularly pollinators, species that prey on pests and soil organisms. Even quite small reserved areas can in some circumstances help to boost numbers of pollinators and pest predators, as shown by research into leaving unsprayed edges around agricultural fields,[60] although these do not meet the criteria to be protected areas. Recent experience of decline in insect biomass suggests that larger scale protected areas will be needed in more places, along with changes in management in the wider landscape, possibly through judicious use of low input farming areas that might themselves be classified as OECMs. Protected areas also help to conserve and where necessary rebuild some of the basic necessities of agriculture, including healthy soils, and carefully sited set-asides can provide critical roles in soil stabilisation in drylands[61] and other areas prone to erosion.

Crop wild relatives (CWR) are species closely related to domesticated crops, which contain genes useful for crop breeding and adaptation (e.g. drought and pest resistance).[62] No global estimates of total numbers of CWR exist as yet, although a recent study documented 1,076 taxa associated with 81 crops,[63] this is only a partial count. The diversity of CWR has decreased overall,[64] particularly in marginal areas experiencing changes in climatic conditions. Protected areas provide tools for CWR conservation but are relatively lacking in some of the ecoregions with the highest number of CWR.[65] However, over 2,000 crop wild relative species are subject to conservation in situ,[66] sometimes in micro-reserves established especially for this purpose and sometimes as an additional benefit of conservation originally with more general aims.[67]

Livestock wild relatives in theory have similar uses for livestock breeding[68] although this is relatively under-utilised at present, despite recognition of a serious decline in genetic diversity within some livestock.[69] The need for adaptive breeding is likely to increase under conditions of rapid climate change.[70] Overall they are more threatened than wild mammals and birds in general: 83 per cent of relatives of cattle, 25 per cent of chicken, 44 per cent of sheep and goat and 50 per cent of pigs are endangered, and for instance the African wild ass (*Equus africanus*) and the wild Bactrian camel (*Camelus ferus*) are critically endangered.[71] Their status has received much less attention than for CWR, and livestock wild relatives are far less used in breeding programmes.[72] Wild relatives may however cross-breed accidentally with domesticated livestock,[73] for example with jungle fowl[74] or wild pigs. In many cases protected areas provide critical options for survival.

Finally, many national systems of protected areas include substantial areas of cultural landscapes; areas that have been managed through traditional agricultural systems for hundreds or thousands of years and have developed significant associated biodiversity. Here the emphasis is less on maximising production per unit area, but is more focused on the social and cultural aspects of keeping old farming traditions alive and supporting sustainable food production systems in areas where no alternatives exist, and where collapse of these systems will directly impact people's food security and wellbeing. In long-settled parts of the world, whole ecosystems exist where associated species have become reliant on the conditions created by traditional agriculture; for example many Mediterranean habitats,[75] temperate heath, meadows and lowland moors.[76] Modern agriculture has often moved on from these practices, which are less economic, sometimes necessitating inclusion and support in protected areas. Protected landscapes (IUCN category V protected areas) often include both traditional agriculture and grazing areas, and these will likely be even more common within OECMs. Such areas can also support important biodiversity.[77] Integration of nomadic pastoralism into the management strategies of protected and conserved areas is one important aspect and is for instance increasingly discussed within UNESCO World Heritage sites.[78]

Locally ,managed marine mine in Samoa

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Approaches that support SDG 2

Many – perhaps most – protected areas and OECMs will offer something towards food security and thus can be part of an overall response to the remit of SDG 2. But some types of area-based conservation have special roles to play. Integrating these benefits into national and global strategies means building links with relevant UN bodies, donor agencies and agribusiness companies. Some of the most important opportunities are outlined below, along with factors that will help give optimum results:

Protected areas

- **Terrestrial protected areas maintaining water and climate services**: play a key role in agriculture, by providing water for downstream irrigation or through their role in stabilising local and global climate. Some of the benefits manifest far from the protected area itself; for example transpiration from Amazon trees creates the climatic patterns that facilitate agriculture further south in Argentina and Uruguay, known as the "flying rivers" of the Amazon.[79]
- **Micro-reserves for crop wild relatives**: many crop wild relatives are primary colonisers or weed species and require disturbed ground to grow, which means that they require a certain amount of management to sustain them in a small protected area. Micro-reserves have been developed to protect targeted CWR, where land is managed so that these particular species can survive,[80] such as wild relatives of wheat (*Triticum* spp.) in Armenia.[81]
- **IUCN category V protected landscapes and seascapes**: the fifth IUCN protected area management category is: *"where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area …"*.[82] Optimising protected landscapes and seascapes: successful category V protected areas are based on planning that covers the entire area and considers how the various management approaches within the

protected area can be integrated to provide optimal benefits to both biodiversity conservation and food security.

