United Nations University
Institute for Environment and Human Security

The contribution of land and water management approaches to Sustainable Land Management and achieving Land Degradation Neutrality

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The contribution of land and water management approaches to Sustainable Land Management and achieving Land Degradation Neutrality

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Executive summary

Land and water management approaches that address environmental and social challenges, such as land degradation, food insecurity, water scarcity, health, climate change and the decline in biodiversity, have been gaining importance in recent years. Several of these approaches are well known, while others have been only recently developed. While these approaches are being employed in countries around the world, the Parties of the United Nations Convention to Combat Desertification (UNCCD) acknowledge that some "may not yet be formally recognized in intergovernmental frameworks" (UNCCD Decision 19/COP.15/23/Add.1). These approaches have different names, specific objectives and principles and may employ different methods and technologies. At their core, however, all have the potential to address land degradation and desertification, to mitigate drought and to deliver many other environmental, economic and/or social co-benefits.

The internationally recognized framework of land degradation neutrality (LDN)—whereby the amount and quality of land for supporting ecosystem functions and services remains stable or increases relative to a baseline—was developed to help overcome many of these same land-related challenges. Similarly, sustainable land management (SLM) is globally acknowledged as a land-based solution to desertification, land degradation and drought and as a means to address the causes and impacts of climate change. SLM refers to the use of land resources—including soils, water, plants and other biodiversity—to produce goods that meet human needs while ensuring the long-term productivity of these resources and maintaining their environmental function.

The well-known concepts of LDN and SLM offer benchmarks against which land and water management approaches can be assessed. Understanding how well aligned these approaches are with SLM and LDN can help different communities that solve similar problems to work together to remedy global environmental challenges. It can also advance the formal recognition of these approaches by multiple intergovernmental processes. Alignment with LDN and SLM means these approaches can be more readily and more appropriately incorporated into the "integrated strategies" (described in Article 2 of the UNCCD Convention text) that improve land productivity while ensuring the rehabilitation, conservation and sustainable management of land and water and improved livelihoods for communities around the world.

To explore this opportunity more systematically, the Parties of the UNCCD requested "a coherence and alignment assessment of the expanding number of approaches that may contribute to the sustainable management of land and water resources … [and] to addressing desertification/land degradation and drought and the achievement of land degradation neutrality" (UNCCD Decision 19/COP.15/23/Add.1).

Against this background, the United Nations University Institute for Environment and Human Security (UNU-EHS) prepared this report to better understand the alignment of different land and water management approaches with SLM and LDN. This alignment was assessed using criteria that comprise three pillars essential to SLM and LDN: ecosystem health, food security and human well-being. Other socioeconomic criteria used in the assessment are known to simultaneously contribute to all three pillars (i.e., cross-cutting criteria). Accordingly, this report addresses the following questions: 1. How do selected land and water management approaches align with the pillars and criteria of SLM and LDN? 2. Where do gaps in alignment occur? 3. How can these gaps in alignment be addressed to achieve the highest possible contribution of each approach to implementing SLM and achieving LDN? By demonstrating the alignment of the approaches with SLM and LDN and by identifying entry points for addressing gaps in alignment, this report can guide UNCCD Parties in planning and evaluating land and water management projects, leverage policy and donor support and increase the potential to advance SLM and achieve LDN.

Importantly, this report provides the results of its coherence and alignment assessment *without* comparing the land and water management approaches with each other. The report does *not* evaluate the effectiveness of any of the approaches under consideration. Similarly, it does *not* provide guidance regarding the application or context specificity of any of the approaches. Instead, the report is focused *solely* on assisting policy makers, project designers and land managers/users to understand the alignment of each approach with the pillars and criteria of SLM and LDN. Its aim is to help all countries to contribute to the multiple mutual co-benefits of addressing desertification, land degradation and drought in a coordinated way.

A qualitative participatory and formative research framework was used to i) select and characterize the land and water management approaches for analysis; ii) review literature to assess the alignment of each approach with SLM and LDN framework criteria; iii) consult experts to evaluate and complement the literature-based assessment; and iv) develop recommendations, using the convergence of multiple lines of evidence, to address identified gaps and improve alignment.

The following seven land and water management approaches were identified and assessed: agroecology, integrated agriculture, conservation agriculture, regenerative agriculture, climate-smart agriculture, rewilding and forest landscape restoration. Other approaches addressing more specific management areas (e.g., integrated water management) or targeting specific land use systems (e.g., sustainable rangeland management) were not included, but these could be analysed in a similar way in the future.

The assessment revealed five key findings:

All seven selected land and water management approaches align with many, but not all, of the SLM and LDN criteria.
Each of the selected land and water management approaches was found to contribute to SLM and to achieving LDN in different ways and to varying degrees. Agroecology, as a holistic approach addressing a broad range of objectives, was assessed to have the highest degree of alignment with SLM and LDN criteria. Regenerative agriculture and integrated agriculture are approaches strongly aligned with many SLM and LDN criteria, especially those related to improving the biophysical conditions of agroecosystems and the sustainable use of resources. Forest landscape restoration also aligns with SLM and LDN criteria, but some gaps in alignment result from its failure, in practice, to address several human well-being criteria.

Conservation agriculture, meanwhile, aligns with criteria in all SLM and LDN pillars by addressing the biophysical conditions of agroecosystems and soil conservation, but the approach's frequent use of environmentally detrimental glyphosate and a lack of attention to local knowledge and communities result in alignment gaps. Rewilding, which emphasizes natural processes, aligns with fewer human well-being and cross-cutting criteria, but efforts to include human activities and sustainable agriculture can increase alignment. Climate-smart agriculture, with its narrow emphasis on greater productivity, emissions mitigation and climate adaptation in agricultural systems, consequently shows the lowest degree of alignment with SLM and LDN criteria.

All seven land and water management approaches show the most alignment with criteria comprising the ecosystem health and the food security pillars of SLM and LDN.
Among the 15 SLM criteria and 20 LDN criteria against which the alignment of the seven approaches was assessed, criteria of the ecosystem health and food security pillars are the most frequently aligned. All approaches align with SLM and LDN criteria pertaining to ecosystem health because they aim to minimize land degradation (i.e., contribute to the LDN response hierarchy: avoid, reduce and reverse land degradation) and improve ecological conditions. All approaches were also found to align most with food security criteria, thanks to their emphasis on maintaining and enhancing land quality and potential. Nearly all approaches were found to align with cross-cutting criteria that address climate change, drought and extreme weather events, as well as those aimed at policy, institutional goals and planning and development. Most approaches promote carbon capture and sequestration, targets central to LDN and to the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement. Many approaches have dimensions that also contribute to one or more of the UN Sustainable Development Goals (SDGs) and to the aim of the UN Decade on Ecosystem Restoration.

All seven land and water management approaches show the most gaps in alignment with criteria comprising the human well-being pillar of SLM and LDN, as well as with certain cross-cutting socioeconomic criteria that span all the pillars.
While none of the approaches embrace principles or practices that directly conflict with the criteria of SLM and LDN, some gaps in alignment were identified where the specific objectives and methodologies of the approaches did not address particular environmental, social and economic criteria. This report considered gaps in alignment to occur where approaches were assessed as *not* aligned with criteria by all or *any* of the literature and experts consulted for this study. Gaps in alignment of the seven approaches with SLM and LDN criteria mostly relate to the LDN criterion "protects all human rights and right to property". Evidence from the literature and experts suggests that several approaches (e.g., climate-smart agriculture, rewilding and integrated agriculture) fail to explicitly safeguard land tenure, in theory or in practice, because tenure is unclear or existing land-use agreements are inaccessible (e.g., for forest landscape restoration).

Other common gaps in alignment were revealed through evidence that, in certain contexts, the needs and livelihoods of local communities, smallholders and/or vulnerable groups, such as women, are not considered by many approach-based projects. The gaps include, for example, a frequent lack of project focus on SLM and LDN criteria related to the need for inclusive, representative participation by multiple levels of government and stakeholders to ensure projects are socially accepted. For many approaches, identifying and bringing together all relevant actors and accommodating individual interests is challenging. Several approaches showed gaps in alignment related to insufficiently integrating or prioritizing context-specific social and economic needs. This was often attributed to their narrowly defined objectives and scope. While almost all the assessed approaches recognize the need for gender responsiveness (i.e., an important LDN criteria), it is not always translated into practice.

Gaps in alignment of land and water management approaches with SLM and LDN criteria are best addressed during project planning and implementation by employing supplementary activities that directly target the gaps and by applying recognized principles and guidelines.
All of the assessed approaches can potentially support SLM and LDN interventions if the identified gaps in alignment are addressed through locally appropriate supplementary activities by project designers and implementing agencies. For example, an approach such as integrated agriculture may not explicitly address gender responsiveness, but gender-related activities can be incorporated within a project's design, implementation and monitoring to ensure equality and empowerment. Approaches can also improve alignment by integrating site-specific activities into larger landscape-scale interventions involving other approaches. For example, integrating regenerative agriculture practices within rewilding projects can ensure both approaches achieve their aims to restore natural ecological processes, improve livelihoods and increase food security.

