Maintaining or improving the productive capacity of land requires a move towards land degradation neutrality. This is a matter of preserving or enhancing the ability of land resources to support ecosystem functions and services. Sustainable management of soil, water and biodiversity can help close yield gaps, increase the resilience of land and thus support the people who depend on it for their livelihoods. This will come at a cost, but the cost of action or prevention is always lower than the cost of inaction.

Source: Liniger, Hanspeter.
A growing inventory of adapted land-use practices

The World Overview of Conservation Approaches and Technologies (WOCAT) is a global network on sustainable land management (SLM). The network develops, archives, shares and disseminates SLM knowledge to support adaptation, innovation and decision-making. Methods and tools for documenting sustainable land management (SLM) practices are available via a worldwide platform at https://qcat.wocat.net/en/wocat/

Sustainable Land Management: Current State

Human activities involving land use and land-use changes are widespread across the globe and are a major driver of land degradation. While there are many land-use practices associated with land degradation (over-cultivation, overgrazing, etc.), the existence of any of these practices alone does not constitute land degradation. For example, based on simple cause-effect logic, overgrazing and primitive farming techniques by peasants and pastoralists were traditionally blamed for causing Sahelian drought and land degradation. A new paradigm exposed the overly simplistic nature of this view by documenting the complex nature of non-equilibrium systems, such as abiotic versus biotic controls, short- versus long-term dynamics, and the value of local stakeholder knowledge in governing coupled human-socio-economic systems. As per the convergence of evidence principle, no GCI by itself is sufficient to infer land degradation but if multiple GCIs were to occur at any location, this suggests the potential for land degradation (at least in some form) and further investigation would be warranted.

SLM practices and measures

SLM is defined as the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while ensuring the long-term productive potential of the resources and the maintenance of their environmental functions.

Sustainable land-management practice consists of an SLM technology and SLM approach. An SLM technology is a physical practice on the land that controls land degradation, enhances productivity, and/or other ecosystem services. A technology consists of one or several measures, such as agronomic, vegetative, structural, and management measures (WOCAT 2016). An SLM approach includes the ways and means of support that help introduce, implement, adapt and apply SLM technologies on the ground to foster an enabling environment.
Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) has undergone drastic political, economic and social changes during the past decades. Soviet policies led to a collapse and dismantling of collective irrigated networks, overuse of water (with consequent drying of the Aral sea), land tenure insecurities and insufficient market development. The resulting land fragmentation and abandonment on marginal lands made it very difficult for land users to adopt sustainable land management (SLM) practices. Hence, unsustainable agricultural practices, e.g. excessive irrigation without adequate drainage, mono-cropping, tillage on steep slopes, inadequate replenishment of soil fertility, overgrazing of pastures, and deforestation remain problematic in the region to date. Combinations of these factors contributed to severe impact on the land resources that is expressed by different types of land degradation along the agro-ecological regions: widespread salinisation in irrigated areas, soil erosion and nutrient depletion in rain-fed areas, decline in pasture quality in rangelands and soil and vegetation erosion in mountainous areas. The consequent reduction in overall productivity threatens the livelihoods of millions of farmers and pastoralists in this region.

Successful prevention of and solutions to existing land degradation, including drought adaptation, require practical proven and scientifically approved technologies and approaches for sustainable land management that integrate ecological, economic, and social dimensions of land use. Many efforts have been made within the region of Central Asia to mitigate land degradation. Success stories on implementation of SLM practices, along with policy actions, have been documented. Taking into account the local and transboundary use of natural resources, the need for new arrangements and agreements emerges throughout the area. Some of these include better market access, improved land tenure for smallholders and livestock owners, and support for extension and experience exchange which can positively stimulate the uptake of SLM measures.

