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GUIDELINES FOR THE APPLICATION OF THE "SCIENTIFIC CONCEPTUAL FRAMEWORK FOR LAND DEGRADATION NEUTRALITY"

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

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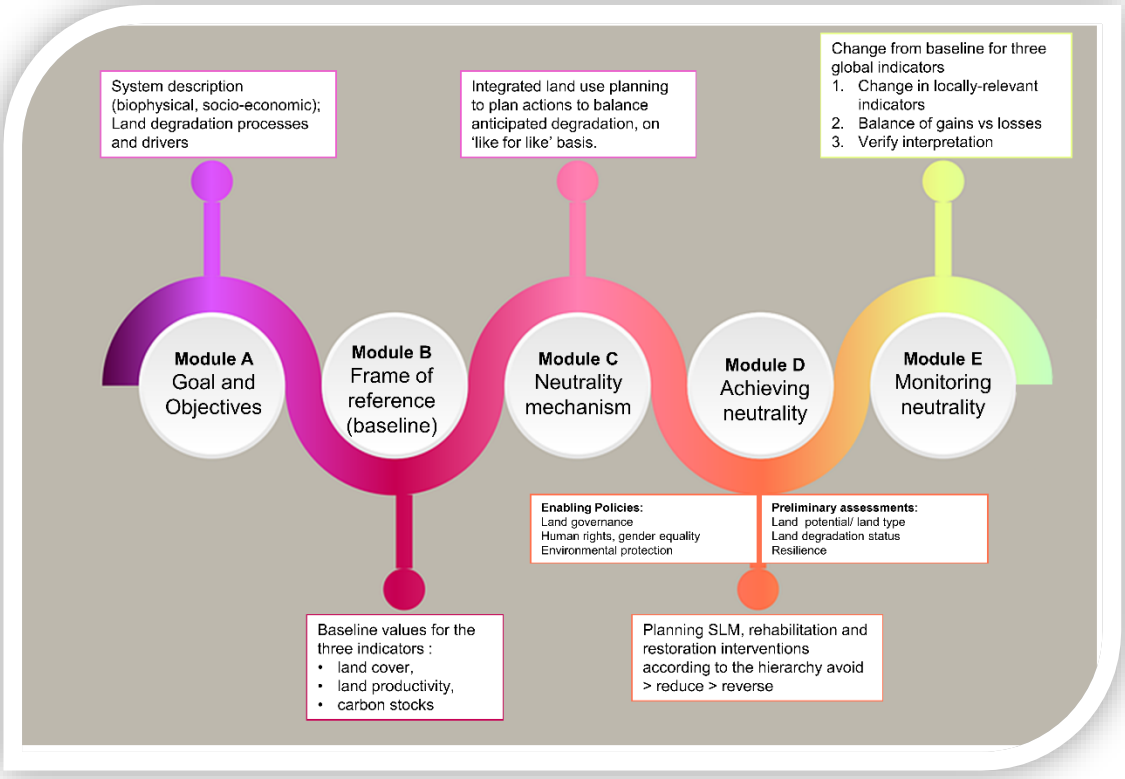

Author: Dr Annette Cowie, NSW Department of Primary Industries/ University of New England, Australia.

Reviewers:

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Ulrich Apel (GEF Secretariat), Simeon Hengari (Windhoek Research and Data Analysis Consultants), Sandrine Jauffret (Global Mechanism of the UNCCD), Juan Carlos Mendoza (Global Mechanism of the UNCCD), Graciela Metternicht (STAP), Barron Orr (UNCCD Secretariat), Asha Imani Bobb Semple (GEF Secretariat), Jean-Marc Sinnassamy (GEF Secretariat), and Mark Stafford Smith (STAP).

The draft guidelines were presented at a side event led by the Scientific and Technical Advisory Panel of the Global Environment Facility (STAP/GEF) at the Fourteenth Conference of the Parties to the United Nations Convention to Combat Desertification (UNCCD) in Delhi, India, September 2019. Stakeholders provided input on the applicability of the guidelines for developing 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 UNCCD CoP 14.

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EXECUTIVE SUMMARY

1. 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.

2. Through its 7th replenishment, the 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 UNCCD at its 13th COP. As such, LDN interventions can be included in projects within the portfolio of the land degradation focal area, as well as in projects articulated within Impact Programs.

3. 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 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, at the problem definition and intervention design stages, and are also relevant to monitoring achievement of LDN goals.

4. 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 monitoring the achievement of LDN (module E).

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

6. Achieving LDN requires concerted and coordinated efforts, integrating LDN objectives in 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, application of integrated land use planning, informed by preparatory assessments, as described in the LDN-SCF.

Introduction: background to LDN and purpose of guidelines

7. Recognising that previous approaches have had limited success in addressing land degradation, the UNCCD introduced the concept of Land Degradation Neutrality (LDN), which has now also been adopted as a target of Goal 15 of the SDGs, Life on Land [1]. The objectives of LDN are to:

- maintain or improve the sustainable delivery of ecosystem services
- maintain or improve productivity, in order to enhance food security
- increase resilience of the land and populations dependent on the land
- seek synergies with other social, economic and environmental objectives, and
- reinforce responsible and inclusive governance of land.

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

9. Through GEF-7, the 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 program, 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 programs should be compatible with LDN, if not targeting it explicitly.

Purpose of the guidelines

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

11. LDN will only be achieved through concerted and coordinated effort, integrating 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 through establishing enabling policies, application of integrated land use planning, informed by

[1] LDN was recognized by the UNCCD at twelfth session of the Conference of the Parties (COP 12), 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 (decision 3/COP.12, UNCCD, 2015a).

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

[3] Checklist developed by the Global Mechanism with input resulting from a scientific review by the UNCCD's SPI with supporting from the GEF Secretariat https://knowledge.unccd.int/knowledge-products-and-pillars/checklist-land-degradation-neutrality-transformative-projects-and

preparatory assessments, as described in the scientific conceptual framework for LDN (LDN-SCF, see below). Furthermore, a review[4] of experience in setting LDN targets and implementing LDN identified gaps in capacity with respect to applying the neutrality mechanism and integrate land use planning; assessing resilience; and socio-economic aspects of land governance; assessing multiple benefits; and managing trade-offs. 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, then practical steps for implementation and finally a list of resources (tools and data sources) that could be helpful. For Module D, additional details of the sub-components on Enabling environment, Preparatory assessment and Planning interventions are provided in Appendices 1-3.

National Target-setting for LDN

12. The UNCCD's Global Mechanism is supporting countries, through the LDN target-setting programme (LDN-TSP), to undertake 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 (NAPs). Furthermore, to achieve maximum synergy from land-based interventions, countries have also been encouraged to integrate LDN planning into their UNFCCC Nationally Determined Contributions (NDCs), National Biodiversity Strategies and Action Plans (NBSAPs) and plans for SDG implementation.

Project-based interventions to attain LDN

13. LDN is intended to be achieved at national level, and over 120 countries have already undertaken LDN target-setting. Therefore, an LDN project, if undertaken at sub-national 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 underway. LDN can also be assessed at sub-national 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 are expressed assuming 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.

[4] Verburg, P.H., Metternicht, G., Allen, C., Debonne, N., Akhtar-Schuster, M., Inacio da Cunha, M., Karim, Z., Pilon, A., Raja, O., Sanchez-Santivañez, M., and Senyaz, A. 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. United Nations Convention to Combat Desertification (UNCCD), Bonn, Germany. To be presented at COP 14, New Delhi, September 2019.

Facilitating transformation

14. 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

15. 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, Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests (VGGTs) and safeguards such as the IFC Performance Standards should be followed to reduce the risk that pursuit of LDN could have unintended consequences associated with land tenure insecurity, land appropriation and land conflict. Further information is available from "Guide for the Development of LDN Transformative Projects and Programmes. Operational guidance for country support" (GM/UNCCD, 2019)

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

(a) Land governance: ensure that access to land, and livelihoods, of vulnerable people are protected, and that free, prior and informed consent is obtained, and just compensation provided, where land access is infringed.

(b) Gender: ensure that stakeholder engagement processes are gender-sensitive, and that impact on women is considered in devising LDN interventions.

(c) Ecosystem protection:

- ensure that effective land use planning and implementation instruments are in place to enable "like for like" counterbalancing of gains and losses; and that
- LDN interventions do not threaten Red List species or high conservation value ecosystems, or facilitate the introduction or spread of invasive species.

Overview of the Scientific Framework for Land Degradation Neutrality LDN-SCF

17. The scientific conceptual framework for LDN (LDN-SCF)[5], developed by the UNCCD's Science Policy Interface, presents the scientific basis for planning, implementing and monitoring LDN.

18. 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
- Policy brief: 6-page summary in English, French and Spanish: UNCCD (2016) https://www.unccd.int/sites/default/files/documents/18102016_Spi_pb_multipage_ENG_1.pdf
- Guide to the scientific conceptual framework for land degradation neutrality

  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.