Some identified gaps can be addressed by more rigorous adherence to approach principles. Some approaches (e.g., rewilding, agroecology and forest landscape restoration) have defined principles that align with SLM and LDN criteria, but these are not always translated into practice. Once principles and guidelines are incorporated in a project's design, project monitoring and evaluation can ensure they are subsequently followed. Where an approach needs to address gaps in alignment with certain criteria, established, internationally vetted guidelines can also help to address these shortcomings, including the Voluntary Guidelines on the Responsible Governance of Tenure and the Gender and Land Rights Database.

Context matters. Conclusions about the degree of alignment or about gaps in alignment between each land and water management approach and SLM and LDN criteria should not be considered universal and may depend on where and how projects are implemented.
Projects applying practices of land and water management approaches may align with SLM or LDN criteria in one context and location but not in others. Thus, the conclusions of this report should not be considered universally valid for every context. Ultimately, the effective application of each approach depends on high-quality, spatially explicit data on environmental, economic and social factors to ensure the evidence-based design and implementation of practices that have the potential to achieve multiple environmental, economic and social benefits.

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Abbreviations

AE	Agroecology
CA	Conservation Agriculture
CBD	Convention on Biological Diversity
COP	Conference of the Parties
CSA	Climate-Smart Agriculture
CST	United Nations Committee on Science and Technology
DLDD	Desertification, Land Degradation and Drought
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FLR	Forest Landscape Restoration
GLRD	Gender and Land Rights Database
HLPE	High-Level Panel of Experts on Food Security and Nutrition
IA	Integrated Agriculture
ICLS	Integrated Crop-Livestock Systems
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
LDN	Land Degradation Neutrality
RA	Regenerative Agriculture
SDG(s)	Sustainable Development Goal(s)
SLM	Sustainable Land Management
UNCCD	United Nations Convention to Combat Desertification
UNEA	United Nations Environmental Assembly
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNU-EHS	United Nations University Institute for Environment and Human Security
VVGTs	Voluntary Guidelines on the Responsible Governance of Tenure
WOCAT	World Overview of Conservation Approaches and Technologies

Micaela Fachin, small agroforestry producer from Roya community.

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1. Introduction

Land and water management approaches that address environmental and social challenges, such as land degradation, food insecurity, water scarcity, health, climate change and the decline in biodiversity, have been gaining importance in recent years. Several of these approaches are well known, while others have only recently been developed. While these approaches are being employed in countries around the world, the Parties of the United Nations Convention to Combat Desertification (UNCCD) note that they "may not yet be formally recognized in intergovernmental frameworks" (Decision 19/COP.15/23/Add.1, UNCCD, 2022a), which may hinder their more strategic incorporation into broader efforts to remedy global environmental challenges.

These approaches come under different names, have different specific objectives and may employ different methods and technologies. However, at their core, all have the potential to address land degradation and desertification, to contribute to the mitigation of drought and to deliver a suite of other environmental, economic and/or social co-benefits. Understanding how well aligned these approaches are with sustainable land management (SLM) practices and efforts to achieve land degradation neutrality (LDN) offers the opportunity to more readily and more appropriately incorporate them into the "integrated strategies" described in Article 2 of the Convention text and to "focus simultaneously, in affected areas, on improved productivity of land, and the rehabilitation, conservation and sustainable management of land and water resources, leading to improved living conditions, in particular at the community level" (UNCCD, 2022c).

To explore this opportunity more systematically, the Parties of the UNCCD requested "a coherence and alignment assessment of the expanding number of approaches that may contribute to the sustainable management of land and water resources which, while not being formally recognized under the UNCCD or other intergovernmental processes, may contribute to addressing desertification/land degradation and drought and the achievement of land degradation neutrality" (Decision 19/COP.15/23/Add.1, UNCCD, 2022a). LDN is the formulated goal of UNCCD to ensure no net loss of healthy, productive land by 2030. It is defined as "a state whereby the amount and quality of land resources necessary to support ecosystem functions and services to enhance food security remain stable, or increase, within specified temporal and spatial scales and ecosystems" (UNCCD, 2024a). LDN is integral to target 15.3 under the UN Sustainable Development Goal (SDG), "Life on Land". The UNCCD's scientific conceptual framework for LDN suggests that avoiding and reducing land degradation can be achieved through Sustainable Land Management (SLM; Orr and others, 2017). SLM is defined as "the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions" (WOCAT, 2024). According to the World Overview of Conservation Approaches and Technologies (WOCAT) secretariat, SLM fosters land degradation prevention and reduction through soil and water conservation practices (WOCAT, 2024) that include agroforestry, minimum soil disturbance, soil erosion control, water management, animal waste management and others (UNCCD, 2024b). The importance of

SLM is explicitly recognized by the UNCCD and is embraced by efforts under the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD) and the Sendai Framework for Disaster Risk Reduction and the United Nations Environment Assembly (UNEA) (Walz and others, 2021). Moreover, SLM is essential to both sustainable development (WOCAT, 2024) and to efforts that address desertification, land degradation and drought (i.e., DLDD). DLDD refers to those processes that increase pressure on productive land and water resources, undermining ecosystem function and the production of food (United Nations Technical Support Team, 2013).

Against this background, the United Nations University Institute for Environment and Human Security (UNU-EHS) prepared this report to generate an understanding of the alignment of a number of land and water management approaches with SLM and LDN. This alignment was assessed using criteria that comprise three pillars essential to SLM and LDN: ecosystem health, food security and human well-being. Other socioeconomic criteria used in the assessment are known to simultaneously contribute to all three pillars (i.e., cross-cutting criteria).

Accordingly, this report addresses the following questions:

1. How do selected land and water management approaches align with the pillars and criteria of SLM and LDN?
2. Where do gaps in alignment occur?
3. How can these gaps in alignment be addressed to achieve the highest possible contribution of each selected approach to implementing SLM and achieving LDN?

By demonstrating the alignment of selected land and water management approaches with SLM and LDN and by identifying entry points for addressing gaps in alignment, this report aims to guide UNCCD Parties in planning and evaluating land and water management projects that leverage policy and donor support to increase SLM and achieve LDN.

Importantly, this report provides the results of the underlying coherence and alignment study *without* comparing the land and water management approaches with each other. This report does *not* evaluate the effectiveness of any of the approaches under consideration. Similarly, the report does *not* provide guidance in the application or context specificity of any approach. Instead, this report focuses *solely* on assisting policy makers, land managers and land users to understand the alignment of each approach to established criteria under SLM and LDN so that they may be incorporated, as appropriate, into the integrated strategies called for under the Convention. Understanding the contribution of these approaches to SLM and LDN can help ensure the approaches overcome the lack of international recognition that may be preventing their strategic inclusion in broader efforts to remedy global environmental challenges. It may also help to ensure that activities in all countries contribute in a coordinated way to the multiple, mutual co-benefits of addressing desertification/land degradation and drought.

2. Methods

This report is based on a content analysis of information from literature and statements provided by experts from research, policy and practice. It is characterized by a formative approach through which the different steps in the methods were continuously re-evaluated to improve the effectiveness and targeted nature of their design. The following subchapters summarize these methods.

2.1. Selection of land and water management approaches

A selection process was developed to review a suite of land and water management options to identify those that qualify as relevant land and water management approaches for which their alignment with SLM and LDN could be assessed as requested in the UNCCD decision text (Decision 19/COP.15/23/Add.1; UNCCD, 2022a). This five-step process is presented schematically in Figure 1. A more detailed version of this flow chart can be found in Annex 1.

2.1.1. Identifying candidate land and water management options

The starting point of the research process was a statement by the UNCCD Committee on Science and Technology (CST)[1] following the COP 15 Decision 19[2]. The statement provides a preliminary list of seven land and water management options for which alignment with SLM and LDN was unknown, including concrete approaches, specific methods, technologies or theoretical management concepts. To identify additional relevant options, UNCCD's Global Land Outlook, Second Edition (UNCCD, 2022b) was consulted. Further, literature was scanned to collect more options to be investigated in the scoping phase of this report (Step 1). These steps yielded 22 potentially relevant land and water management options for consideration along with the seven suggested by the CST for a total of 29 options on the candidate list.