WOCAT monitored and inventoried a large number of cases where SLM practices have been implemented successfully and this database is a key knowledge base for expansion of SLM in Central Asia, as access to extension plays an important role in adopting SLM by rural farmers and herders.
Many efforts have been made to mitigate land degradation in Central Asia. Success stories on implementation of SLM practices, along with policy actions, have been documented and are ready to be upscaled.
Sustainable Land Management: Examples

Good land management practices

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**6.** Stone walls and forward-sloping terraces help prevent soil erosion and improve water retention on agricultural fields. However, in the hot drylands of Rajasthan, India, this is not sufficient to maintain adequate soil moisture. Other agronomic or vegetative measures that provide more permanent cover of the soils are still needed to ensure sustainable land use. Source: WOCAT case studies; photo: Liniger, H.

**8.** Widespread implementation of small-scale water-harvesting systems make better use of precious rainfall in drylands. Micro-basins as seen here near Mount Kenya are an effective way of maximizing rainwater retention. However, the loss of soil moisture through evaporation can only be reduced when the soil is covered. Leaving crop residues and weeds (applied as a mulch) between crop rotations is a good practice to keep permanent soil cover and reduce moisture loss. Source: WOCAT case studies; photo: Liniger, H.

**9.** In mountainous regions in Kyrgyzstan, Central Asia, hay harvesting provides a growing economic opportunity for productive land use. Increasing numbers of livestock drive a growing demand for hay and supplementary feed as rangelands are under pressure from overuse and degradation. The shrinking availability of quality land for free ranging and the economic advantages of landless livestock production systems (see page 58) increase the attraction of and need for hay cultivation. This practice is sustainable as it follows the natural vegetative cycle and keeps the land well covered and protected. Source: WOCAT case studies; photo: Liniger, H.

**10.** Large-scale terracing in the Loess plateau of China has improved land productivity and the livelihoods of millions of land users. Implementation was driven by requirements for increased food production for a growing population and supported by downstream interests in reducing catastrophic floods and reducing sedimentation of large dams. Source: WOCAT case studies; photo: Liniger, H.

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**3.** Wind farms in the Alicante area of Spain show a profitable alternative land use that taps the potential for wind generation. This allows for rehabilitation of degraded land. To reduce increased risk of spread of forest fires in this wind-rich region, adaptive management is required. Removing dead wood, selective cutting of mature trees and planting fire-resistant tree species can limit the accumulation of fuels and reduce fire hazard. Also, grazing to reduce undergrowth, and the establishment and maintenance of firebreaks are necessary management options. All contribute to the success and sustainability of this complementary set of land uses. Source: WOCAT case studies; photo: Liniger, H.

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**7.** Maintaining soil fertility by applying manure while leaving crop residues to cover the soil and maintaining traditional terraces. These good sustainable and productive land management practices implemented on both gentle and steep slopes in Nepal. Source: WOCAT case studies; photo: Liniger, H.

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**5.** Wind farms in the Alicante area of Spain show a profitable alternative land use that taps the potential for wind generation. This allows for rehabilitation of degraded land. To reduce increased risk of spread of forest fires in this wind-rich region, adaptive management is required. Removing dead wood, selective cutting of mature trees and planting fire-resistant tree species can limit the accumulation of fuels and reduce fire hazard. Also, grazing to reduce undergrowth, and the establishment and maintenance of firebreaks are necessary management options. All contribute to the success and sustainability of this complementary set of land uses. Source: WOCAT case studies; photo: Liniger, H.
It is the goal of WOCAT to inventory and document individual initiatives as showcases for other land users. The few examples here show successful sustainable land management practices around the globe and their environmental, ecological and societal benefits.
Good land-management practices (cont’d)

Sustainable land management also encompasses the safeguarding and protection of the fauna and flora of unique environments and ecosystems. Biodiversity is the intrinsic ecological value that spurs the maintenance of protected forests that are home to the gorillas in the volcano region of Northern Rwanda. Source: WOCAT case studies; photo: Liniger, H.

Terracing and irrigation in this very dry environment in Morocco is challenging and requires well-adapted sustainable land-management technologies. To ensure availability of water in fields and equitable societal sharing of this common resource, well-established and ethically functioning water users’ associations are essential. Source: WOCAT case studies; photo: Providoli I.