19. The fundamental aim of LDN is to preserve the land resource base, by ensuring no net loss of healthy and productive land, at 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 Figure 1.

[5] Orr et al., 2017 Full report; Cowie, A.L., Orr, B.J., Sanchez, V.M.C., Chasek, P., Crossman, N.D., Erlewein, A., Louwagie, G., Maron, M., Metternicht, G.I., Minelli, S. and Tengberg, A.E., 2018. Land in balance: The scientific conceptual framework for Land Degradation Neutrality. Environmental Science & Policy, 79, pp.25-35.

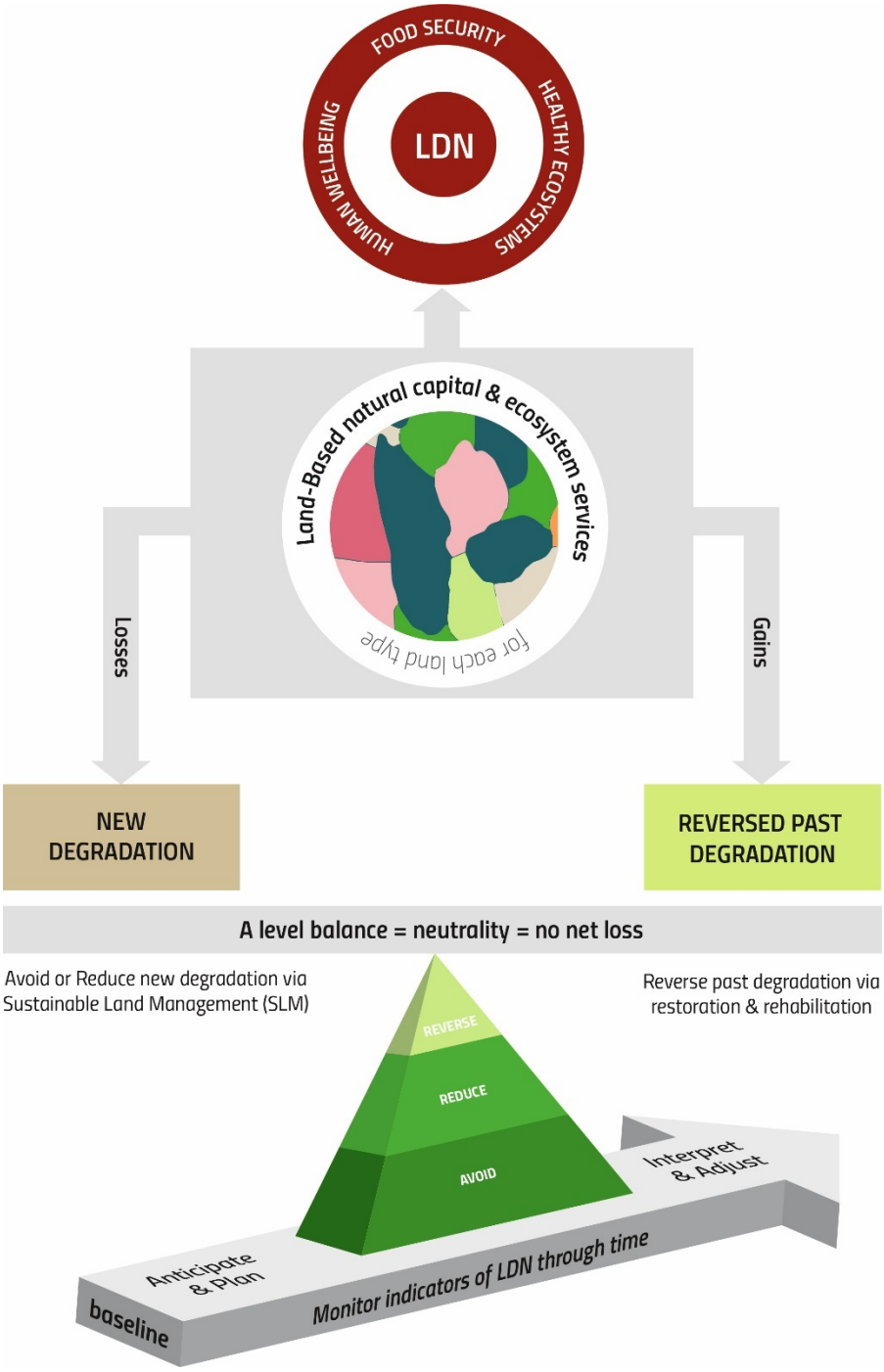


Figure 1 The overarching concept of LDN, the key elements of the LDN-SCF, and their interrelationships. Source: Orr et al., 2017

20. The LDN-SCF consists of five modules (Figure 2):

- Module A, the Vision of LDN, articulates the aspirational goal of LDN;
- Module B, the Frame of Reference, explains the LDN baseline against which achievement is measured;

- Module C, the Mechanism for Neutrality, describes the counterbalancing concept;
- Module D, Achieving Neutrality, that describes the pathway for implementing LDN, and the elements required including preparatory analyses and enabling policies; and
- Module E, Monitoring Neutrality, which presents the indicators for assessing achievement of LDN.

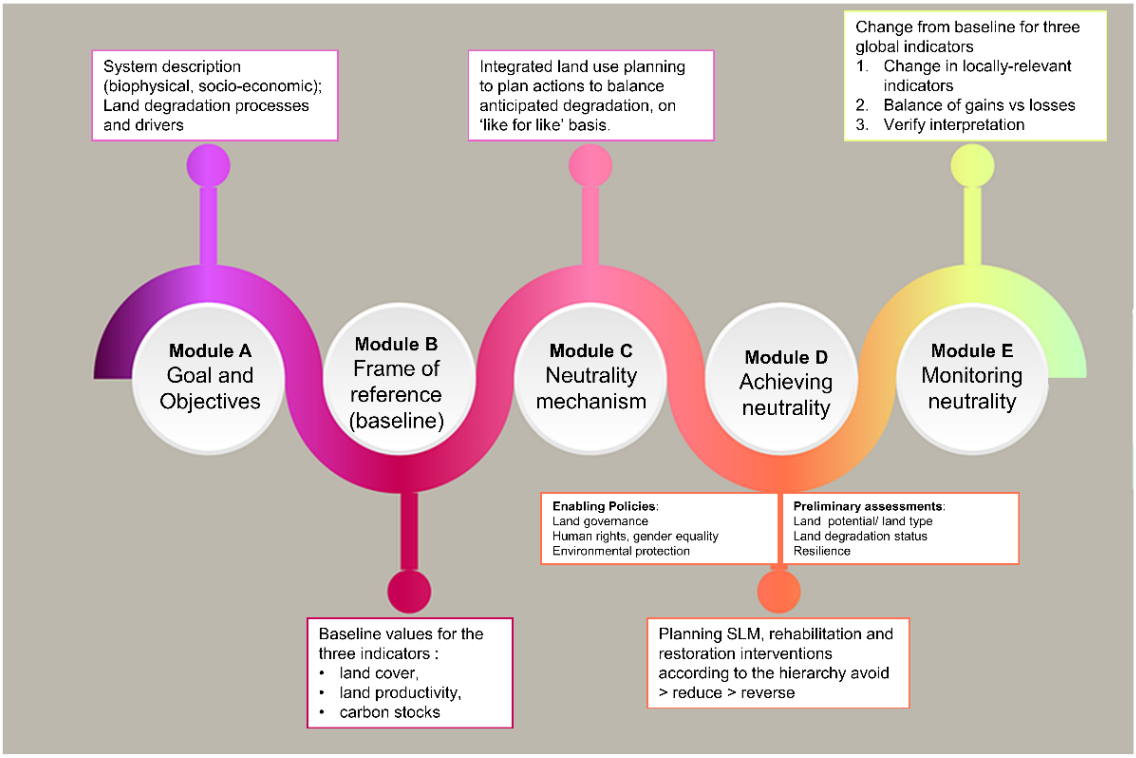
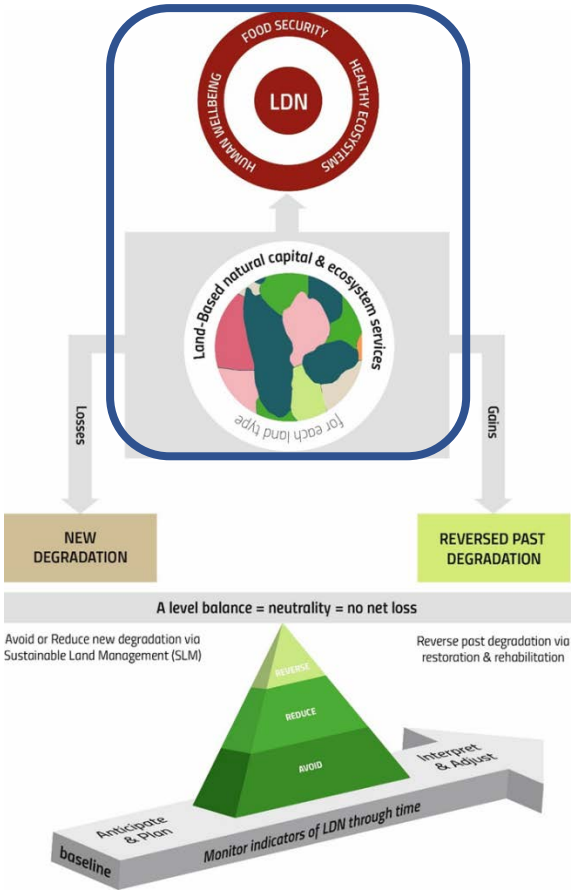


Figure 2 – The five modules of the LDN-Scientific Conceptual Framework

LDN Principles

21. The LDN-SCF is not prescriptive with respect to its implementation. Rather, it presents principles for 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 assist project developers to interpret and apply the principles for their specific circumstances.