2.1.2. Google Trends analysis to identify "new and existing" options

Since the CST statement particularly mentions "new and existing approaches", Google Trends was used in Step 2 of the process to evaluate worldwide Internet search trends for the land and water management options identified from the literature published within the last five years. For land and water management options that showed the highest public interest (i.e., highest hit rates), increasing hit trends across time were an indicator of increasing interest. The identification and review of candidate approaches was performed in the English language. Since different approaches are used in different world regions in different languages, some approaches may show hit rates that reflect the relative interest in them by English-speaking practitioners

1 "[T]here has been an expansion of new and existing approaches to the sustainable management of water and land that may also fall under and be coherent with the umbrella concept of NbS, however they may not yet be formally recognized in intergovernmental frameworks. Examples, as mentioned by some participants, include, but are not limited to, conservation agriculture, agroecology, regenerative agriculture, agroforestry, permaculture, biodynamic agriculture and drought-smart agriculture. The workshop participants suggested a similar cohesion and alignment analysis as conducted by UNU would benefit all the SLM, EbA and Eco-DRR, the UNCCD and other multilateral environmental agreements, and the organizations implementing NbS, SLM, EbA and Eco-DRR" (UNCCD 2022, ICCD/COP(15)/CST/5, section IV, para 56).

2 "Requests the secretariat to conduct, subject to the availability of resources, a coherence and alignment assessment of the expanding number of approaches that may contribute to the sustainable management of land and water resources which, while not being formally recognized under the United Nations Convention to Combat Desertification or other intergovernmental processes, may contribute to addressing desertification/land degradation and drought and the achievement of land degradation neutrality" (UNCCD 2022 Decision 19/COP.15/23/Add.1).

Akili Mali Women Association member working on a plot in Yanonge, Tshopo Province - DRC.

and donors rather than their popularity as approaches implemented at national or regional levels. Thirteen of the options derived from the literature that showed low hit rates and/or static or decreasing hit rate trends were excluded from the 29 candidate options. The remaining 16 options were considered in the next step of the selection process.

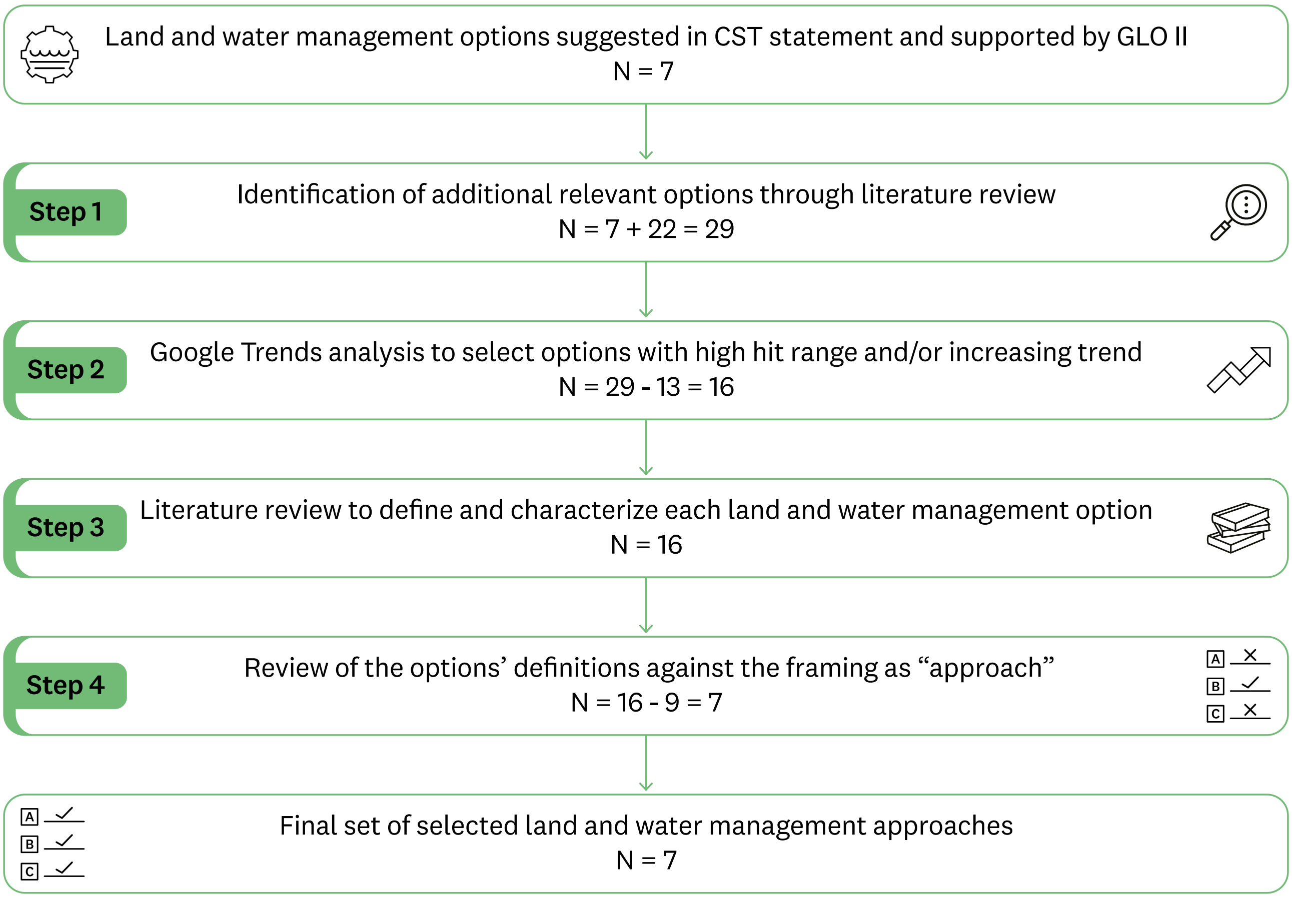

Figure 1: Selection process for land and water management approaches to be assessed in this report.

2.1.3. Defining and characterizing options

Relevant, English-language literature from the past five years concerning each of the remaining 16 options was collected through a search of scientific articles and grey literature (e.g., reports, briefs, handbooks) using five databases: ScienceDirect, Scopus, Web of Science, JSTOR and Google Scholar (Step 3). For this search, the options were entered along with the qualifications "AND 'definition' OR 'framework' OR 'review' OR 'concept'". Additionally, a snowball technique was used to identify additional, frequently cited sources that could aid in further characterizing the options.

The literature review served to clearly define each of the selected land and water management options and to derive their important and distinguishing characteristics using a deductive qualitative coding process. The coding system is based on UNU-EHS's Align-SLM report (Walz and others, 2021) and includes codes for each characteristic of the selected options. These characteristics include defining elements, as well as specific goals, principles and implemented techniques and practices that are at the core of each approach. These were considered the “key characteristics” of each approach and were used to help develop and implement the subsequent steps in this selection process. They were also used during the alignment assessments conducted for this report.

2.1.4. Selecting options that qualify as “land and water management approaches”

The COP decision requested an assessment of land and water management “approaches”. Accordingly, Step 4 of the selection process reviewed the definitions and key characteristics of the 16 options to clarify whether they are framed as an “approach” (i.e., instead of being more widely understood as a “method” or a “conceptual framework”). This report adopted the scientific definition of an “approach” as “the ways and means used to implement one or several measures [...]. Its implementation is motivated by the specific goal to address certain challenges and their drivers” (Walz and others, 2021, p. 9). Thus, this report defines a land and water management approach as the ways and means for organizing human activities on land and for using land resources (see also Walz and others, 2021; European Environment Agency, 2024; United Nations Economic Commission for Europe, 1996).

Seven of the 16 land and water management options included in this selection step were found to match this definition, based on their defining key characteristics (Annex 1). While the other nine options excluded from the analysis in this step may also be important for addressing SLM and LDN criteria, they were considered outside the scope of this report’s mandate to explore existing and emerging land and water management approaches. One of these options, smart farming, was initially included, but it was excluded later in the process as it became apparent during the expert consultation that it is understood as a method and not a land and water management approach.

The seven options that matched the definition of “approach” were included in the final set of “land and water management approaches” assessed in this report: agroecology, regenerative agriculture, conservation agriculture, integrated agriculture, climate-smart agriculture, rewilding and forest landscape restoration. While these approaches focus mainly on the management of croplands, forest landscapes and other natural ecosystems and while none specifically addresses water management per se, the approaches are understood to include water management as an integral part of their agriculture and natural ecosystems management practices. For example, water management is addressed through specific practices such as water harvesting in agroecology (Altieri and others, 2015), through enhancement of soil water conservation through mulching and other techniques in conservation agriculture (Mugandani and others, 2021) and through the promotion of water-related ecosystem services during the restoration of natural ecological processes required for rewilding and forest landscape restoration projects (Carver and others, 2021; Beatty and others, 2018). Thus, the seven selected approaches can all be considered as management approaches addressing both land and water.

2.2. Alignment with SLM and LDN criteria

The seven selected land and water management approaches were assessed for their alignment with criteria and pillars of SLM and LDN. Alignment refers to the "process of identifying synergies among strategies with common objectives to increase efficiency and effectiveness for improved outcomes" (adapted from Dazé and others, 2018, p. 3). Here, such synergies leading to improved outcomes were identified by investigating how key defining characteristics for each selected approach correspond to the criteria (and their pillars) for each of the SLM and LDN conceptual frameworks. These synergies reflect the degree to which the selected approaches "align" with SLM and LDN and contribute to their conceptual aims. The method for assessing this alignment is described in the following sections.