Cyclones and heavy rainfall have a worsening impact on already severely degraded slopes in Haiti. Yet, around these homesteads, degraded slopes were restored by afforestation, productive agroforestry systems and home gardens. These were not destroyed during recent catastrophic storms. The green area visible at the top of the hill up the valley illustrates the potential to restore badly degraded and heavily exposed slopes in less than 10 years. These sustainable land-management practices reduce the risk for disasters such as landslides and floods further downstream. Community mechanisms must be established to ensure investments in productive and protective land-use practices upstream. Source: WOCAT case studies; photo: Liniger, H.

In mountainous semi-arid environments of Tajikistan, the protection of land reduces water loss and erosion by runoff, thus reducing degradation. Implementing adaptive management practices to increase soil cover and land productivity is both protective and economically productive. Protective land management in the upstream areas reduces risks of flooding and erosion downstream. Source: WOCAT case studies; photo: Liniger, H.

Multi-story agroforestry in the Popayan region of the Colombian Andes provides adequate coverage and soil protection to regulate water flows to downstream lowlands, while preventing local erosion and soil-fertility loss. Mountain areas are crucial water sources in nearly all climates. Land-use change in tropical and subtropical mountain areas can provide productive systems. However, loss of vegetative cover may rapidly lead to erosion and soil loss, leaving these areas vulnerable. In many mountain regions of the world, multi-story agroforestry has proven to be a sustainable practice, preserving and ensuring essential ecosystem functions. Source: WOCAT case studies; photo: Liniger, H.
The National Observatory of Land Degradation and Desertification

Prevention and mitigation measures are proposed and promoted based on information on the status and risk of land degradation and desertification. In Argentina, the National Observatory of Land Degradation and Desertification (ONDTyD), as its acronym in Spanish) was established in 2011 to provide such services. The observatory is a national system for land monitoring and assessing land degradation and desertification at different scale levels (national, regional and local). The adopted approach is holistic, interdisciplinary and participative. A network of scientific, technological and political organisations both uses and supports the observatory with data and knowledge. The observatory advises public and private decision-makers and organises awareness and education programmes.

The ONDTyD is an example of a successful partnership built across political, scientific, and technological sectors in Argentina. Currently, more than 30 institutions and 150 professionals from all over Argentina are part of the ONDTyD. Monitoring and assessment activities are executed with close links among all partners and sectors. Hence, multi-sectoral knowledge feeds directly into the policy process.

Several national workshops were launched to create networks linking the political, scientific, and technological sectors at regional and national levels, as well as non-governmental organisations working in the area. The Secretariat of Environment and Sustainable Development (SAyDS), the National Scientific and Technical Research Council (CONICET), the Argentine Institute for And Zone Research (IADIZA), the National Institute of Agricultural Technology (INTA), and two national universities (Center for Surveying and Assessment of Agricultural and Natural Resources, University of Córdoba and School of Agriculture, University of Buenos Aires) were all founding institutions of ONDTyD. Together, they established its organisation and internal regulation. These institutions are all part of the steering committee and work together with other agencies on the advisory council. They are in charge of compiles and reporting data at the national level and directing work on specific topics.

Across scale monitoring methodology

Building further on experiences gained from the Land Degradation Assessment in Drylands in Argentina and from the earlier system of integrated assessment of desertification as well as many other projects, e.g. Patagonia, the participatory monitoring approach considers local, regional, and national levels. The scheme highlights the importance of pilot sites in generating local contextual evidence that is needed for correct interpretation of higher-level information. Currently, fifteen pilot sites, representing almost all of Argentina’s ecosystems, are networked and gather biophysical and socio-economic data. Criteria have been defined through a participatory process to ensure comparability issues on which local data is gathered include: human (e.g. education completion rates, illiteracy rates, local rates of principal illnesses), social (e.g. participation of herders and farmers in civil organisations, social programmes), physical (housing quality, forms of land ownership, household access to water), and financial (household income, access to government subsidies or credits).

Other topics covered include:
- State of water
- Erosion
- Soil characteristics
- Vegetation cover and composition
- Local-specific degradation processes
- Societal impact of changing conditions

Trends on biophysical data are monitored and linked with satellite data. Regular reports are compiled by members of the steering committee and advisory council and made available on the website.