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 (Orr et al, 2017). **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 marginalised land users.

P3 Set national LDN targets based on national circumstances.

Steps for Module A

1. Characterise the system

    - Ideally, co-develop the system description in a participatory process with the key stakeholders, considering gender balance.
    - Describe the key biophysical and socio-economic 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 high

[6] Decision 3/ COP.12, UNCCD, 2015

nutritional value food, livelihoods, habitat for native herbivores, carbon sequestration in vegetation and soil.)

- Describe the system's constituent components, their internal and external linkages and dependencies, particularly the key controlling variables and feedbacks that influence land use and land condition. (For example: timing of onset, and duration, of rainy season impacts pasture biomass and therefore feed available, longer term survival of perennial grasses; grazing management influences groundcover and therefore susceptibility to erosion).
- Identify the key relationships between variables, 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, that describes the processes that sustain land-based ecosystem services in the project context. RAPTA (see below) provides guidance on systems analysis.

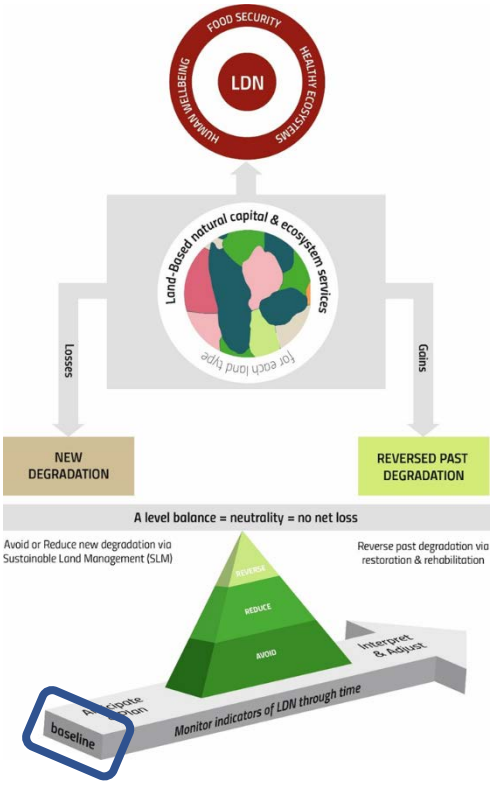
2. Identify the causes and effects of land degradation:

    - Identify the land degradation processes – what forms of land degradation are affecting productivity and natural ecosystems? (Examples: 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).

Resources:

- RAPTA (O'Connell et al., 2016): Component 4, guidance on development of system description Section 3.4 pp 56-62
- LDN-SCF (Orr et al., 2017) Figure 2: Generic driver-pressure-state-impact-response (DPSIR) framework. Adapt for the project context.
- LDN-SCF (Orr et al., 2017) Figure 3: Lists a wide range of land degradation drivers, processes, inherent and responsive soil /site properties, and illustrates their relationships with ecosystem services
- STAP SLM report (Henry et al., 2018) Tables 3 and 4: land degradation drivers and processes
- ITPS Status of the World's Soil Resources (ITPS, 2015).

Module B: The baseline



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 programme for the Land Degradation Focal Area, the Food Systems and Land Use Restoration Impact Program, and the Sustainable Forest Management Impact Program, that 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, measures as Net primary productivity, NPP) and 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; and change in SOC stocks, which responds more slowly, indicates the change in productive capacity.
- The baseline values do not show land degradation status. For example, low SOC may occur in low rainfall sites with sandy soil, or in degraded sites in productive environments. Land degradation status is assessed in Module D.

Note: "LDN baseline" is the baseline as described in the LDN-SCF and LDN Target Setting process, and is different from the "project baseline" in GEF terminology (which specifies the activities/existing systems/current projects that the GEF project seeks to build on).

Principles of Module B:

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

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

Note: 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 they forecast that some portion of future land

degradation associated with past decisions/ realities is not currently possible to counterbalance. Justification for this reduced target needs to be provided.

Steps for Module B

1. Identify data sources for the three global indicators. It is preferable to use national data where available. Land cover change and Land productivity dynamics (NPP) can be assessed by remote sensing. Soil carbon change can be estimated using Land Cover Change data and soil carbon models, or by direct measurement. Direct measurement is expensive and time-consuming, as it requires collection of soil cores, sample processing and laboratory analyses. Therefore, direct measurement of soil carbon should be focussed on those sites where accurate information on change in soil carbon stock is necessary: where the LDN interventions are not likely to change the other LDN indicators, or where the stakeholders wish to participate in emissions trading (Figure 8).

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 Process and for SDG 15.3 the baseline year is usually 2015, the time 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 time of commencement of project planning.

3. Determine the baseline value for each indicator: The values of the indicators fluctuate over time, between seasons and between years, largely due 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.

4. It is important to determine the baseline precisely (ie minimise the error) to make it easier to detect change over time.

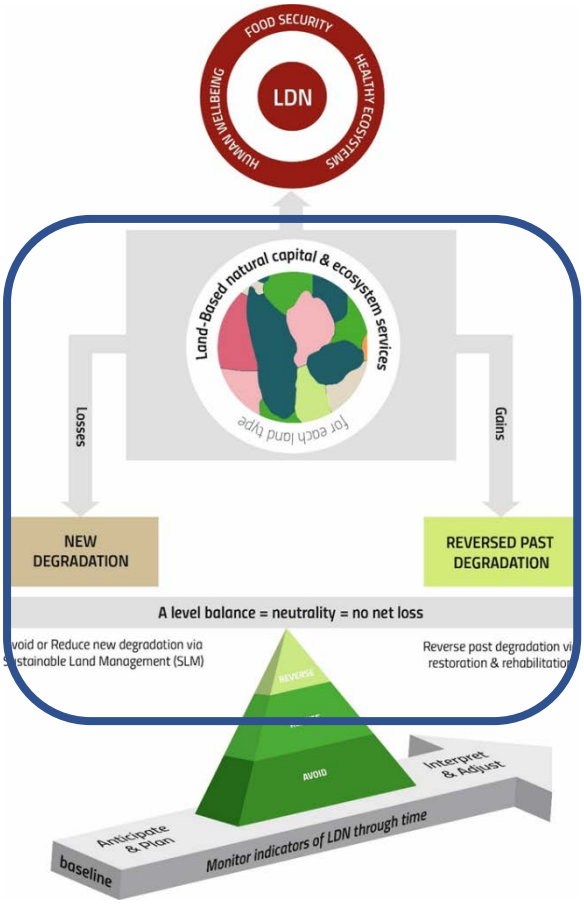
5. The baseline becomes the target to be achieved in 2030.

Resources and Data sources:

- Trends.Earth provides access to global default data sets through the cloud, and also, as a QGIS plugin, provides the functionality to compare these data sets to other global and/or national data sets with the Good Practice Guidance for SDG 15.3.1 algorithms necessary for standardized computation and cross-national comparability. Global data include LCC and LPD from earth observation, and methods to estimate SOC based on SoilGrids 250m dataset to provide baseline SOC stock, and land cover change to estimate impacts of land use on SOC stock change. http://trends.earth/docs/en/
  Available in English, French, Spanish, Swahili, Portuguese.
  Designed to support national -level assessment of land degradation. Allows a user to access default data from the cloud 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.

- Good Practice Guidance for SDG Indicator 15.3.1: Proportion of Land That Is Degraded Over Total Land Area (Sims et al., 2017)
  http://www2.unccd.int/sites/default/files/relevant-links/2017-10/Good%20Practice%20Guidance_SDG%20Indicator%2015.3.1_Version%201.0.pdf.
  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 (different sensors, different vegetation indices) and their relevance for different contexts, including spatial scales.
- UNCCD 2017 Methodological note to set national voluntary Land Degradation Neutrality (LDN) targets using the UNCCD indicator framework
  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
- National greenhouse gas inventory methods and data used for UNFCCC reporting: 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 IPCC Tier 2 or Tier 3 methods for soil carbon stocks and stock change.
- IPCC 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol 4 Ch 3 Table 3A.1.1: table of global land cover datasets

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 practise, so that an equal area of land can be restored/rehabilitated to counteract the anticipated loss.