2.2.1. SLM and LDN criteria

The seven land and water management approaches were assessed for their alignment with SLM and LDN by examining how well the defining key characteristics of these approaches address their criteria and pillars, respectively. Figure 2 illustrates the 15 criteria used to analyse the alignment of the approaches with SLM. It is based on the SLM framework developed by Smyth and Dumanski (1995), on the definition of SLM by Sanz and others (2017) as well as on the characterization of SLM by Walz and others (2021). These publications were identified as key to operationalizing SLM. The SLM criteria are categorized within four categories, or "pillars": criteria that address "food security", criteria that address "human well-being", criteria that address "ecosystem health", and "cross-cutting" socioeconomic criteria that simultaneously address more than one of the other three pillars.

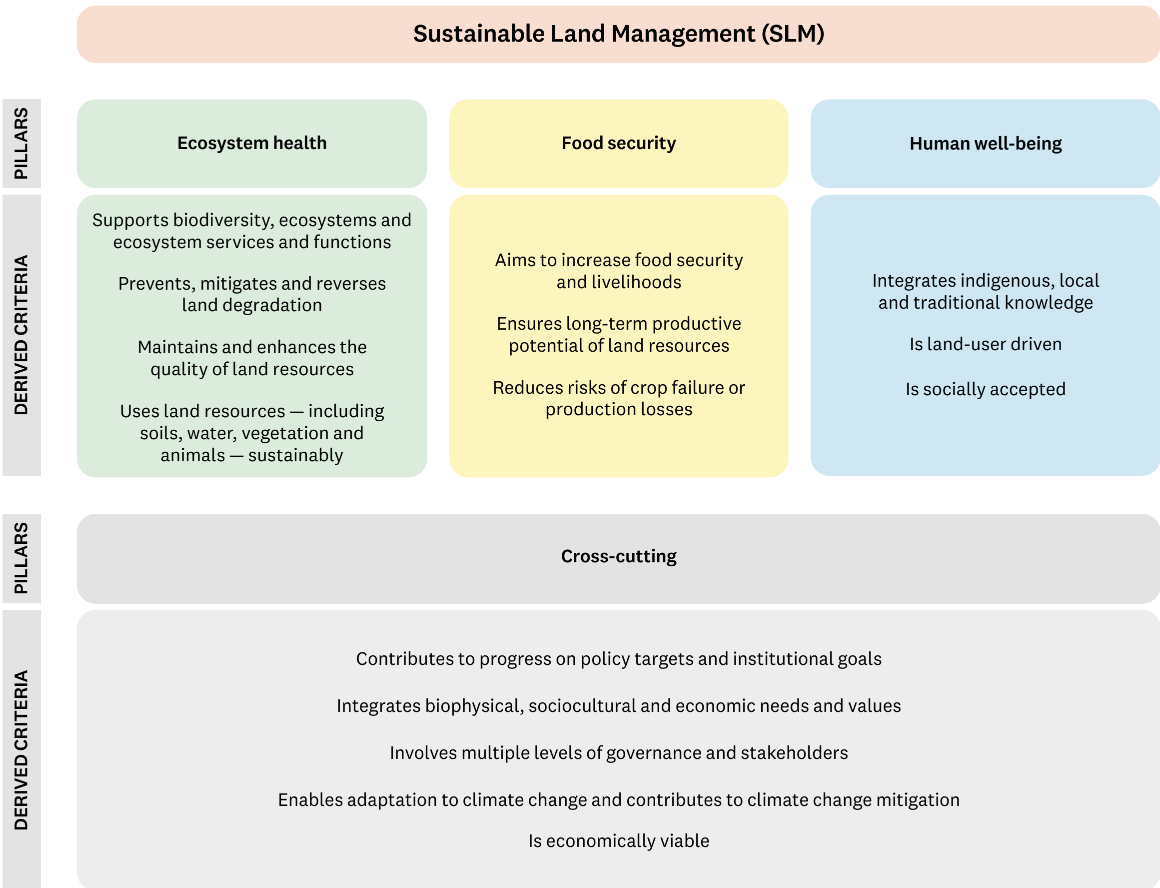

Figure 2: The 15 criteria used to assess the alignment of approaches with SLM, adopted from Smyth and Dumanski (1995), Sanz and others (2017) and Walz and others (2021).

Orr and others (2017) introduced a first conceptual framework for LDN. It creates a common understanding of LDN and guides implementation and monitoring by describing LDN principles, such as the protection of vulnerable communities and multi-stakeholder cooperation. Additionally, the UNCCD Strategic Framework 2018-2030 outlines strategic objectives for achieving LDN, such as increased ecosystem resilience, enhanced land productivity, diversified livelihoods and contributions to the goals of other UN conventions (UNCCD, 2017). Based on this framing, 20 criteria were derived to analyse alignment of the selected approaches with LDN (Figure 3). These criteria were categorized within four major "pillars" representing LDN's main objectives and mirroring the "pillars" of the SLM framework. That is, the criteria were categorized as addressing "food security", "human well-being", "ecosystem health" or multiples of these pillars as "cross-cutting" criteria. The criteria guide interventions that avoid, reduce and reverse land degradation (i.e., known as "the LDN response hierarchy"), while preventing unintended consequences and contributing to beneficial outcomes (Orr and others, 2017, p. 5).

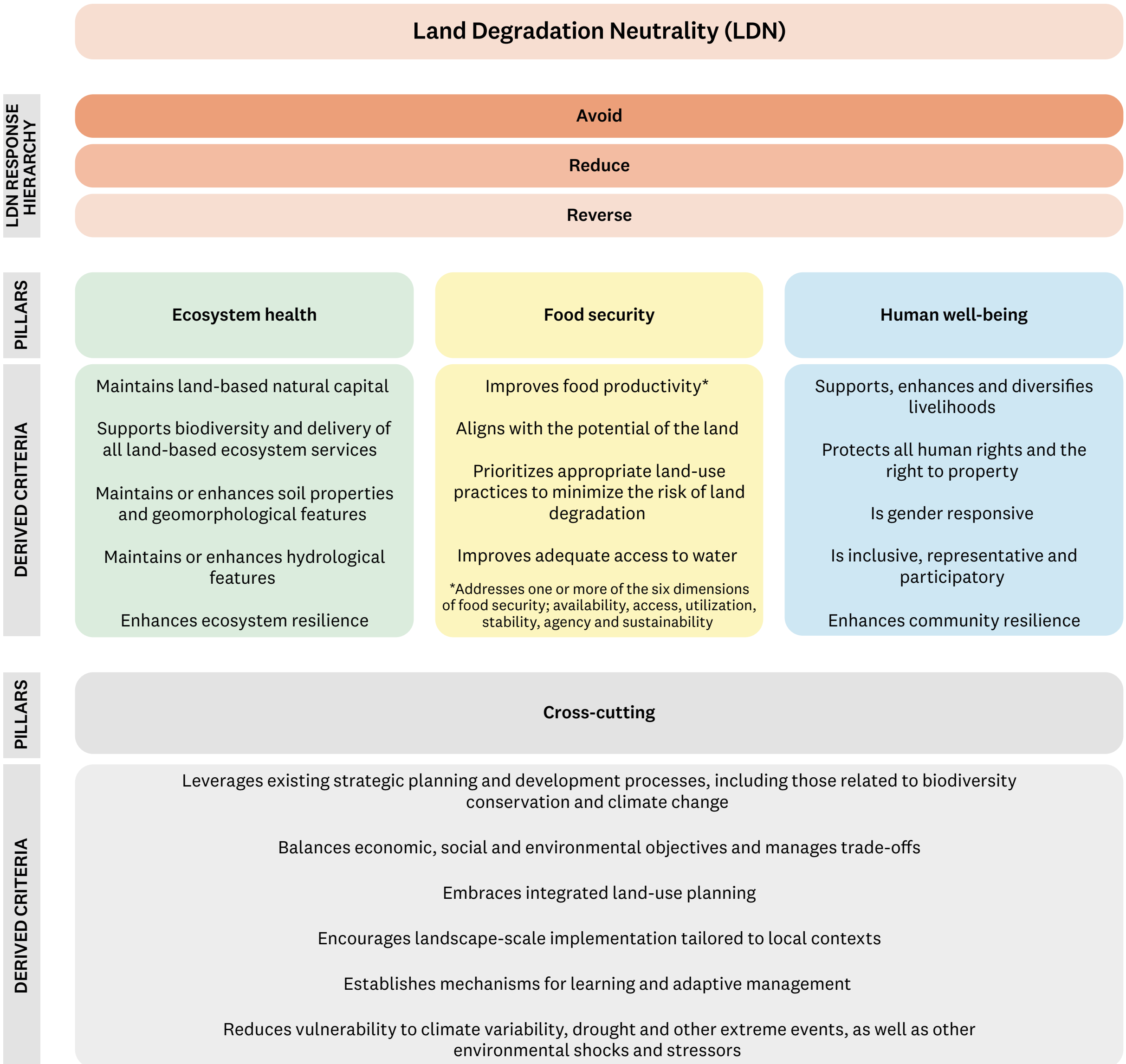

Figure 3: The 20 criteria used to assess the alignment of approaches with LDN, adopted from Orr and others (2017) and UNCCD (2017).