On 14 July 2015, the Observatory of Land Degradation and Desertification and its work were declared a matter of national interest by the Argentine Congress.
Cost of Land Degradation

Understanding economics increases awareness and prompts sustainable land management

Annually, the loss of ecosystem services due to land degradation represents a reduction of 10-17% of global GDP. Historically, a reduction in productivity (usually plant yield) and its subsequent economic cost, was the main criterion used to define the severity of land degradation. A more robust criterion now exists that places land degradation into the context of issues that matter the most to humans — estimating the monetary value associated with a “persistent reduction of ecosystem goods and services.” For example, in absolute terms the monetary value of total global ecosystem goods and services – the terrestrial ecosystem services value (ESV) which includes food, feed, water availability, timber, air and water purification, soil formation, storage of carbon, flood mitigation and polination – was recently estimated to be $125-145 trillion US$/year while losses due to land degradation ranged from $43-202 trillion US$/year. The Economics of Land Degradation (ELD) initiative, which is a global initiative that promotes an awareness of the economic consequences of land degradation, and the value of sustainable land management (SLM), estimates that the value of ecosystem services lost due to land degradation is equivalent to 10-17% of global GDP.

Monetary valuations of ecosystem goods and services such as these should nonetheless be considered as rough approximations. There are numerous reasons for this, including (i) the lack of a universally accepted pricing system, (ii) the lack of cost-benefit economic analyses at local scales and in data-poor areas, (iii) many physical or environmental linkages that support or maintain ecosystem functions are difficult to quantify and thus remain “hidden”, and (iv) most ecosystem services are interdependent, interactive, and function on long time scales, which makes their economic valuation extremely challenging. In spite of these shortcomings, the monetary valuation of ecosystem services has many benefits, from raising awareness to supporting decision-makers who are considering the economic benefits of SLM. Econometric data at the local scale has the potential to impart insights into the cost-benefits of alternative strategies (and their trade-offs) as well as the monetary value of adopting a specific land-management practice.

Case study: Ecosystem services and economics in Botswana rangelands

In rangelands of southern Botswana, ecosystem services provide local inhabitants with food, fuel, construction material, groundwater, genetic diversity, climate regulation, recreation and spiritual inspiration. In a report prepared by the ELD initiative, four land uses – communal grazing, private cattle ranching, private game ranching and protected areas (WMAs, Wildlife Management Areas) – were ranked according to their abilities to deliver these ecosystem services.

Communal livestock grazing was found to deliver the widest range of ecosystem services, mainly via commercial food production, wild food production, fuel, construction material, climate regulation and spiritual values; WMAs delivered the next widest range of ecosystem services, followed by private cattle ranches and private game ranches.

While cattle production provides the largest financial returns to private cattle ranchers, its negative consequences in terms of land degradation affect all users of communal rangelands. Hence, costs and benefits are not distributed fairly and policy incentives that support the livestock sector – especially those linked to fencing and borehole drilling – result in an overemphasis on commercial food production, at the expense of other services. Veld products, construction material and fuel wood remain undervalued due to a lack of markets, while access to these ecosystem services is negatively affected by policy support for fencing and borehole drilling. The ELD report concludes that there is a need for policy reform that can support livelihood diversification – and hence SLM – and highlights the need for investment to explore new and potential market opportunities for veld products and carbon trading.
PART VI – SOLUTIONS

Calculating the economics of land degradation

International organisations, such as the Organisation for Economic Co-operation and Development (OECD) and the United Nations Convention to Combat Desertification (UNCCD), initiated programmes to investigate and test different pragmatic approaches to estimate the costs of land degradation. In 2005, the OECD highlighted the cost of inaction as a key consideration for decision-making and resource allocation in combating desertification and land degradation. In April 2013, the UNCCD held the second Scientific Conference to analyse, discuss and build on experiences, and test different pragmatic approaches to estimate the costs of land degradation and local scale.

