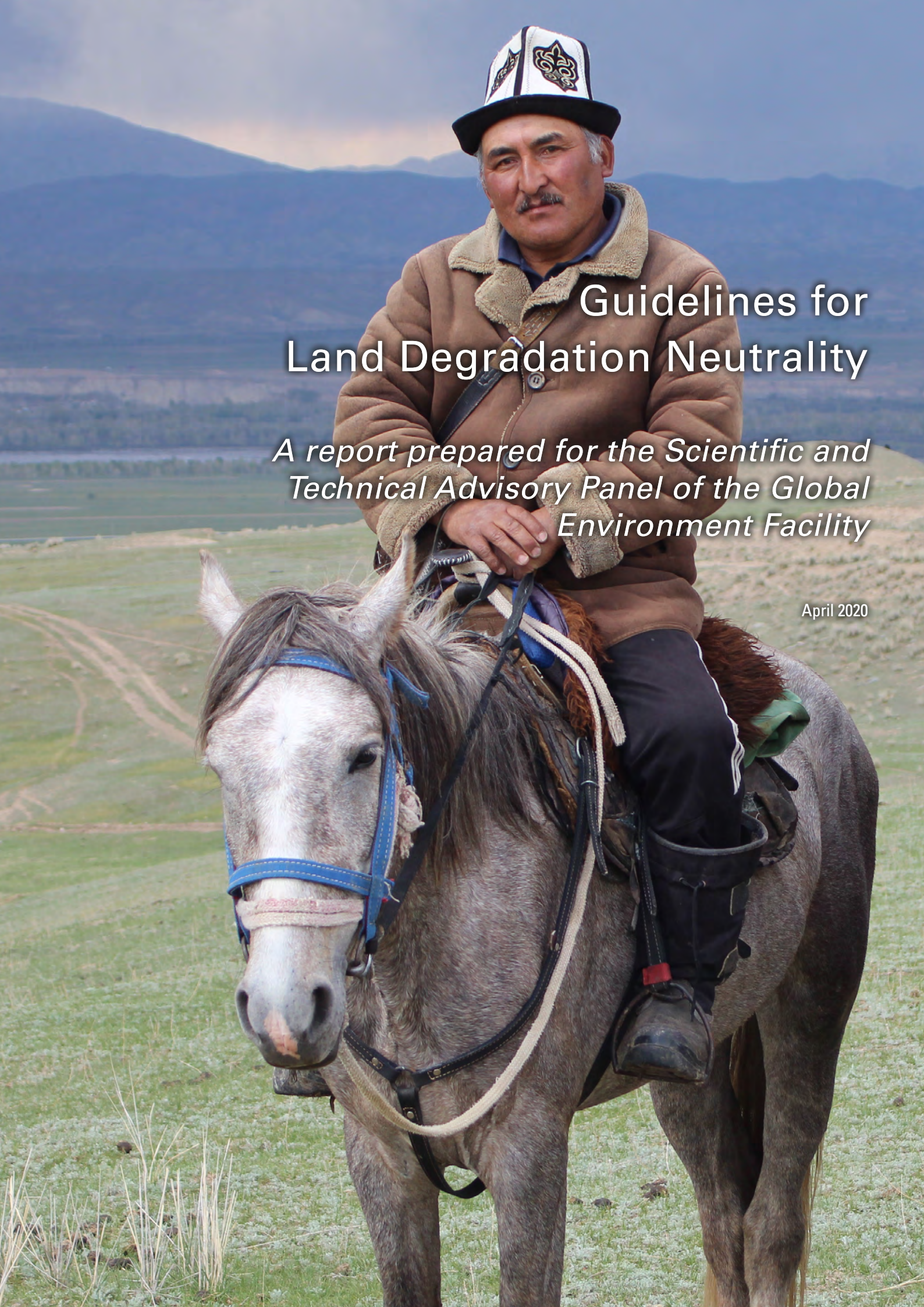

# Guidelines for Land Degradation Neutrality

*A report prepared for the Scientific and Technical Advisory Panel of the Global Environment Facility*

April 2020

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The draft guidelines were presented at a side event led by the STAP GEF at the fourteenth Conference of the Parties to the UNCCD in Delhi, India, in September 2019. Stakeholders provided input on the applicability of the guidelines for developing land degradation neutrality (LDN) interventions. Participants recognized the utility of the guidelines, and the underpinning LDN Scientific Conceptual Framework, for targeting interventions using the response hierarchy of Avoid > Reduce > Reverse land degradation. The guidelines emphasize the scientific and stakeholder-led foundations welcomed by participants at the STAP session at the fourteenth UNCCD Conference of the Parties.



ABOUT STAP
The Scientific and Technical Advisory Panel (STAP) comprises seven expert advisors supported by a Secretariat, who are together responsible for connecting the Global Environment Facility to the most up to date, authoritative and globally representative science. http://www.stapgef.org

ABOUT GEF
The Global Environment Facility (GEF) was established on the eve of the 1992 Rio Earth Summit, to help tackle our planet's most pressing environmental problems. Since then, the GEF has provided close to $20 billion in grants and mobilized an additional $107 billion in co-financing for more than 4,700 projects. The GEF has become an international partnership of 183 countries, international institutions, civil society organizations, and the private sector to address global environmental issues. http://www.thegef.org

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# EXECUTIVE SUMMARY

Land degradation neutrality (LDN) aims to preserve the land resource base by ensuring no net loss of healthy and productive land. LDN is pursued through a combination of measures that avoid, reduce and reverse land degradation. Achieving neutrality requires estimating the likely impacts of land-use and land management decisions, then counterbalancing anticipated losses through strategically planned rehabilitation or restoration of degraded land within the same land type.

Through its seventh replenishment, the Global Environment Facility (GEF) continues supporting countries financially in their pursuit of LDN (e.g. within the Land Degradation Focal Area; the Food Systems, Land Use, and Restoration Impact Program; and the Sustainable Forest Management Impact Program on Dryland Sustainable Landscapes), as requested by parties of the United Nations Convention to Combat Desertification (UNCCD) at its thirteenth Conference of the Parties. As such, LDN interventions can be included in projects within the portfolio of the Land Degradation Focal Area, as well as in projects within Impact Programs.

To facilitate programme implementation, and in response to the request of the UNCCD parties for support of capacity-building, reporting, and voluntary LDN target setting and implementation, the Scientific and Technical Advisory Panel (STAP) committed to develop guidelines to assist project developers in the preparation of GEF-funded projects that advance the LDN ambitions of countries. As of June 2019, 122 countries have committed to pursue voluntary LDN targets. These guidelines are intended to be applied during the project development phase and at the problem definition and intervention design stages; they are also relevant to monitoring the achievement of LDN goals.

The Scientific Conceptual Framework for Land Degradation Neutrality (LDN-SCF) that underpins these guidelines comprises five modules, which describe the overall approach to LDN: articulate the vision, goal and objectives of LDN for the specific context of intervention (Module A); determine the baseline against which achievement of LDN is to be measured (Module B); estimate the area of expected losses that must be counterbalanced to achieve neutrality (Module C); create an enabling environment for LDN, including establishing required policies and undertaking preparatory assessments (Module D); and monitor the achievement of LDN (Module E).

These guidelines briefly outline the key concepts, state the principles and present practical steps for applying each of these modules; they also provide a list of suggested resources (data, tools, explanatory documents).

Achieving LDN requires concerted and coordinated efforts to integrate LDN objectives into land-use planning and land management, underpinned by sound understanding of the human-environment system and effective governance mechanisms. Therefore, these guidelines focus particularly on laying the foundation to achieve LDN by (i) establishing enabling policies and (ii) applying integrated land-use planning, informed by preparatory assessments, as described in the LDN-SCF.

# INTRODUCTION:

## BACKGROUND TO LAND DEGRADATION NEUTRALITY AND PURPOSE OF GUIDELINES

Recognizing that previous approaches have had limited success in addressing land degradation, the United Nations Convention to Combat Desertification (UNCCD) introduced the concept of land degradation neutrality (LDN), which has now also been adopted as a target of Sustainable Development Goal (SDG) 15, Life on Land.[1] The objectives of LDN are to:

- Maintain or improve the sustainable delivery of ecosystem services
- Maintain or improve productivity to enhance food security
- Increase resilience of the land and populations dependent on the land
- Seek synergies with other social, economic and environmental objectives
- Reinforce responsible and inclusive governance of land

As of June 2019, 122 countries have committed to pursue voluntary LDN targets.[2]

Through its seventh replenishment, the Global Environment Facility (GEF) aims to support countries in their pursuit of LDN, particularly within the Land Degradation Focal Area; the Food Systems, Land Use, and Restoration Impact Program; and the Sustainable Forest Management Impact Program on Dryland Sustainable Landscapes. Therefore, within the GEF-7 programme, LDN interventions could be included in projects within the Land Degradation Focal Area portfolio, the Food Systems Impact Program and its affiliated projects, and the Dryland Sustainable Landscapes Impact Program and its affiliated projects. Furthermore, projects in these programmes should be compatible with LDN, if not targeting it explicitly.

## PURPOSE OF THE GUIDELINES

These guidelines support GEF project developers in formulating projects that contribute to the LDN ambitions of countries and in ensuring that other projects not directly targeting LDN are compatible with LDN objectives and approaches. The guidelines complement and expand the Checklist for Land Degradation Neutrality Transformative Projects and Programmes.[3] They are intended to be applied during project development and at the problem definition and intervention design stages; they are also relevant to monitoring the achievement of LDN goals.

**LDN will only be achieved through concerted and coordinated efforts to integrate LDN objectives with land-use planning and land management**, underpinned by sound understanding of the human-environment system and effective governance mechanisms. Therefore, these guidelines focus particularly on laying the foundation to achieve LDN by establishing enabling policies and applying integrated land-use planning, informed by preparatory assessments, as described in the Scientific Conceptual Framework for LDN (LDN-SCF). Furthermore, a review of experience in setting LDN targets and implementing LDN identified gaps in capacity with respect to applying the neutrality mechanism and integrating land-use planning; assessing resilience and socioeconomic aspects of land governance; assessing multiple benefits; and managing trade-offs.[4] Therefore, these guidelines put greatest emphasis on those aspects. The guidelines are structured as follows: for each of the five modules of the LDN-SCF, the key concepts are presented, followed by the principles, practical steps for implementation and a list of resources (tools and data sources) that could be helpful. For Module D, additional details on the subcomponents of enabling environment, preparatory assessments and planning interventions are provided in appendices 1–3.

1 LDN was recognized by the UNCCD at the twelfth Conference of the Parties, which stated that "striving to achieve SDG target 15.3 is a strong vehicle for driving implementation of the UNCCD, within the scope of the Convention" and endorsed the definition of LDN (UNCCD, 2015).

2 https://www.unccd.int/news-events/record-number-countries-takes-target-achieving-ldn

3 Checklist developed by the Global Mechanism of the UNCCD with input resulting from a scientific review by the UNCCD's Science-Policy Interface, with support from the GEF secretariat: https://knowledge.unccd.int/knowledge-products-and-pillars/access-capacity-policy-support-technology-tools/checklist-land

4 Verburg *et al.*, 2019.

## NATIONAL TARGET SETTING FOR LDN

The UNCCD's Global Mechanism is supporting countries, through the LDN target-setting programme, in undertaking national-level planning for LDN. This involves developing LDN targets; quantifying the baseline; identifying land degradation hotspots; and planning measures to avoid, reduce and reverse land degradation. Countries have been encouraged to integrate LDN plans into their UNCCD national action programmes. Furthermore, to achieve maximum synergy from land-based interventions, countries have also been encouraged to integrate LDN planning into their United Nations Framework Convention on Climate Change (UNFCCC) nationally determined contributions, their National Biodiversity Strategies and Action Plans, and their plans for SDG implementation.

## PROJECT-BASED INTERVENTIONS TO ATTAIN LDN

LDN is intended to be achieved at the national level, and over 120 countries have already undertaken LDN target setting. Therefore, an LDN project, if undertaken at subnational level in a country that has undertaken LDN target setting, should be planned such that it contributes to national targets and complements any LDN or other land-based interventions planned or under way. LDN can also be assessed at the subnational level, so if no national targets exist, a project could be undertaken that encompasses all aspects of LDN planning and implementation within the project boundary. These guidelines assume that the project is self-contained; therefore, the guidelines describe all aspects of LDN planning and implementation. However, if the project is undertaken in a country that has commenced or completed LDN target setting, the project developer should seek to complement this effort and integrate the project with the national LDN targets.

## FACILITATING TRANSFORMATION

Both the UNCCD and the GEF seek to support transformative projects and programmes through pursuit of LDN. "Transformations" are shifts that fundamentally alter system functions, interactions and feedbacks. Under global change, it is likely that shifts will occur that could result in negative consequences for the environment and people, such as if climate change causes repeated crop failures. The goal of LDN is to facilitate beneficial transformation that ensures that systems will be able to function and support livelihoods in the long term.

## SAFEGUARD CRITERIA FOR LDN TRANSFORMATIVE PROJECTS AND PROGRAMMES

Achievement of the LDN goal of maintaining land resources must not come at the expense of adverse social and ecosystem impacts. Project developers should comply with all relevant environmental and social safeguards. The guidance provided in the LDN-SCF's *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests* (VGGTs) and safeguards such as the International Finance Corporation's Performance Standards should be followed to reduce the risk that pursuit of LDN will result in unintended consequences associated with land tenure insecurity, land appropriation or land conflict. Further information is available from *Land Degradation Neutrality Transformative Projects and Programmes: Operational Guidance for Country Support*.[5]

At a minimum, the following safeguards must be applied in planning and implementing LDN projects:

- **Land governance:** Ensure that the access to land and the livelihoods of vulnerable people are protected and that free, prior and informed consent is obtained, and just compensation provided, where land access is infringed.

- **Gender:** Ensure that stakeholder engagement processes are gender-sensitive and that impact on women is considered in devising LDN interventions.

- **Ecosystem protection:** Ensure that
  - Effective land-use planning and implementation instruments are in place to enable "like for like" counterbalancing of gains and losses.
  - LDN interventions do not threaten Red List species or high conservation value ecosystems and do not facilitate the introduction or spread of invasive species.

5 Global Mechanism of the UNCCD, 2019.

Photo by Nick Fewings on Unsplash

# OVERVIEW

## OF THE SCIENTIFIC CONCEPTUAL FRAMEWORK FOR LAND DEGRADATION NEUTRALITY

The LDN-SCF, developed by the UNCCD's Science-Policy Interface, presents the scientific basis for planning, implementing and monitoring LDN.

