A NATURAL FIX

SUSTAINABLE DEVELOPMENT GOALS

A JOINED-UP APPROACH TO DELIVERING THE GLOBAL GOALS FOR SUSTAINABLE DEVELOPMENT

In September 2015, 17 global goals for sustainable development (the SDGs) were adopted by world leaders meeting at the United Nations in New York. These 17 goals are our roadmap for the next 15 years. They set out what all countries should strive to achieve in order to restore a balance between humans and the environment. A balance that is good for people, the planet, prosperity, peace and partnership. As an evolution of the Millennium Development Goals, the SDGs represent new hope for the forgotten billion. Hope for the poorest people on earth who are left ever further behind. Hope for those who survive on rapidly diminishing resources in the dryland regions of the world.

The goals, if fully implemented are bold and transformative, universal and indivisible. No one will be left behind this time. However, at this stage the SDGs are merely a statement of intent. The challenge is to move from ambition to action. In this brochure we set out the case for implementation of goal 15 "Life on Land" because all life on earth depends on access to healthy and productive land. If we ignore land, we are clearly on shaky ground. We are losing around 12 million hectares each year to degradation processes. Achieving the overarching goals for sustainable development is unrealistic if we do not secure the ground beneath our feet for this generation and for generations to come. The SDG agenda will stand or fall depending on how successful we are in delivering on this goal.

The conclusion of the preamble to "Transforming Our World: the 2030 Agenda for Sustainable Development" stresses the importance of the linkages and integrated nature of the global Goals in realizing the 2030 Agenda. To meet the SDGs, it will be vital to manage these linkages, to harness synergies and minimize potential conflicts and trade-offs within and between the Sustainable Development Goals and targets. The successful implementation of target 15.3 - on land degradation neutrality - can connect the dots between many of these goals and targets. Healthy and productive land is the natural fix to a number of pressing problems, such as food and water security. By safeguarding life on land, we deliver for all life on Earth. We establish the basis for communities – all citizens - everywhere to not just survive but thrive by building a future on a healthy and productive foundation.

Monique Barbut
UNCCD Executive Secretary

EXECUTIVE SUMMARY

The sustainable management and restoration of our landscapes – achieving land degradation neutrality - will deliver many co-benefits. From biodiversity conservation and combating climate change to ensuring economic growth and human wellbeing. How we manage the land is closely linked to how many decent jobs we can create; to food and water security; migration and urbanization trends; real climate change mitigation and adaptation action; responsible consumption or resource conflict. In fact, healthy terrestrial ecosystems contribute significantly to the delivery of many SDG targets.[1]

While our working landscapes are often ignored, they are the clear foundation for real sustainability and for all of the SDG's. This brochure shines a spotlight on some of the main synergies that can be exploited and the diverse benefits that would flow if we protect and restore "Life on Land". We have identified just some of the global goals for sustainable development, where investing in healthy and productive landscapes would be a highly cost-effective intervention with the most immediate and tangible benefits, but delivering land degradation neutrality would be an accelerator of SDG implementation across the board.

OPPORTUNITIES FOR ALL: Our future economic growth, prosperity and human wellbeing depend upon whether we are able to protect and restore our working landscapes. Two billon hectares of degraded land and terrestrial ecosystems are available to kick-start a real green economy creating enormous multiplier effects for employment, learning and poverty reduction.[2] For even greater impact, gender-neutral resource access and use as well as equitable land tenure systems could be mainstreamed within national Land Degradation Neutrality (LDN) approaches. P. 10-13.

DOING MORE AND BETTER WITH LESS: 795 million people are estimated to be chronically undernourished, often as a direct consequence of land degradation, declining soil fertility, unsustainable water use, drought and loss of biodiversity. The sustainable management and the restoration of our terrestrial resources are vital to enhance agricultural productivity especially for small scale food producers. It ensures sustainable food production and resilient agricultural practices, as well as the efficient use of natural resource thereby contributing to human wellbeing. P. 14-17.

BLUE LIFELINES: Water scarcity affects more than 40 per cent of the global population and this is projected to rise. Sustainable land use practices that improve water efficiency and quality in a cost-effective way, as well as the restoration of water-related ecosystems, are essential to mitigate water scarcity. This is an important precondition to achieve access to adequate and equitable sanitation and hygiene for all. P. 18-21.

FUEL FOR LIFE: Climate change requires a rethink and a bold move towards renewable energy sources. Nearly three billion people will rely on biomass for cooking and heating in 2030. The sustainable management of land and water is pivotal to ensure a reliable, affordable and sustainable energy supply for all. P. 22-24.

WORKING WITH NATURE: By 2030, almost 60 per cent of the world's population will live in urban areas. It is critical to promote integrated spatial development planning approaches to optimize the allocation of resources human settlements in urban and peri-urban areas rely upon. Health benefits and disaster prevention are additional advantages sustainable land use planning are able to provide. P. 26-29.

LAND MATTERS FOR CLIMATE: Without the proper consideration of the land sector we cannot get to a 2° C stabilization pathway and deliver climate change resilient landscapes. Improved land use and management, such as low-emissions agriculture, agro-forestry and ecosystem conservation and restoration could close the remaining emissions gap by up to 25 per cent, while simultaneously reducing the risks posed by climate change and enhancing the resilience of key sectors. P. 30-33.

INVITATION: We believe that by achieving land degradation neutrality, we can make the biggest and most inclusive contribution to securing life on earth. We extend a warm invitation to all of those who are like-minded to join us in achieving land degradation neutrality by 2030. P. 34.

WHY LAND DEGRADATION NEUTRALITY?

Human life depends on the land. Plant life provides 80 per cent of our diet[3] and millions rely directly on agriculture for their survival and livelihoods. Forests - trees on the land - account for 30 per cent of the Earth's surface[4], providing vital habitats for millions of people[5] and species. They are important sources of clean air and water.

Today we are seeing unprecedented rates of land degradation and ecosystem loss. Arable land is being lost at 30 to 35 times the historical rate.[6] Drought and desertification is on the rise as a result of extreme weather events and unsustainable land use. While, of the 8.7 million species thought to have been living on Earth[7], 8 per cent are extinct and 22 per cent are at risk of extinction[8] as a result of habitat destruction.

All of these trends adversely impact the poorest and most vulnerable communities. Human induced land use change has caused devastating economic losses, particularly in the long term. Current estimates, for global land use change between 1997 and 2011, value the loss of ecosystem services at a range of USD 4.3 to 20.2 trillion per year.[9] Furthermore, the direct cost of land degradation amounts to nearly USD 66 billion per year.[10] In certain regions, such as Sub-Saharan Africa, the figure can represent as much as 10 per cent of the national Gross Domestic Product (GDP).[11]

BOX1: LAND DEGRADATION NEUTRALITY LDN[14]

LDN can be generally understood as a state where the amount and quality of land resources, necessary to support ecosystem functions and services, remains stable or increases. This can occur at different scales and within different ecosystems. At its core are better land management practices and more rational land use planning. It is really the combination of avoiding or reducing the rate of land degradation and increasing the rate of recovery.

Preventing further land degradation must be a high priority if we are to make a transition to a more sustainable society. This is strongly reflected in SDG 15 which states: "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"

At its heart is the concept of Land Degradation Neutrality (LDN)[13], which is about achieving a balance between three processes: degradation, rehabilitation/restoration and sustainable land management. We need to tip the scales in favor of sustainable land management and restoration processes.

Sustainable development requires smarter integrated approaches than those we have used up until now. It requires these to be applied at a much greater scale. As a globally agreed target, LDN can be used to galvanize action to address land degradation in all terrestrial ecosystems across entire landscapes. Achieving LDN will require a paradigm shift in land stewardship: from 'degrade-abandon-migrate' to 'protect-sustain-restore'.[15]

This means cooperation among various sectors and national sustainable development plans that embrace complementary management options:

- adopting sustainable land management policies and practices in order to minimize current, and avoid future, land degradation; and
- rehabilitating degraded and abandoned production lands as well as restoring degraded natural and semi-natural ecosystems that provide vital benefits to people and working landscapes.

Different approaches exists to restore, protect and sustain land resources (i.e. soil, water and biodiversity), such as Sustainable Land Management (SLM)[16], Integrated Landscape Management (ILM)[17] Agroecological[18]- ,Ecological[19]- and Ecosystem–based[20] approaches. Regardless of the different labels all approaches are suitable for virtually all land use systems and climate regions, and applicable at both small and large scales.

While the SDG agenda is global, practical solutions will be needed at both the local and landscape-scale. It is at these scales that natural resources and ecosystem services are best managed and that people live their daily lives. Sustainable land management, rehabilitation and restoration can provide immediate, cost-effective benefits across the board. With forward-looking policies, tailored finance and incentives, and strong political will and ambition, the potential of the land use sector can be unleashed. We already have proven technologies and good practices that contribute to a more stable and resilient world. Now it is just a matter of scaling them up and scaling them out to accelerate implementation of the SDGs.

The next sections demonstrate some of the clearest linkages and benefits achieving Land Degradation Neutrality would bring to the delivery of the SDG's.