- **Protected areas incorporating pastoralism and grazing**: low-level livestock grazing, including transhumance and nomadic pastoralism, has been successfully incorporated into the management strategies of many grassland and savannah protected areas, including within natural World Heritage sites.[83] These places help support traditional communities alongside delivering conservation.
- **Marine and freshwater protected areas**: have a key role to play in protecting fish stocks, and other harvested species. *Optimising MPAs*: There is strong evidence to suggest that MPAs under the stricter IUCN management categories are the most effective[84] although pressure from fishing and tourism interests frequently limits these in number and area covered.

OECMs

- **Marine OECMs**: will also sometimes provide ancillary protection for fish and other species that are important for commercial or subsistence fishing. Examples might include wrecks and other war graves, exclusion zones around wind farms, military exclusion zones, etc.[85]
- **Terrestrial OECMs incorporating food production**: some OECMs will consist of or include areas of low intensity grazing on natural pasture, organic farms and other forms of agriculture that include a major focus on wider ecosystem services.

Key complimentary approaches

Another specialised designation is important in marine areas:

- **Locally Managed Marine Areas** (LMMAs): an LMMA is an area of nearshore waters and its associated coastal and marine resources that is largely or wholly managed at a local level by the coastal communities, land-owning groups, partner organisations, and/or collaborative government representatives who reside or are based in the immediate area.[86] Many but not all will contain permanent or temporary set-aside areas;[87] set-asides are generally an important part of sustainable management.

The World Heritage Laurisilva forests of Madeira play a predominant role in maintaining the hydrological balance across the Island; assisted by the 'Levadas' a system of channels and aqueducts which transport water to agricultural areas.

Case study

Protecting crop wild varieties for food security

The Potato Park, Peru

Co-benefit SDGs

Nigel Dudley and **Sue Stolton**, (Equilibrium Research and IUCN WCPA).

Background: The Potato Park, near Cuzco in the Peruvian Andes, is a self-declared protected area, developed and managed since 1992/4 to conserve traditional landraces of potatoes and other Andean tubers. The park covers 9,872 ha, and contains six predominantly Quechua-speaking communities, with a current population of 7,444 people. Most of the area is farmed, with land divided into three ecological levels: the lowest is devoted to cereals, the middle to Andean tubers and the highest ecological level (at an altitude of 4,350 metres) to potatoes. In the highest areas, agriculture follows an eight-year rotation; one crop followed by seven years fallow. Along with potato diversity, the Potato Park also consciously protects Quechua traditions, dress and culture, along with food security and sovereignty. People follow the Quechua philosophy of three intersecting realms (Figure 2.1) and every day's work starts with offerings of coca leaves.

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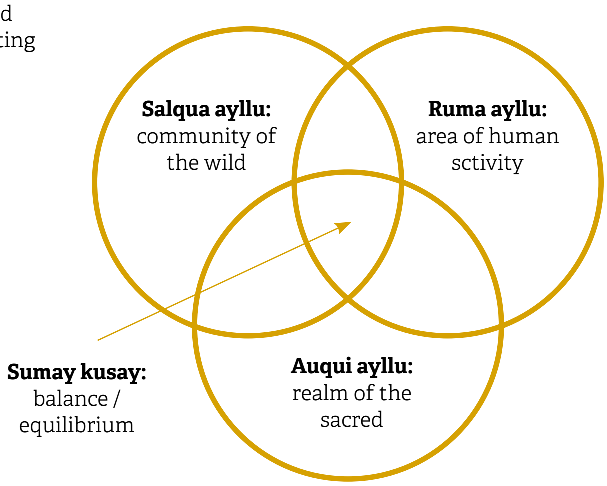
Sustainability challenge: Changes in agriculture, such as the introduction of high yielding varieties, have led to losses of traditional crop varieties ("landraces"). The Food and Agricultural Organization estimates that 75 per cent of crop genetic diversity was lost over the last century.[88] Many landraces offer benefits such as resistance to drought, cold or disease. Today, the bulk of this genetic diversity is maintained by traditional agricultural systems. Additionally, many crop wild relatives (CWR) of domesticated plants are also threatened.[89] Landraces and CWR are critical for crop breeding, which is increasingly important in the uncertain conditions created by climate change. CWR of potatoes (*Solanum* spp.) have been used to improve cultivated varieties since the 1900s, when genes from the Mexican *S. demissum* helped to breed resistance against potato blight.[90] The park protects more potato varieties than anywhere else on the planet. It is the centre of origin of three potato crop wild relatives and supports 1,377 potato varieties, along with 92 other Andean tubers.