A number of criteria that appear in both the SLM and LDN conceptual frameworks are similar and can be considered to "overlap". These include, for example, support for biodiversity and ecosystem services and the participatory engagement of multiple stakeholders. This overlap reflects the fact that LDN is envisaged to be achieved through the adoption of SLM. Therefore, the characteristics of SLM as expressed through its criteria are frequently reflected by LDN criteria as well. Both SLM and LDN criteria are described in detail in Annex 2.

2.2.2. Evidence from the literature

As a first step in this alignment assessment, more than 200 documents and articles concerning the seven land and water management approaches were reviewed to analyse how the characteristics of the approaches align with the 15 SLM and 20 LDN criteria (and their pillars). An effort was made to include both conceptual publications and case studies documenting the implementation of the approaches whenever possible. This was done to avoid the tendency of conceptual papers to ignore or gloss over practical, important and on-the-ground characteristics that could be central to SLM or to achieving LDN.

The alignment between the characteristics of the approaches and the criteria of SLM and LDN was considered to be either direct or indirect. Direct alignment between the characteristics and the criteria was determined when the literature provided *direct* evidence linking the two. For example, an approach that fosters multi-stakeholder collaboration aligns *directly* with the SLM criterion to involve multiple levels of stakeholders and governance. Indirect alignment was determined when the literature did not explicitly address alignment between the key characteristics and the criteria, but conclusions could be indirectly drawn to that effect. For example, a description of an approach might not explicitly indicate that it is "land-user driven", but it might include evidence that farmers are the main actors adopting the approach. This indirect evidence also suggests alignment with the corresponding SLM criterion.

The literature review also looked for evidence of "non-alignment" or "misalignment". Non-alignment was detected when the evidence showed that a criterion is not addressed by an approach. For example, an approach was considered to be non-aligned with LDN criterion requiring gender responsiveness when it includes no practices or measures to address gender equality in most or all of its implementation contexts. However, non-alignment does not imply misalignment. Misalignment occurs when approaches include measures that might actively undermine SLM or LDN criteria. For example, misalignment could occur when an approach—and the project implementing it—violates land tenure rights in direct contradiction of the LDN criterion to protect all human rights and the right to property.

Evidence of alignment from the literature review was determined to be either "good", "limited", or "no evidence found". For this report, "good evidence" was defined as corroborating evidence regarding alignment from at least three independent sources. "Limited evidence" is evidence from less than three publications. When no publication provided evidence one way or the other regarding alignment between an approach and a criterion, the alignment evidence was categorized as "no evidence found". The robustness of evidence was used in determining the final alignment assessment.

2.2.3. Expert review of preliminary literature-based assessment

Following the literature review, experts working in science, policy and practice relevant to the selected land and water management approaches were consulted. The experts were identified using literature and targeted web searches and approached to request their participation in the alignment assessment. Overall, 65 experts participated in initial 15-minute virtual meetings, in Focus Group Discussions (FGD) and in a final, large-scale expert conference. Efforts were made to ensure gender and geographic balance among the experts. Even so, most were male (68 per cent) and from Europe and North America (60 per cent).

After the initial meetings with individual experts to introduce the project and better identify an expert's field of knowledge, FGDs involving these experts were used to i) review the evidence on alignment extracted from literature, ii) enhance the evidence on alignment by providing expert assessments iii) and recommend other relevant literature, particularly case studies and databases, to generate more robust evidence. Seven FGDs were conducted, each addressing one of the seven land and water management approaches. Experts were asked

- whether and why they agree or disagree with the preliminary literature-based assessment of the alignment, lack of alignment or misalignment of the selected land and water management approaches with SLM and LDN criteria, and
- to provide an expert assessment of whether a land and water management approach aligns with a criterion for which no or limited evidence exists.

The results of this expert consultation provided an additional layer of information relevant to the final alignment assessment and contributed practical knowledge from experts working on the approaches in different contexts.

2.2.4. Final alignment assessment

The final alignment assessment combined evidence from the literature review and from the expert consultations, focus groups and meetings. In several cases, different sources from the literature indicated diverging perspectives on whether or not an approach aligns with a particular criterion. Similar diverging perspectives on alignment also existed among experts. Consequently, the alignment assessment considered agreement and disagreement between literature, between literature and experts and among experts when aggregating evidence: **Alignment** between the approaches and the SLM and LDN criteria was determined when all sources of evidence (literature and experts) showed agreement on alignment. In contrast, a **gap in alignment** was determined when *any* (i.e., one or more) source of evidence (i.e., from literature and/or experts) indicated an approach is not aligned with a certain criterion. This minimum threshold for determining a gap in alignment reflects the study's rationale that *any* evidence, however slight, suggesting that an approach is not aligned with SLM or LDN criteria means that some additional measures could improve the alignment and could more effectively ensure that an approach advances SLM and helps in achieving LDN. No **misalignment** (see above) was detected for any approach with any criterion.

2.2.5. Addressing gaps in alignment

An additional review of the literature was used to develop ideas for addressing identified gaps in alignment between approaches and the SLM and LDN criteria, where they occur. Participating experts were reassembled in a final, virtual conference to discuss these and other ideas for improving the alignment and thus the contribution of the selected land and water management approaches to SLM and to efforts to achieve LDN.

3. Alignment assessment of the selected land and water management approaches

The following subsections provide the findings of the alignment assessment for each of the seven selected land and water management approaches. Each approach is introduced with a definition and characterization derived from the literature followed by an assessment of their alignment with SLM and LDN criteria and pillars. A more detailed version of the alignment assessment for each approach at the level of individual criteria for SLM and LDN can be found in Hartmann and others (forthcoming). Chapter 4 provides a summary overview of these findings across all the selected approaches.

3.1. Agroecology

3.1.1. Definition and characterization of agroecology

Agroecology (AE) is an approach to agriculture that considers ecological, economic, social and political aspects beyond agricultural production (Hecht, 1995; Coopération Internationale pour le Développement et la Solidarité (CIDSE), 2018). The term can be traced in the scientific literature back to the end of the 1920s (Wezel and others, 2020) and has its origins in agricultural sciences, the environmental movement, ecology and the analysis of indigenous practices and rural development studies (Hecht, 1995). There is not one dominant definition for AE as different institutions and countries have adopted an interpretation of the term that reflects their contextual concerns and priorities. Among several existing definitions, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) defines AE in the following terms: “The science and practice of applying ecological concepts, principles and knowledge (i.e., the interactions of, and explanations for, the diversity, abundance and activities of organisms) to the study, design and management of sustainable agroecosystems. It includes the roles of human beings as a central organism in AE by way of social and economic processes in farming systems. AE examines the roles and interactions among all relevant biophysical, technical and socioeconomic components of farming systems and their surrounding landscapes” (IPBES, 2018a, p. 584).

Common across all AE definitions is an understanding that AE represents more than a set of land management and food production practices and entails a broader consideration of social justice and the human-nature connection. A recent guide to AE principles and practices was developed by the international High Level Panel of Experts on Food Security and Nutrition (HLPE). According to the HLPE, AE comprises 13 principles related to both the greater food systems and agroecosystems (HLPE, 2019), and these principles cover aspects such as participation, fairness, biodiversity and input reduction (Agroecology Europe, 2020). AE encompasses practices such as agroforestry, cover crops, no-tillage, integrated water resource management, mixed cultivation, use of peasant seeds, cultivar choice, biological pest control and soil conservation (HLPE, 2019; Wezel and others, 2014; Altieri, 1999).

Women in rice fields in the village of Nalma.

Importantly, AE has a critical political dimension. This is especially true in regions such as Latin America, where AE was introduced via different social movements based on indigenous agricultural practices that aim to work with nature instead of against it (Wezel and others, 2020; Altieri and Toledo, 2011). Here, AE represents an aspiration towards autonomy from dominant production systems and encourages the agency of networks of producers and citizens to self-organize for sustainability and social justice (Anderson and others, 2019).

3.1.2. Alignment of agroecology with SLM and LDN criteria

The assessment of AE found that the approach is in **alignment** with 13 of the 15 SLM criteria and with 18 of the 20 LDN criteria (Figure 4).