OPPORTUNITIES FOR ALL

- **About one billion people in developing countries live in extreme poverty, two-thirds of them live in rural areas;**
- **Worldwide, over 200 million people, a disproportionate share of young people are unemployed and actively looking for work: almost 74 million young people (aged 15–24) were looking for work in 2014. The youth unemployment rate is three times higher than for the general population[21];**
- **Land-related activities, most notably agriculture, have tremendous potential to alleviate poverty and generate employment especially among the world's poorest people. A 1 per cent gain in Gross Domestic Product (GDP) originating from agriculture generates a 6 per cent increase in overall expenditure of the poorest 10 per cent of the population while a 1 per cent gain in GDP originating from non-agricultural sectors creates zero growth in overall expenditure of the poorest 10 per cent of the population[22];**
- **To keep employment as a share of the working-age population constant till 2050, around 700 million jobs need to be created, mainly in Asia and Sub-Saharan Africa.[23]**

To eradicate extreme poverty or to generate additional income and employment we must look to healthy and productive land. With a global workforce of over one billion, agriculture is the most obvious place to start. The land use sector, with its high concentration of poor people offers some of the most significant opportunities for green growth and prosperity.

How can achieving Land Degradation Neutrality help?

Agriculture has tremendous potential to alleviate poverty and generate employment especially among the world's poorest people. The switch to sustainable agriculture, agroforestry and other sustainable land uses reinforces this potential as many of these low-impact farming practices tend to have higher labor requirements and create more direct jobs per unit of output than industrial agriculture.

A macroeconomic model[24] that simulated green investments in the agricultural sector suggests that the transition to sustainable agriculture could create over 200 million full-time jobs across the food production system in 2050.[25]

Poverty reduction and job creation through sustainable land use is not, however, limited just to agriculture. Land-related activities are also relevant in the broader context of rural development. Examples of poverty reducing and job generating sectors are those related to sustainable forest management, sustainable tourism and clean energy production as well as ecosystem restoration. Many of those green jobs are known for their multiplier effects[26] and can be attractive to young people. These jobs also confer a certain social status, require advanced skills and provide a good income.

Moreover environmental stewardship is far from being a job killer of employment. A recent study suggests that the total employment effect of the restoration economy ranges from 10.4 to 39.7 jobs per USD 1 million invested.[27] To set this into perspective, the oil and gas industry supports approximately 5.3 jobs per USD 1 million invested.[28] In this context it is further suggested that restoring just 12 per cent of degraded agricultural land could boost smallholder's incomes by USD 35-40 billion per year and feed 200 million people per year within 15 years.[29]

Gender and land rights are additional factors influencing rates of poverty and employment. Having land, controlling it and using it – with secure access and tenure - are critical for rural livelihoods. Secure access to resources and tenure contributes to investment decisions that determine rural wealth and poverty. This is especially true for woman.

Agriculture is the most important source of employment for women in rural areas in most developing country regions. But women are consistently less likely to own land; they are less likely to have access to rented land and the land they do have access to is often of poorer quality and in smaller plots. Conversely, if women had the same access to, and control over productive resources as men, they could increase yields on the farms by 20 to 30 per cent.[30]This could raise total agricultural output in developing countries by 2.5 to 4 per cent, which could in turn reduce the number of hungry people in the world by 12 to 17 per cent.[31]

The implementation of sustainable land management approaches cannot deliver land rights nor can it turn around gender relations. Yet because sustainable land management deals with the multiple dimensions (social, economic, and environmental) and interactions (people, institutions, and values) of land use issues matters of tenure and secure access can be more easily addressed.

Entry points are the wide range of participatory and community concepts that build upon skill development, cooperation and shared decision making. Indeed, it will create increased opportunities for both men and woman. While change is not instant, the basic steps that shape trust, self-confidence and empowerment amongst stakeholders involved will provide a good start.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 1.1.AND 1.5

Organic farming breaks new ground in Zimbabwe[32]

Founded as a community development organization in 2007, the association, with 450 members, originally focused on raising awareness on organic farming as an alternative to tobacco cultivation and pesticide use. Supported with a USD 50,000 contribution from the Global Environment Facility, the farmers established organic gardens and trained in the application of crop rotation, livestock and green manure, composting, mulches and cover crops. The introduction of alternative organic livelihood options – ranging from horticulture production to nursery management, mushroom production, aquaculture, beekeeping and agro-forestry - has helped local farmers increase incomes and facilitated access to new, more lucrative markets. As a result, the food security status of the participating community has significantly improved, while participating farmers have reported improved and increased yields from their fields. On average, participating farmers have been able to generate annual incomes of USD 250 to USD 300 from the sale of vegetables in local markets. Out of over 450 farmers in the association, about 60 per cent are women.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 1.4/ 5A

Participatory rangeland management shifted gender roles in Syria[33]

After years of severe drought and intensive grazing, rangelands in the Badia were severely degraded. By reintroducing native plants that help meet fodder requirements, fix the soil and stop sand encroachment, ecosystems were restored and the local population's vulnerability to the effects of climatic instability was reduced. After two years of resting, reseeding and planting, birds, insects and animals returned to the area. The rehabilitated ecosystems offered further potential for income generation, as truffles grow in some areas of the Badia, and women could gather them to boost their family incomes. In 2010, a community with a 100 000-ha grazing area could earn up to USD1 million through the sale of truffles. Higher household incomes provided a basis for the project to diversify income-earning opportunities for women through literacy classes and training courses in new skills such as first aid, food processing and sewing. With households being better off, there is less pressure on young girls to marry early, and as women gain more economic autonomy, they are finding that gender relations are shifting.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 8.2

Farmer-managed natural regeneration diversified village economy in Niger[34]

The southern savannas of Niger were long considered to be a hot spot of dryland degradation. Farmer managed natural regeneration (FMNR) and soil and water conservation have led to what has been called a "regreening" in Niger FMNR involves simple, low-cost techniques for native tree and shrub management to produce continuous harvests of trees for fuel, building materials, food, medicine, and fodder. Benefits to ecosystems and people have been significant: 200 million trees are protected and managed, amounting to a 10- to 20-fold increase over 30 years. With improved yields, people eat better and have more food security in drought years, and families and communities have been able to diversify their livelihoods. Not only are fuelwood and fodder more readily available, but households are able to sell surplus products in the local market. For example, regeneration on a 1 ha field can earn the farmer an additional USD140 per year from selling firewood, which is half the average annual income of a farming household. In Zinder, each baobab tree can bring in USD 20 a year from the sale of its edible leaves. Large-scale revegetation with native trees has benefited watershed functions and wild biodiversity.


SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 4.4./4.7 AND 8.6

Restoring land, nurturing young leaders in Nepal[35]

Despite the beautiful landscapes, life in the mountains of Nepal can be tough, particularly for rural youth. Abandoning their villages in search of employment elsewhere has led to an absence of young people and an increasing labour shortage. Consequently, there has been an increase in abandoned agricultural lands in the Parbat district in the Panchase region. Realising the urgency of these challenges, the Mountain Ecosystem-based Adaptation (EbA) Programme is supporting the Chihandanda Community Forest User Groups (CFUGs) to transform 10 hectares of barren land into healthy agroforestry plantations that will provide future access to fodder, fuel wood and commercial income from sale of broom grass and fruit-bearing Laps. In addition to the planting work, the project has also provided necessary materials and financial support to construct a 195m long wall to stop animals from grazing and to protect the young plants. A brush-wood check dam, using the locally available bamboo, was constructed to prevent gully erosion resulting from land degradation. Today, gully erosion at the site has been markedly reduced. An integral part of this transformation has been the creation of a local school-based Eco-club. Inspiring a new generation of environmental and social awareness, the Eco-club is building the knowledge and momentum to lead these communities towards low carbon, climate resilient futures. The Eco-club committee was established with students from grade 6, 7, 8 and 9. Working with the CFUGs, these students have actively participated in planting and maintaining the site - weeding, mulching, and maintaining the health of the newly planted trees. *Being part of the Eco-club is on a volunteer basis. I like being outside with my friends. We get to plant different species and learn about how they grow. We are learning a lot about conservation and how to protect our environment."* Mihash Gurung, 10th Grade, 15 years old.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 8.9

Large-scale forest restoration spurred ecotourism in Costa Rica[36]

Costa Rica is a success story in large-scale forest restoration after significant deforestation. In 1943, forests occupied 3.9 million ha of Costa Rica, 77% of the country's land area. Crop production and cattle grazing – supported by a rapid expansion of the road network – became the prime causes of deforestation over the course of the next quarter-century. From 1986 onwards Costa Rica was able to convinced landowners to pursue forest restoration principally through natural regeneration on abandoned pastures. By 2005, forest area had increased by 394,000 ha, to cover 48% of the country. To spur the restoration process Cost Rica established a PES system financed by a dedicated 3.5% tax on fossil fuel sales as well as fees on beneficiaries of forest-based ecosystem services in 1996. The efforts payed off: restoration curtailed soil erosion and sedimentation of waterways, and protected biodiversity. Eco-tourism also emerged as a major industry that provided new employment opportunities and contributions to the national economy. The number of tourists visiting Costa Rica jumped from just 60,000 in 1986 to 1.7 million in 2005.