Key concepts

- In order to achieve neutrality, action must be taken to reverse degradation, 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 can be counterbalanced by reversing land degradation on the same land type, 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, floods wash away topsoil, or 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 (for example, 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).

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, to achieve 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”, that embeds the neutrality mechanism in land use planning, enabling categorizing and accounting for land use decisions and the impacts of land management, and planning for LDN interventions to achieve neutrality.

2. Quantify projected land degradation: estimate cumulative losses resulting from individual land use and management decisions eg 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:

    3.1. Manage counterbalancing at the same scale as land use planning: ie using the biophysical or administrative domains at which land use decisions are made.

    3.2. 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 (see Appendix 2: land potential), over the same land area. So each land type must be managed for neutrality, to achieve neutrality at national level. However, counterbalancing may occur across land type boundaries where there is a demonstrated net gain.

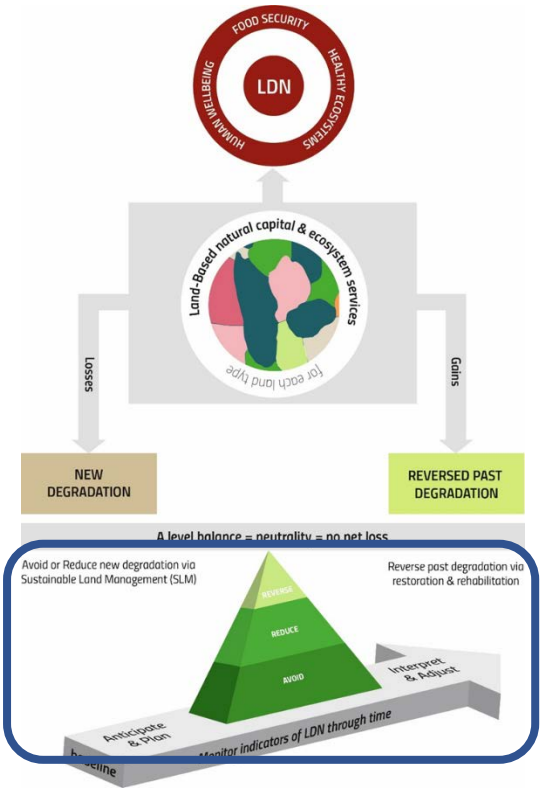
4. Ensure that counterbalancing does not occur between protected areas and land managed for productive uses.

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

Resources:

- Integrated land use planning is described further in Module D and Appendix 1 and Appendix 3.
- 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 et al., 2019 Experiences from the South African land degradation neutrality target setting process

Module D: Elements necessary to achieve 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 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 reduce, avoid and reverse land degradation, with SLM to avoid/reduce land degradation and rehabilitation/restoration to reverse land degradation.
- Successful implementation of LDN interventions requires an enabling environment – 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 the access to and use of land, the manner in which those decisions are implemented and the way that conflicting interests in land are reconciled. Providing individual freehold title is not always the optimal solution; formalising communal land governance may be more effective in some cases. The principles and standards of the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGGT) should be applied.
- Policy coherence is critical – between institutions, sectors, levels of governance – to resolve fragmentation, lack of connectivity, conflicting interests.
- Integrating LDN planning and implementation with other relevant processes will increase efficiency in achieving multiple environmental and development objectives, and minimise trade-offs and unintended adverse impacts. Ensuring that co-benefits are realised 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 socio-economic context including gender equity.

- Choosing the right intervention to apply in the right place requires biophysical data, socio-economic data and methods/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 should be included in LDN planning: mining, settlements, infrastructure.

Principles of Module D

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

P11 Base land use decisions on multi-variable assessments, considering land potential, land condition, resilience, 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

Steps of 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 revision where required to provide effective policy framework for implementation of LDN. See Appendix 1 for guidance on developing an enabling environment.

2. Undertake preparatory assessments

    2.1. Land potential and land stratification

    2.2. Current land degradation status

    2.3. Resilience of current and proposed land uses

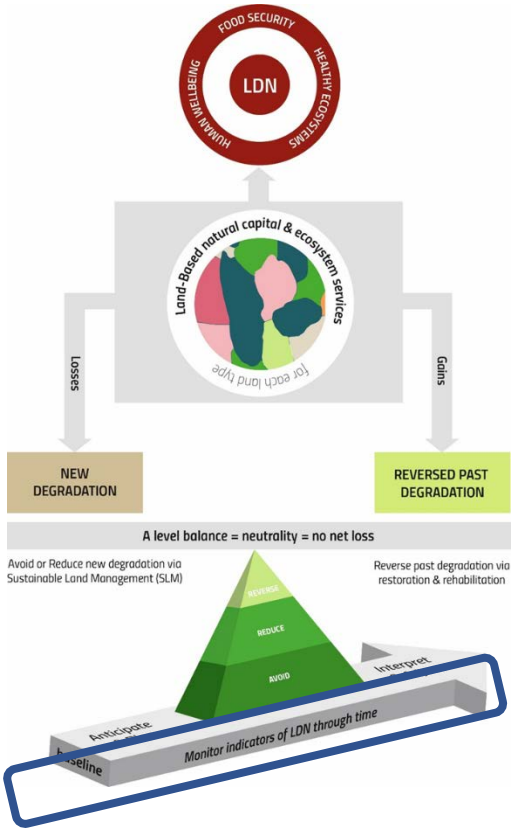
    2.4. Socio-economic context including assessment of gender equality and barriers to participation of women and youth

    2.5. 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 achievement of neutrality



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

Key concepts

- Monitoring LDN involves tracking change in the three global indicators relative to the baseline value, for each land unit, and also tracking relevant complementary indicators.
- The three global indicators and associated metrics are: land cover (assessed as land cover change), 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 or indirect (e.g. climate change) human action 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, in order to focus interventions where 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 timeframe.

Principles of Module E

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

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

P17 Use additional national and sub-national 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, create the next plan.

Steps for Module E

(Overlaps with Module B for the first 2 steps)

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

2. Determine baseline values for LDN metrics. See Module B.

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

4. Decide the interpretation of land cover change. Some land cover transitions are universally agreed to be negative (eg conversion of tropical peatland forest to cropping or settlements) whereas some are ambiguous: eg conversion of pasture to forest in rangelands: this could result from woody shrub encroachment, which is often considered to be a negative transition due to adverse impacts on livelihoods, however it is likely to have higher NPP and carbon stock in vegetation and, possibly, also soil. Such "false positives" point for the need for verification (see below). Some stakeholders may view the same transition as a positive change; in such circumstances where the interpretation is somewhat subjective, and/or trade-offs are involved, a participatory process involving local stakeholders will be required to reach a decision on how this 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. Crowd-sourcing could be used for verification of imagery; citizen science could be helpful to engage the community in on-ground verification of aspects such as weed incursions or monitoring water quality. Some changes may result from the effects of climate change rather than impacts of management. Simultaneous monitoring of protected areas can help to identify whether a change in productivity or loss in soil carbon, for example, is due to climate variability or climate change, rather than management effects.

6. Consider the need for additional indicators: Are there important land degradation processes that are not captured? Examples could include heavy metal contamination from mining, salinization from inefficient irrigation, surface sealing from urban expansion and densification, loss of habitat of threatened

species. Where necessary, determine appropriate indicators for monitoring these additional issues.

7. The Red List, or another biodiversity indicator supported nationally recognised by the Convention on Biological Diversity and relevant to national circumstances, should be applied as a safeguard in planning interventions, to avoid disturbing areas of high biodiversity value, and also 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 4-year intervals.

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

11. LDN is achieved if the area of gains at least matches the area of losses within each land type.

12. Be aware that the “area for area” exchange may not fully compensate losses, over the timeframe of the target, as soil carbon is slow to accumulate.