All methods depend heavily on the way degradation is approached and measured, which explains the large range of estimates in economic costs. As shown in WAD3, this should be viewed and estimated following methods that consider the Total Economic Value (TEV) of land. The ecological economics approach, based on the estimated Total Terrestrial Ecosystem Services value at global level and its degraded fraction with results for all countries.

iii) Econometrical models, where the cost of land degradation is obtained by calculating the difference in cultivation output between affected and non-affected lands. These models calculate production and yield functions of the most important crops in affected and non-affected lands, as well as data from affected areas compared with optimal economic frontiers of production. Value differences in crop produce between non-degraded and degraded land drive the estimation of economic loss of degradation.

iv) Methods that consider the Total Economic Value (TEV) of land estimate the economic loss by comparing the economic benefits derived from adopting sustainable land-management practices with the costs of these practices.

v) The ecological economics approach, based on the estimated Total Terrestrial Ecosystem Services value at global level and its degraded fraction with results for all countries.

Currently applied methods to estimate the cost of land degradation illustrate the diversity of views and approaches:

i) Replacement cost method, which counts the value of nutrients needed to add to the land, in order to recover the lost fertility.

ii) Methods based on the loss of net erosion and other associated losses related to water and biodiversity.

iii) Econometrical models, where the cost of land degradation is obtained by calculating the difference in cultivation output between affected and non-affected lands. These models calculate production and yield functions of the most important crops in affected and non-affected lands, as well as data from affected areas compared with optimal economic frontiers of production. Value differences in crop produce between non-degraded and degraded land drive the estimation of economic loss of degradation.

iv) Methods that consider the Total Economic Value (TEV) of land estimate the economic loss by comparing the economic benefits derived from adopting sustainable land-management practices with the costs of these practices.

v) The ecological economics approach, based on the estimated Total Terrestrial Ecosystem Services value at global level and its degraded fraction with results for all countries.

All methods depend heavily on the way degradation is approached and measured, which explains the large range of estimates in economic costs. As shown in WAD3, this should be viewed and estimated following stakeholders’ interests which will likely yield a wide variety of spatial and numerical results which are all valid and complementary, reflecting very different and local situations.
Land Degradation Neutrality

A scientific conceptual framework

The objectives of LDN are to:
- Maintain or improve ecosystem services;
- Maintain or improve productivity, in order to enhance food security;
- Increase resilience of the land and populations dependent on the land;
- Seek synergies with other environmental objectives;
- Reinforce responsible governance of land tenure.

Introduction

Achieving Land Degradation Neutrality (LDN) is the new paradigm, introduced to halt the ongoing loss of healthy land as a result of unsustainable management and land conversion. Defined as “a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable within specific temporal and spatial scales and ecosystems”, the goal of LDN is to maintain the land resource base so that it can continue to supply ecosystem services while enhancing the resilience of the communities that depend on the land.

While the scope of the United Nations Convention to Combat Desertification (UNCCD) is limited to drylands, the LDN conceptual framework is intended to be applicable across all land types, so it can be used by countries according to their individual circumstances. The LDN conceptual framework is designed to apply to all land uses (i.e. land managed for production – e.g. agriculture, forestry, for conservation – e.g. protected areas and also land occupied by human settlements and infrastructure) and all types of land degradation.

To achieve LDN countries will need to assess the cumulative effect of land use decisions and then undertake measures to restore degraded land so as to compensate anticipated losses – what the policy refers to as a counterbalance. Linking LDN objectives with existing land-use planning mechanisms will facilitate the implementation of LDN. Countries should consider the social, economic as well as environmental outcomes of alternative options when planning LDN measures and should engage relevant stakeholders.

Overview of the conceptual framework

The Scientific Conceptual Framework for Land Degradation Neutrality provides a scientific foundation for planning, implementing and monitoring LDN. It was developed by a group of experts led by the Science–Policy Interface (SPI) of the UNCCD and has been reviewed by technical experts and policymakers. By defining the LDN concept in operational terms, the framework is designed to create a bridge between the vision and its practical implementation. It articulates the scientific basis for the vision and logic of LDN and, based on this, presents a strategy for achieving LDN, an approach to monitoring LDN status and guidance on interpreting the results of monitoring.