DOING MORE AND BETTER WITH LESS

- **795 million people are estimated to be chronically undernourished as of 2014, often as a direct consequence of land degradation, declining soil fertility, unsustainable water use, drought and loss of biodiversity;**[37]
- **52 per cent of agricultural land worldwide is moderately or severely affected by soil degradation and it is estimated that over the next 25 years, land degradation could reduce global food productivity by as much as 12 per cent, leading to a 30 per cent increase in world food prices;**[38]
- **Adopting sustainable land management practices and reaching 95 per cent of the potential maximum crop yields could deliver up to 2.3 billion tons of additional crop production per year, equivalent to USD 1.4 trillion;**[39]
- **The World Health Organization estimates that up to 3 million severe pesticide poisoning episodes occur globally each year. 250,000 people die. 99% of cases are in low and middle-income countries. Recent evidence links severe pesticide poisoning with suicides;**[40]

Rapid economic growth and increased agricultural productivity over the past two decades has seen the proportion of undernourished people drop by almost half. Unfortunately, extreme hunger and malnutrition remains a huge barrier to development in many countries. At the same time the demand for agricultural products is expected to rise in the following decades. We could require up to a 70 per cent increase in world food production to feed the 9.5 billion people expected to live on earth by 2050.[41] Yet, 52 per cent of agricultural land worldwide is affected by soil degradation. In many African countries agricultural production is projected to be severely affected by climate variability and change that could lead up to a 50% reduction in crop yields for rain-fed agricultural crops from 2020.[42]

How can achieving Land Degradation Neutrality help?

Sustainable, resource-conserving, and low-external input techniques[43] have been successfully employed to bring degraded land back into production, improve yields and enhance resilience.

Comparing the impacts of 286 sustainable agriculture projects in 57 developing countries covering over 37 million hectares[44], it was found that sustainable practices increased productivity on 12.6 million farms. There was an average crop yield increase of 79% with 128% being achieved for some projects in East Africa. The most recent large-scale study points to the same conclusions.[45]

Forty sustainable land management projects implemented in the early 2000s throughout Africa created benefits for 10.4 million farmers and their families. Crop yields more than doubled on average (increasing 2.13-fold) over a period of 3-10 years resulting in an increase in aggregate food production of 5.79 million tonnes per year. That is an average benefit equivalent to 557 kg per farming household. In this context the Economics of Land Degradation Initiative has suggested that reaching 95 per cent of the potential maximum crop yields by adopting sustainable land management practices could deliver up to 2.3 billion tons[46] of additional crop production per year, equivalent to USD 1.4 trillion.

Table 1: Sustainable land management productivity outcomes (nd= no data)[47]

Thematic Focus	Area improved (ha)	Mean yield increased (ratio)	Net multiplicative annual increase in food production (thousand tonnes yr-1)
Crop variety and system improvements	391,060	2.18	292
Agroforestry and soil conservation	3,385,000	1.96	747
Conservation agriculture	26,057	2.20	11
Integrated pest management	3,327,000	2.24	1,418
Horticulture and very small scale agriculture	510	nd	nd
Livestock and fodder crops	303,025	nd	nd
Novel regional and national partnerships and policies	5,319,840	2.05	3,318
Aquaculture	523	nd	nd
Total	12,753,000	2.13	5786

Sustainable land management can also minimize the negative impacts of conventional agriculture. By reducing and better using external inputs such as fertilizers, pesticides, water and energy[48], sustainable land management can reduce the widespread pollution of air, water[49]and soil. The sustainable management of land leads to improved water and nutrient availability in the soil.[50] On-farm fertility generation such as nitrogen-fixing trees or leguminous–cover crops reduce the need for mineral fertilizes.[51] The smart use of biodiversity helps to create a natural barrier against disease and pests[52] and lessens the negative health effects caused by dangerous pesticides.

BOX 2: PESTICIDES USE AND HUMAN HEALTH[53]

Agricultural systems that do not use pesticides result in greater net social benefits because of the reduction in illnesses among farmers and their families, and the associated treatment costs. In China, the externalities of pesticides used in rice systems cause USD 1.4 billion of costs per year through health costs to people, and adverse effects on both on- and off-farm biodiversity. In Ecuador, annual mortality in the remote highlands due to pesticides is among the highest reported anywhere in the world at 21 people per 100,000 people, and so the economic benefits of Integrated Pest Management-based systems that eliminate these effects are increasingly beneficial.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 2.3/ 2.4/ 12.2

Smallholder conservation agriculture pays off[54]

The Southern Province is a semi-arid plateau zone that receives 750–900 mm of annual rainfall. Agricultural systems are mixed crop-livestock, with maize, groundnut, and cotton dominant. The Tonga (the main ethnic group in the area) farm 1–5 hectares per family, but the plateau also houses commercial farming operations. Large expanses of the region have been subjected to serious soil erosion, nutrient depletion, watershed deterioration, and loss of biodiversity as a result of unsustainable farming practices and overexploitation of natural vegetation. To address these challenges, the government of Zambia promoted the widespread adoption of conservation agriculture (CA). The socioeconomic and environmental benefits have been well documented. Yields on farms using CA practices doubled in maize plots and were 60 per cent higher for cotton compared with yields under conventional plowing systems. A 2010 budget analysis in Zambia found that returns under CA are significantly higher than under conventional systems: USD104/ha under CA and USD19/ha under conventional tillage. A switch to CA has allowed women and children to carry out lighter and more diversified tasks. In terms of ecosystem services, CA has improved soil structure, water retention, and biological activity, and has reduced greenhouse gas emissions, as residue is not burned.

Sustainable land management: enhanced productivity with less input: Evidence from around the world[55]

- Soil and water conservation in the drylands of Burkina Faso have combated land degradation, resulting in the average family shifting from being in cereal deficit of 650 kg per year to producing an annual surplus of 150 kg.
- Soil fertility management using a range of biological pest management methods together with legumes, cover crops and green manures have doubled beans and groundnut yields from 300 to 600 kg/ha in western Kenya.
- In Nigeria, alley crops of Gliricidia and Leucaena reduced soil erosion by 73 and 83 per cent, respectively.
- In low rainfall areas of Ethiopia, reduced tillage without chemical fertilizer increased gross crop revenue by USD 106 per hectare compared to conventional tillage without chemical fertilizer. Moreover, this productivity impact was superior to that of chemical fertilizers with conventional tillage (USD 13 per ha). Lower impacts of reduced tillage without chemical fertilizer were found in high rainfall areas (USD 6 per ha).
- In northern Vietnam, contour planting of hedgerows on sloping lands reduced soil loss from 18 to 7.4t/ha/year.
- In Pakistan, yields of citrus fruits increased by 150-200 per cent after adopting sustainable agriculture practices such as mulching, no till production, and composting.
- 45,000 families in Honduras and Guatemala have increased crop yields from 400-600 kg/ha to 2000-2500 kg/ha using green manures, cover crops, contour grass strips, in-row tillage, rock bunds and animal manures.
- Soil and water conservation using contour grass barriers, contour ploughing and green manures has raised maize yields from 3 to 5 tons/ha and soybeans from 2.8 to 4.7 tons/ha in the states of Santa Caterina, Parana and Rio Grande do Sol in Brazil.
- Some 2000 farmers in Bolivia have improved potato production from about 4 tons/ha to 10-15 tons/ha in particular by using green manures to enrich the soil.

Save in time of drought: The ngitili system in Tanzania[56]

In the traditional Tanzanian ngitili fallowing system, certain individualand communally-owned lands are excluded from grazing during the wet season, assuring regeneration and making forage available during the peak dry season. In recent decades, deforestation, bush clearing, and chronic overgrazing have degraded the original woodland ecosystem, negatively impacting human welfare. Through the efforts of the Shinyanga Soil Conservation Programme (HASHI), the ngitili system was reinstated on more than 350,000 hectares of degraded woodlands to jumpstart an ecosystem restoration process while also meeting the subsistence needs of the local population. As a result, villages across Shinyanga are gradually revitalizing ngitili, expanding its use beyond simple soil and fodder conservation. Now, the region provides a wide range of woodland goods and services that have enhanced livelihoods and created a vital safety net during dry seasons and droughts. The total monthly value of benefits from restoring the ngitili in Shinyanga is estimated at USD14 per person, considerably more than the national monthly average consumption level per person of USD 8.50 in rural areas.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 3.9/12.4

Integrated Pest management reduced pesticide use in Florida[57]

Tomatoes are the No. 1 vegetable crop in Florida. Tomato growers began to adopt Integrated Pest management (IPM) in 1976-77, following a severe outbreak of leafminers that caused significant economic loss. This outbreak, which required as many as 34 insecticide sprays in a single 90-day season, was attributed to a build-up of pesticide resistance in the leafminers and pesticide-induced mortality in the leafminer parasites - a phenomenon common to crops receiving high chemical inputs. The outbreak served as a wake-up call to set in motion pilot IPM programs in Dade County, Florida. Growers and the general public have reaped the rewards thanks to IPM.

- Yields have risen dramatically from 29,000 to 36,700 pounds per acre in only 8 years (1988-89 to 1996-97).
- Fifty per cent of growers routinely scout for pests.
- Growers using IPM report 82 per cent reduction in overall pesticide use.
- Insecticide use has been significantly reduced from an average of 8.9 pounds per acre in 1994-95, to 3.5 pounds per acre in 1996-97.
- A shift toward using reduced-risk pesticides is evident throughout Florida.
- New scouting companies with highly trained personnel have developed.
- Scouting actions have detected outbreaks of new and unusual diseases, enabling early intervention.