The LDN-SCF is described in the following documents:

- Full report: Orr *et al*. (2017) https://www.unccd.int/publications/scientific-conceptual-framework-land-degradation-neutrality-report-science-policy (available in English, French and Spanish)

- Scientific paper: Cowie *et al*. (2018) https://www.sciencedirect.com/science/article/pii/S1462901117308146 with supplementary tables and figures

- Science Policy brief: UNCCD (2016) https://www.unccd.int/sites/default/files/documents/18102016_Spi_pb_multipage_ENG_1.pdf (available in English, French and Spanish)

- Guide to the Scientific Conceptual Framework for Land Degradation Neutrality: UNCCD (n.d.) https://knowledge.unccd.int/knowledge-products-and-pillars/guide-scientific-conceptual-framework-land-degradation-neutrality comprising:

  · Extended description of the **principles** of LDN
  · **Key elements** of the LDN-SCF
  · **Tools and resources** for LDN implementation

**The fundamental aim of LDN is to preserve the land resource base by ensuring no net loss of healthy and productive land at the national level.** This goal is achieved through a combination of measures that avoid, reduce and reverse land degradation. Achieving LDN requires estimating the likely cumulative impacts of land-use and land management decisions, then counterbalancing anticipated losses through strategically planned rehabilitation or restoration of degraded land, within the same land type. These concepts are illustrated in *Source:* Orr *et al.*, 2017.

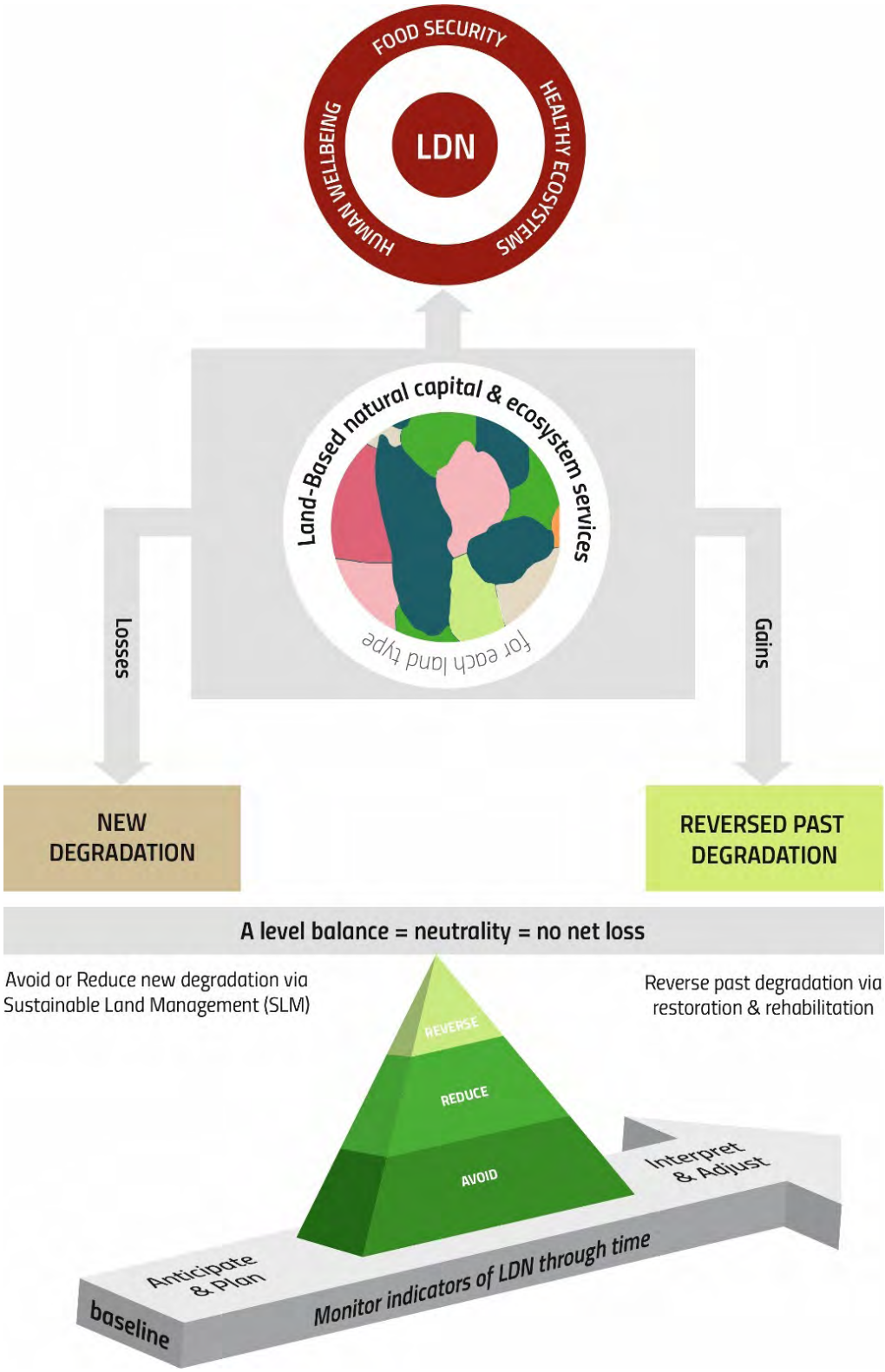



Figure 1: The overarching concept of LDN, the key elements of the LDN-SCF and their interrelationships.
*Source:* Orr *et al.*, 2017.

The LDN-SCF consists of five modules (figure 2):

- **Module A, Vision and objectives of LDN:** Articulates the aspirational goal of LDN
- **Module B, Frame of reference:** Explains the LDN baseline against which achievement is measured
- **Module C, Mechanism for neutrality:** Describes the counterbalancing concept
- **Module D, Achieving neutrality:** Describes the pathway for implementing LDN and the elements required, including preparatory analyses and enabling policies
- **Module E, Monitoring LDN:** Presents the indicators for assessing achievement of LDN

The LDN-SCF is not prescriptive about how it should be implemented. Rather, it presents principles for the application of each module. The principles describe the manner in which the framework is implemented and the intended outcomes of LDN and thereby provide bounded flexibility to suit individual contexts, while ensuring that the core features of LDN are maintained and unintended consequences are avoided. These guidelines help project developers interpret and apply the principles for their specific circumstances.

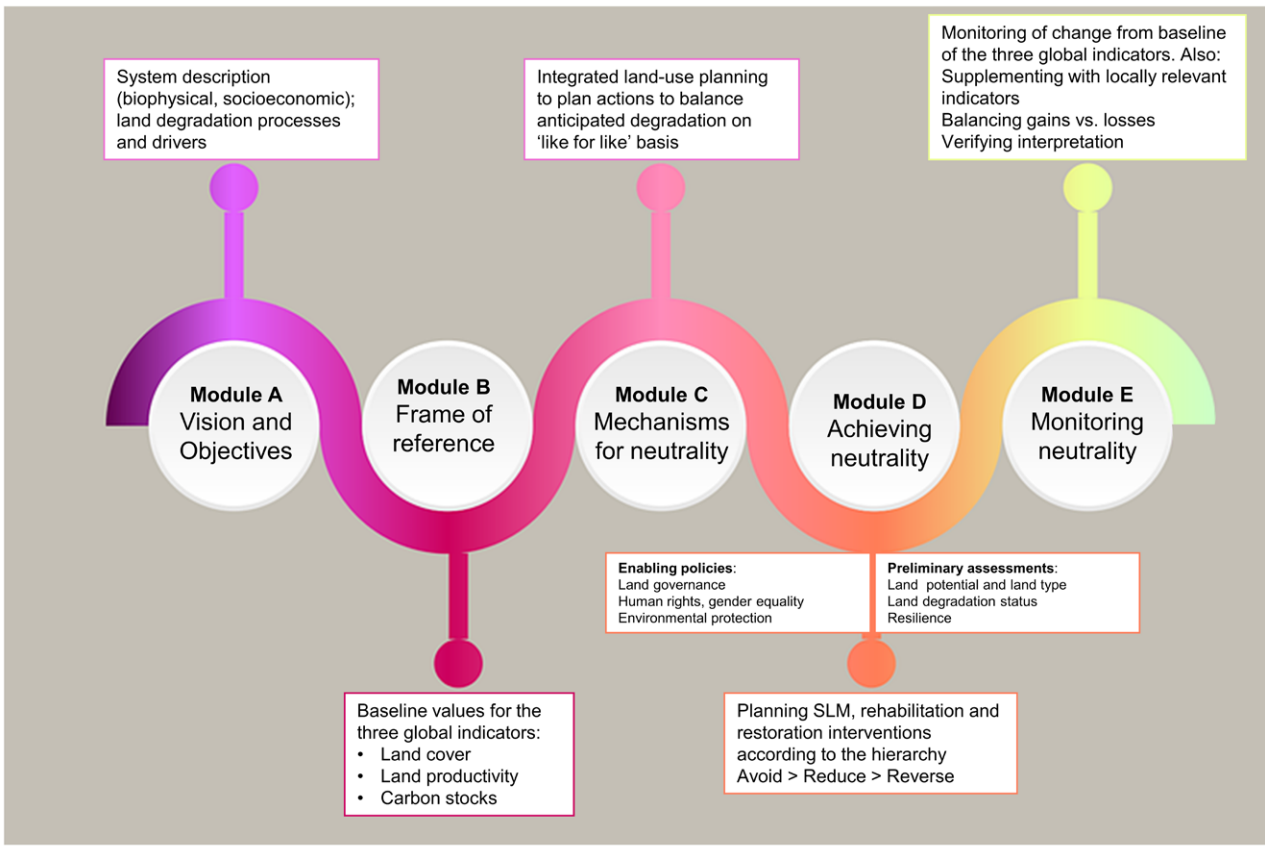
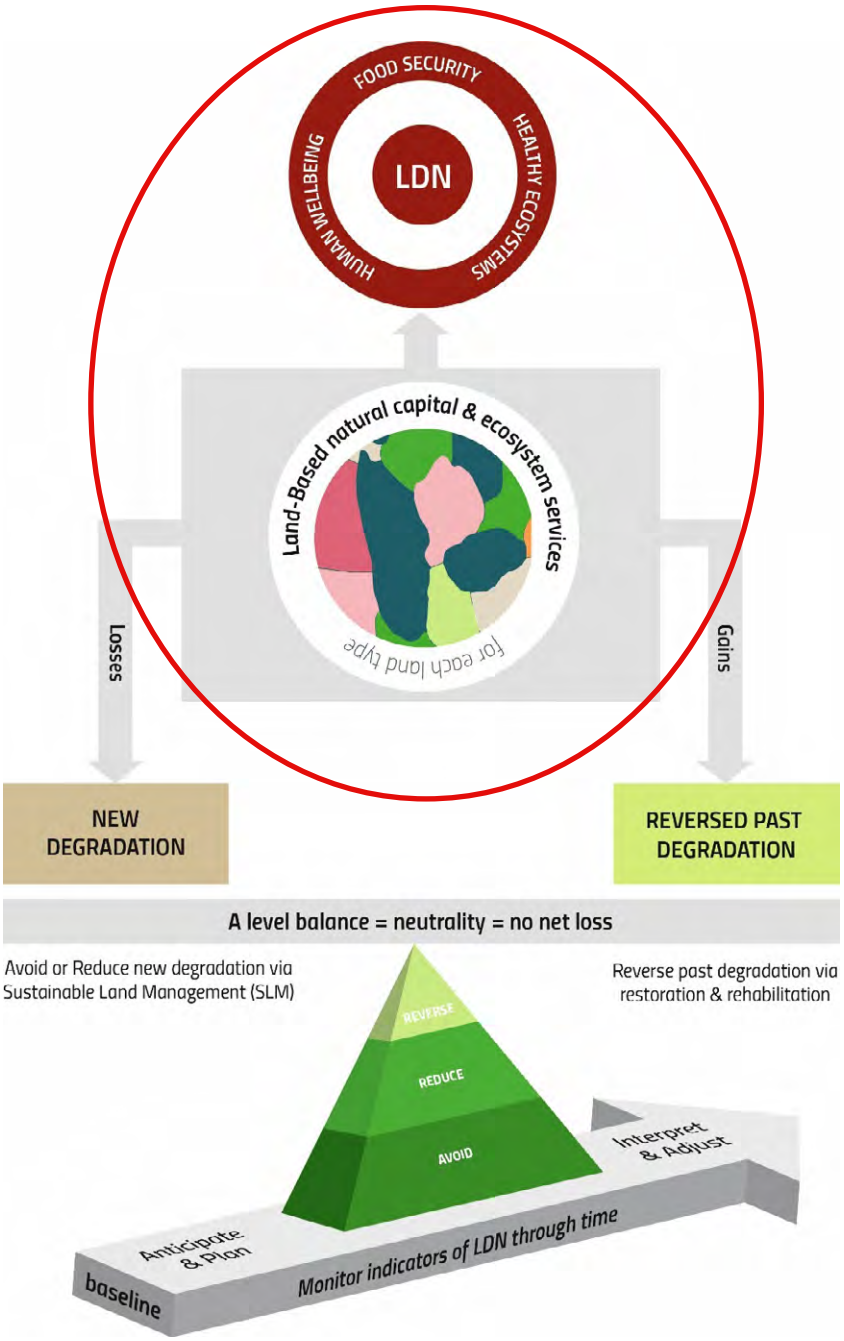



Figure 2: The five modules of the LDN-SCF.

# MODULE A:
# THE VISION AND OBJECTIVES OF LDN

Module A lays out the goal of the LDN project based on a system-level understanding of the project context: the key features of the human-environment system, the land degradation issues being faced, and their drivers.



## KEY CONCEPTS

LDN is 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 or increase within specified temporal and spatial scales and ecosystems".[6] The LDN-SCF explains that the goal of LDN is to maintain the land resource base so that it can continue to supply ecosystem services, such as provision of food and regulation of water and climate, while enhancing the resilience of the communities that depend on the land.[7] **Put simply, the goal of LDN is to maintain or increase the amount of healthy and productive land**.

This goal needs to be articulated for the specific project. Articulating the goal involves identifying the features and values that must be maintained, or improved, in the project context.

## PRINCIPLES OF MODULE A

**P1 Maintain or enhance land-based natural capital.**

**P2 Protect the rights of vulnerable and marginalized land users.**

**P3 Set national LDN targets based on national circumstances.**

## STEPS FOR MODULE A

1. Characterize the system:

    - Ideally, co-develop the system description in a participatory process with the key stakeholders, considering gender balance.