As a holistic approach, AE was found to address many criteria across all pillars of SLM and LDN. In the context of the **food security** pillar, for example, AE is concerned not only with how food is produced but also with what kinds of food are produced. It encourages the cultivation of diverse crops and supports dietary principles that promote health, nutrition and well-being (HLPE, 2019). Practices such as intercropping, agroforestry, rotation, cover crops, no-tillage and composting allow farmers to carefully manage agroecosystems without unnecessary or irreparable damage to land resources. This helps reduce degradation and ensures the long-term productive potential of the land (Wezel and others, 2014; Altieri, 1999). Several studies found agroecological practices can have positive impacts on food security and household nutrition in low- and middle-income countries (Bezner Kerr and others, 2021; Global Alliance for the Future of Food, 2021).

AE addresses the human well-being pillar by encouraging farmers, especially smallholders, to harness their own local knowledge and skills to encourage positive interactions with biodiversity that support stable natural states. The approach emphasizes the active involvement and participation of farmers and local communities in the design and implementation of agricultural systems (Altieri, 1995; López-García and González De Molina, 2021; Global Alliance for the Future of Food, 2021; Food and Agriculture Organization (FAO), 2018). Further, social movements and farming families often highlight how AE can help farmers rely less on input and credit markets, expensive technologies and exploitative long supply chains.

In the context of the **ecosystem health** pillar, AE is known to encourage high biodiversity, which helps regulate ecosystem functioning and provides valuable ecosystem services with local and global implications (Boeraeve and others, 2020; Oteros-Rozas and others, 2019; Rosset and Altieri, 2017). A primary goal of the approach is to enhance various ecosystem services and to bolster the resilience of agroecosystems against disturbances, mitigating or managing pest incidents and conserving agricultural biodiversity. AE uses ecological concepts to facilitate natural processes and biological interactions, fostering synergies that improve soil fertility, safeguard crops and boost overall productivity (Wezel and others, 2014). AE also integrates water cycle management into agriculture, including reducing damage to water sources and increasing water infiltration that recharges groundwater (Wezel and others, 2009; Sinclair and others, 2019; Altieri, 1999). In this sense, AE helps maintain the health of water sources and ensures sustainable access to water for both agriculture and communities, clearly aligning with the specific LDN criteria “improves adequate access to water” and “maintains or enhances hydrological features” (Altieri and Toledo, 2011; Palomo-Campesino and others, 2022; Global Alliance for the Future of Food, 2021; Paracchini and others, 2020).

Further, AE was found to align with several cross-cutting criteria. In particular, AE was found to align with the SLM criterion “integrates biophysical, sociocultural and economic needs and values” and the LDN criterion “balances economic, social and environmental objectives and manages trade-offs”. Unlike conventional agriculture, which often focuses on maximizing yields and profits through the use of external inputs such as synthetic fertilizers and pesticides, AE takes an integrated and sustainable approach, seeking to incorporate matters of food security, ecosystem preservation and human well-being (Anderson and others, 2019; Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), 2023; Sinclair and others, 2019). In AE, increases in yield do not come at the expense of the environment, because agricultural practices are environmentally friendly and adapted to the context. As described by Wezel and others (2014, p. 3), AE aims “to produce significant amounts of food while valuing ecological processes and ecosystem services by integrating them as fundamental elements”. Successfully meeting different objectives through AE projects can be assured through monitoring efforts that may include, for example, applying the Tool for Agroecology Performance Evaluation (TAPE; FAO, 2019a).

The assessment of AE found that two of the 15 SLM criteria and two of the 20 LDN criteria show **gaps in alignment** (Figure 4).

These gaps were found in the context of specific criteria within the **human well-being** pillar as well as certain **cross-cutting** criteria. For instance, one gap in alignment corresponds with the SLM criterion “involves multiple levels of governance and stakeholders”. Participation and democratization are at the heart of transformative AE, especially concerning farmers and local communities (Altieri, 1995; Global Alliance for the Future of Food, 2021; FAO, 2018). Yet, this bottom-up, grassroots focus can exclude participation of upper-tier governance actors and generate tension with higher-level stakeholders (Oteros-Rozas and others, 2019; Global Alliance for the Future of Food, 2021). This differs from case to case, however, as many AE initiatives manage to involve multiple levels of governance and recognize the need to work within existing political contexts.

Livelihood in Northern Ghana. Harvesting hot peppers near Chiana, Kassena Nankana District, 2017.

Similarly, the alignment assessment of AE revealed a gap in alignment with the SLM criterion "is socially accepted". This gap reflects the widely varied levels of acceptance of the approach across different regions, communities and stakeholders. AE is based on bottom-up and territorial processes with people at the center to build social acceptance (FAO, 2018). Yet, AE often challenges traditional power structures and is frequently associated with social movements. These attributes affect the acceptance of AE among some established social and governance institutions (López-García and González De Molina, 2021). Here, resistance to change and dominant narratives that marginalize AE also play an important part, as traditional agricultural production has wide legitimacy and profit-driven agribusinesses often hinder the growth and popularization of alternative agricultures, including AE (Montenegro de Wit and Iles, 2016; HLPE, 2019).

Another related gap in alignment concerns the LDN criterion "leverages existing strategic planning and development processes". The contribution of AE to global institutional goals, such as the SDGs, suggests the approach is aligned with this criterion, but AE can disrupt established processes by defying dominant power and governance and by encouraging a shift from top-down technocratic approaches to bottom-up forms of governance (Anderson and others, 2019). Some development processes are often not inclusive of AE activities and often contradict the approach's main principles.

Lastly, AE shows a gap in alignment with the LDN criterion "is gender-responsive". While women's participation is essential for AE and women are frequently leaders of AE projects (Global Alliance for the Future of Food, 2021; Paracchini and others, 2020; FAO, 2018), these essential roles are often not recognized by projects implementing the approach. Oteros-Rozas and others (2019) point out that the academic exploration of gender perspectives within AE remains limited relative to the expansion the field is experiencing. While experts agree that gender responsiveness is an essential principle for AE, they indicate that it is not always followed by on-the-ground practices. More alignment can be generated by including a gender perspective in project planning and implementation. Publications, such as the booklet *Women, Agroecology & Gender Equality* for the Indian context (Khadse, 2017), can serve as guidance.

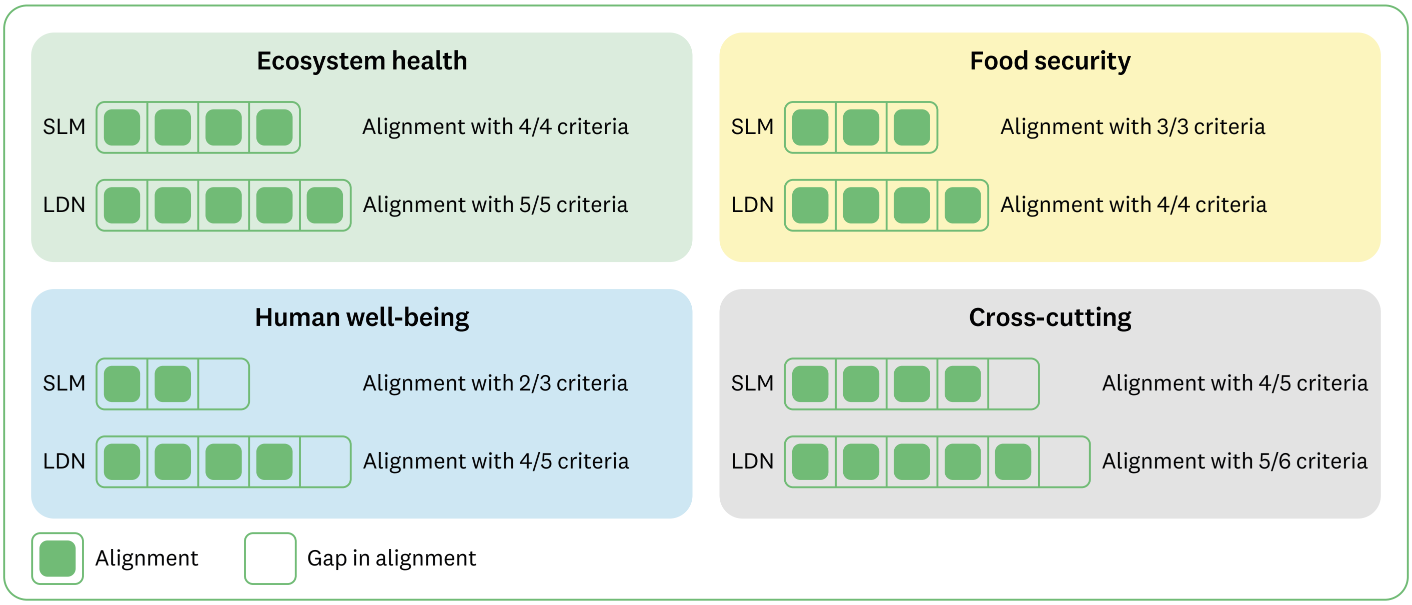

Figure 4: Summary of the alignment of agroecology (AE) with SLM and LDN criteria.