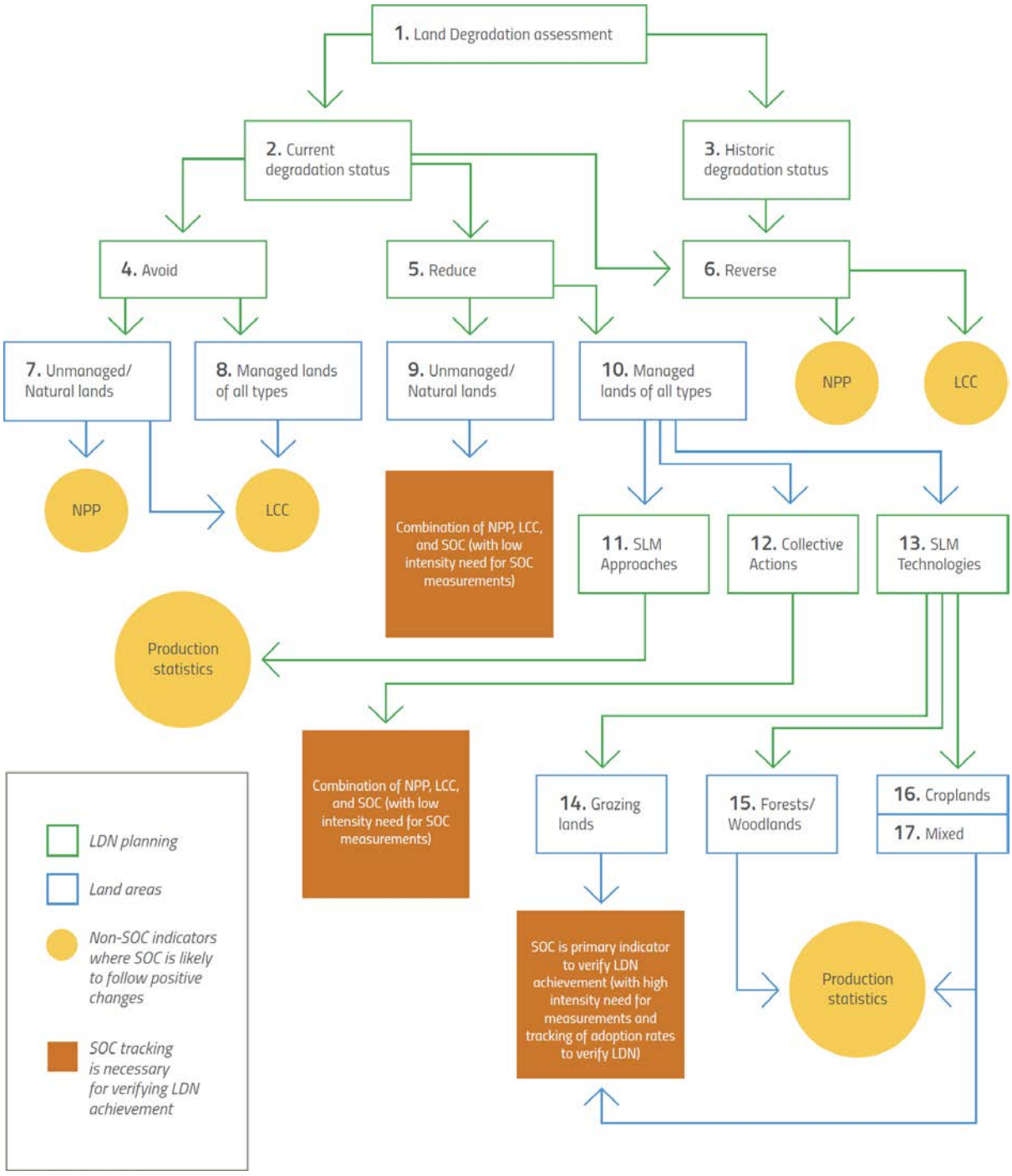


Figure 3 Key sites for monitoring SOC (dark orange) in the context of other indices of tracking LDN (yellow), as distributed across degradation status following land degradation assessment and response actions (green) by land types (blue). Intensive SOC monitoring is needed in lands that are more variable and where SOC is the key indicator for LDN (i.e. where land cover and 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.

Resources:

- Trends.Earth (See Resources Module B): Data source for the three indicators, designed to support national-level assessment of land degradation, and including methods to estimate NPP and distinguish form climate trends; SOC based on SoilGrids 250m dataset to provide baseline SOC stock; and land cover change to estimate impacts of land use on stock change. Can also be used for separating the climate signal, to distinguish sites that have lost productive capacity.
- Collect Earth: high resolution imagery, could be used for verification. https://collect.earth/home
- "AusCover Good Practice Guidelines: A technical handbook supporting calibration and validation activities of remotely sensed data products." Guidance on field validation of remotely sensed data, relevant to validation of land cover and land productivity data. http://qld.auscover.org.au/public/html/AusCoverGoodPracticeGuidelines_2015_2.pdf
- GFOI Methods and Guidance Document (MGD): "Integration of remote-sensing and ground-based observations for estimation of emissions and removals of greenhouse gases in forests: Methods and Guidance from the Global Forest Observations Initiative". Provides detailed guidance on monitoring forest cover and forest growth. https://www.reddcompass.org/documents/184/0/MGD2.0_English/c2061b53-79c0-4606-859f-ccf6c8cc6a83

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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, topography, and human settlements and infrastructure that operate within that system
Land cover	The biophysical coverage of land (e.g., bare soil, rocks, forests, buildings and roads or 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 (ESA) Climate Change Initiative Land Cover (CCI-LC).
Land cover change	Change from one land cover class to another, due to change in land use or change 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 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	Land productivity can indicate the land's ability to support and sustain life and is useful for identifying land degradation. 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 NDVI and EVI, are correlated with quantity of live biomass and are used in NPP models.
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 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/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 shows a negative trend it is considered 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 simultaneously enhancing resilience, to ensure the long-term productive potential of these resources and the maintenance of their environmental functions.

Abbreviations

LCC	Land cover change
LDN	Land degradation neutrality
LPD	Land productivity dynamics
NPP	Net primary productivity
RAPTA	Resilience, adaptation and transformation approach
SLM	Sustainable land management
SOC	Soil organic carbon
LDN-TSP	Land degradation neutrality target setting programme
VGGTs	Voluntary guidelines on the responsible governance of tenure of land, fisheries, forests
NDVI	Normalized Difference Vegetation Index
EVI	Enhanced Vegetation Index

Appendix 1 Developing an enabling environment

Steps to develop and support an enabling environment

1. Seek/obtain national commitment to LDN, with agreed long-term vision.

2. Establish the Lead agency and a coordination mechanism between relevant institutions including agriculture, forestry, environment, urban, water planning and management; also engage central planning and finance ministries.

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

4. Remove policy drivers that lead to poor land management

5. Embed LDN planning and implementation into existing policies and planning processes, including UNCCD NAPs, United Nations Framework Convention on Climate Change (UNFCCC) National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs), Bonn Challenge, New York declaration; CBD actions, as well as national land use planning processes. This will promote action to achieve LDN, reduce costs and minimise duplication of effort.

6. Establish/ 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.

7. Ensure policy for responsible land governance:

8. Review 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.

9. Apply the principles and standards of the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries, Forests (VGGTs) (FAO, 2012). Protection of customary land governance, and decentralisation of land governance, can be effective approaches. Consider capacity to administer a changed system. Providing individual freehold title is not always the best option. Decentralisation could conflict with counterbalancing land condition across a land type; the scale and boundaries of planning/land administration and counterbalancing should coincide.

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

11. Review policy for land conservation, SLM, environmental protection, and revise to enhance effectiveness, where necessary. Consider the following policy options:

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

13. Regulatory frameworks including incentives, restrictions (eg prohibiting land clearing in high conservation value areas or on slopes), protected areas, compliance assessment/enforcement

14. Policy measures to encourage behaviour change: e.g. subsidies linked to SLM practices; tax breaks for costs of inputs such as fencing, tree planting

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

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

17. Drought policy: drought preparedness, seasonal forecasting, support to destock.

18. Climate and land policies that amplify social resilience

19. Policy to ensure accountability and transparency

20. Procedures for adaptive management: develop /apply a mechanism for the timely review of implementation outcomes, and process for improvement

21. Education/training/extension – Agricultural advisory services especially when implemented through peer to peer learning environment such as the Landcare program, farmer networks including those specifically for women farmers; citizen science; decision support tools for land managers eg access to climate services such as seasonal forecasts.

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

23. Mobilise an appropriate science-policy interface

24. Build technical capacity for preparatory assessments to support LDN implementation including socio-economic context/status; resilience; land degradation status, land potential.

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

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

27. Ensure enabling finance by assessing financing needs and securing financial sources. Measures that deliver multiple benefits have broader support and more readily attract funding, so seek synergies with development and environmental objectives, especially climate

change adaptation and implementation of SDGs, also the Bonn Challenge and New York Declaration; engage central planning and finance ministries; prioritise livelihood outcomes; involve private sector, such as pension funds that can take a long term view of investment.

Note that the list above applies to national level projects. Steps 1-2 apply if LDN planning has not been undertaken. If sub-national, omit steps that are not relevant. Substitute the following:

Strategy for sub-national level projects:

1. Identify lead agency coordinating LDN target setting, baseline assessment and target development; negotiate role for project in supporting implementation of national LDN targets.
2. Review, and enhance (where necessary/appropriate) existing planning context.
3. Follow steps above that are applicable to the sub-national context.