    - Describe the key biophysical and socioeconomic features of the system, including its boundaries. What are the valued ecosystem services and ecological functions provided by the land in the project context? (For example, rangeland used for transhumant grazing of livestock provides livelihoods, high nutritional value food, habitat for native herbivores and carbon sequestration in vegetation and soil.)

    - Describe the system's constituent components and their internal and external linkages and dependencies, particularly the key controlling variables and feedbacks that influence land use and land condition. (For example, the timing of the onset and the duration of the rainy season impacts pasture biomass and therefore the feed available and the longer term survival of perennial grasses; grazing management influences ground cover and therefore susceptibility to erosion.)

    - Identify the key relationships between variables and the connections to levels above and below the level targeted by the project. (For example, relationships between different levels of government regulating different aspects of land governance or access to water for irrigation.)

The system model can be expressed in diagram or narrative form to describe the processes that sustain land-based ecosystem services in the project context. The Resilience, Adaptation Pathways and Transformation Assessment (RAPTA) Framework provides guidance on systems analysis (see Module A resources).

2. Identify the causes and effects of land degradation:

    - Identify the land degradation processes. What forms of land degradation are affecting productivity and natural ecosystems? (For example, soil erosion, including loss of topsoil; gullying; soil salinization; coastal inundation.)

    - Identify the drivers of land degradation – that is, external influences that lead to land degradation (drought, migration, market forces) – and the pressures, such as land-use change (e.g. forest conversion to agriculture, urban expansion) and unsustainable land-use practices (e.g. overgrazing, burning crop stubble, intensive cultivation on slopes) that leave soil bare and vulnerable to erosion.

6 UNCCD, 2015.
7 Orr *et al.*, 2017.

## RESOURCES

RAPTA: Practical guidance on resilience assessment developed for the STAP GEF, with a particular focus on land degradation and food security in the drylands.

O'Connell, D., *et al*. (2016). *Designing Projects in a Rapidly Changing World: Guidelines for Embedding Resilience, Adaptation and Transformation into Sustainable Development Projects*, version 1.0. Washington, D.C.: Global Environment Facility. http://www.stapgef.org/rapta-guidelines

Component 4, Guidance on development of system description, section 3.4, pp. 56–62.

O'Connell, D., *et al*. (2019). *The Resilience, Adaptation Pathways and Transformation Approach (RAPTA): A guide to designing, implementing and assessing interventions for sustainable futures* (O'Connell, D. *et al*., 2019) Version 2.0 https://research.csiro.au/eap/rapta/

LDN-SCF: Provides a scientific foundation for understanding, implementing and monitoring LDN. It has been designed to create a bridge between the vision and the practical implementation of LDN, by defining LDN in operational terms. The framework was developed by the Science-Policy Interface of the UNCCD.

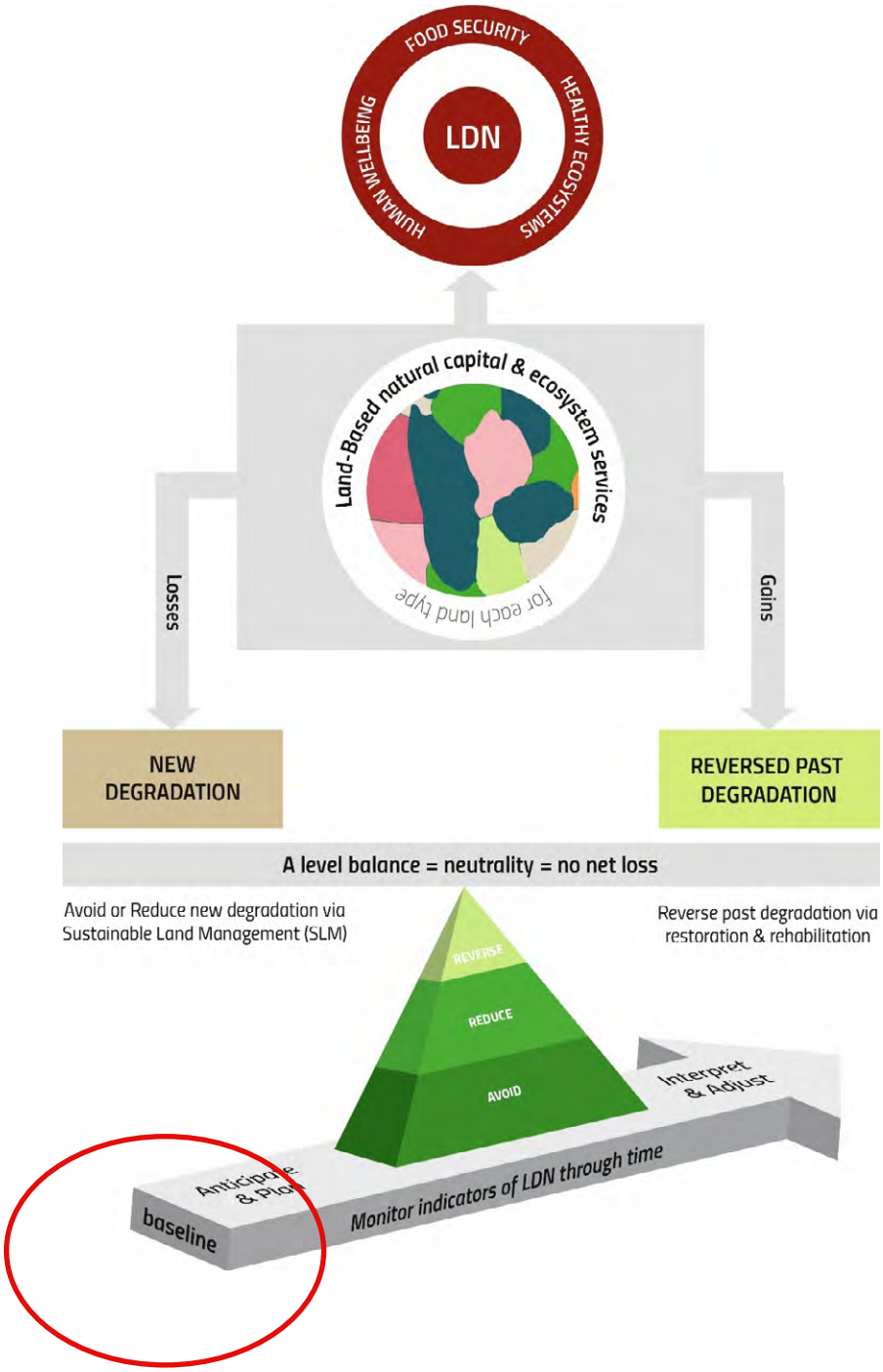
Orr, B., *et al*. (2017). *Scientific Conceptual Framework for Land Degradation Neutrality: A Report of the Science-Policy Interface*. Bonn: United Nations Convention to Combat Desertification https://www.unccd.int/publications/scientific-conceptual-framework-land-degradation-neutrality-report-science-policy Figure 2, Generic driver-pressure-state-impact-response framework. Adapt for the project context. Figure 3, Examples of land degradation drivers, processes, inherent and responsive soil or site properties and their relationships with ecosystem services.

Henry, B., *et al*. (2018). *Sustainable Land Management for Environmental Benefits and Food Security* Sustainable Land Management for Environmental Benefits and Food Security. Washington, D.C.: Global Environment Facility): Tables 3 and 4, Land degradation drivers and processes. http://www.stapgef.org/sustainable-land-management-environmental-benefits-and-food-security-synthesis-report-gef

Food and Agriculture Organization and Intergovernmental Technical Panel on Soils. (2015). Status of the World's Soil Resources (SWSR) – Main Report. Food and Agriculture Organization of the United Nations and Intergovernmental Technical Panel on Soils, Rome, Italy. http://www.fao.org/3/a-i5199e.pdf

# MODULE B:
# FRAME OF REFERENCE

The purpose of Module B is to establish the values for the indicators in the baseline year.



## KEY CONCEPTS

- Neutrality is achieved when losses are (at least) counterbalanced by gains so there is no net loss of the land-based natural capital relative to a reference state, or baseline. This means that the baseline is also the (minimum) target.

- The target of neutrality aligns with the aims of the GEF Land Degradation Focal Area; the Food Systems, Land Use, and Restoration Impact Program; and the Sustainable Forest Management Impact Program, which seek to maintain or improve natural capital and land resources, restore productive landscapes and deliver environmental benefits.

- The baseline is the land-based natural capital as measured by the three global LDN indicators at the time of the decision to commit to LDN. The LDN indicators (and metrics) are:

  - Land cover (land cover change, LCC).

  - Land productivity dynamics (LPD; measured as net primary productivity, NPP).

  - Carbon stocks (soil organic carbon, SOC).

- Each of these indicators assesses a different aspect relevant to LDN:

  - LCC detects the human actions that drive land degradation and its reversal.

  - LPD reflects the impacts of those drivers on plant production as a measure of ecosystem function.

  - Change in SOC stocks, which responds more slowly, indicates the change in productive capacity.

- The baseline[8] values do not show land degradation status. For example, low SOC may occur in low rainfall sites with sandy soil as well as in degraded sites in productive environments. Land degradation status is assessed in Module D.

## PRINCIPLES OF MODULE B

**P4 For neutrality, the LDN target equals (is the same as) the baseline.**

**P5 Neutrality[9] is the minimum objective: countries may elect to set a more ambitious target.**

## STEPS FOR MODULE B

1. Identify data sources for the three global indicators. It is preferable to use national data, where available. LCC and LPD (NPP) can be assessed by remote sensing. SOC change can be estimated using LCC data and SOC models or by direct measurement. Direct measurement is expensive and time-consuming as it requires the collection of soil cores, sample processing and laboratory analyses. Therefore, direct measurement of SOC should be focused on those sites where accurate information on change in SOC stock is necessary: those where the LDN interventions are not likely to change the other LDN indicators or where the stakeholders wish to participate in emissions trading (Figure 3).

2. Determine the baseline year: If the project takes place within a country that is committed to LDN, then the baseline of the project is the country baseline. Under the UNCCD Target Setting Programme and for SDG 15.3, the baseline year is usually 2015: the year that LDN was agreed as a goal by UNCCD and for the SDGs. If the country has not committed to LDN, then the baseline year is the year of commencement of project planning.

8 "LDN baseline" is the baseline as described in the LDN-SCF and the LDN target-setting process and is different from the "project baseline" in GEF terminology (which specifies the activities, existing systems or current projects that the GEF project seeks to build on).

9 For some countries, neutrality may be unachievable because it is inconsistent with their agreed development objectives. In these circumstances, a country may set its LDN target acknowledging that losses may exceed gains if it forecasts that some portion of future land degradation associated with past decisions or realities is not currently possible to counterbalance. Justification for this reduced target needs to be provided.

3. Determine the baseline value for each indicator: The values of the indicators fluctuate over time, between seasons and between years, largely owing to climatic variability, so the values of the indicators must be averaged over a multi-year period (ideally 10–15 years) to establish the baseline value. It is important to determine the baseline precisely (i.e. minimize the error) to make it easier to detect change over time. The baseline becomes the target to be achieved in 2030.

## RESOURCES AND DATA SOURCES

*Trends.Earth:* Designed to support national-level assessment of land degradation. Allows a user to access default data and add in any other relevant data, from other global data sets and national data sets, to build improved capacity for mapping and monitoring LDN indicators. It provides access to global default data sets through the cloud and as a QGIS plugin. It also provides the functionality to compare these data sets to other global or national data sets with the *Good Practice Guidance – SDG Indicator 15.3.1*[10] algorithms necessary for standardized computation and cross-national comparability. Global data include (i) LCC and LPD from earth observation, (ii) methods to estimate SOC based on a SoilGrids 250 m data set, which can be used to provide baseline SOC stock, and (iii) LCC to estimate impacts of land use on SOC stock change. http://trends.earth/docs/en (available in English, French, Portuguese, Spanish and Swahili).

Sims, N., *et al*. (2017). *Good Practice Guidance: SDG Indicator 15.3.1 – Proportion of Land That Is Degraded over Total Land Area. Bonn: United Nations Convention to Combat Desertification:* Detailed description of the methodology and data sources for quantifying the three global indicators, including global standards for the computation of LCC, LPD and SOC and their integration for the computation of SDG indicator 15.3.1. It includes a discussion of various remotely sensed products (sensors, vegetation indices) and their relevance in different contexts, including spatial scales. http://www2.unccd.int/sites/default/files/relevant-links/2017-10/Good%20Practice%20Guidance_SDG%20Indicator%2015.3.1_Version%201.0.pdf

United Nations Convention to Combat Desertification (2017). *Methodological note to set national voluntary land degradation neutrality (LDN) targets using the UNCCD indicator framework. Bonn.* Describes global data sets available for quantifying the indicators. https://knowledge.unccd.int/sites/default/files/2018-08/LDN%20Methodological%20Note_02-06-2017%20ENG.pdf

United Nations Framework Convention on Climate Change: The national body responsible for reporting to the UNFCCC is a potential source of national data for the indicators, especially if the country is using Intergovernmental Panel on Climate Change (IPCC) Tier 2 or Tier 3 methods for SOC stocks and stock change. https://unfccc.int/process-and-meetings/transparency-and-reporting/greenhouse-gas-data/ghg-data-unfccc/ghg-data-from-unfccc

Intergovernmental Panel on Climate Change (2019). *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize, S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S. (eds). Published: IPCC, Switzerland: vol. 4, ch. 3, table 3A.1.1 – Global land cover data sets. https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