Eggplant grafting transforms life in Bangladesh[58]

In Gaidghat, a small village in western Bangladesh, under the shade of a bamboo-framed thatch roof, Shovarani Kar and Trishna Rani Biswas sit and work with razor blades and eggplant seedlings. With quick and careful movements of hand on plant, the two women are able to graft a high-yielding variety of eggplant onto the rootstock of another variety that is resistant to a devastating soilborne scourge: bacterial wilt. In many areas of the country today, and in Jessore before the grafting technique was introduced, Bangladeshis dealt with pests and diseases by using chemicals supplied by pesticide makers. Although using pesticides was satisfying at first because farmers could see lots of dead insects, the negative effects began to show up quickly. People developed frequent headaches and burning eyes. They lost sleep and their skin started to itch. To make matters worse, children did the spraying. As a response, a simple integrated pest management technique was introduced to minimize the negative effects of chemical use and to combat poverty. The programme was so successful that farmers have been able to reduce their purchase of chemical pesticides. Their cost of production has gone down, and their yield has gone up — resulting in higher income. The farmers use the extra money to repair houses, buy cattle, and save to buy more land on which to grow vegetables. In the village of Gaidghat, all the children attend school, and health problems are down. On a global scale, these changes are small, but they make a big difference in the lives and livelihoods of people like Shovarani Kar and Trishna Rani Biswas.

The influence of effluent - the power to do good, Australia[59]

After 24 years of conventional dairying, Ian and Wendy Klein began using organic farming methods, actively turning away from the use of chemical or artificial fertilizers, drugs, antibiotics and hormones that are common in today's food production. Their underlying principles were to not pollute the environment or use toxic chemicals and to reduce their environmental footprint – while producing a wholesome food and remaining pro table. The Kleins no longer have problems with excessive amounts of harmful or toxic nutrients and offensive odours from the dairy effluent. By treating their dairy effluent with beneficial bacteria, they are able to use the modi ed slurry as a fertilizer, returning nutrients to the soil and lowering costs of fertilizing the pasture. Using foliar sprays and bio-fertilizers to address the condition of the soil has also promoted the storage and cycling of organic matter in the soil, making the pastures more productive. The cows are healthier and require fewer interventions to prevent animal health problems. The Kleins are also using a third less water after establishing a state-of-the-art water reticulation system for irrigating the pastures, linked to laser levelling of the paddocks. By focusing on keeping nutrients and water on the farm, Ian and Wendy have developed a successful recycling and composting program. In the Klein's experience, changing from conventional farming practices to working with more natural inputs and processes has reduced their input and veterinarian costs and supports a pro table organic dairy.

- **Water scarcity affects more than 40 per cent of the global population and is projected to rise. Over 1.7 billion people are currently living in river basins where water use exceeds recharge;**[60]
- **By 2050, at least one in four people is likely to live in a country affected by chronic or recurring shortages of fresh water;**[61]
- **Approximately 70 per cent of all water abstracted from rivers, lakes and aquifers is used for irrigation;**[62]
- **More than 80 per cent of wastewater resulting from human activities is discharged into rivers or sea without any treatment.**[63]

If we are to improve water resource efficiency and reduce the risk of increasing water scarcity we have to better manage the land. While it is considered in general that there is enough freshwater on the planet for 7 billion people, the distribution is uneven and much of it is wasted, polluted and unsustainably managed.[64] With climate change and continued poor resource management, the situation will get worse as we race towards 9.5 billion people on earth.

Every land-use decision is a water-use decision. Improving water management goes hand in hand with mitigating or preventing land degradation. Sustainable land use practices that improve water efficiency and quality in a cost-effective way as well as the restoration of water-related ecosystems are essential to mitigate water scarcity.

How can achieving Land Degradation Neutrality help?

Degraded land and ecosystems cannot provide some of the most important regulating services needed for "Life on Land". The decline in water quality and availability – with more prolonged and more intense droughts - will continue if current land use practices and climate change trends continue. Smart, coordinated land and water management provides a cost-effective, long-term solution to water scarcity, drought and pollution.

Many ecological farming practices are available that create soils rich in organic matter with better capacity to conserve water in the root zone and increase water-use efficiency.[65]

Mulching with crop residues, introducing legumes as cover crops, and inter-cropping with trees all build soil organic matter, thus reducing water run-off[66] and improving soil fertility. In a study of 40 sustainable land and water management technologies documented by WOCAT, it was found that nearly 88 per cent of the technology cases lead to an increase in soil moisture. Reduced runoff and increased water infiltration and storage in the soil lead to greater water availability. Additionally, sustainable land and water management technologies enhance the potential for reducing evaporation in drier environments where up to 70 per cent of rainfall can be lost.[67] Better land management practices will make an important contribution in easing the competition for water resources.

Table 2: Summary of changes in water productivity by major crops arising from adoption of agro-ecological technologies and practices in 144 projects[68]

Crops	% Increase of water productivity
Irrigated	
Rice	15.5%
Cotton	29.4%
Rain fed	
cereals	70.2%
legumes	102.3%
roots and tubers	107.5%
urban and kitchen gardens	
vegetables and fruits	256.6%

Water pollution caused by land degradation and unsustainable practices is also a problem for water quality. Conventional water treatment removes unwanted contaminants such as pesticides and nutrients but this is costly in terms of both energy and money. Implementing sustainable land management measures and reducing land degradation in drinking water catchments can minimize the entry of pollutants into the water supply. This has huge potential to reduce costs at water treatment works. While implementing sustainable measures often incur costs, it is increasingly clear that is cheaper, particularly in the long term, than treating polluted water.[69] Scottish Water has, for example, estimated that in a large drinking water catchment, implementing sustainable land management measures could save upwards of GBP 10 million over 25 years.[70]

It doesn't always have to be a major investment. Even small changes in the existing technology or equipment, such as low-cost buckets and drip lines, or changes in the current practices, such as no-till agriculture, supplemental irrigation, ground water recharge and adopting alternative water harvesting systems have been shown to improve the livelihoods of the poorest of farmers and substantially increase productivity gains.[71]

Planning and implementing land degradation neutrality at the watershed level would revolutionize integrated natural resource management and build resilience against drought and other climate change impacts.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 6.2 AND 6A/B

Ancient technology for sustainable impact[72] in Swaziland

A sand dam is an ancient method of water harvesting where a concrete embankment wall is built across a river to harvest sand sediments and runoff from upstream. The water contained in the sand can be extracted through various means during the dry season. Via UNDP's South-South initiative, officials from Kenya with extensive experience building sand dams showed Swazi officials and community members the benefits of the method. With the community participating in the construction efforts, five pilot sand dams have since been constructed in the Lowveld. The dam has harvested approximately 15-20 million litres of water, an amount that will increase as the dam matures and already provides sufficient water for the community. Overall, the five sand dams have improved the water supplies of five communities that are home to some 6,711 community members. One of the sand dams facilitates health and sanitation services for a local clinic. Ten schools with a total student population of 3,693 received integrated rainwater harvesting systems, as well as training on the importance of water harvesting and sanitation. An ecosystem restoration effort resulted in the clearing of alien and invasive plants from an area covering more than 70 hectares, leading to improved rainwater infiltration.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 6.3

Wastewater Treatment with Wetlands in California [73]

The Hidden Valley treatment wetland in Riverside, California, is an example of a treatment wetland. A regulatory revision required the city of Riverside to remove nitrogen from its wastewater. The cost of a conventional denitrification facility at the treatment plant was estimated at $20 million. After investigating alternatives, the city decided to employ a wetland system for nitrogen removal. A low grade wetland infested with invasive, non native vegetation near the treatment plant was cleared of invasives and rehabilitated to provide the treatment along with ecosystem benefits. The cost of constructing the 28 ha wetlands project was only USD 2 million, a savings of USD18 million, 90 per cent less than a conventional facility. The operation and maintenance costs of the wetland system are also more than 90 per cent less than a conventional system. In operation since May 1995, the system has proven effective at nitrogen removal and has met all permit requirements. Furthermore, the wetland provides important ancillary benefits that could not be provided by a conventional facility. The wetland includes an interpretive center for environmental education and trails for recreational use that attract more than 10,000 visitors a year. It also supports wildlife habitat that is home to 94 bird species.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 6.4 AND 6A/B

Good land, more water= better life in Ecuador[74]

To help communities address the effects of increasingly erratic weather, UNDP, the Global Environment Facility (GEF) and the Ministry of Environment of Ecuador (MAE), have implemented the "Adapting to Climate Change through Effective Water Governance (PACC)" project. Since 2008, the project has focused on Ecuador's most vulnerable watersheds: Chone, Portoviejo, Babahoyo, Advertise, Jubones and Catamayo. To improve food and water security of communities, 116 agro-ecological farms and 134 orchards were created, as was a drinking water system and 149 sprinkler, spray and mixed irrigation systems to be used in rural gardens. The project planted 506 native plants and reforested 440 hectares of land. It also built 50 reservoirs and mini-reservoirs, 96 ponds, 33 wetlands and 32 weathering pits. The project worked to strengthen local institutions and stakeholders—the new regulatory framework for Ecuador's water resources established a Watershed Council for communities. In 12 communities in Azuay Province women have been actively involved in decision-making, a crucial development given that many of the region's men have left the area to work as migrants. One of these women, Gladys Sagbay, said that before the project, "there were no jobs. Whereas now, we have water to plant our gardens and sell our products. The land is my sustenance." The project's activities have benefitted some 4,455 families, numbering 28,983 people in eight provinces and 116 communities.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 6.6