3.2. Climate-smart agriculture

3.2.1. Definition and characterization of climate-smart agriculture

Climate-smart agriculture (CSA) emerged out of growing awareness for the need to understand and address the impacts of a changing climate on agriculture and food security (Mann and others, 2009; Karlsson and others, 2018). CSA as a term was first introduced by the Food and Agriculture Organization (FAO) in 2009 and recognizes that agriculture is both affected by and drives climate change, mainly through the emission of greenhouse gases (Lipper and others, 2014; Alexander, 2019). This report adopts the definition of CSA developed by the FAO: "Climate-smart agriculture is an approach that helps guide actions to transform agrifood systems towards green and climate resilient practices in order to effectively support development and ensure food security in a changing climate. It has three main objectives, which are (i) sustainably increasing agricultural productivity and incomes; (ii) adapting and building resilience to climate change; and (iii) reducing and/or removing greenhouse gas emissions, where possible" (FAO, 2024a; FAO, 2017a).

Concrete practices are used to achieve CSA's three main objectives. These encourage sustainable intensification on existing agricultural land, using available resources more efficiently and reducing and/or removing emissions and land degradation by limiting land use change for agricultural purposes (Lipper and others, 2014). Several publications elaborate on the practices implemented under CSA at the farm and agricultural-plot level in landscapes where climate risks and impacts occur (FAO, 2017a; FAO, 2024a). Importantly, to ensure practices are appropriate for their particular contexts, CSA requires robust data on climate risks that need to be addressed (FAO, 2013a; Alvar-Beltrán and others, 2021).

3.2.2. Alignment of climate-smart agriculture with SLM and LDN criteria

The assessment of CSA found that the approach is in **alignment** with nine of the 15 SLM criteria and with 14 of the 20 LDN criteria (Figure 5).

Foremost, CSA aligns with criteria of the **food security** and **ecosystem health** pillars. CSA maintains and enhances the productive potential of land and therefore sustains agricultural opportunities in the face of climate change (Alvar-Beltrán and others, 2021). It does so by emphasizing resource efficiency and by adopting targeted practices to reduce climate change impacts on crops and livestock (Alvar-Beltrán and others, 2021; FAO, 2013a). Examples of these practices include planting heat-tolerant crops to adapt to extreme heat; the integration of agroforestry to reduce soil heat exposure as well as cover cropping; and nutrient management and rotational grazing to avoid soil erosion and land degradation (Du Preez, 2020; Lipper and others, 2014; Alvar-Beltrán and others, 2021; Aggarwal and others, 2018). The choice of practices used by a CSA approach reflects each region's specific climate risks and the adaptive capacity of the land (Lipper and others, 2014; FAO, 2013a; Alvar-Beltrán and others, 2021). These context-specific practices contribute to the maintenance of the natural resource base for secured food production as well as to the health and functionality of ecosystems. According to the FAO (2021), increasing the resilience of agroecosystems is central to the CSA approach, and many CSA practices aim to improve an agroecosystem's biophysical soil and water conditions to help crops cope with and adapt to climate extremes (Du Preez, 2020; Choudhary and others, 2022; Datta and others, 2022; Alvar-Beltrán and others, 2021). For example, case studies suggest CSA practices increase plant-available nutrients (Tadesse and others, 2021; Choudhary and others, 2022; Datta and others, 2022). These, in turn, help maintain and enhance agroecosystem health and promote the provision of agroecosystem services. However, the extent to which CSA supports natural ecosystems is unclear. Torquebiau and others (2018) point out that biodiversity and ecosystem services beyond agricultural contexts are not priorities for CSA. These authors conclude that the approach should be integrated with agroecological practices that follow ecological principles. Harvey and others (2014) suggest CSA should be applied across landscapes that include different land uses, integrating agricultural and natural habitats that allow for sustainable intensification in one place and the preservation of natural habitats in another. Scherr and others (2012) highlight the benefits of embedding CSA in a larger context, suggesting that a variety of land uses across a landscape supports resilience and that the management of interacting land uses within a landscape can help achieve multiple ecological and agricultural goals.

CSA was also found to align with cross-cutting criteria of SLM and LDN: “enables adaptation to climate change and contributes to climate change mitigation” (SLM); “reduces vulnerability to climate variability, drought and other extreme events” (LDN); “contributes to progress on policy targets and institutional goals” (SLM); and “leverages existing strategic planning and development processes” (LDN). These criteria are reflected in two of the core objectives of the approach, climate change adaptation and mitigation. They support SLM and efforts to achieve LDN by emphasizing the reduction of agriculture-related greenhouse gas emissions and strategies to reduce the climate vulnerability of food producers (FAO, 2021; Lipper and others, 2014; Du Preez, 2020; Alvar-Beltrán and others, 2021). This vulnerability is reduced through measures such as weather insurance, community-led water management or contingency planning (Aggarwal and others, 2018). These characteristics ensure the approach contributes to progress on climate policy targets and institutional goals, such as the 1.5°C climate change mitigation goal of the UNFCCC Paris Agreement (2015). A report by the FAO (2016) documents that more than 30 countries referred to CSA in their intended Nationally Determined Contributions (NDCs) to the Paris Agreement. On the other hand, existing targets and processes sometimes limit the willingness of relevant stakeholders to support CSA as a new approach, therefore limiting the potential of CSA to contribute to institutional goals such as the Paris Agreement. Lipper and others (2014) suggest that CSA’s potential to support policy targets requires greater coherence across multilateral political processes. Reviewing national and international frameworks, such as the UNCCD and UNFCCC National Adaptation Plans, National Action Plans and Nationally Determined Contributions, could reveal potential synergies among CSA and policy targets (Orr and others, 2017) and encourage the adoption of the approach.

The assessment of CSA found that six of the 15 SLM criteria and nine of the 20 LDN criteria show **gaps in alignment** (Figure 5).

The most frequent CSA gaps in alignment with SLM and LDN concern criteria within the **human well-being** pillar, as well as related cross-cutting criteria. In particular, the gaps in alignment correspond with the SLM criterion “involves multiple levels of governance and stakeholders”, the LDN criteria “inclusive, representative and participatory” and the SLM criterion “is socially accepted”.

Although the FAO’s CSA sourcebook (FAO, 2017a) describes several social considerations important to the approach (i.e., rural development, gender, knowledge sharing and social protection), CSA projects are frequently criticized for failing to implement these measures. For example, CSA aims to support smallholder farmers who are the most vulnerable to climate change impacts, but researchers suggest that this group and their knowledge are often excluded from participation and inclusion in CSA efforts (Karlsson and others, 2018; Taylor, 2018; Autio and others, 2021). They warn that by insufficiently considering these smallholders, CSA can fail to address issues of vulnerability and equity in agriculture. Vulnerability, however, is complex and general statements of this kind may not be entirely accurate. Indeed, vulnerability can be reduced by CSA if it improves climate change adaptation and, in turn, reduces the exposure of vulnerable groups to climate hazards (GIZ and EURAC, 2017; Oppenheimer and others, 2014). Nevertheless, neglecting key stakeholders, such as smallholders, and their needs affects the livelihoods of these groups and potentially reduces the long-term effectiveness and social acceptance of CSA (Fanen and Olalekan, 2014; Taylor, 2018; Autio and others, 2021; Karlsson and others, 2018; La Via Compensia, 2014).

The alignment assessment of CSA showed a similar gap of alignment with the LDN criterion "is gender-responsive". That is because CSA projects sometimes fail to address gender equity. Evidence from the literature suggests that female farmers are more vulnerable to climate risks because of societal norms, gendered division of labor, access to information, access to services and limited entitlements relative to those of men (Huyer and Partey, 2020; Autio and others, 2021; FAO and The World Bank, 2017). In their study of CSA projects, Huyer and Partey (2020) conclude that the contribution of CSA to gender equality is generally not well understood. CSA may even solidify existing power relationships and gender inequalities by failing to account for what groups benefit from CSA projects and what groups do not (Haapala, 2019). To encourage more action for gender equity when implementing CSA projects, the FAO and The World Bank (2017) published *How to integrate gender issues in climate-smart agriculture projects* as a training module. The module provides examples of gender-responsive interventions, such as organizing capacity development for women, increasing women's access to services, education and information and ensuring financing mechanisms are accessible for women.