10 Sims *et al.*, 2017.

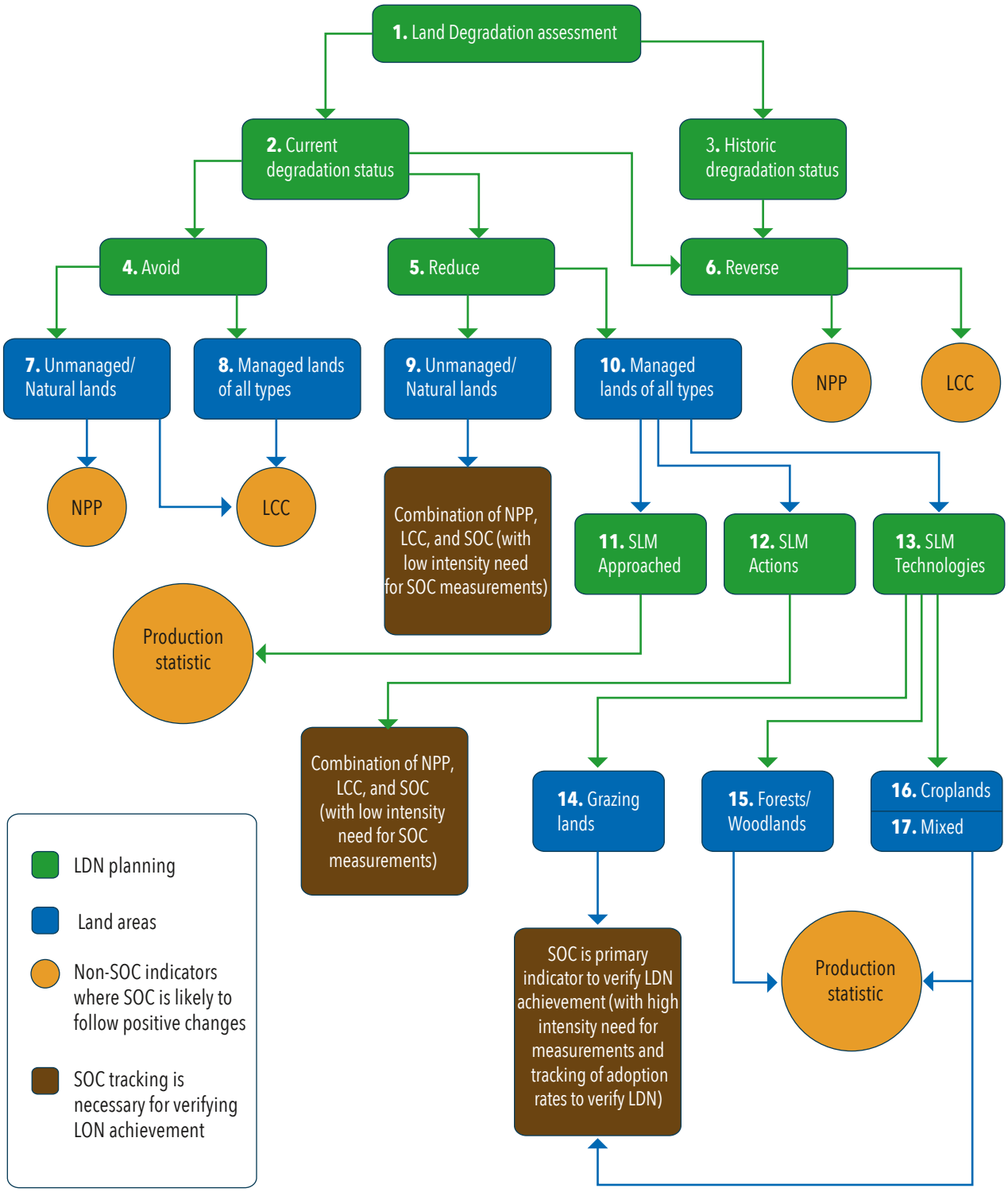
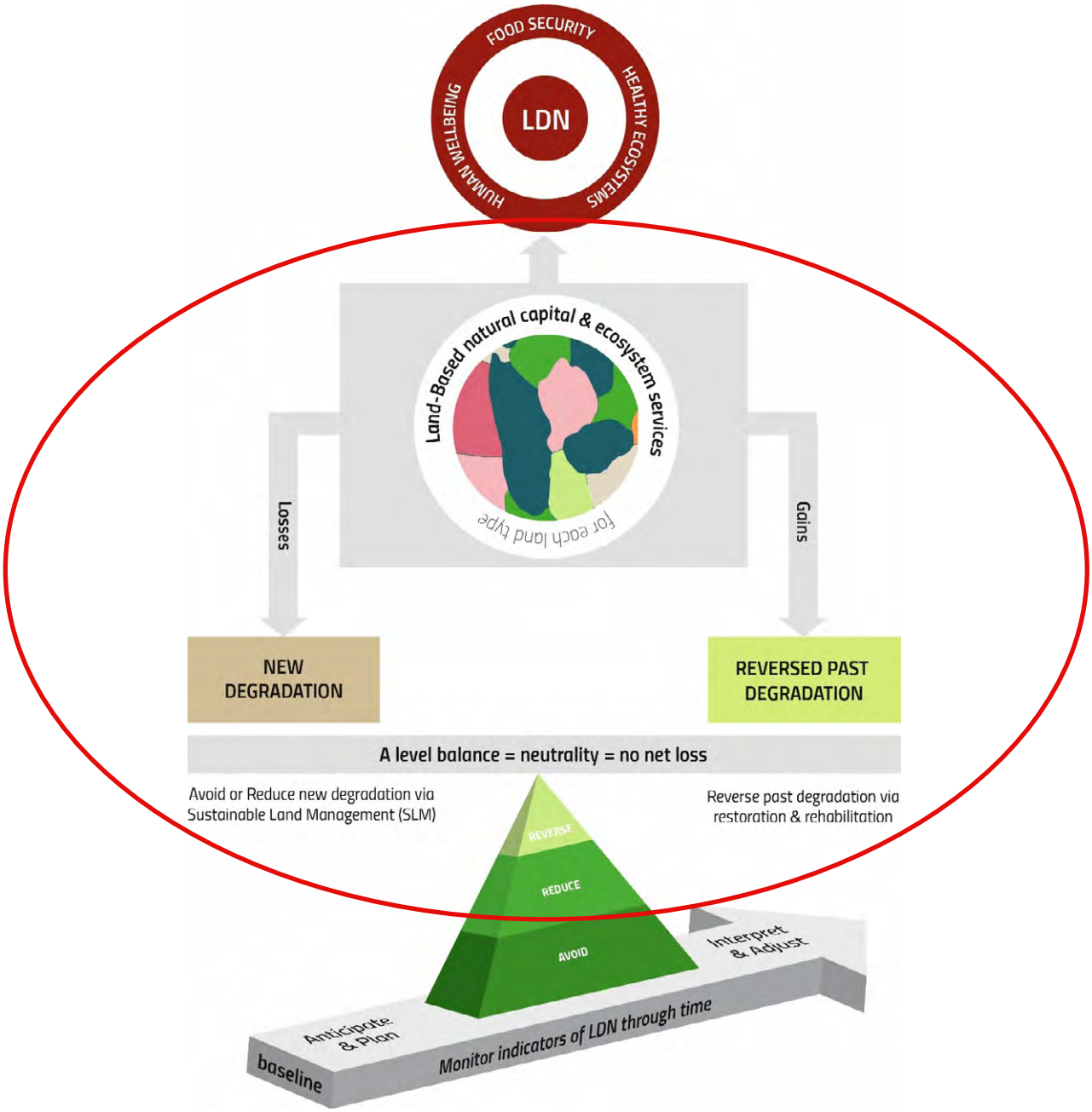



Figure 3: Key sites for monitoring soil organic carbon (SOC; brown) in the context of other indices of tracking land degradation neutrality (LDN; orange), as distributed across degradation status following land degradation assessment and response actions (green) by land types (blue). Intensive SOC monitoring is needed in lands that are more variable and where SOC is the key indicator for LDN (i.e. where land cover and net primary productivity [NPP] are not expected to change, or where soil carbon trading is undertaken). Production statistics are related to NPP and can be valuable as an indicator of LDN.

*Source:* Chotte *et al.*, 2019.

# MODULE C: MECHANISM FOR NEUTRALITY

The aim of Module C is to estimate the likely area of degradation for each land type as a result of land-use decisions and ongoing degrading land-use practice, so that an equal area of land can be restored or rehabilitated to counteract the anticipated loss.



## KEY CONCEPTS

- To achieve neutrality, action must be taken to reverse degradation and to counterbalance any losses due to ongoing land degradation. Therefore, achieving LDN requires land managers to monitor land-use decisions that may impact LDN and estimate their likely cumulative impacts so that these impacts can be counterbalanced by reversing land degradation on the same land types elsewhere.

- Land that is already degraded in the baseline and remains degraded does not count as a loss.

- Land degradation can occur quickly, such as when land is cleared, wetlands are drained, land is converted to settlements or floods wash away topsoil, or it can develop gradually, such as when acidification gradually reduces productivity. Reversing degradation is usually a slow process.

**Note: Protecting an area that is currently undegraded** does not generate gains because the value of the indicators remains constant over time, so this **does not count towards counterbalancing degradation**. Nevertheless, the objective in Module C is to anticipate losses and plan action to ensure neutrality is achieved. This means that taking action to avoid losses – protecting an undegraded area that is vulnerable to loss (e.g. forest that would have been cleared) – is a legitimate LDN intervention. Therefore, funding such actions is important as part of the response hierarchy (see Module D).

*Photo by Biegun Wschodnion Unsplash*

## PRINCIPLES OF MODULE C

**P6 Integrate planning and implementation of LDN into existing land-use planning processes.**

**P7 Counterbalance anticipated losses in land-based natural capital with interventions to reverse degradation with the aim of achieving neutrality.**

**P8 Manage counterbalancing at the same scale as land-use planning.**

**P9 Counterbalance "like for like" (within the same land type).**

## STEPS FOR MODULE C

1. Apply "integrated land-use planning", which embeds the neutrality mechanism into land-use planning, enabling (i) categorizing and accounting for land-use decisions and the impacts of land management and (ii) planning for LDN interventions to achieve neutrality.

2. Quantify projected land degradation: Estimate cumulative losses resulting from individual land-use and management decisions (e.g. due to anticipated land-use changes such as planned urban expansion and due to anticipated ongoing unsustainable management).

3. Plan gains to counteract anticipated losses:

    - Manage counterbalancing at the same scale as land-use planning (i.e. using the biophysical or administrative domains at which land-use decisions are made).

    - Counterbalance "like for like": Because each land type has different potential to deliver ecosystem services, losses must be balanced with gains on the same land type over the same land area (see appendix 2, Land potential). So, to achieve neutrality at the national level, each land type must be managed for neutrality. However, counterbalancing may occur across land type boundaries where there is a demonstrated net gain.

4. Ensure that counterbalancing does not occur between protected areas and land managed for productive uses.

5. Ensure that counterbalancing measures do not diminish the well-being of land users: Involve all stakeholders – men and women, public and private – in effective participatory processes; work in partnership with relevant levels of government and local landholders; apply transparent and participatory planning processes; provide spatial systems to record individual and collective tenure rights; and apply safeguards to reduce the risk of dispossession of legitimate tenure right holders, of environmental damage and of other threats and infringements.

## RESOURCES

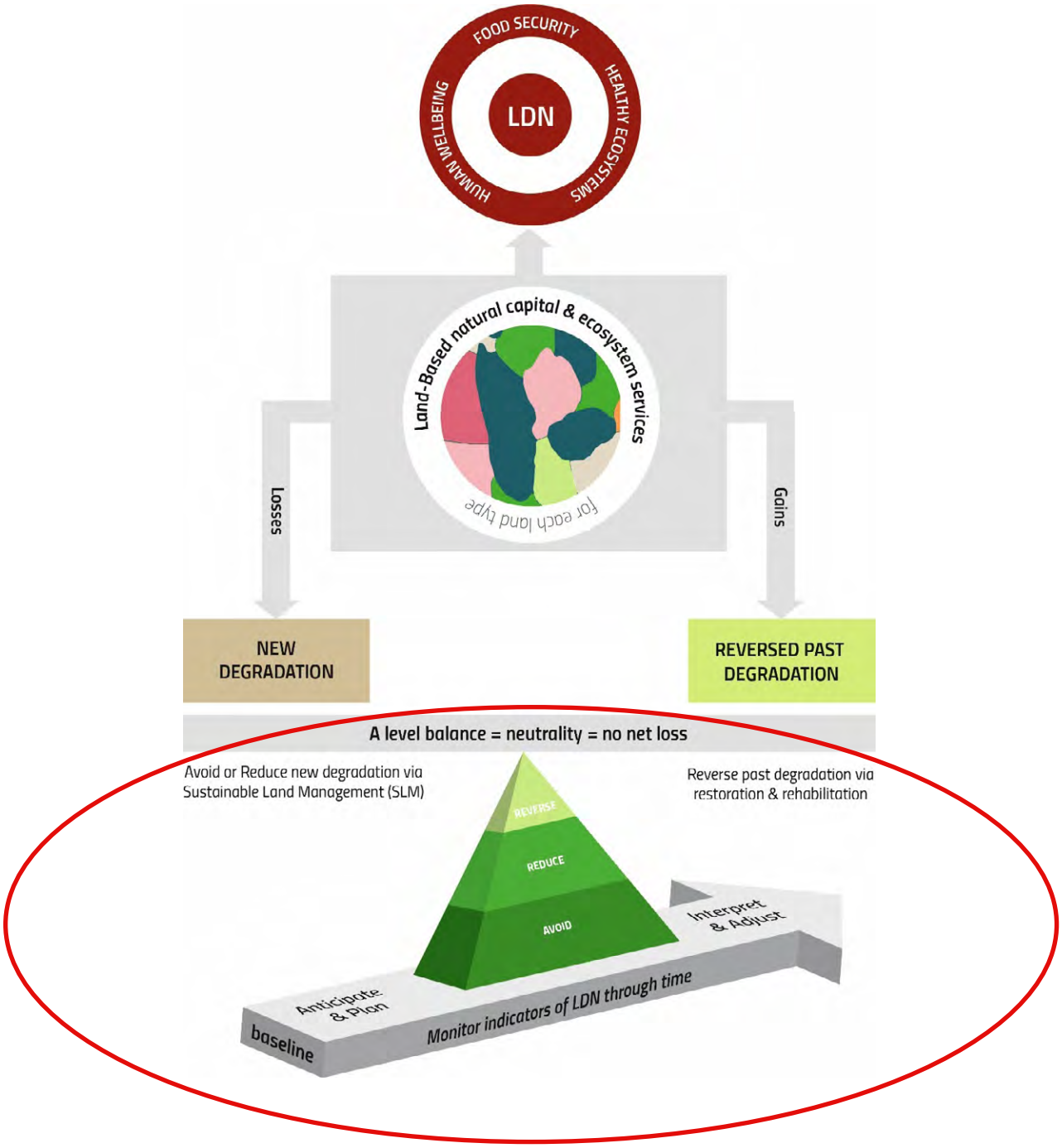
Module D and Appendices 1 and 3: Integrated land-use planning

*LDN-SCF* (Orr *et al.*, 2017): Table 2 and figure 6, Theoretical examples of anticipating losses and gains based on land-use decisions and current land management

Von Maltitz, G.P., *et al.* (2019). *Experiences from the South African land degradation neutrality target setting process. Environmental Science and Policy, vol. 101, pp. 54–62.* https://www.sciencedirect.com/science/article/abs/pii/S1462901119302308)

# MODULE D: ACHIEVING NEUTRALITY (OVERVIEW)

Module D focuses on the elements required to underpin LDN planning and implementation – that is, creating the enabling environment – especially with respect to establishing the required policies and undertaking preparatory assessments to obtain the required information.