Integrated land use planning and the counterbalancing mechanism

Achieving LDN will require monitoring land use where degradation is anticipated (so that cumulative negative impacts can be estimated), followed by interventions designed to avoid, reduce or reverse land degradation, with the intent of achieving neutrality at national scales. Therefore, the conceptual framework introduces a new approach in which land-degradation management is coupled with land-use planning. Decision-makers are encouraged to consider the cumulative effects on the health and productivity of a nation’s land resources caused by the collective impact of their individual decisions. LDN thus promotes integrated land use planning, with a long-term planning horizon including consideration of the likely impacts of climate change. The counterbalancing mechanism requires implementation of interventions that will deliver gains in land-based natural capital equal to or greater than anticipated losses due to degradation elsewhere.

Like-for-like

Countering ideally should not occur between different land types, to ensure “like for like” when assessing and managing the counterbalancing between losses and gains. In other words, a gain in one land type cannot counterbalance a loss in a different land type. Counterbalancing losses in land types managed for conservation with gains in land types managed for production should be avoided. LDN activities should seek to deliver ‘win–win’ outcomes, whereby land restoration and rehabilitation contribute to broader environmental goals and more sustainable livelihoods.

Source: Orr B., 2017

Schematic of the scientific conceptual framework for land degradation neutrality. Envisaged new land degradation needs to be counterbalanced by restoring already degraded land so that on balance the area degraded remains the same or decreases. This is done per land type on a like-for-like basis. 
PART VI – SOLUTIONS

Monitoring LDN

Land Degradation Neutrality

Suites of measured values

- Derived from NOVEX
- Derived from MODIS

Derived indicators (metrics)

- Land productivity (NPP)
- Carbon stocks (SOC)
- Land cover change

Land-based Ecosystem Services (ES)

- Food supply
- Nutrient cycling
- Water regulation
- Cultural heritage
- all other ESs

Land-based supporting process

- Avoid
- Reduce
- Reverse land degradation

The principles for governing LDN:

1. Maintain or enhance land-based natural capital.
2. Protect the rights of land users.
3. Respect national sovereignty.
4. For neutrality, the LDN target equals (is the same as) the baseline.
5. Neutrality is the minimum objective: countries may elect to set a more ambitious target.
6. Integrate planning and implementation of LDN into existing land-use planning processes.
7. Counterbalance anticipated losses in land-based natural capital with interventions to reverse degradation, to achieve neutrality.
8. Manage counterbalancing at the same scale as land-use planning.
9. Counterbalance “like for like” (within the same land type).
10. Balance economic, social and environmental sustainability.
11. Base land-use decisions on multi-variable assessments, considering land potential, land condition, resilience, social, cultural and economic factors.
13. Apply a participatory process: include stakeholders, especially land users, in designing, implementing and monitoring interventions to achieve LDN.
14. Reinforce responsible governance: protect human rights, including tenure rights; develop a review mechanism, and ensure accountability and transparency.
15. Monitor using the three UNCCD land-based global indicators: land cover, land productivity and carbon stocks.
16. Use additional national and sub-national indicators to aid interpretation and to fill gaps for ecosystem services not covered by the three global indicators.
17. Use the “one-out, all-out” approach to interpret the result of these three global indicators.
18. Apply local knowledge and data to validate and interpret monitoring data.
19. Apply a continuous learning approach: anticipate, plan, track, interpret, review, adjust, create the next plan.

LDN can help achieve multiple global development and environmental goals

Achieving LDN can have major benefits for both society and the environment. The Sustainable Development Goal 15 (SDG 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” includes the specific target (15.3) to “combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods and strive to achieve a land degradation-neutral world”. Achieving this goal will be a catalyst to many other SDG goals relating to poverty, hunger, water, fuel and climate. LDN, however, also cuts across all three of the Rio conventions, as in addition to its obvious links to the Convention to Combat Desertification, it will also help maintain biodiversity as well as reduce the rate of climate change through the sequestering of carbon.