Resources

Verburg, P.H., Metternicht, G., Allen, C., Debonne, N., Akhtar-Schuster, M., Inacio da Cunha, M., Karim, Z., Pilon, A., Raja, O., Sanchez-Santivañez, M., and Senyaz, A. 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. United Nations Convention to Combat Desertification (UNCCD), Bonn, Germany. Table 2 Nuffield ladder of public and private governance interventions towards LDN. Collation of policy options to support LDN.

RAPTA (O'Connell et al, 2016): Multi-stakeholder engagement and governance pp43-51

Gender: UN-HABITAT, IIRR, G., 2011. Handling Land, Tools for land governance and secure tenure. https://unhabitat.org/books/handling-land-innovative-tools-for-land-governance-and-secure-tenure/
Criteria to evaluate incorporation of gender equality

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: (1) the natural capital, determined by soil and site attributes that together determine the capacity to deliver ecosystem services (Figure 1); and (2) 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 1).

1. Use existing sub-national land stratification based on geographic /ecosystem features, if available.
2. If no suitable stratification is available, review available data on climate, vegetation, topography, soil type, soil properties: Is there complete coverage at a resolution that would allow stratification into distinct biogeographic units?
3. 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/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.
4. Alternatively, initial stratification could be based on land cover, with units in areas targeted for intervention subsequently subdivided as suggested in point 3.
5. The map of land types should remain spatially consistent throughout the monitoring period (baseline, interim monitoring and final monitoring).

Resources

Land stratification

- Global Agro-ecological Zoning Tool (GAEZ) of the Food and Agriculture Organization (FAO). Available at: http://www.fao.org/nr/gaez/
- U.S. Department of Agriculture's 8-class Land Capability Classification system, which identifies limitations to sustainable production, with an emphasis on soil erosion 1961
- NSW The land and soil capability assessment scheme https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Land-and-soil/land-soil-capability-assessment-scheme-120394.pdf

Land potential

The Land Potential Knowledge System (Land PKS) is a tool that uses mobile phone and cloud computing technologies to guide the user in land potential assessment based on easily observed site properties, and provides site specific information about long term production and degradation risk under different management scenarios. LandPKS is being linked to GAEZ and also to Trends.Earth. A

current project is also linking LandPKS to the WOCAT database and the Carbon Benefits Project tool, allowing land potential information to feed directly into these tools for estimation of carbon sequestration potential and identification of suitable SLM practices. LandPKS is available at: https://landpotential.org/
and described at: http://onlinelibrary.wiley.com/doi/10.1002/ehs2.1209/epdf.

Soil properties:

The Global Soil Partnership (FAO/IIASA/ISRIC/ISS-CAS/JRC, 2012) 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, and regional and continental soil information products such as the Soils Atlas of Africa.

Box 1: Assessing land potential

Land potential is a function of 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 (Figure 4,Table 1)

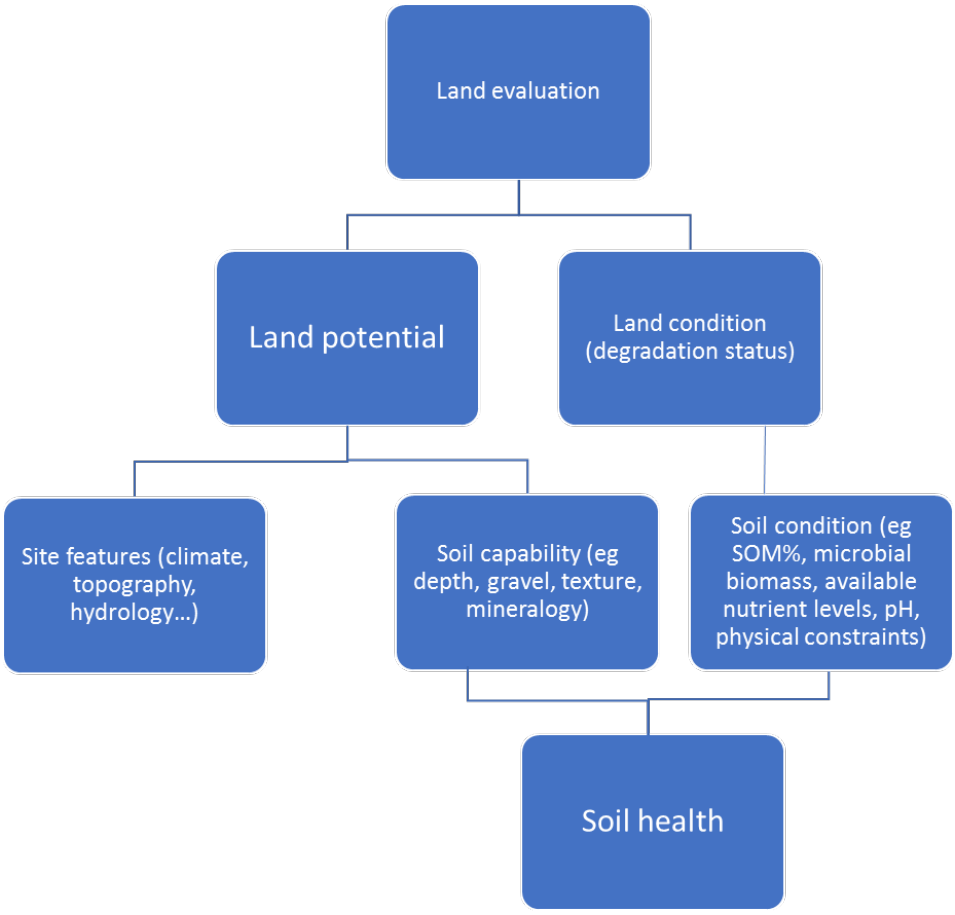

Figure 2 Relationship between land potential and soil health, and the factors that determine these key aspects Source: Henry et al., 2018

Table 1. Inherent site and soil properties that determine land potential. Key indicators are underlined. Source: Adapted from Henry et al 2018

Horizon properties	Profile properties	Site properties
Soil physical properties	Classification (WRB - IUSS 2015; Soil Taxonomy - Soil Survey Staff 1999)	**Climate**
Matrix colour	Horizon depth	Rainfall – amount, distribution, intensity, erosivity.
Soil texture	Depth to water table	Drought frequency, duration
Content of sand, silt, and clay	Depth to bedrock – soil depth	Temperature – distribution, average annual temperature, extremes, frosts
Clay mineralogy/types	Depth to a restrictive layer	Evaporation – annual, timing of high evaporative demands
Natural Bulk density*	Plant available water capacity	Wind – velocity, timing in relation to ground cover and growth stages of crops
Porosity	Profile drainage	
Self-mulching characteristics	Salinity profile	
Aggregate stability	Incidence of waterlogging	
Friability of the surface soil	Presence of acid sulphate minerals	
Soil strength and structure of subsoil		
Saturated hydraulic conductivity		
Rock fragment content/stoniness		
1/3 Bar water holding capacity		
15 Bar water holding capacity		
Infiltration rate		
		Vegetation
Engineering properties		Native vegetation
Particle size distribution (texture)		Extent of clearing
Unified soil classification		
AASHTO class		**Geomorphology**
Plastic and liquid limits		Parent material
Swelling potential		Slope (gradient, shape, length, aspect)
Linear shrinkage		Landform element
		Surface stones
Soil chemical properties		Rock outcrop
Natural soil pH*		Elevation
Natural nutrient levels*		
Buffering against acidification		
Cation exchange capacity		**Hydrology**
Exchangeable cations		Concentration of flows, flow regimes
Exchangeable sodium percentage		Flood hazards
Base saturation		Drainage – waterlogging
Natural organic carbon content*		
P buffer capacity		
Toxicities (e.g. exch Al, heavy metals)		**Other**
Electrical conductivity (salinity)		Day length
Alkalinity		Land use history
		Erosion risk

*Properties that can be influenced by management.

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Land degradation status

Knowledge of the condition of each land parcel, with respect to its state of degradation, is needed to inform LDN planning, particularly decisions on location and type of interventions. This assessment can be based on national and/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, analysed to assess land condition, including, for example, a trend analysis of the UNCCD land-based progress 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 on 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 SDG indicator 15.3.1 "Proportion of land that is degraded over total land area".

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

2. Optionally: classify each land unit into the categories of Table 2.

3. (For SDG 15.3: Determine the percent of land degraded, per land type, in the baseline year.)

Table 2 Classes of productivity dynamics UNCCD 2017

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

Resources

- Trends.Earth (See Resources Module B) – trend in land degradation indicators can indicate degradation (see Monitoring, Module E for note about interpretation).

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 its 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 the susceptibility to land degradation. 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 may be devised to assist transformation. If the system is generally in a desirable state, then enhancing resilience is an appropriate goal. However, where a system is close to adaptation limits, or in a poor biophysical or socio-economic state, such as if land degradation is widespread or poverty is prevalent, then facilitating transformative change should be the target.