## KEY CONCEPTS

- Achieving LDN requires a landscape perspective, system-level holistic action and a long-term view.

- LDN interventions comprise a mix of actions according to the hierarchy Avoid > Reduce > Reverse land degradation, using sustainable land management to avoid or reduce land degradation and implementing rehabilitation and restoration to reverse land degradation.

- Successful implementation of LDN interventions requires an enabling environment – a combination of institutional capacity, financial resources, policy and regulatory mechanisms, and science-policy interaction.

- A key enabler is responsible land governance, including measures to secure access to land, because land managers are more likely to invest time and financial resources in land management if their livelihood assets are sufficient and secure. Land governance refers to the process by which decisions are made regarding access to and use of land, the manner in which those decisions are implemented and the way in which conflicting interests in land are reconciled. Providing individual freehold title is not always the optimal solution; formalizing communal land governance may be more effective in some cases. The principles and standards of the VGGTs should be applied.

- Policy coherence – between institutions, sectors and levels of governance – is critical to resolve fragmentation, lack of connectivity and conflicting interests.

- Integrating LDN planning and implementation with other relevant processes will increase efficiency in achieving multiple environmental and development objectives and will minimize trade-offs and unintended adverse impacts. Ensuring that co-benefits are realized requires advance planning; integration between sectors; and participation of multiple stakeholders, with particular consideration of gender.

- Preparatory assessments provide the knowledge base to inform planning of interventions. These include assessments of land potential; current degradation status; resilience of current and proposed land uses; and socioeconomic context, including gender equity.

- Choosing the right intervention to apply in the right place requires biophysical data, socioeconomic data, and methods and tools to predict outcome (e.g. SOC modelling).

- Different policy approaches to facilitate adoption will be applicable in different jurisdictions, based on different land governance systems. In countries where landholders have few restrictions, this may require incentives and training; in others, regulation may be applicable and effective.

- Besides agriculture and forestry, other land uses (e.g. mining, settlements, infrastructure) should be included in LDN planning.

## PRINCIPLES OF MODULE D

**P10 Seek solutions that provide multiple environmental, economic and social benefits, and minimize trade-offs.**

**P11 Base land-use decisions on multivariable assessments, considering land potential; land condition; resilience; and social, cultural and economic factors.**

**P12 Apply the response hierarchy in devising interventions for LDN: Avoid > Reduce > Reverse land degradation.**

**P13 Apply a participatory process: Include stakeholders, especially land users, in designing, implementing and monitoring interventions to achieve LDN.**

**P14 Reinforce responsible governance: Protect human rights, including tenure rights; develop a review mechanism; and ensure accountability and transparency.**

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## STEPS FOR MODULE D (SUMMARY)

1. Review policies for land governance, land-use planning, and natural resource conservation and management, including mechanisms for learning and adaptive management. Facilitate revisions when they are required to provide an effective policy framework for implementation of LDN. See appendix 1 for guidance on developing an enabling environment.

2. Undertake preparatory assessments:

   - Land potential and land stratification
   - Current land degradation status
   - Resilience of current and proposed land uses
   - Socioeconomic context, including assessment of gender equality and barriers to participation of women and youth
   - Cost-benefit analysis of proposed interventions

   Appendix 2 provides guidance on assessing land potential, degradation status and resilience.

3. Apply integrated land-use planning, which seeks to balance economic, social, cultural and environmental objectives, to achieve a mosaic of land uses across the landscape such that land is used for the purposes to which it is best suited. Appendix 3 provides further information on planning interventions.

# MODULE E: MONITORING LDN

Module E describes the requirements for monitoring the LDN indicators to determine whether LDN has been achieved.

## KEY CONCEPTS

- Monitoring LDN involves tracking (i) change in the three global indicators relative to the baseline value for each land unit and (ii) relevant complementary indicators.

- The three global indicators and associated metrics are land cover (assessed as LCC), land productivity (assessed as NPP) and carbon stocks (assessed as SOC).

- These are also the indicators used for parties' reporting to the UNCCD.

- The indicators are applied using the "one out, all out" approach, such that a negative change in any of the three is interpreted as a loss. This is a conservative approach to integrate and interpret results for the three indicators.

- Negative change counts as a loss, irrespective of whether it is due to direct human action, indirect human action (e.g. climate change) or natural factors; non-anthropogenic losses cannot be ignored, as this would prevent achievement of the goal of LDN to maintain the land-based natural capital and capacity to supply ecosystem services.

- However, it is important to analyse the data and identify whether the changes in indicators result from climatic variation rather than land degradation so that interventions can be focused where they are most needed. Land degradation equates to loss of productive potential; a decline in NPP may result from dry conditions. If a rangeland area does not respond by regreening after rainfall, this suggests land degradation and should trigger closer investigation.

- The three global indicators may not capture all relevant issues; they should be supplemented with locally relevant indicators. Activity-based indicators should also be used, especially to monitor progress for interventions that will be slow to produce a measurable result in any of the outcome indicators during the project time frame.

## PRINCIPLES OF MODULE E

**P15 Monitor using the three UNCCD land-based global indicators: land cover, land productivity (net primary productivity) and carbon stocks (soil organic carbon).**

**P16 Use the "one out, all out" approach to interpret the result of these three global indicators.**

**P17 Use additional national and subnational indicators to aid interpretation and to fill gaps for ecosystem services not covered by the three global indicators.**

**P18 Apply local knowledge and data to validate and interpret monitoring data.**

**P19 Apply a continuous learning approach: Anticipate, plan, track, interpret, review, adjust and create the next plan.**

## STEPS FOR MODULE E

(Overlaps with Module B for the first two steps)

1. Identify data sources for the three global indicators. See Module B.

2. Determine the baseline value for each indicator (ie. the LDN metrics). See Module B.

3. Identify key sites for SOC monitoring, that is, where LCC and LPD are not likely to be affected by interventions, such as where the sustainable land management practices are introduced into an existing cropping system.

4. Decide on the interpretation of LCC. Some land cover transitions are universally agreed to be negative (e.g. conversion of tropical peatland forest to cropping or settlements), whereas some are ambiguous (e.g. conversion of pasture to forest in rangelands could result from woody shrub encroachment and is often considered to be a negative transition owing to its adverse impacts on livelihoods; however, it is likely to have higher NPP and higher carbon stock in vegeta-

tion and, possibly, soil). Such "false positives" point to the need for verification (see step 5). Some stakeholders may view the same transition as a positive change; in circumstances where the interpretation is somewhat subjective or trade-offs are involved, a participatory process involving local stakeholders will be required to reach a decision on how the transition will be interpreted for LDN monitoring.

5. Verify interpretation using on-ground observation or high-resolution imagery (e.g. proximal sensing with drone). It is important to distinguish between deforestation and forest harvest that is part of the forest management cycle. Similarly, changes in productivity and land cover, including fallow periods, that are associated with agricultural rotations must be distinguished from changes in productive capacity. Crowdsourcing could be used for verification of imagery; citizen science could be helpful in engaging the community in on-ground verification of aspects such as weed incursions or water quality. Some changes may result from the effects of climate change rather than the impacts of management. Simultaneous monitoring of protected areas can help identify whether a change in productivity or a loss in SOC, for example, is due to climate variability or climate change rather than management effects.

6. Consider the need for additional indicators: Have any important land degradation processes not been captured? Examples could include heavy metal contamination from mining, salinization from inefficient irrigation, surface sealing from urban expansion and densification, and loss of habitat of threatened species. Where necessary, determine appropriate indicators for monitoring these additional issues.

7. Apply the Red List, or another biodiversity indicator recognized by the Convention on Biological Diversity and relevant to national circumstances, as a safeguard in planning interventions (to avoid disturbing areas of high biodiversity value) and in monitoring outcomes.

8. Because gains are often slow to accumulate to detectable magnitude, include process-based indicators to record activity expected to deliver gains (e.g. proportion of landholders retaining crop stubble, proportion of cropped area ploughed along contour).

9. Establish plan for regular monitoring of the global and local indicators at approximately four-year intervals.

10. Establish a knowledge management platform as a repository and mechanism for the sharing and verification of monitoring data.

LDN is achieved if the area of gains at least matches the area of losses within each land type. Be aware that the "area for area" exchange may not fully compensate losses over the time frame of the target, as SOC is slow to accumulate.

## RESOURCES

*Trends.Earth* (See Module B resources): Data source for the three global indicators, designed to support national-level assessment of land degradation, and including methods to estimate (i) NPP and distinguish from climate trends, (ii) SOC based on SoilGrids 250 m data set to provide baseline SOC stock and (iii) LCC to estimate impacts of land use on stock change. Can also be used to separate the climate signal to distinguish sites that have lost productive capacity. http://trends.earth/docs/en (available in English, French, Portuguese, Spanish and Swahili).

*Collect Earth*: High-resolution imagery that could be used for verification. https://collect.earth/home

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## GLOSSARY:

**land:** The terrestrial portion of the biosphere that comprises the natural resources (soil, near-surface air, vegetation and other biota, and water), the ecological processes, the topography, and the human settlements and infrastructure that operate within that system.

**land cover:** The biophysical coverage of land (e.g. bare soil, rocks, forests, buildings, roads, lakes). Land cover is often categorized in land cover classes (e.g. deciduous forest, coniferous forest, mixed forest, grassland, bare ground), such as the classes used in the European Space Agency's Climate Change Initiative Land Cover Project.

**land cover change:** Change from one land cover class to another due to changes in land use or in natural conditions.

**land degradation:** A negative trend in land condition caused by direct or indirect human-induced processes (including anthropogenic climate change), expressed as long-term reduction or loss of at least one of the following: biological productivity, ecological integrity or value to humans.

**land degradation neutrality:** A state whereby the amount and quality of land resources necessary to support ecosystem functions and services and to enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems.

**land potential:** The inherent, long-term potential of the land to sustainably generate ecosystem services, which reflects the capacity and resilience of the land-based natural capital in the face of ongoing environmental change.

**land productivity:** The land's ability to support and sustain life. Measures of land productivity* are useful for identifying land degradation.

**land rehabilitation:** Actions undertaken with the aim of reinstating ecosystem functionality, where the emphasis is on provision of goods and services.

**land restoration:** The process of assisting the recovery of land from a degraded state, where the emphasis is on recovery of ecosystem integrity.

**LDN baseline:** Baseline values for the three global land degradation neutrality (LDN) indicators: land cover, land productivity and soil organic carbon stock.

**LDN response hierarchy:** The priority of interventions to achieve LDN: Avoid > Reduce > Reverse.

**one out, all out:** A conservative approach to combining different indicators or metrics to assess status, which follows the precautionary principle. The "one out, all out" approach is applied to LDN such that where any of the three indicators pertaining to a land unit shows significant negative change, it is considered to be degrading (and conversely, if at least one indicator shows a positive trend and none show a negative trend, it is considered a reversal of degradation).

**resilience:** The ability of a system to absorb disturbance and reorganize itself so as to retain essentially the same function, structure and feedbacks. Resilience is a neutral property, neither good nor bad.

**sustainable land management:** The stewardship and use of land resources (including soils, water, animals and plants) to meet changing human needs, while enhancing resilience, to ensure the long-term productive potential of these resources and the maintenance of their environmental functions.

* Note: The net primary productivity (NPP), defined as the energy fixed by plants minus their respiration, which translates into the rate of biomass accumulation per unit area, is a measure used to assess land productivity. Many vegetation indices – particularly the Normalized Difference Vegetation Index and the Enhanced Vegetation Index – are correlated with the quantity of live biomass and are used as a surrogate estimator of NPP in some cases.

## ABBREVIATIONS:

**FAO:** Food and Agriculture Organization of the United Nations

**GEF:** Global Environment Facility

**GFOI:** Global Forest Observations Initiative

**IPCC:** Intergovernmental Panel on Climate Change

**ITPS:** Intergovernmental Technical Panel on Soils

**LCC:** land cover change

**LDN:** land degradation neutrality

**LDN-SCF:** Scientific Conceptual Framework for Land Degradation Neutrality

**LPD:** land productivity dynamics

**NPP:** net primary productivity

**RAPTA:** Resilience, Adaptation Pathways and Transformation Assessment (Framework)

**SDG:** Sustainable Development Goal

**SOC:** soil organic carbon

**UNCCD:** United Nations Convention to Combat Desertification

**UNFCCC:** United Nations Framework Convention on Climate Change

**VGGTs:** Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests

Photo by Tim Oun on Unsplash

# APPENDIX 1

## DEVELOPING AN ENABLING ENVIRONMENT

## STEPS TO DEVELOP AND SUPPORT AN ENABLING ENVIRONMENT: NATIONAL-LEVEL PROJECTS

1. Seek and obtain national commitment to land degradation neutrality (LDN), with agreed long-term vision.

2. Establish the lead agency and a coordination mechanism between relevant institutions, including agriculture, forestry, environment, urban, and water planning and management. Engage central planning and finance ministries.[11]

3. Review existing policies and facilitate the revision and adoption of innovative approaches to achieve policy coherence across environmental regulation, planning and enforcement in support of LDN planning and implementation.

   3.1. Remove policy drivers that lead to poor land management.

   3.2. Embed LDN planning and implementation into existing policies and planning processes – including United Nations Convention to Combat Desertification national action programmes, United Nations Framework Convention on Climate Change national adaptation plans and nationally determined contributions, Bonn Challenge, New York Declaration, and Convention on Biological Diversity actions – as well as national land-use planning processes. This will promote action to achieve LDN, reduce costs and minimize duplication of effort.

4. Establish or enhance integrated land-use planning that incorporates planning related to agriculture, conservation, urban settlements, infrastructure, industry and mining. Protect valuable farmland from urban expansion. Consider land-use zoning, such as applied in Brazil.

5. Ensure policy for responsible land governance:

   5.1. Review the current tenure system, that is, the existing arrangements for the rights to use, control and transfer land, including formal and informal arrangements and subsidiary tenure rights, such as gathering rights.

   5.2. Apply the principles and standards of the *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests*.[12] Protection of customary land governance and decentralization of land governance can be effective approaches. Consider the capacity to administer a changed system. Providing individual freehold title is not always the best option. Decentralization could conflict with counterbalancing land condition across a land type; the scale and boundaries of planning, land administration and counterbalancing should coincide.

   5.3. Apply safeguards to provide security of access, especially for women, vulnerable people and communities. Ensure that an effective mechanism for free prior and informed consent is applied and that fair compensation and alternative livelihoods are provided if rights are infringed.