Healthy soil, less pollution, reduced costs: Benefits from grassland restoration projects in South Africa[75]

In the Drakensberg mountains, local communities depend heavily on various ecosystem services for their livelihoods. By restoring degraded grasslands and riparian zones and changing the regimes for fire management and grazing, early results suggest that it may be possible to increase base water flows during low-flow periods (i.e. winter months when communities are the most vulnerable to not having access to any other source of water) by an additional 3.9 million m^3. Restoration and improved land use management should also reduce sediment load by 4.9 million m^3/year. While the sale value of the water is approximately EUR 250,000 per year, the economic value added of the additional water is equal to EUR 2.5 million per year. The sediment reduction saves EUR 1.5 million per year in costs, while the value of the additional carbon sequestration is EUR 2 million per year. These benefits are a result of an investment in restoration that is estimated to cost EUR 3.6 million over seven years and which will have annual management costs of EUR 800,000 per year. The necessary ongoing catchment management will create 310 permanent jobs, while about 2.5 million person-days of work will be created during the restoration phase.

Integrated land management makes river flow again in India[76]

The state Rajasthan, faced problems of environmental degradation and drought including reduced food security and water access and loss of wildlife. To tackle the challenge, collective community investments were undertaken to re- establish and manage johads, (traditional large- scale water harvesting structures). The outcomes of this integrated landscape initiative befitted people, livelihoods and the environment:

- Increased access to water for irrigation (permitting some communities to have an additional growing season) and livestock has led to increased agricultural production.
- Improved access to water for domestic uses and increased likelihood security; increased interest in collective action.
- Increased groundwater re-charge, improved hillside forest growth, and increased water for wildlife. Restoration of the Avari river, which had not flowed since the 1940s.

FUEL FOR LIFE

- **3 billion people rely on wood, coal, charcoal or dung for cooking and heating;**[77]
- **Energy is the leading contributor to climate change, accounting for around 60 per cent of total**[78] **global greenhouse gas emissions, thus the rapid scaling up of low-carbon, clean and renewable energy sources is a key objective in long-term climate goals;**
- **As renewable energy relies to a great extent on healthy and functioning ecosystems, the sustainable management of land and water would ensure a reliable energy supply especially for the world's poor.**

Energy is central to nearly every major challenge and opportunity the world faces today. Be it for jobs, security, climate change, food production or increasing incomes, access to energy for all is essential. Traditionally, the growth in energy demand has been met predominantly by tapping further into our fossil fuel, freshwater and land resources. However, these resources are limited and their extraction has significant social and environmental impacts leaving a "footprint" on the land. Production, transportation, and use of oil can cause water pollution and habitat fragmentation. Oil spills, for example, leave waterways and their surrounding shores uninhabitable for some time while mining causes physical disturbances to the landscape, creating eyesores such as waste-rock piles and open pits.[79]

Renewable energy sources are the only smart choice for scaling up energy provision and meeting demand, particularly in poor rural communities. Yet a closer look at some renewable energy sources, such as wood-fuel, charcoal and hydropower reveals that renewable energy relies to a great extent on healthy and functioning ecosystems e.g. land and water. Energy production and security, for example, is threatened by the lack of available water resources for thermoelectric power and hydropower plants. Energy production intensifies the competition between different uses of land (e.g. food vs. biofuels) and can jeopardize the quality of the land for future use (e.g. land degradation/deforestation).

How can achieving Land Degradation Neutrality help?

Today wood used as fuel (fuelwood - i.e. firewood and charcoal) accounts for around 10% of the global energy supply. It dominates energy provision in many parts of the developing world, particularly remote communities. Given current trends in population growth, urbanization, economic growth, and the relative price of other energy sources, it is likely that wood-based biomass will remain an important source of energy for many decades.[80]

While fuelwood consumption by rural households is no longer considered a principal cause of forest degradation or deforestation[81], charcoal production is largely unsustainable leading to the serious loss of tree cover, especially in the dryland areas. Integrated land management approaches offer various options for sustainable wood fuel and charcoal sourcing so as to protect energy security especially for the rural poor.

Trees grown outside forests, such as in agroforestry and silvopastoral systems and small-scale plantations have the potential to provide a more sustainable alternative to wood fuel harvesting from natural forests and woodlands.

Growing global demand for clean and renewable energy will also lead to an expansion of hydropower. The amount of untapped hydropower in the developing world is tremendous — nearly four times the capacity currently installed in Europe and North America.[83]

Hydropower can be complex and can bring a range of economic, social and environmental risks if not done properly.[84] Hydropower is highly sensitive to rainfall variability, droughts and land degradation in upper watersheds, as these can affect water level and water flow for electricity production. California hydropower production for instance declined significantly during the recent drought, as water flows dropped, with both economic and environmental costs. Much of this lost hydropower was made up by purchasing and combusting natural gas, costing California ratepayers an additional USD 1.7 billion and producing an additional 13 million tons of carbon dioxide.[85]

While drought as a natural phenomenon cannot be prevented, it can be better managed. Sustainable management of watersheds and river basins reduces land degradation and soil erosion which offers cost-effective natural fixes for hydropower supply by decreasing the sediment yield[86] and hedging against the negative impacts of water shortage or run-off. To lessen environmental impacts, hydropower can run on a small or even micro level. Micro-hydropower development is a proven, attractive and economically promising resource especially in remote parts of the world lacking huge investment capacities. It works best if the land is healthy.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 7.1/ 7.2/AND 7B

Safeguarding fuelwood supply through agroforestry in Guatemala[87]

In Guatemala, the conversion of degraded land to woodlots and permanent agriculture through agroforestry systems increased fuelwood supply and met most of the local fuelwood needs. In this case, a CARE project established tree nurseries run by local farmers which later became self-sufficient. It also increased fuelwood availability and agricultural productivity by providing trees. The agroforestry systems have persisted during years of political strife and uncertainty primarily because they involve local people as the primary stakeholders. The local farmers then adopted the project's techniques in areas beyond its boundaries by setting up their own tree nurseries, potentially increasing the amount of carbon sequestered (positive leakage) and providing a steady and sustainable supply of fuelwood. In this case, the methods of increasing fuelwood availability and agricultural productivity were widely reproducible.

Ecosystem restoration and sustainable hydropower production in Rwanda[88]

In 2003-04, Rwanda experienced a major electricity crisis. This crisis was triggered by a steep decline in power generation at the Ntaruka hydropower station, attributed to a significant drop in the depth of Lake Bulera, the station's reservoir. The water loss was precipitated by a combination of factors, including: poor management of the upstream Rugezi Wetlands; degradation of the surrounding Rugezi-Bulera-Ruhondo watershed due to human activity; poor maintenance of the station; and reduced rainfall in recent years. In response to its energy crisis, Rwanda sought to restore the degraded watershed by halting on-going drainage activities in the Rugezi Wetlands and banning agricultural and pastoral activities within and along its shores, as well as along the shores of nearby lakes Lakes Bulera and Ruhondo. But this left the region's poor rural households no longer able to access key resources, jeopardizing their livelihoods. The Government responded with additional agricultural and watershed management measures including: building erosion control structures; planting a bamboo and grass belt around the Rugezi Wetlands; planting trees on surrounding hillsides; distributing improved cookstoves; and promoting both environmentally sound farming practices, and introducing additional income-generating activities such as beekeeping. Today, the Ntaruka hydropower station has returned to full operational capacity while local livelihoods are, in the main, more secure. The story of Rwanda's electricity sector demonstrates the importance of integrated watershed management in pursuing energy security in a changing climate.

Out of poverty through micro hydropower in Kenya[89]

The Tungu-Kabiri community micro hydropower project, funded by the United Nations Development Programme and developed by Practical Action East Africa and the Kenyan ministry of Energy, brought 200 households together to own and operate their own power station, supplying electricity to local businesses and households. Once river flow records, going back 40 years, had been assessed and the river Tubgu, near Mbuiru, had been passed as suitable, work began on building the hydropower station. To construct the scheme, villagers gave up their Thursdays every week for several months, digging, shifting stones, laying concrete, building the intake weir and canal and penstock. The project took two years but now provides real benefit to all 200 households. Electricity from the plant gives the community access to power to charge car batteries, to light their homes, and to charge mobile phones.

- **Half of humanity – 3.5 billion people – lives in cities today;**[90]
- **By 2030, almost 60 per cent of the world's population will live in urban areas;**[91]
- **Every year, 19.5 million hectares of agricultural land is converted to spreading urban centers and industrial developments;**[92]
- **Rapid urbanization is exerting pressure on fresh water supplies, sewage, land and soil resources, biodiversity, and public health;**[93]
- **The sustainable developments of urban areas, along with their rural environs, require that competing demands for social, economic and environmental uses of land are dealt within an integrated manner.**

The processes of industrialization, globalization and urbanization have caused shocking changes in land use and forged decisive linkages between urban and rural areas. Divisions of labor, increasing mobility and migration as well as changing social preferences have modified the flows of goods, people and resources.