Figure 2.1: Qechua philosophy and three intersecting realms



Conservation solution: Community members undertake crop breeding, particularly coloured potatoes with important medical properties. Farming is organic, using hand tools due to steep conditions; alpaca manure is important. The main effort is in maintaining varieties in the field; but there is also greenhouse cultivation, where landraces are hand pollinated to avoid cross breeding. In 2015 the community sent seeds to the global seed storage facility at Svalbard, Norway, providing triple security: in the field, on the site and in long-term storage. Over 500 varieties have been given to communities in Peru to help them to adapt to new climatic conditions and help to maintain the wealth of potato varieties. Some potatoes are treated for long-term food storage (up to 20 years), important for years when yields are low, and all are used in multiple food and drink products.

Sustainability measures in place: The park is working to adapt potatoes to climate change; community members have been trained to undertake monitoring and collaborate with scientists and agronomists. Native potatoes are found to be more resilient. Warmer weather means more crops (e.g. beans) can be grown and potatoes grown at higher altitudes. But pests are also commoner at lower altitudes, forcing farmers to grow higher: there are therefore currently both gains and losses as a result of climate change to date. Transects and insect traps measure changes in pests, timing of frost and experiments with calcium additives. Motivation is high, and members of the community are proud that their local actions are providing a national, and global, contribution to food security.

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Selling local pproducts at the Potato Park

Business case: The Potato Park is not a conventional case in that most of the community are still largely and deliberately outside the cash economy, existing by subsistence and barter. Some cash is raised through sale of medicinal plants, artisanal products, a restaurant, guiding and tourism. Different communities take charge of different aspects. Money raised is used to maintain infrastructure, for production of materials and for community use, plus celebration of International Potato Day on 30 May. Annual community meetings determine use of funds and the various communities within the park benefit depending on the amount of time spent on community activities during the year.

Lessons learned: The Potato Park has shown that dedicated community action can help to do what many governments have failed to achieve in terms of maintaining crop diversity. Integration of traditional ecological knowledge and Western science knowledge has proved an important benefit. The presence of a supportive NGO has also been critically important in maintaining enough funding for the necessary investment (in greenhouses, travel to conferences, essential equipment, etc.).

Next steps: Community members are still trying to get official recognition within Peru as a protected area (IUCN category V, protected landscape), in large part to reduce risks of being targeted by mining companies. Secure funding remains a challenge and there are concerns about the potential for introducing GM potatoes into Peru and consequent contamination of their genetic resource. They are working with other groups in Peru (for maize) and globally (e.g. Bhutan, Kyrgyzstan) on a 15-20-year vision to develop similar models of genetic crop preservation with working communities.

This case study was based on a site visit by the first two authors in October 2019, plus written material and input from the Andes Organisation and members of the Potato Park Community.

Information linked to this case study can also be found through the PANORAMA initiative.

Case study

Growing coffee to restore rainforest and local livelihoods

Gorongosa National Park (GNP), Mozambique

Co-benefit SDGs

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Andrea Egan and Midori Paxton (UNDP), based on existing literature.

Background: Gorongosa National Park (GNP) in Mozambique is the site of one of Africa's greatest wildlife restoration initiatives.

Established in 1960 due to its importance as the habitat for some of the densest wildlife populations in Africa, GNP was touted as one of Africa's most spectacular national parks, with massive herds of charismatic megafauna roaming its Rift Valley grasslands and woodlands. But for 15 years, during Mozambique's brutal post-colonial civil war (1977-1992), hostilities raged in and around the park, devastating human and wildlife populations alike.

Sustainability challenge: Wildlife populations declined by 90-99 per cent between the mid-1970s and the late 1990s, due largely to hunting by military forces and continued to decline thereafter due to post-war poverty. Aerial wildlife counts and anecdotal reports from local communities noted a near-total collapse of wildlife.

A generation after the civil war, more than 100,000 large animals now populate GNP. But a resurging animal population can sometimes be a source of human–wildlife conflicts. And bolstering ecosystem protection without ensuring sustainable livelihoods for nearby people can be a recipe for friction, jeopardising long-term sustainability for both nature and people. Therefore, "a common vision of the integrated relationship between sustainable land use, community development, and biodiversity" is key to the long-term viability of the area.

Key benefits to sustainability: The introduction of alternative livelihoods to the area, such as shade-grown coffee plantations and tourism development, has the potential to improve incomes for buffer zone households, and generate environmental benefits such as biodiversity preservation and habitat conservation. Increased income can spill over to other social benefits and positive externalities. Studies have shown that the children of certified shade-grown coffee farmers have significantly higher educational levels than those of non-certified ones, and certified farmers were more likely to be members of relevant trade unions.