6. Review current policies for land conservation, sustainable land management and environmental protection. Revise to enhance effectiveness, where necessary. Consider the following policy options:

   6.1. Governance arrangements supporting local management of natural resources, with cooperation between different levels of governance.

   6.2. Regulatory frameworks, including incentives, restrictions (e.g. prohibiting land clearing in areas of high conservation value or on slopes), protected areas, and compliance assessment and enforcement.

11 Steps 1 and 2 apply if LDN planning has not already been undertaken.

12 Food and Agriculture Organization of the United Nations (2012).

6.3. Policy measures to encourage behaviour change, for example subsidies linked to sustainable land management practices or tax breaks for costs of inputs such as fencing and tree planting.

6.4. Payments for ecosystem services (e.g. markets for carbon sequestration, biodiversity protection, avoided deforestation, ecological restoration).

6.5. Schemes that require or encourage sustainability certification for land-based products (food, fibre, bioenergy).

6.6. Drought policy: Drought preparedness, seasonal forecasting, and support to destock.

6.7. Climate and land policies that amplify social resilience.

6.8. Policy to ensure accountability and transparency.

6.9. Procedures for adaptive management: Develop or apply (i) a mechanism for the timely review of implementation outcomes and (ii) a process for improvement.

6.10. Education, training and extension of (i) agricultural advisory services, especially when implemented through (i) a peer-to-peer learning environment such as the Landcare programme; (ii) farmer networks, including those specifically for women farmers; (iii) citizen science; and (iv) decision support tools for land managers (e.g. access to climate services, such as seasonal forecasts).

7. Establish (or enhance an existing) platform for multi-stakeholder engagement and a mechanism for conflict resolution. The process should foster local stakeholder engagement and collaboration between multiple stakeholders and should be sensitive to gender and imbalances in power and information access.

8. Mobilize an appropriate science-policy interface:

    8.1. Build technical capacity for preparatory assessments to support LDN implementation including socioeconomic context and status, resilience, land degradation status and land potential.

    8.2. Develop the capacity for evaluating and managing multiple benefits and trade-offs.

    8.3. Engage or establish a knowledge management platform to house and share baseline and monitoring data, as well as peripheral data that support planning (e.g. land cover, soil layers, topography).

9. Ensure enabling finance by assessing financing needs and securing financial sources. Measures that deliver multiple benefits have broader support and more readily attract funding: seek synergies with other development and environmental objectives, especially climate change adaptation and Sustainable Development Goal implementation, as well as objectives under the Bonn Challenge and the New York Declaration. Engage central planning and finance ministries, prioritize livelihood outcomes and involve the private sector (e.g. pension funds that can take a long-term view of investment).

## STEPS TO DEVELOP AND SUPPORT AN ENABLING ENVIRONMENT: SUBNATIONAL-LEVEL PROJECTS

The list above applies to national-level projects. For subnational projects, omit the steps that are not relevant, and substitute the following:

1. Identify the lead agency coordinating LDN target setting, baseline assessment and target development. Negotiate a role for project in supporting the implementation of national LDN targets.

2. Review and enhance (if necessary and appropriate) the existing planning context.

3. Follow the steps above that are applicable to the subnational context.

## RESOURCES

**Collation of policy options to support LDN:**
Verburg, P.H., *et al*. (2019). *Creating an Enabling Environment for Land Degradation Neutrality and its Potential Contribution to Enhancing Well-being, Livelihoods and the Environment:* A Report of the Science-Policy Interface. Bonn: United Nations Convention to Combat Desertification: Table 2 (Nuffield ladder of public and private governance interventions towards LDN). https://www.unccd.int/publications/creating-enabling-environment-land-degradation-neutrality-and-its-potential

**Multi-stakeholder engagement and governance:**
O'Connell, D., *et al*. (2016). *Designing Projects in a Rapidly Changing World: Guidelines for Embedding Resilience, Adaptation and Transformation into Sustainable Development Projects*, version 1.0. Washington, D.C.: Global Environment Facility: Component 2 Section 3.2 pp.43–51. http://www.stapgef.org/rapta-guidelines

**Criteria to evaluate incorporation of gender equality:**
UN-Habitat (2011). *Handling Land: Innovative Tools for Land Governance and Secure Tenure. Nairobi*. https://cepa.rmportal.net/Library/natural-resources/Handling%20Land%20-%20Innovative%20tools%20for%20land%20governance%20and%20secure%20tenure.pdf

# APPENDIX 2

## PREPARATORY ASSESSMENTS

## LAND POTENTIAL ASSESSMENT AND LAND STRATIFICATION

Land potential is the basis for classification into land types; land types are the basis for "like for like" exchange to counterbalance losses with gains.

Land potential refers to the inherent capacity of the land to sustain land use and generate ecosystem services. To reduce the risk of land degradation, land use should be consistent with land potential. Land potential has two components:

(i) the natural capital, determined by soil and site attributes, which together determine the capacity to deliver ecosystem services (*Source:* Henry, B. *et al.* (2018) Figure .1); and,

(ii) the capacity to resist and to recover from land degradation. Land potential is assessed from inherent properties, including the biophysical characteristics of the land: climate, vegetation and landscape features as well as soil properties (Table A2.1).

1. Use existing subnational land stratification based on geographic or ecosystem features, if available.

2. If no suitable stratification is available, review available data on climate, vegetation, topography, soil type and soil properties: Is there complete coverage at a resolution that would allow stratification into distinct biogeographic units?

    2.1. If not, land types could be based on biogeographic regions. Within a bioregion, a finer land stratification is desirable, based for example on soil type and topographic position, to ensure that rehabilitated or restored land is of similar (potential) "value" as land that is being degraded. So, for example, if the bioregion includes rich dark clay plains, moderate fertility slopes and shallow rocky ridges (each with different potential for agricultural production and different ecology), then counterbalancing should occur within these three land types within the bioregion.

3. Alternatively, base initial stratification on land cover, with units in areas targeted for intervention subsequently subdivided as suggested in point 2.1.

4. Ensure map of land types remains spatially consistent throughout the monitoring period (baseline, interim monitoring and final monitoring).

## RESOURCES

### Land stratification

Food and Agriculture Organization: Global Agro-Ecological Zones (GAEZ) tool http://www.fao.org/nr/gaez.

U.S. Department of Agriculture: Eight-class Land Capability Classification system (1961) that identifies limitations to sustainable production, with an emphasis on soil erosion. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

New South Wales Government (2012). The Land and Soil Capability Assessment Scheme – Second approximation. Sydney. Available at https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Land-and-soil/land-soil-capability-assessment-scheme-120394.pdf.

### Land potential

Land Potential Knowledge System (LandPKS): Uses cellular phone and cloud computing technologies to guide the user in land potential assessment based on easily observed site properties, and it provides site-specific information about long-term production and degradation risks under different management scenarios. LandPKS is being linked to GAEZ and also to *Trends.Earth.* A current project also links LandPKS to the WOCAT database and the Carbon Benefits Project tool (see appendix 3 resources), allowing land potential information to feed directly into these tools for the estimation of carbon sequestration potential and the identification of suitable sustainable land management practices. LandPKS is available at https://landpotential.org and described at http://onlinelibrary.wiley.com/doi/10.1002/ehs2.1209/epdf

## Soil properties

Global Soil Partnership: Has begun assembling information on soil properties at a global scale. It aims to develop global data sets of derived soil properties such as texture, colour, soil depth and basic soil type: http://www.fao.org/global-soil-partnership/en

Regional and continental soil information products such as the *Soil Atlas of Africa:* https://esdac.jrc.ec.europa.eu/content/soil-map-soil-atlas-africa

## BOX A2.1: ASSESSING LAND POTENTIAL

Land potential is a function of the inherent properties of the site and the more stable soil properties. It influences the capacity of the site to resist degradation and to recover once degraded. Land potential determines the uses to which the land is best suited. Land used according to its potential is less likely to be degraded. Land potential is determined from soil properties and site features (*Source:* Henry, B. *et al.* (2018) Figure 2.1, Table A2.1).

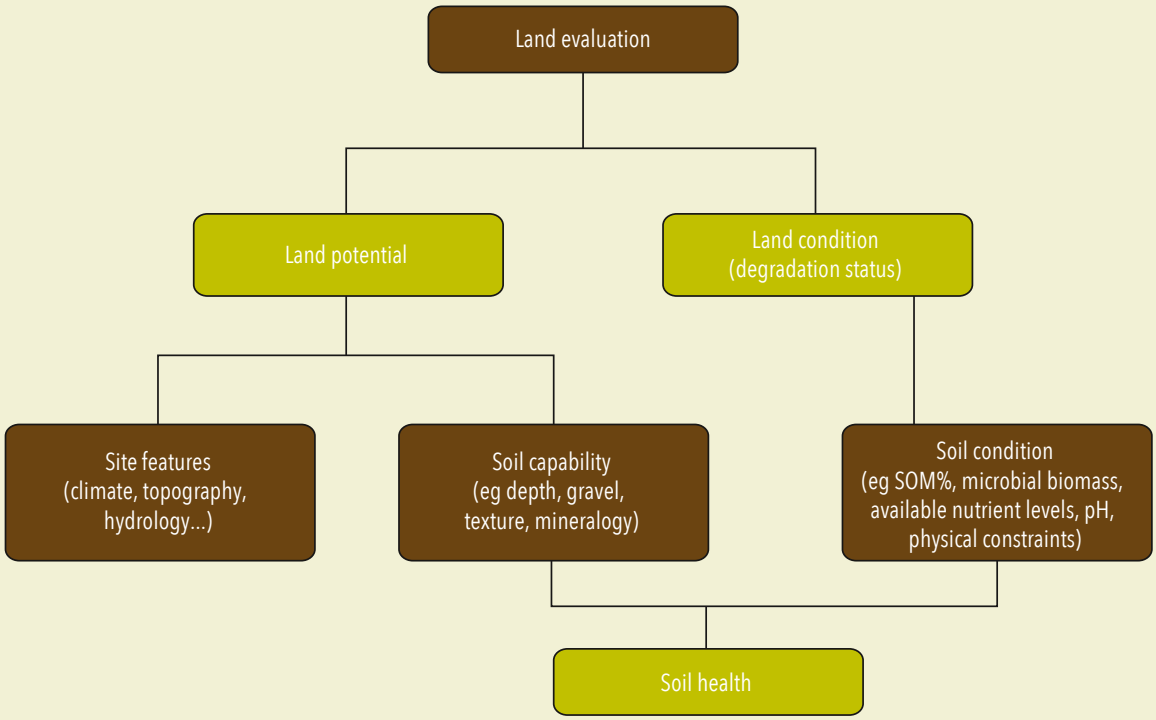



Figure A2.1: Relationship between land potential and soil health, and the factors that determine these key aspects. SOM = soil organic matter. *Source:* Henry, B. *et al.* (2018)

Table A2.1
Inherent site and soil properties that determine land potential

| Horizon properties | Profile properties | Site properties |
|---|---|---|
| **Soil physical properties**<br>• Matrix colour<br>• Soil texture<br>• Content of sand, silt and clay<br>• Clay mineralogy/types<br>• Natural bulk densitya<br>• Porosity<br>• Self-mulching characteristics<br>• Aggregate stability<br>• Friability of the surface soil<br>• Soil strength and structure of subsoil<br>• Saturated hydraulic conductivity<br>• Rock fragment content/stoniness<br>• Moisture content at permanent wilting point, -1500 kPa (-15 bar)<br>• Moisture content at field capacity, 33 kPa (-0.33 bar)<br>• Infiltration rate<br><br>**Engineering properties**<br>• Particle size distribution (texture)<br>• Unified soil classification<br>• AASHTO class<br>• Plastic and liquid limits<br>• Swelling potential<br>• Linear shrinkage<br><br>**Soil chemical properties**<br>• Natural soil pH[a]<br>• Natural nutrient levels[a]<br>• Buffering against acidification<br>• Cation exchange capacity<br>• Exchangeable cations<br>• Exchangeable sodium percentage<br>• Base saturation<br>• Natural organic carbon contenta<br>• P buffer capacity<br>• Toxicities (e.g. Exchangeable Aluminium, heavy metals)<br>• Electrical conductivity (salinity)<br>• Alkalinity | • Classification: (WRB – IUSS 2015; Soil Taxonomy – Soil Survey Staff 1999)<br>• Horizon depth<br>• Depth to water table<br>• Depth to bedrock – soil depth<br>• Depth to a restrictive layer<br>• Plant available water capacity<br>• Profile drainage<br>• Salinity profile<br>• Incidence of waterlogging<br>• Presence of acid sulfate minerals | **Climate**<br>• Rainfall – amount, distribution, intensity, erosivity<br>• Drought frequency – duration<br>• Temperature – distribution, average annual temperature, extremes, frosts<br>• Evaporation – annual, timing of high evaporative demands<br>• Wind – velocity, timing in relation to ground cover and growth stages of crops<br><br>**Vegetation**<br>• Native vegetation<br>• Extent of clearing<br><br>**Geomorphology**<br>• Parent material<br>• Slope (gradient, shape, length, aspect)<br>• Landform element<br>• Surface stones<br>• Rock outcrop<br>• Elevation<br><br>**Hydrology**<br>• Concentration of flows, flow regimes<br>• Flood hazards<br>• Drainage – waterlogging<br><br>**Other**<br>• Day length<br>• Land-use history<br>• Erosion risk |

*Source:* Henry, B. *et al.*(2018).
*Note:* Key indicators are underlined.
*Abbreviation:* AASHTO, American Association of State Highway and Transportation Officials.
[a] Properties that can be influenced by management.

## LAND DEGRADATION STATUS

Knowledge of the condition of each land parcel, with respect to its state of degradation, is needed to inform land degradation neutrality (LDN) planning, particularly decisions on location and type of interventions. This assessment can be based on national or global data sources relevant to land degradation. Ideally, determining land degradation status would involve the same data sets that will be used to monitor LDN and analysed to assess land condition, for example a trend analysis of the United Nations Convention to Combat Desertification (UNCCD) land-based global indicators and their associated metrics (see Module E). Analysis of trends in each of the indicators can help identify degradation "hotspots" (where land condition is good but deteriorating) in support of efforts to select and prioritize interventions to arrest degradation at the highest priority locations. Information about land condition can inform decisions on actions to avoid or reduce land degradation. Also, the initial land degradation status is necessary for calculating Sustainable Development Goal (SDG) indicator 15.3.1 (proportion of land that is degraded over total land area).

1. Determine status: degraded or undegraded. There are no specified criteria for the evaluation, but it may be based on trends in the indicators, adjusted for the impacts of climate variability.