1. Recall the system description (Module A Step 1), that identified the key system variables and their relationships, and step 2 that identified the current land degradation processes and their drivers.

2. Research the hazards that may impact the system in future – especially climate change projections, including trends (e.g. rising average temperature and sea level) and extreme events (increased frequency and severity of drought or hurricanes); socio-economic factors such as market trends (eg changing demand for red meat) and climate change policies. Consider the impacts of these shocks and trends on the system. Performance of similar systems operating in a location whose present climate is similar to the projected climate (climate analogues) could be informative. 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 salt water intrusion, and hurricanes will cause coastal erosion.

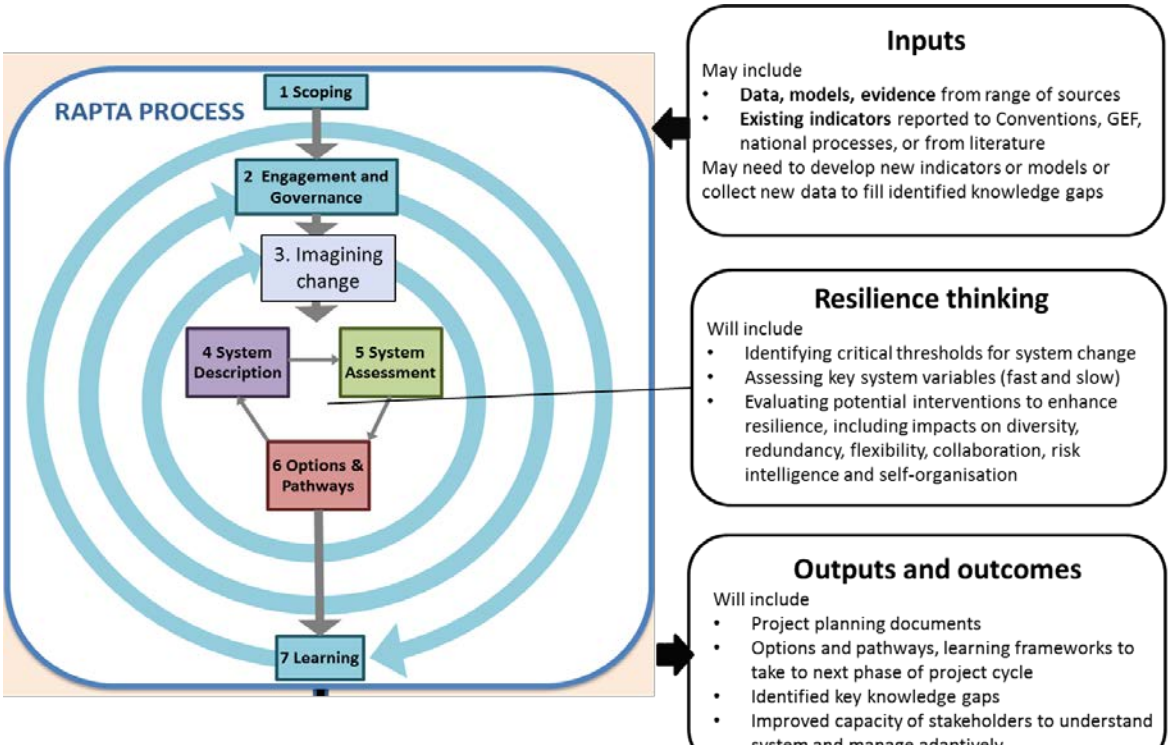
3. Identify thresholds (tipping points) beyond which the system would transition to a less desirable state (such as when overgrazing leads to shift from perennial to less productive pasture species)

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

Box 2: (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 SLM 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/grazing; delayed fertiliser application; plant short season cultivars. Alternatively, transformative change could include establishment of an irrigation scheme. However, this could increase 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 groundcover. Climate projections suggest increasing incidence of drought, which will reduce available feed, exacerbating degradation and reducing profitability. Transformation could involve destocking to encourage regeneration of native vegetation and wildlife, with new livelihoods based on nature tourism and payments for ecosystem services.



Resources

- RAPTA O'Connell et al, 2016 Resilience, Adaptation Pathways and Transformation Approach. Guidelines: "Designing projects in a rapidly changing world: guidelines for embedding resilience, adaptation and transformation into sustainable development projects (Version 1.0)." Global Environment Facility, Washington, DC (2016). http://www.stapgef.org/rapta-guidelines
  Practical guidance on resilience assessment developed for the Scientific and Technical Advisory Panel of the GEF, with a particular focus on land gradation and food security in the drylands.
- Wayfinder: (Enfors-Kautsky et al., 2018) www.wayfinder.earth
  Comprehensive practical guide including activities and video clips to support resilience assessment and development of transformative strategies.
- ISO standard 14090: Adaptation to climate change — Principles, requirements and guidelines. Annex B Threshold analysis

Appendix 3

Planning interventions

This component involves landscape-scale planning to identify sites where "reducing" and "reversing" interventions should take place, and identification of 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 sustainability of current land use and need for SLM interventions. It uses resilience assessment to determine the need for transformative change.

Steps for planning interventions

1. Plan 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.

1. 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/rehabilitated to achieve neutrality.

2. 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. Utilise the land potential information (Appendix 2 and Box 1) to determine the 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/encourage specific land uses in specific locations.

3. Engage stakeholders. Competing interests and divergent stakeholder perspectives must be managed. Coordination across multiple levels of government may be required. Local stakeholders should decide priorities, where tradeoffs occur. 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 globalised supply chains, and companies involved in large-scale land acquisitions, are a potential opportunity to influence management of large land areas, to facilitate scaling-up; ensure the host government has adequate regulatory power, and monitoring capacity, to minimise risk of adverse environmental and social impacts.

4. Use a wide evidence base to inform decisions on land use and land management, including 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 CSOs and SMEs 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.

5. Where relevant, apply a mix of "land sparing" and "land sharing" approaches across the landscape. Land sparing involves 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 of native vegetation.

6. Consider the need for transformation: use insights from the resilience assessment (Appendix 2 Resilience assessment) 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 example, if the water supply for an irrigation scheme is expected to decline due to climate change, 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.

7. Encourage SLM for avoiding/reducing land degradation:

8. Ensure that land use and management align with the capability of the land, to minimise the risk of land degradation

9. Identify SLM practices that address the identified land degradation processes affecting the area, and are economically and socially feasible (Figure 2, Table 2.) Focus on landscape-scale assessment/management, applying whole system understanding and agroecology practices, which encourage integrated pest management, integrated nutrient management, to minimise negative environmental impacts. Recommended SLM practices may be a complete farming system (e.g. regenerative agriculture, permaculture, organic agriculture, Climate-Smart Village (Aggarwal et al., 2013) 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. use of biosolids for fertiliser).

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

11. Protecting undegraded areas that are vulnerable to loss does not deliver a gain to counterbalance a loss elsewhere, but is an important part of a LDN strategy, to minimise areas of loss.

12. Undertake Land restoration and rehabilitation for reversing land degradation.

Restoration refers to actions undertaken with the aim of reinstating ecosystem functionality, whereas rehabilitation refers to actions undertaken with a goal of provision of goods and services. Restoration may involve actions such as destocking to encourage regeneration of native vegetation; shelter belts of local species, established from seed or seedlings, strategically located to provide wildlife corridors and link habitat; rewetting drained peatland. "Farmer-managed natural regeneration" is a low-cost approach in which regeneration of tree stumps and roots is encouraged, stabilising soil and enhancing

soil fertility and organic matter. Rehabilitation could include establishment of energy crops or afforestation with fast-growing exotic trees to sequester carbon or produce timber. Application of biochar can facilitate rehabilitation by enhancing nutrient retention and water holding capacity, and stimulating microbial activity. Biochar type should be selected to suit the identified soil constraints, and its effectiveness can be enhanced through incubation with organic fertilisers.

13. Use SOC estimation tools/models to predict impact of SLM practices and rehabilitation/restoration on SOC. Tools such as CBP and EX-ACT (see "Resources" below) can be used to estimate potential change in soil carbon in response to change in land use or land management. This information can aid in identifying practices that will deliver gains in SOC required to achieve LDN.

Box 3. Example: Using Theory of Change in planning LDN interventions

Figure 6 illustrates the "theory of change" developed for a study assessing the impacts of carbon farming practices in western NSW. The study aimed to determine whether "carbon farming projects" encouraging native vegetation are likely to enhance the resilience of the rangeland management. RAPTA was used to assess resilience of the current grazing system and the system integrating carbon farming. RAPTA facilitated a holistic assessment of social, biophysical and economic impacts of carbon farming in western NSW, that improved understanding of the opportunities, trade-offs, synergies and risks. Details of the method and results are provided in Cowie et al. (2019).