While urbanization can be seen as part of a healthy development process, if it is unplanned, it can have adverse effects on people and the environment. Cities and suburbs often encroach on fertile land and the uncontrolled sprawl and spill over can create a vulnerable urban environment prone to natural hazards adjacent to devastated rural and peri-rural landscapes.[94]

How can achieving Land Degradation Neutrality help?

Harnessing the positive aspects of urbanization and strengthening the rural-urban linkage would be a good entry point for creating sustainable cities and communities. Future cities require planning that focuses on the needs and capacities of the region and not just the urban area in isolation.

New patterns of built and/or green infrastructure with multi-functional land use[96] are emerging. Urban areas must embrace their peri-urban and rural surroundings. The creation of "green mosaics", with integrated green infrastructure[98], can connect the urban-rural divide. Open spaces for recreation and habitats for biodiversity, including elements like urban forests and horticulture, provide for healthy and livable cities. This landscape mosaic pattern – or green spatial plan if you like – can make cities work better. It positively enhances the life and health of the city dweller. It certainly maintains ecological processes and protects valuable resources.[99]

BOX 3: SOIL SEALING IN EUROPE[95]

Every year in Europe, soils covering an area larger than the city of Berlin are lost to urban sprawl and transport infrastructure. Soil sealing (its permanent covering with impermeable layers of buildings, asphalt roads, parking lots and so on) causes an irreversible loss of the ecological functions of soil. As water can neither infiltrate nor evaporate, water runoff increases, sometimes leading to catastrophic floods. Cities are increasingly affected by heat waves, because of the lack of evaporation in summer. Landscapes are fragmented and habitats become too small or too isolated to support certain species. In addition, the food production potential of land is lost forever. The European Commission's Joint Research Centre estimates that four million tonnes of wheat are potentially lost every year to soil sealing. Between 1990 and 2000, at least 275 hectares of soil were lost per day in the EU, amounting to 1,000 km per year, with half of this soil being sealed by layers of concrete and asphalt. This effectively means that every ten years an area the size of Cyprus is paved over.

Water infrastructure is of particular concern. Cities demand a lot of water. They are often located near bodies of water so demand can be met but often cause severe ecological damage to the vital resource. While the alteration of waterways to suit urban needs affects both upstream and downstream users, it also increases the competition between urban and rural demands for water[100]

The sustainable management of land and water together should be part and parcel of resilient urban-rural planning. Landscape planning that recognizes the vital services that ecosystems provide can enhance water supply and quality while simultaneously reducing the risks of droughts and floods. At the watershed level, better land management uses the natural ability of ecosystems to retain water by slowing down and absorbing some of the storm runoff. Forests also help to stabilize slopes, reducing the impacts of flooding, land erosion and landslides. In urban areas, green roofs, permeable pavements and green spaces help to absorb water and minimize storm water runoff. Along rivers, floodplains that are protected can increase river channels' abilities to convey water and reduce pressures on levees.[101]

BOX4: HEALTH ADVANTAGES OF GREEN SPACES[102]

The role of vegetation in mitigating the effects of air pollution has been highlighted as one of the potential benefits of urban green space. Trees in urban green space can influence air quality in a number of ways; for example through direct absorption of gaseous pollutants and interception of particles onto leaf surfaces, by lowering air temperatures through transpiration which can reduce the formation of ozone, and through the direct production of oxygen during photosynthesis. Moreover, studies show that people with access to parks and green space are less stressed and less likely to suffer from anxiety, obesity and asthma, high blood pressure and cholesterol among other benefits. The restorative benefits of green space generally come at no direct cost to the user whereas other forms of relaxation or medical treatment usually do, hence benefiting especially low-income and minority communities. Green spaces can also help improve mental well-being by encouraging social activity and interaction.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TTARGET 11.5/11B

Reduce floods and save money with green infrastructure in Louisiana, USA[103]

For many years, Episcopal High School in Baton Rouge, Louisiana, was troubled with severe flooding in the school's quadrangle because of an inadequate and aging drainage system. Estimates for re-piping the site were approximately $500,000. In 2008, bioswales and a rain garden were designed to capture rainfall and slow down the impact to the storm drain system, costing about USD 110,000 for design and construction. Not only does this project represent cost savings in reduced capital costs, but two years following implementation of the project, the quadrangle has yet to experience any flooding.

Green infrastructure facilitates groundwater recharge in semi-arid areas. Evidence from Los Angeles and Atlanta, USA[104]

In many cities and towns in the arid and semi-arid West of the USA, impervious cover and engineered conveyance systems reduce the amount of precipitation that enters the groundwater store. Green infrastructure practices that reduce impervious cover and enhance infiltration can increase the flow of water to the groundwater. The Los Angeles Basin Water Augmentation Study (WAS) for instance, estimates that the installation of green infrastructure practices that infiltrate the first three quarters of rainfall on each parcel could increase groundwater recharge in the Los Angeles region from 16% of annual rainfall to 48%. Likewise in Atlanta, it was shown that due impervious cover between 56.9 and 132.8 billion gallons of groundwater infiltration have been lost in 1997 compared to 15 years earlier. That is enough water to supply the average daily household needs of between 1.5 and 3.6 million people per year.[105]

Gully control and catchment protection in Bolivia[106]

In the Cochabamba District a degraded catchment led to loss of cropland as well as serious downstream damage to the city of Cochabamba. The integrated gully treatment consisted of several simple practices, including stone and wooden check dams, cut-off drains, and reforestation in sediment traps (biotrampas). Through reforestation, better vegetation cover stabilized the land. Furthermore, the applied measures led to safe discharge of runoff from the surrounding area through the main gullies down to the valley.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 11.6

Reducing pollutants in local waters, Washington, DC, USA[107]

A 2007 study of Washington, DC found that the use of urban trees and green roofs for stormwater management would keep 1.2 billion gallons of runoff out of the water infrastructure system. This equals a 10 per cent reduction in untreated discharge entering local rivers and would reduce the frequency of combined sewer overflows by almost 7%. At the minimum, this would keep an estimated 120 pounds of copper, 180 pounds of lead, 340 pounds of phosphorous, and 530,000 pounds of total solids among other pollutants out of local waterways every year.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 11 A

Food security for Cities: integrating urban agriculture into land use planning in Daressalam, Tanzania[108]

In Daressalam, urban agriculture has been developed and promoted as an income earner as well as a food source at the subsistence or household level. Food security was a national concern following droughts in the 1970s and 1980s, and the government supported urban agriculture in a bid to encourage households to be self-sufficient. The challenge has been to regulate the largely informal urban agricultural activities so that natural systems such as river valleys and wetlands are not compromised.

The results so far are remarkable:

- Helped to protect open spaces (such as slopes along river valleys and road reserves) for use in urban agriculture, rather than leaving it vulnerable to the encroachment of houses and city waste.
- Improved the lives of both men and women in Daressalam due to the additional income generated through the sale of food crops. Daressalam's urban producers supply an estimated 95,000 litres of milk, 6,000 trays of eggs, and 11,000 kilograms of poultry to city residents every day. This ready market is a source for increases in income.
- Urban farming was the second largest employer engaging about 7 per cent of the 3 million people in Daressalam in 2000.
- The use of open spaces and unbuildable land for urban agriculture (plants and forests) has a positive impact on air quality as well as on the aesthetics of the city. Well-maintained roadside horticulture is pleasing to the eye.

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 11B

Green roofs save energy in Chicago USA[109]

In an effort to address and plan for the future impacts of climate change, Chicago employed green infrastructure (including green roofs, tree planting and rainwater harvesting) as a strategy for climate change adaptation and reduction of risks of the combined sewer overflow problems in the region.. To date, Chicago has over 400 green roof projects .Green roofs, along with bioretention and infiltration practices and tree plantings also yield co-benefits for reduced building energy use, direct carbon sequestration and public health. The 1,900 m^2 roof on Chicago City Hall for instance has helped decrease stormwater runoff and improves urban air quality by reducing the urban heat island effect around the site. Since its completion in 2001, the green roof has saved the city USD 5,000 a year in energy costs. Monitoring of local temperatures found that the "cooling effects during the gardens first summer showed a roof surface temperature reduction of 21°C and an air temperature reduction of 15°C".

- **From 1880 to 2012, average global temperature increased by 0.85°C. To put this into perspective, for each 1 degree of temperature increase, grain yields decline by about 5 per cent. Maize, wheat and other major crops have experienced significant yield reductions at the global level of 40 megatons per year between 1981 and 2002 due to a warmer climate.**
- **Global emissions of carbon dioxide (CO_2) have increased by almost 50 per cent since 1990. Between 2000 and 2010, emissions grew more quickly than in each of the three previous decades**
- **The land use sector represents almost 25 per cent of total global emissions.**
- **The gap that needs to be closed in order to stay on target is currently estimated at 14-17 $GtCO_2e$ (gigatons carbon dioxide equivalent) .**
- **Improved land use and management, such as low-emissions agriculture, agro-forestry and ecosystem conservation and restoration could, under certain circumstances, close the remaining emissions gap by up to 25 per cent.**

The greenhouse gas emissions from human activities are driving climate change and continue to rise. They are now at their highest levels in history. Without action, the world's average surface temperature is projected to rise over the 21st century and is likely to surpass 3°C his century—with some areas of the world expected to warm even more. Due to their lack of resources, the poorest and most vulnerable people are affected the most.