2. Classify each land unit into the categories of Table A2.2 (optional).

3. For SDG 15.3.1: Determine the percentage of land degraded, per land type, in the baseline year.

Table A2.2
Classes of land productivity dynamics

| Productivity trend class | Description |
|---|---|
| 1 | Declining productivity |
| 2 | Early signs of decline |
| 3 | Stable, but stressed |
| 4 | Stable, not stressed |
| 5 | Increasing productivity |

*Source:* Adapted from UNCCD (2017). Methodological note to set national voluntary land degradation neutrality (LDN) targets using the UNCCD indicator framework. Bonn.

## RESOURCES

*Trends.Earth* (see Module B resources): Trends in land degradation indicators can indicate degradation (see Module E for note about interpretation).

Sims, N., *et al.* (2017). *Good Practice Guidance: SDG Indicator 15.3.1 – Proportion of Land That Is Degraded over Total Land Area*. Bonn: United Nations Convention to Combat Desertification. https://www.unccd.int/sites/default/files/relevant-links/2017-10/Good%20Practice%20Guidance_SDG%20Indicator%2015.3.1_Version%201.0.pdf

## RESILIENCE ASSESSMENT

Resilience refers to the capacity of the system to cope with a hazardous event, trend or disturbance by responding in ways that maintain the system's essential function, identity and structure. A resilient system can avoid shifting to an undesirable state and can adapt or transform to a new desirable state when necessary. Resilience influences susceptibility to land degradation. The resilience of intervention options should be assessed to ensure that they are viable under anticipated shocks and trends, especially climate change.

LDN interventions may be devised to enhance the resilience of the current system or to assist transformation. If the system is generally in a desirable state,

enhancing resilience is an appropriate goal. However, if a system is close to adaptation limits or in a poor biophysical or socioeconomic state, such as if land degradation is widespread or poverty is prevalent, then facilitating transformative change should be the target.

1. Recall Module A, step 1, which identified the key system variables and their relationships, and Module A, step 2, which identified the current land degradation processes and their drivers.

2. Research the hazards that may impact the system in the future, especially (i) climate change projections, including trends (e.g. rising average temperature and sea level) and extreme events (increased frequency and severity of drought or hurricanes); (ii) socioeconomic factors, such as market trends (e.g. changing demand for red meat); and (iii) climate change policies. Consider the impacts of these shocks and trends on the system. The performance of similar systems operating in a location whose present climate is similar to the projected climate (climate analogues) could be informative. The risk of land degradation will very likely increase as a result of climate change: drought will leave land exposed and vulnerable to wind erosion, high-intensity storms will cause water erosion, sea level rise will cause saltwater intrusion, and hurricanes will cause coastal erosion.

3. Identify thresholds (tipping points) beyond which the system would transition to a less desirable state (e.g. when overgrazing leads to shifts from perennial to less productive pasture species).

4. Assess resilience: Determine the proximity to the identified thresholds and the probability of exceedance.


Photo by Simon Fanger on Unsplash

## BOX A2.2: ASSESSING RESILIENCE AND THE NEED FOR TRANSFORMATION (CONT.)

Example 1. Climate projections suggest that future rainfall will be insufficient to support the current dryland cropping regime. Crop failures will be increasingly likely, and product quality will decline in high temperatures. Options for incremental change could include sustainable land management practices, such as stubble retention, mulching and biochar application, to enhance infiltration and water retention; water harvesting methods (e.g. Zai pits, retention banks and trenches); introduction of livestock to mixed cropping and grazing; delayed fertilizer application; and planting of short season cultivars. Alternatively, transformative change could include the establishment of an irrigation scheme. However, this could increase the risk of soil salinization and be vulnerable if reliant on groundwater.

Example 2. Current land use is extensive grazing in a region suffering wind erosion due to loss of ground cover. Climate projections suggest increasing incidence of drought, which will reduce available feed, exacerbating degradation and reducing profitability. Transformation could involve destocking to encourage the regeneration of native vegetation and wildlife, with new livelihoods based on nature tourism and payments for ecosystem services.

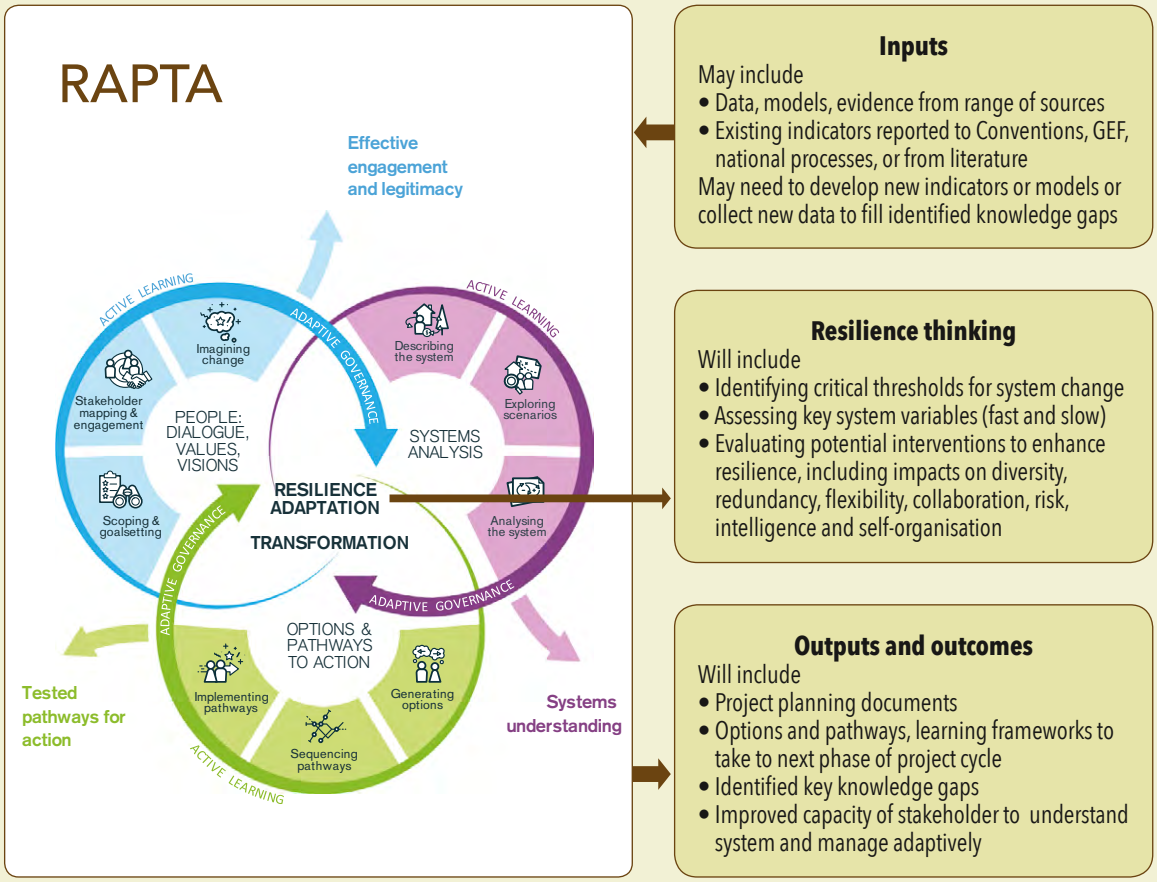



Figure A2.2: The Resilience, Adaptation Pathways and Transformation Assessment (RAPTA) Framework. GEF = Global Environment Facility. *Source:* O'Connell, D. *et al.* (2016) and O'Connell, D. *et al.* (2019).

## RESOURCES

O'Connell, D., *et al*. (2016). *Designing Projects in a Rapidly Changing World: Guidelines for Embedding Resilience, Adaptation and Transformation into Sustainable Development Projects*, version 1.0. Washington, D.C.: Global Environment Facility: Practical guidance on resilience assessment, with a particular focus on land degradation and food security in the drylands. http://www.stapgef.org/rapta-guidelines

O'Connell, D., *et al*. (2019). *The Resilience, Adaptation Pathways and Transformation Approach (RAPTA): A guide to designing, implementing and assessing interventions for sustainable futures* Version 2.0 https://research.csiro.au/eap/rapta/

*Wayfinder – A Resilience Guide for Navigating Towards Sustainable Futures:* Comprehensive practical guide including activities and video clips to support resilience assessment and development of transformative strategies. www.wayfinder.earth

*Standard: ISO 14090: Adaptation to Climate Change: Principles, Requirements and Guidelines. Annex B, Threshold analysis:* https://www.iso.org/obp/ui#iso:std:iso:14090:ed-1:v1:en

# APPENDIX 3

## PLANNING INTERVENTIONS

This component involves landscape-scale planning to identify sites where "reducing" and "reversing" interventions should take place as well as suitable practices to apply at the sites selected. It uses information from preliminary studies to identify degraded land that will respond to restoration or rehabilitation most cost-effectively. It uses land potential to determine the sustainability of current land use and the need for sustainable land management (SLM) interventions. It uses resilience assessment to determine the need for transformative change.

## STEPS FOR PLANNING INTERVENTIONS

1. Plan land degradation neutrality (LDN) interventions according to the response hierarchy of Avoid > Reduce > Reverse land degradation, in which Avoid has highest priority. The plan should include a combination of actions designed to achieve no net loss across the landscape within each land type.

2. Take the result from Module C that estimated the likely loss of land due to degradation for each land type; this determines the area that must be restored or rehabilitated to achieve neutrality.

3. Apply integrated land-use planning, which seeks to balance economic, social, cultural and environmental objectives, to achieve a mosaic of land uses across the landscape such that land is used for the purposes to which it is best suited. Utilize the land potential information (appendix 2 and box A2.1) to determine suitability to various uses – cropping, intensive and extensive grazing, forestry, mining, conservation, recreation, urban, industry, infrastructure – and use planning instruments relevant to the specific context to ensure or encourage specific land uses in specific locations.

4. Engage stakeholders. Competing interests and divergent stakeholder perspectives must be managed. Coordination across multiple levels of government may be required. Local stakeholders should decide on priorities if trade-offs are necessary. Engage all landholders, from large-scale commercial enterprises operated by agribusiness companies to smallholders and subsistence farmers, in LDN planning. Indigenous peoples and other communities with customary tenure systems, transhumant pastoralists, and others who could be affected should be included. Farmer cooperatives could be a vehicle to involve smallholders. Partnerships with industry, including vertically integrated globalized supply chains and companies involved in large-scale land acquisitions, are a potential opportunity to influence the management of large land areas to facilitate scaling up. Ensure the host government has adequate regulatory power and monitoring capacity to minimize the risk of adverse environmental and social impacts.

5. Use a wide evidence base to inform decisions on land use and land management, such as land potential; land condition; resilience; social; cultural; and, economic factors (including consideration of gender), validated at the local level. Involve stakeholders, especially land users, in designing, implementing and monitoring interventions to achieve LDN. Enable civil society organizations and small and medium enterprises to take a leading role in the design and implementation of LDN activities. Consider local, traditional and scientific knowledge, applying a mechanism such as multi-stakeholder platforms to ensure these inputs are included in the decision-making process. Seek technical advice from local experts.

6. Where relevant, apply a mix of "land sparing" and "land sharing" approaches across the landscape. Land sparing involves the application of sustainable intensification to enhance production on some sites while protecting other areas for conservation. Land sharing involves low-intensity farming practices that maintain a high level of ecosystem functions, such as low-intensity grazing on native vegetation.

7. Consider the need for transformation: Use insights from the resilience assessment (appendix 2) to determine the need for adaptation of the existing system or transformation to a different system. Transformation at one level may facilitate resilience at another. For exam-

ple, if the water supply for an irrigation scheme is expected to decline due to climate change, the conversion of some properties to dryland cropping or grazing may enable irrigated farming to continue on others, thus maintaining the capacity of the region to supply fresh food.

8. Encourage SLM to avoid or reduce land degradation:

    8.1. Ensure that land use and management align with the capability of the land to minimize the risk of land degradation.

    8.2. Identify SLM practices that address the identified land degradation processes affecting the area and that are economically and socially feasible (*Source:* Adapted from Henry, B., *et al.* (2018).

    8.3. Focus on landscape-scale assessment and management, applying whole-system understanding and agroecology practices, which encourage integrated pest management and integrated nutrient management, to minimize negative environmental impacts (Figure A3.2, Table A3.1). Recommended SLM practices may be a complete farming system (e.g. regenerative agriculture, permaculture, organic agriculture, Climate-Smart Village[13]) or a narrower set of practices to address a particular constraint, such as heavy metal contamination. Some practices may be unsuitable because of social factors, such as the availability of labour or cultural sensitivities (e.g. the use of biosolids for fertilizer).

    8.4. Devise recommendations of suitable SLM practices for specific contexts (land uses, land types) across the project area.

9. Protect undegraded areas that are vulnerable to loss. Note that this does not deliver a gain to counterbalance a loss elsewhere, but it is an important part of an LDN strategy to minimize areas of loss.