Conservation solution: In 2008, a Global Environment Facility (GEF) financed, UNDP-supported project joined the ongoing work of maintaining GNP – bolstering efforts to return the ecosystem to its pre-war state while lifting surrounding communities out of poverty.

Joining the fruitful partnership between the Government of Mozambique, the Carr Foundation and The Gorongosa Restoration Project, the UNDP GEF project objective was to strengthen the overall effectiveness and sustainability of Mozambique's protected area system, including financial sustainability. Following the 2008-2016 project, there is currently a follow-up project that started in 2018.

This ongoing support is continuing to ensure that some of Mozambique's most vulnerable people are able to benefit from inclusive, equitable and sustainable management of natural resources and the environment. This support also ensures that the conservation of globally threatened species is strengthened through enhanced protection and expanding community development around protected areas.

Gorongosa Mountain provides perennial surface water to the park area in the African rift valley and was incorporated into the protected area some years ago.To ensure symbiosis between conservation measures and development efforts, the GNP administration spearheaded an innovative community-based pilot project on the slopes of Mt Gorongosa. The pilot project was the first in the region to use a fully integrated approach to ecosystem conservation and restoration, bringing together a network of social development interventions in health and education, coordinating with local stakeholders on natural resource management, and improving livelihoods whilst simultaneously propagating indigenous trees in the project area via the project's centrepiece: shade-grown coffee farming.

An additional consideration is the backdrop of intense conflict in the mountain region, which extended the timeline of the pilot project by two full years. The results on the ground for the five-year pilot project, and the first year (2019/2020) under widespread adoption of the initiative by the community include: development of an area of 100 ha into high quality shade-grown Arabica coffee plantations, over 100 ha of rainforest was protected and restored, and payments were tendered for early adopters of high quality coffee. This initiative is currently generating sustainable livelihoods for over 600 local families. The project is actively growing at 100 hectares and 100 new families per year. The target is to reach 1,000 ha over 10 years, so as to build capacity within the local economy, to upskill programme participants, and change minds and attitudes towards key human rights (keeping girls in school, ending child marriages) and conservation challenges (stopping uncontrolled burning, shifting agricultural practices, and de-prioritising subsistence methods compared to less risk-prone agricultural practices). These new changed attitudes, and sustainable livelihood alternatives (combined with lasting peace in the region) will help to protect 30,000 ha of one of Mozambique's – and indeed the world's – most biodiverse ecosystems.

By upskilling farmers and implementing interim agroforestry alternatives such as honey production, coupled with the establishment of a small coffee processing factory in the nearby town, the project smoothed the transition from unsustainable, permanently shifting cultivation to sustainable, stable environment-protecting livelihoods.

Business case: It has been estimated that farmers' incomes in the GNP area have increased 10-fold on average for the more than 600 households in the project area, without impinging on their ability to maintain kitchen gardens. Preserving wildlife is also an important value proposition; living elephants are worth approximately US$1.6m apiece – a figure 76 times greater than the one-time sale of its tusks. The thriving national park gives growth opportunities for local tourism businesses, and intact

Case study

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ecosystem services represent savings to health systems and infrastructure.

Lessons learned: Just as ecosystems are intricately linked via webs of mutual aid, the measures implemented to preserve the ecosystems must account for the intimate relationships between local people and their environment. The case of GNP has highlighted that conservation measures which decrease local quality of life are destined to be short-lived; livelihood projects which unsustainably exploit the environment are similarly doomed. Well-integrated endeavours that harmonise considerations of livelihood and environment, such as the GNP coffee project, are more robust, resilient and sustainable.

Next steps: To promote community-based conservation, the current UNDP-supported, GEF-financed project is expanding protected areas through community conservancies and targeted rural development action. The project is specifically working to ensure that wildlife and forest management plans are developed for three conservancies around GNP and in neighbouring reserves, namely Greater Gorongosa-Marromeu Landscape and the Niassa National Reserve.

The project is also working to train members of conservancies and relevant co-management entities in wildlife management – and continuing to support sustainable agriculture and forestry, and alternative income generation. As part of this effort, the project is also supporting pilot projects on community-based wildlife management, sustainable agriculture, ecosystem restoration and the development of small businesses and ensuring that the lessons learned from the process are documented and shared.

This case study was based on the photo essay: UNDP photo essay - Stimulating Growth, plus a blog post by GEF Biodiversity Analyst Sarah Wyatt. Text editing for this version by Andrea Egan and Midori Paxton, UNDP with input from Matthew Jordan (Director of Sustainable Development, Gorongosa National Park).
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