The time is ripe to mobilize all possible solutions to tackle the climate crises. Yet without the proper consideration of the land sector, we neither get to a 2 or 1.5 °C stabilization pathway nor to more climate change resilient landscapes.

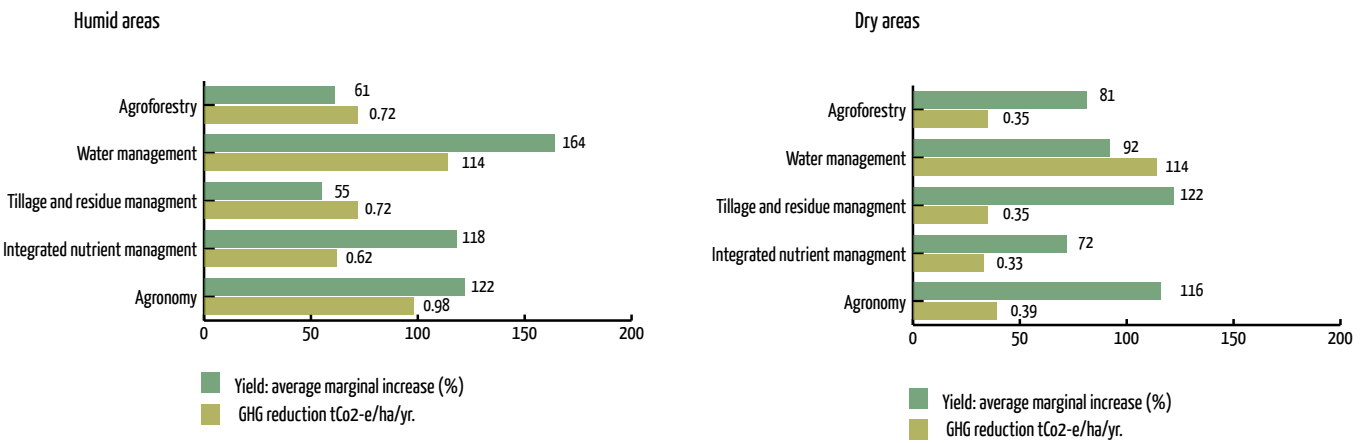
How can achieving Land Degradation Neutrality help?

There are many opportunities for the land use sector to actively reduce emissions and sequester carbon in the short to medium term. In agriculture, the potential amount of reduction is estimated at 2.3–6.4 $GtCO_2e$ per year in 2030.[117] Much of this could be realized through sustainable land management practices such as conservation tillage, combined organic/inorganic fertilizer application or agroforestry and other sustainable approaches and techniques.

BOX 4: THE IMPACTS OF A CHANGING CLIMATE ON AGRICULTURE AND FOOD SECURITY[116]

Climate change will have significant adverse effects on crop yields, livestock health and tree growth due to higher temperatures. Without adaptation, yields of the main cereals in developing countries are expected to be 10 per cent lower by 2050 than they would have been without climate change. Water stress on cropping, already substantial in some areas, is likely to increase due to growing water scarcity. A range of macroeconomic modelling studies suggest that the primary impact of climate change will be on the poor in tropical countries, mainly through decreased local food supply and higher food prices. The most significant impacts are projected for Africa and South Asia, where poverty is highest, agriculture accounts for a large share of employment and GDP, and adaptation investment per capita is low. But significant parts of other regions will also be affected. Generally, the lower the capacity of people to adapt to climate shocks, the larger the negative impacts. Fears of such impacts can lead to excessive risk aversion, which can keep both people and regions locked into patterns of poverty and resource degradation.

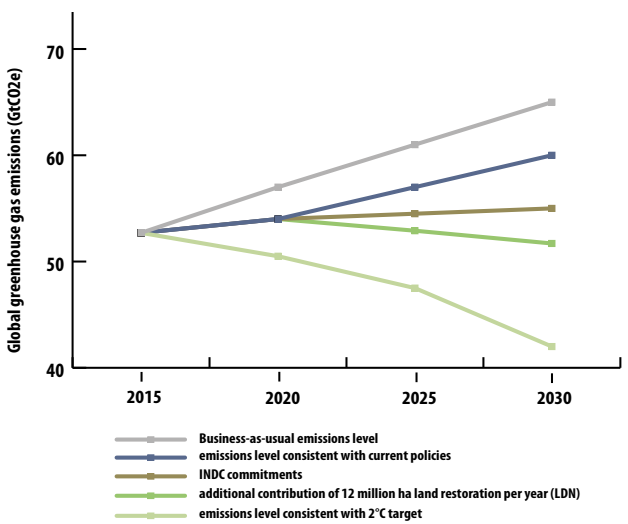
Figure 1: Effects of SLM practices on productivity and climate change mitigation[118]



One practical and scientifically-sound proposal to close the emissions gap and meet the 2° C target is the concept of Land Degradation Neutrality (LDN).

The annual rehabilitation and restoration of 12 million hectares of degraded land up to 2030 as envisaged by LDN, can help close the estimated emission gap of 8-11 $GtCO_2e$ by 3.33 $GtCO_2e$ in 2030. This is roughly 25 per cent of the emissions gap. In other words, the mitigation potential of this additional land rehabilitation roughly equals 50 per cent of the expected emissions reduction pledges of all Intended Nationally Determined Contributions (INDCs).[119]

Figure 2: Emission reduction potential of LDN[120]



The annual average losses from drought and floods count in the hundreds of billions of dollars. As the "world's costliest natural disaster,"[121] drought is imposing an annual cost of USD 6-8 billion in the USA alone. Since 1900, it has affected two billion people, leading to more than 11 million deaths. Floods on the other hand affect on average 250 million people globally each year and cost the global economy staggering USD 90 billion.[122] Thus, sustainable approaches that both reduce the risks posed by climate change and enhance the resilience of key sectors are ever more important.

Improved land use and management, such as low-emissions agriculture, agro-forestry and ecosystem conservation and restoration provide a real resilience booster. Sustainably managed lands are more drought resistant[123], exhibit a higher genetic diversity[124] and are more resilient to extreme external shocks. Healthy soils rich in organic matter such as soils nurtured by agro-ecological fertilizers (green manures, compost, dung, etc.) or landscapes managed by agroforestry or silvopastoral systems are less prone to erosion and degradation. They are able to hold more water and better equipped to deal with more erratic or less rainfall. Also, more landscape biodiversity provides a buffer against losses caused by climate change, pests and diseases.[125]

SUSTAINABLE LAND MANAGEMENT IN ACTION: TARGET 13.1

Sustainable land management and farming as model for Climate Change resilience[126]

In continuously coping with extreme weather events and climatic variability through centuries, farmers living in harsh environments in Africa, Asia, and Latin America have developed and/or inherited complex farming systems managed in ingenious ways. A multi-country study that explored resilience of African smallholder farming systems to climate variability and change between 2007 and 2010, revealed farmers' priorities for strategies to adapt to climate change: (a) improving soil fertility with green manures and organic residues, (b) conserving water and soil, (c) developing mechanisms for establishment and sustenance of local strategic food reserves, (d) supporting traditional social safety nets to safeguard vulnerable social groups, (e) conserving indigenous fruit trees and other locally adapted crop varieties,(f) using alternative fallow and tillage practices to address climate change-related moisture and nutrient deficiencies, and (g) changing land topography to address the moisture deficiencies associated with climate change and reduce the risk of farm land degradation.

Sustainable land management practices brave Hurricane Mitch[127]

Following Hurricane Mitch in 1998, a large-scale study on 180 communities of smallholders from southern to northern Nicaragua demonstrated that farming plots cropped with simple agroecological methods had on average 40 per cent more topsoil, higher field moisture, less erosion and lower economic losses than control plots on conventional farms. Sustainable managed systems showed also a faster recovery of production (80-90 per cent after 40 days after the hurricane), than conventional farms. On average, sustainable managed plots lost 18 per cent less arable land to landslides than conventional plots and had 69 per cent less gully erosion compared to conventional farms.

Flood and head protection: Poplar trees for bio-drainage, Kyrgyzstan[128]

Poplar planting has been applied on a degraded plain in Kyrgyzstan under semi-arid conditions to deal with rising water tables and increasing soil salinity in irrigated areas. Poplar trees, well known for their tolerance to waterlogging and salinity, provide 'bio-drainage'. Excess water is rapidly taken up by the root system and transpired through the dense foliage. Within the plantation, the humidity level of the lower layers of air is increased, thus reducing the influence of the dry, hot winds. A more favourable microclimate for plant growth is thus created. Simultaneously, the original purpose of planting – to obtain cheap timber and firewood – is achieved. The cost/benefit ratio of this measure was negative.