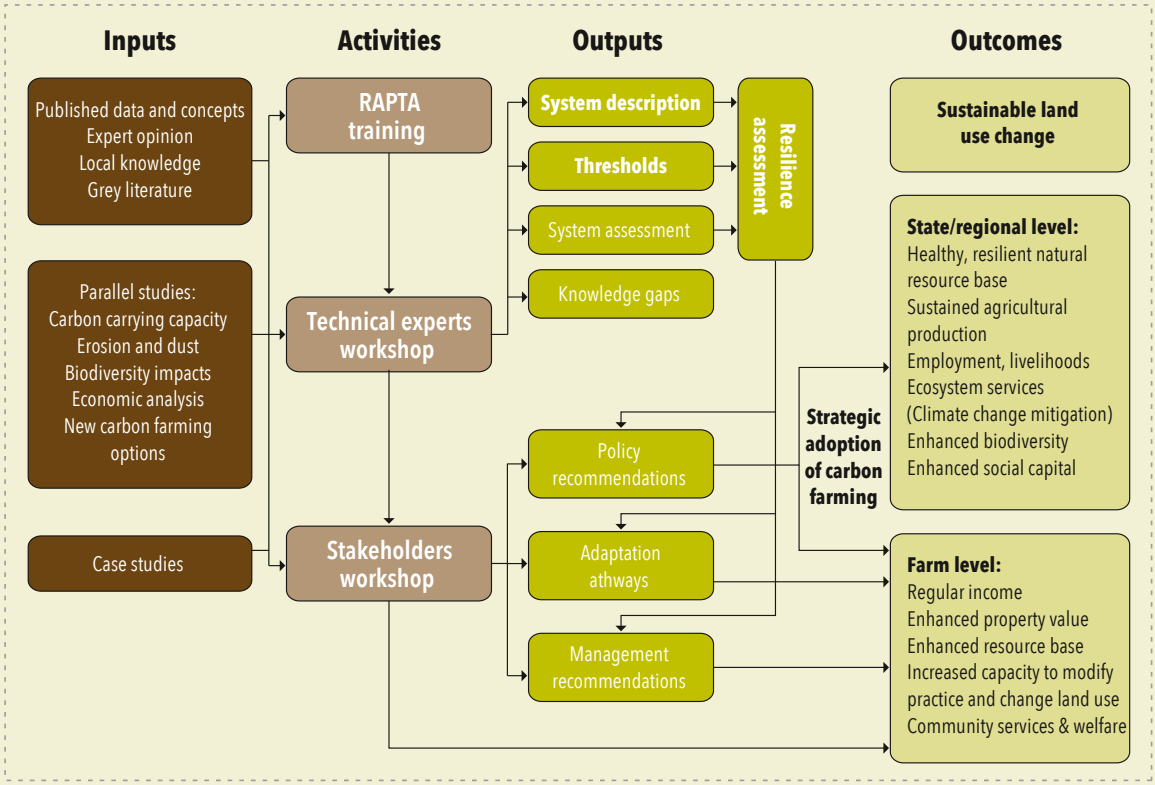
10. Undertake land restoration and rehabilitation to reverse land degradation: Restoration refers to actions undertaken with the aim of reinstating ecosystem functionality; rehabilitation refers to actions undertaken with a goal of providing goods and services. Restoration may involve actions such as destocking to encourage regeneration of native vegetation; establishing shelter belts of local species from seed or seedlings, strategically located to provide wildlife corridors and link habitat; or rewetting drained peatland. "Farmer-managed natural regeneration" is a low-cost approach in which regeneration of tree stumps and roots is encouraged, stabilizing soil and enhancing soil fertility and organic matter. Rehabilitation could include the establishment of energy crops or afforestation with fast-growing exotic trees to sequester carbon or produce timber. The application of biochar can facilitate rehabilitation by enhancing nutrient retention and water-holding capacity and stimulating microbial activity. The type of biochar should be selected to suit the identified soil constraints, and its effectiveness can be enhanced through incubation with organic fertilizers.

11. Use soil organic carbon (SOC) estimation tools and models to predict the impact of SLM practices and rehabilitation or restoration on SOC. Tools are available (see the Carbon Benefits Project and EX-ACT in the resources section) that can be used to estimate potential change in SOC in response to changes in land use or land management. This information can aid in identifying practices that will deliver the gains in SOC required to achieve LDN.

13 Aggarwal, P.K., *et al.* (2013).

## BOX A3.1: USING THEORY OF CHANGE IN PLANNING LDN INTERVENTIONS

Figure illustrates the "theory of change", developed for a study assessing the impacts of carbon farming practices in western New South Wales. The study aimed to determine whether carbon farming projects encouraging native vegetation are likely to enhance the resilience of the rangeland. The Resilience, Adaptation Pathways and Transformation Assessment (RAPTA) Framework was used to assess the resilience of the current grazing system and the system integrating carbon farming. RAPTA facilitated a holistic assessment of the social, biophysical and economic impacts of the carbon farming in western New South Wales and improved understanding of the opportunities, trade-offs, synergies and risks. Details of the method and results are provided in Cowie *et al*. (2019).




*Source:* Cowie, A.L., *et al.* (2019)

Figure A3.2 illustrates the steps involved in selecting effective SLM options based on the context, and Table A3.1 provides examples of SLM practices that address specific soil constraints.

## BOX A3.2: CHOOSING SUITABLE SLM PRACTICES

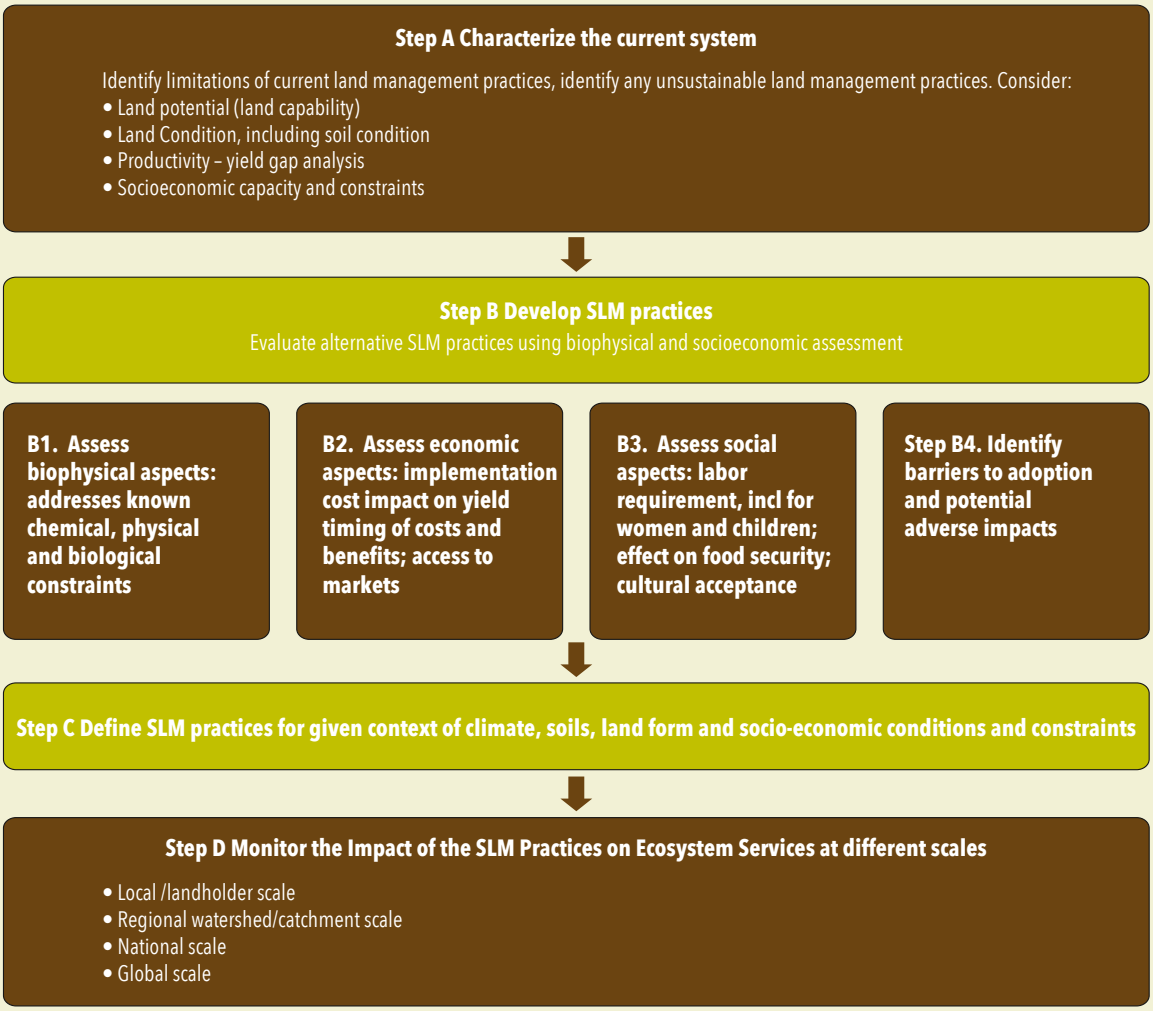



Figure A3.2: Framework for selecting sustainable land management (SLM) practices.

*Source:* Adapted from Henry, B., *et al.* (2018).

Table A3.1

Sustainable land management practices to address land degradation processes

| Land degradation process | Sustainable land management responses (examples) |
|---|---|
| Nutrient decline | Replace nutrients removed through harvest; apply integrated soil fertility management (judicious use of chemical fertilizer with locally available organic fertilizers); plant legume crops in rotation and leguminous trees in agroforestry; encourage soil biological activity to increase nutrient cycling; apply biochar to enhance retention of nutrients and efficiency of fertilizer use. |
| Deforestation | Develop and enforce forest protection policy; apply sustainable intensification on existing agricultural land to reduce pressure on forest. |
| Soil organic matter decline | Maintain ground cover; retain stubble; grow perennial plants; correct nutrient deficiencies to increase plant growth and therefore biomass inputs; maintain nutrient levels; apply organic amendments; reduce soil disturbance. |
| Water erosion | Maintain ground cover particularly on erodible soils; implement contour planting; avoid cultivating steep slopes; undertake structural works (e.g. contour banks, keyline system). |
| Wind erosion | Manage stocking rates to match available feed; use effective drought management strategies; maintain ground cover in cropland with mulches and cover crops; modify micro-environment with windbreaks. |
| Soil acidification | Apply lime or biochar; minimize loss of bases and nitrate leaching; avoid drainage of acid sulfate soils. |
| Salinization | Use drip irrigation and line channels; avoid use of low-quality irrigation water that could increase salinity and soil sodicity. |
| Soil contamination | Apply lime or add biochar to reduce availability of heavy metals; plant accumulator species such as willows to remove toxic elements. |

*Source:* Adapted from Henry, B., *et al.* (2018).

## RESOURCES

### Integrated land-use planning: Tools that assist in balancing multiple objectives and identifying co-benefits and trade-offs

*Restoration Opportunities Assessment Methodology (ROAM):* IUCN and WRI (2014). A guide to the Restoration Opportunities Assessment Methodology (ROAM): Assessing forest landscape restoration opportunities at the national or sub-national level. Working Paper (Road-test edition). Gland, Switzerland: IUCN. 125pp
https://www.iucn.org/theme/forests/our-work/forest-landscape-restoration/restoration-opportunities-assessment-methodology-roam

Land-Use Trade-Offs (LUTO) model: See, for example: Bryan, B.A., *et al.* (2016). *Land-use and sustainability under intersecting global change and domestic policy scenarios: Trajectories for Australia to 2050.* Global Environmental Change, vol. 38, pp. 130–152. https://www.sciencedirect.com/science/article/pii/S0959378016300231

### Choosing SLM practices to address local land degradation issues and context

WOCAT (World Overview of Conservation Approaches and Technologies) – Global database on SLM: https://www.wocat.net/en/global-slm-database

DESIRE-DSS: See, for example: Schwilch, G., F. Bachmann and J. de Graaff (2012). *Decision support for selecting SLM technologies with stakeholders.* Applied Geography, vol. 34, pp. 86–99. https://www.sciencedirect.com/science/article/abs/pii/S0143622811002074

Schwilch, G., *et al.* (2012). *A structured multi-stakeholder learning process for sustainable land management.* Journal of Environmental Management, vol. 107, pp. 52–63.
https://www.sciencedirect.com/science/article/pii/S0301479712002125

GeOC tool – Provides a means to evaluate the biophysical and socioeconomic context for spatial targeting and scaling up of SLM options: Le, Q.B., R. Thomas and E. Bonaiuti (2017). *Global Geo-Informatics Options by Context (GeOC) Tool for Supporting Better Targeting and Scaling-Out of Sustainable Land Management: Designing the System and Use Cases.* Amman: International Center for Agricultural Research in the Dry Areas. https://wle.cgiar.org/global-geo-informatics-options-context-geoc-tool-supporting-better-targeting-and-scaling-out

Standard: ISO 14055-1:2017 Environmental Management – Guidelines for Establishing Good Practices for Combatting Land Degradation and Desertification – Part 1: Good Practices Framework. https://www.iso.org/standard/64646.html

World Bank (2008) Sustainable land management sourcebook. Agriculture and rural development. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/495041468338511373/Sustainable-land-management-sourcebook

### Estimating potential soil carbon response to SLM

Carbon Benefits Project (CBP) tool: CBP offers web-based tools, including a simple and a detailed version. The simple tool is suitable for ex ante estimates; the detailed assessment tool is applicable for project reporting where moderate to high certainty is required.
http://www.carbonbenefitsproject.org

Ex-Ante Carbon Balance (EX-ACT) tool: Spreadsheet-based tool suitable for ex ante estimates of SOC change. Available in Arabic, Bahasa Indonesia, Chinese, French, German, Portuguese, Russian and Spanish.
http://www.fao.org/tc/exact/ex-act-home/en

# REFERENCES


Aggarwal, P.K., R.B. Zougmoré and J. Kinyangi (2013). *Climate-Smart Villages: A Community Approach to Sustainable Agricultural Development*. Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security. https://cgspace.cgiar.org/handle/10568/33322

Bryan, B.A., *et al*. (2016). Land-use and sustainability under intersecting global change and domestic policy scenarios: Trajectories for Australia to 2050. Global Environmental Change, vol. 38, pp. 130–152 https://www.sciencedirect.com/science/article/pii/S0959378016300231

Carbon Benefits Project (CBP) tool: http://www.carbonbenefitsproject.org

Cowie, A.L., *et al*. (2019). Assessing resilience to underpin implementation of land degradation neutrality: A case study in the rangelands of western New South Wales, Australia. Environmental Science and Policy, vol. 100, pp. 37–46. https://www.sciencedirect.com/science/article/abs/pii/S1462901118314023

Ex-Ante Carbon Balance (EX-ACT) tool: http://www.fao.org/tc/exact/ex-act-home/en

Food and Agriculture Organization (2012). Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security. Rome. http://www.fao.org/3/i2801e/i2801e.pdf

Food and Agriculture Organization: Global Agro-Ecological Zones (GAEZ) tool: http://www.fao.org/nr/gaez

Global Soil Partnership: http://www.fao.org/global-soil-partnership/en/

Henry, B., B. Murphy and A. Cowie (2018). *Sustainable Land Management for Environmental Benefits and Food Security*. Washington, D.C.: Global Environment Facility. http://www.stapgef.org/sustainable-land-management-environmental-benefits-and-food-security-synthesis-report-gef

IUCN and WRI (2014). A guide to the Restoration Opportunities Assessment Methodology (ROAM): Assessing forest landscape restoration opportunities at the national or sub-national level. Working Paper (Road-test edition). Gland, Switzerland: IUCN. 125pp https://www.iucn.org/theme/forests/our-work/forest-landscape-restoration/restoration-opportunities-assessment-methodology-roam

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*Source:* Adapted from Henry, B., B. Murphy and A. Cowie (2018). *Sustainable Land Management for Environmental Benefits and Food Security*. Washington, D.C.: Global Environment Facility. http://www.stapgef.org/sustainable-land-management-environmental-benefits-and-food-security-synthesis-report-gef

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