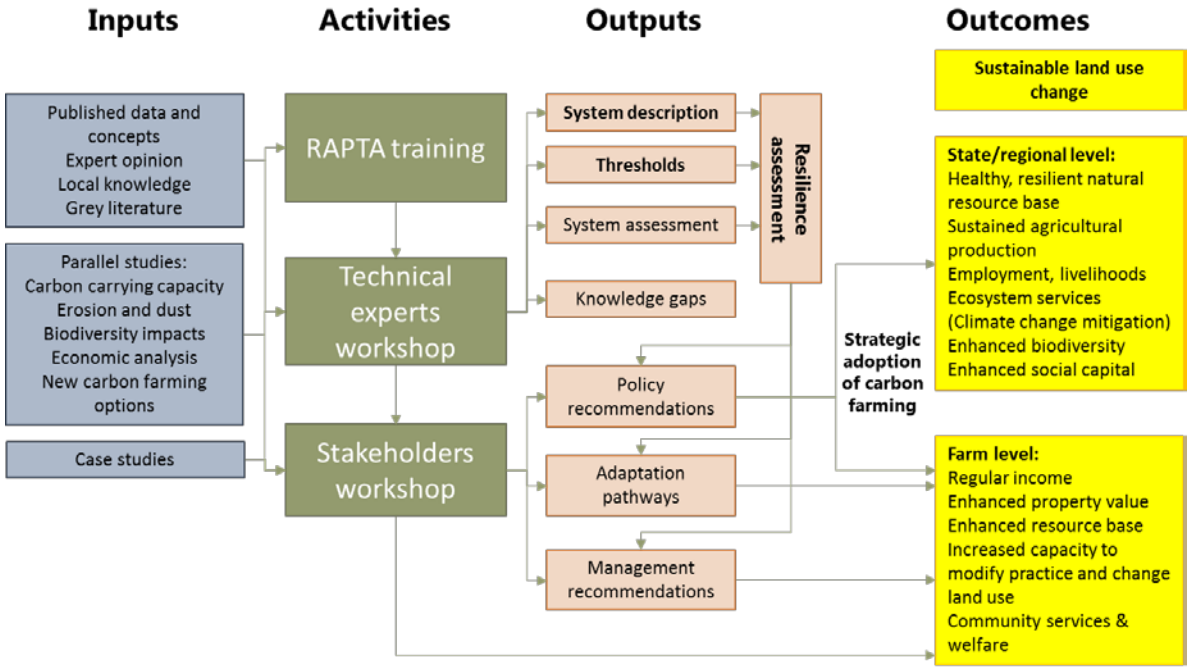


Figure 4 Example of Theory of Change, for project on carbon farming in the rangelands of NSW. (Source: Cowie et al., 2019)

Box 4.: Choosing suitable SLM practices

Figure 7 illustrates the steps involved in selecting effective SLM options based on the context, and Table 3 provides examples of SLM practices that address specific soil constraints.

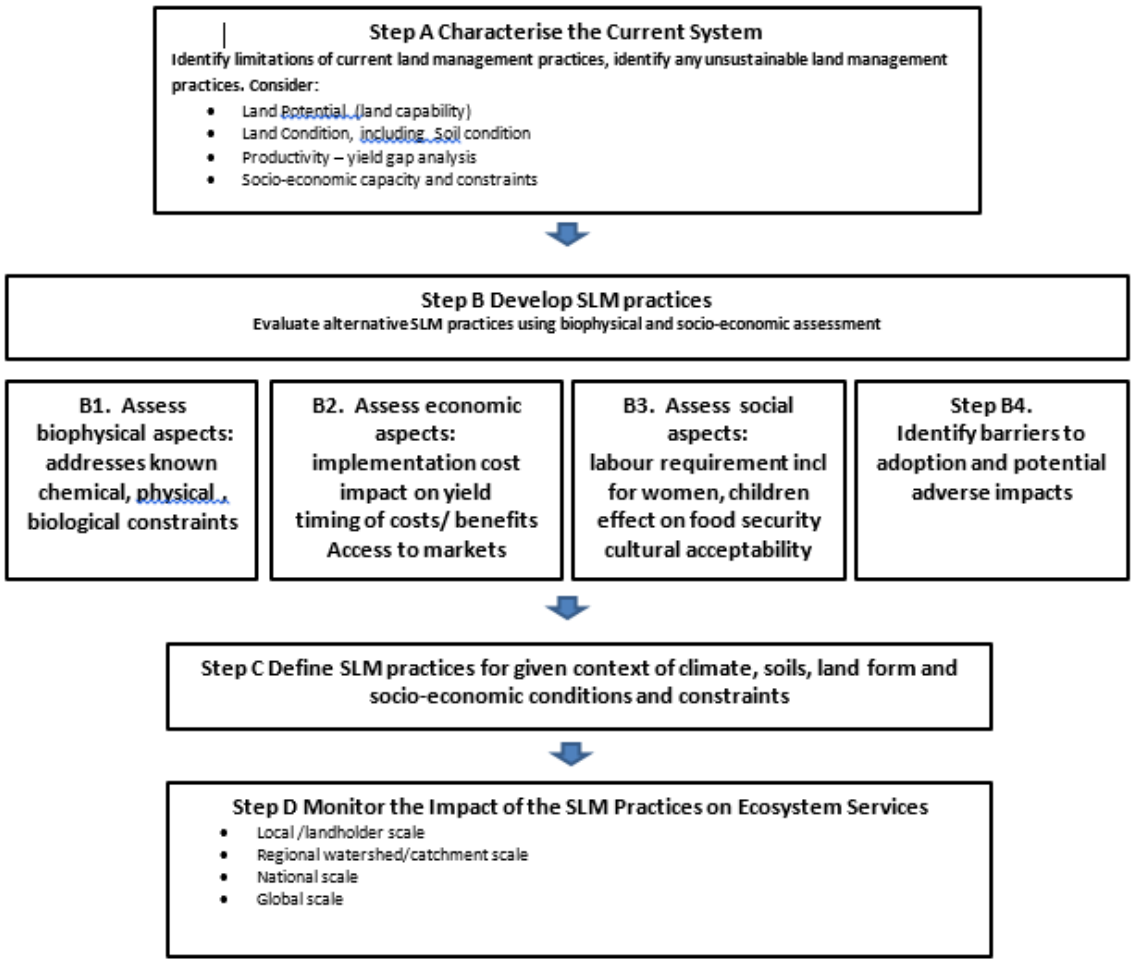


Figure 5 Framework for selecting SLM practices Source: Adapted from Henry et al 2018

Table 3 SLM practices to address land degradation processes Source: Adapted from Henry et al 2018

Land degradation process	SLM responses (examples)
Nutrient decline	Replace nutrients removed through harvest, apply integrated soil fertility management – judicious use of chemical fertiliser with locally available organic fertilisers; plant legume crops in rotation, leguminous trees in agroforestry; encourage soil biological activity to increase nutrient cycling; apply biochar to enhance nutrient retention and fertiliser use efficiency.
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, contour planting, avoid cultivating steep slopes, undertake structural works: 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, cover crops; modify microenvironment with windbreaks.
Soil acidification	Apply lime or biochar, minimise loss of bases and nitrate leaching, avoid drainage of acid sulfate soils.
Salinization	Use drip irrigation, 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.

Resources

Integrated land use planning – tools that assist in balancing multiple objectives, identifying co-benefits and trade-offs:

- ROAM Forest landscape restoration methodology (IUCN, 2014)
- Land use trade-offs model (LUTO): eg Bryan et al. (2016)

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

- WOCAT: World Overview of Conservation Approaches and Technologies, Global Database on Sustainable Land Management https://www.wocat.net/en/global-slm-database
- DESIRE-DSS (https://www.sciencedirect.com/science/article/abs/pii/S0143622811002074; https://www.sciencedirect.com/science/article/pii/S0301479712002125)
- GeOC tool provides a means to evaluate the biophysical and socio-economic context for spatial targeting and scaling up of SLM options (Le et al., 2017).
- ISO 14055-1:2017 Environmental management -- Guidelines for establishing good practices for combatting land degradation and desertification -- Part 1: Good practices framework

- World Bank SLM Sourcebook: World Bank. 2008. Sustainable land management sourcebook (English). Agriculture and rural development. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/495041468338511373/Sustainable-land-management-sourcebook
  Contains short descriptions of many SLM options and issues, including lessons learned and recommendations.

Estimating potential soil carbon response to SLM:

- CBP tool: Carbon Benefits Project http://www.carbonbenefitsproject.org/
  CBP offers web-based tools, including a simple and a detailed version. The simple tool is suitable for ex-ante estimates while the detailed assessment tool is applicable for project reporting where moderate-high certainty is required.
- EX-ACT: Ex-Ante Carbon-balance Tool http://www.fao.org/tc/exact/ex-act-home/en/
  Spreadsheet-based tool suitable for ex-ante estimates of SOC change. Available in French, Spanish, Chinese, Russian, Arabic, Portuguese, German and Bahasa Indonesia.