Getting ready for climate change: Sustainable living in the heart of the desert, Turkmenistan[129]

The dunes of the Karakum Desert in Turkmenistan are expanding by 1 to 1.5 meters a year, overtaking arable land, making roads impassable and forcing area residents to move their homes. A changing climate is partly to blame, but so are unsustainable land use practices. In 2012, UNDP and affected communities from the Karakum region stated to address manmade factors contributing to desertification and help communities adapt to the changing climate. In large part, this new initiative relied on an old technology—sand fixation. This involves planting reeds and saxaul (a type of shrub) in the sand, which helps to fix the sand in place. Saxaul was planted on 10 hectares of community land, and its success was soon evident. The village roads were kept clear of the encroaching desert and residents were no longer forced to move. To address land degradation, seven new wells were constructed and six existing wells were renovated, which increased the amount of available water and helped expand pastureland. 15 sardobs (concrete-lined, covered water reservoirs built into the ground) were also built to hold drinking water. Altogether, the water improvements benefitted some 632 families, providing an additional 125,310 m^3 of water for drinking and livestock, increasing the livestock population by 1,265 cows, and irrigating an additional 6,240 hectares of land to be used for breeding cattle. To enhance climate-resilient farming practices, the project introduced community members to new methods for maintaining soil moisture, as well as new types of fertilizers (such as bio-humus and compost) that increase the efficiency of water irrigation, soil fertility and crop productivity. Since they began in 2013, some 2,000 residents have benefited. The project also supported the construction of a greenhouse. This year, the first harvest from the greenhouse yielded 1.2 tons of cucumbers—vegetables like cucumbers are usually imported into the community, and the measure saved community members some USD 1,000. By using special techniques to "fix" the sand and creating "belts" of trees and plants, the villages are now protected from moving sands and can live more stable lives.

INVITATION TO PARTNER

We have highlighted how land can play a critical role in achieving the Goals. Investing in land degradation neutrality is a smart and cost-effective way of getting things done. We are determined to mobilize all the means necessary to implement the goal of Life on Land and in particular to achieve land degradation neutrality through active partnerships with all key stakeholders. Our partnerships will be based on a spirit of solidarity and mutual benefit, and will target the poorest and most vulnerable.

We believe that by achieving land degradation neutrality, with our partners, we can make the biggest practical contribution to safeguarding life on earth. By taking practical steps to address degradation and massively scale up land restoration activities, we can regain our balance and harmony with nature. We can feed people, protect habitats, and grow a prosperous future for all.

So if you want to see an end to poverty with decent opportunities for all, collaborate with us. If you aim to do more and better while consuming responsibly so there is no hunger and there is greater health and well-being, partner with us. To secure clean water, energy and a resilient future, please take an active part in the partnership for Life on Land.

Take action to reduce your land footprint whenever and wherever you can. Apply the natural fix and let us hear your success stories. We extend a warm invitation to you. Please join us in achieving land degradation neutrality by 2030.

ANNEX: THE SDG'S AND ITS TARGETS (IN PART)

GOAL 1 END POVERTY IN ALL ITS FORMS EVERYWHERE

1.1
By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day

1.4
By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance

1.5
By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters

GOAL 2 END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION AND PROMOTE SUSTAINABLE AGRICULTURE

2.3
By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment

2.4
By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality

GOAL 3 ENSURE HEALTHY LIVES AND PROMOTE WELL-BEING FOR ALL AT ALL AGES

3.9
By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination

GOAL 4 ENSURE INCLUSIVE AND EQUITABLE QUALITY EDUCATION AND PROMOTE LIFELONG LEARNING OPPORTUNITIES FOR ALL

4.4
By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship

4.7
By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development

GOAL 5 ACHIEVE GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS

5.a
Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws

GOAL 6 ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

6.2
By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

6.3
By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

6.4
By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

6.6
By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

6.a
By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies

6.b
Support and strengthen the participation of local communities in improving water and sanitation management

GOAL 7 ENSURE ACCESS TO AFFORDABLE, RELIABLE, SUSTAINABLE AND MODERN ENERGY FOR ALL

7.1
By 2030, ensure universal access to affordable, reliable and modern energy services

7.2
By 2030, increase substantially the share of renewable energy in the global energy mix

7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support

GOAL 8 PROMOTE SUSTAINED, INCLUSIVE AND SUSTAINABLE ECONOMIC GROWTH, FULL AND PRODUCTIVE EMPLOYMENT AND DECENT WORK FOR ALL

8.2
Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors

8.6
By 2020, substantially reduce the proportion of youth not in employment, education or training

8.9
By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products

GOAL 11 MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

11.5
By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations

11.6
By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

11.a
Support positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning

11.b
By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels

GOAL 12 ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS

12.2
By 2030, achieve the sustainable management and efficient use of natural resources

12.4
By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment

GOAL 13 TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS

13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

GOAL 15 PROTECT, RESTORE AND PROMOTE SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS, SUSTAINABLY MANAGE FORESTS, COMBAT DESERTIFICATION, AND HALT AND REVERSE LAND DEGRADATION AND HALT BIODIVERSITY LOSS

15.1
By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements

15.2
By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally

15.3
By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world

15.4
By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development

15.5
Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species

15.6
Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed

15.7
Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products

15.8
By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species

15.9
By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts

15.a
Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems

15.b
Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation

15.c
Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities

GOAL 17 STRENGTHEN THE MEANS OF IMPLEMENTATION AND REVITALIZE THE GLOBAL PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT

Multi-stakeholder partnerships

17.16
Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries

17.17
Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships

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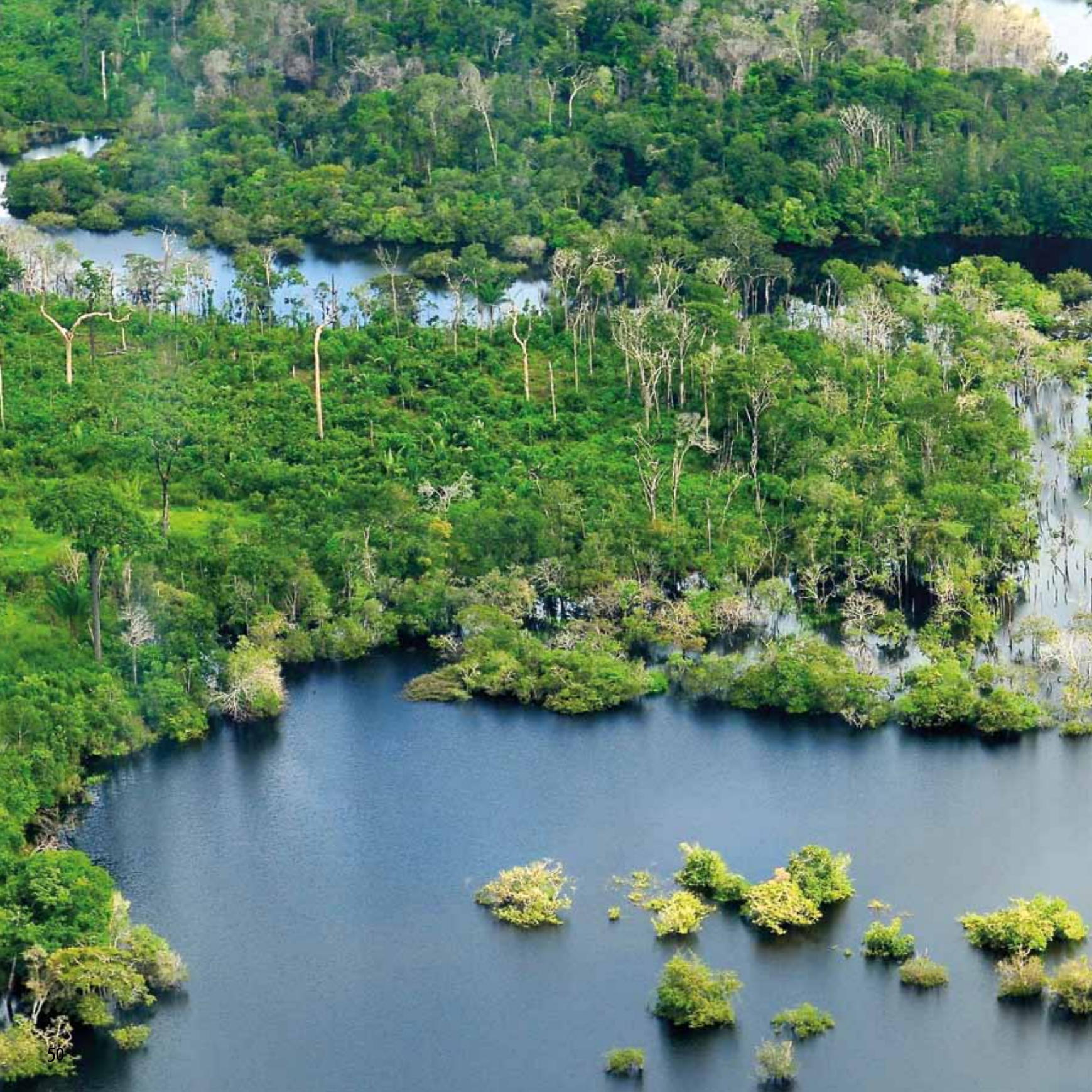

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