Another gap in alignment linked to the human well-being pillar corresponds to the LDN criterion "protects all human rights and right to land tenure" (LDN). Literature suggests that CSA has a narrow focus on productivity and that smallholders often lose land to profit-oriented companies—a criticism supported by one expert who described small-scale farmers in Africa who have lost their land to monoculture-oriented agricultural investors (Karlsson and others, 2018; Sharma and Suppan, 2011). CSA does not strongly emphasize issues of human rights, particularly tenure rights, as the approach tends to focus on technical, crop-oriented solutions for adaptation and mitigation rather than on social considerations (Taylor, 2018; Karlsson and others,

A local man walks on parched soil in the Chibayish marshland in Iraq's southern Dhi Qar province in June, 2023. © AFP / Asaad Niazi

2018). The enabling environment of CSA needs to protect land users and farmers as part of a social safeguard within each CSA project. Lipper and others (2014) stress the need to improve tenure governance to provide security over privately owned and managed land, particularly if it improves the interests of poor and marginalized groups, such as women. A number of publications provide guidance on how to protect and improve land tenure, such as the *Voluntary Guidelines on the Responsible Governance of Tenure* (VGGTs, FAO, 2019b) and the *Gender and Land Rights Database* (GLRD, FAO, 2010b). The latter provides contextual data that can inform decision-making in the implementation process of CSA projects (Orr and others, 2017). However, participating experts suggest these guidelines may not be effective as they are voluntary and their application is not guaranteed. The experts emphasized a need for CSA to include the protection of community and tenure rights within its definition.

Other gaps in alignment were found to correspond to the **cross-cutting** SLM criterion “integrates biophysical, sociocultural, and economic needs and values” and the cross-cutting LDN criterion “balances economic, social and environmental objectives and manages trade-offs”. These gaps reflect CSA’s focus on mostly economic, production-related objectives, the approach’s lack of attention to the participation of people on the ground and its failure to sufficiently integrate and balance different objectives and social needs (Karlsson and others, 2018; Taylor, 2018; CIDSE, 2015; La Via Compensia, 2014). In their evaluation of the effectiveness of CSA projects, van Wijk and others (2020) found that many assessment methods do not address all three of the CSA objectives (i.e., productivity, adaptation and mitigation). Instead, most focus on production-related biophysical metrics, such as yield, income, water use or carbon emissions, while neglecting social indicators, such as equity and poverty reduction.

Lastly, the criterion “increases food security and livelihoods” of the SLM food security pillar is also considered a gap in CSA’s alignment with SLM and LDN. Although food security, as a social need, is considered an ultimate goal of CSA (FAO, 2013a; Lipper and others, 2018; CIAT and World Bank, 2018), Karlsson and others (2018) and Taylor (2018) criticize the approach for not sufficiently addressing access to food and for not supporting marginalized poor and vulnerable groups in ways that increase food security.

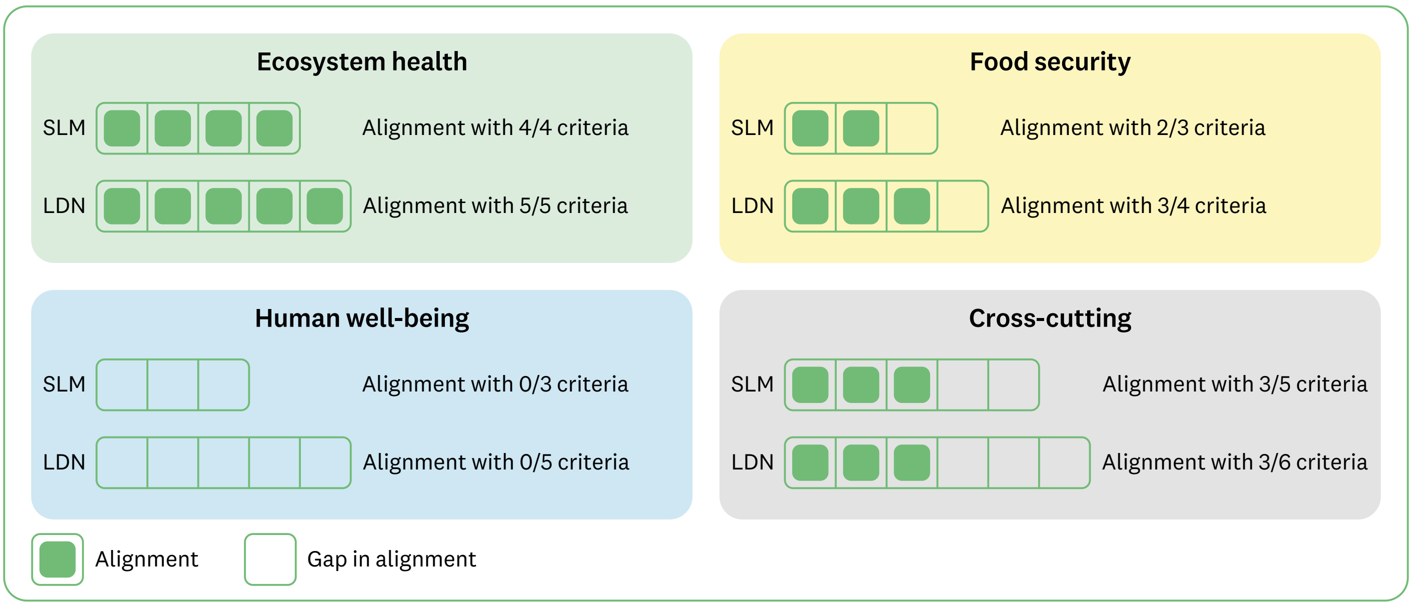

Figure 5: Summary of the alignment of climate-smart agriculture (CSA) with SLM and LDN criteria.

3.3. Conservation agriculture

3.3.1. Definition and characterization of conservation agriculture

Conservation agriculture (CA) is a land management approach that promotes minimal soil disturbance, permanent soil cover and the use of diverse plant species (FAO, 2024b). The approach emerged from the field of soil conservation in response to the ecological consequences of the Dust Bowl droughts of the 1930s in North America (Baveye and others, 2011). According to the FAO (2024b), CA aims to enhance biodiversity and promote biological processes within and above the soil, while contributing to increased water- and nutrient-use efficiency and greater crop production. This framing is adopted by the IPBES (2019, p. 1036) which defines CA in the following terms: "An approach to managing agroecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. It is characterized by three linked principles, namely: 1) continuous minimum mechanical soil disturbance; 2) permanent organic soil cover; and 3) diversification of crop species grown in sequences and/or associations. This covers a wide range of approaches from minimum till to permaculture and 'mimicking nature'". This definition, however, is not universally followed. Giller and others (2015) point to different interpretations of CA that have emerged over the years, highlighting different objectives with significant implications for the types of practices used to achieve them.

Nevertheless, a consensus among these interpretations suggests that CA addresses the three underlying, fundamental principles described in the IPBES definition: In particular, these are (1) CA minimizes soil disturbance through mechanical action (i.e., using no tillage practices or using direct seed and fertilizer placement as an alternative); (2) it maintains a permanent soil organic cover of at least 30 per cent using crop residues and/or cover crops; and (3) it encourages crop species diversification by varying crop sequences and associations and involving at least three different crop types (FAO, 2024b). Lal (2015) uses an integrated, system-based interpretation of CA to suggest adding a fourth principle that includes integrated nutrient management. In this view, the interconnectedness of the four principles is considered essential to CA's functioning. Other scholars also suggest adding the appropriate use of organic fertilizers to enhance productivity as another key characteristic of the CA approach (Vanlauwe and others, 2014; Giller and others, 2015; Bajwa and others, 2014).

The practices that typify a CA approach closely reflect the principles and primarily concern crop and soil-related activities at the field level: Minimizing soil disturbance is directly tied to the practice of no-tillage (Lal, 2015; FAO, 2024b; Mugandani and others, 2021); ensuring permanent soil cover is achieved through crop residue, the use of cover crops, agroforestry and/or mulch; and greater crop species diversity is associated with crop rotation involving several different crop types (FAO, 2024b; Jiban and others, 2020; Mitchell and others, 2019; Jayaraman and others, 2021; Kassam and others, 2019).

3.3.2. Alignment of conservation agriculture with SLM and LDN criteria

The assessment of CA found that the approach is in **alignment** with 10 of the 15 SLM criteria and with 14 of the 20 LDN criteria (Figure 6).

The approach, which seeks to improve biophysical conditions for and through agricultural production, mainly aligns with criteria of the **food security** and **ecosystem health** pillars. CA directly conserves soil fertility and restores it where degradation is present. This helps to sustain land productivity, conserve the natural resource base, enhance plant diversity, reduce the need for inputs (i.e., fuel, seed, fertilizer and water), minimize soil disturbance and enhance soil water infiltration and retention.

In turn, these processes support the long-term potential of the land to generate ecosystem services (Mitchell and others, 2019; Jiban and others, 2020; Kassam and others, 2014; Araya and others, 2016; Wittwer and others, 2021; Jayaraman and others, 2021; Mugandani and others, 2021; Lal, 2015; Eze and others, 2020) and contribute to the LDN response hierarchy (i.e., to avoid, reduce and reverse land degradation; Pandit and others, 2018).

CA was also found to align with three cross-cutting criteria: "economically viable" (SLM), "enables adaptation to climate change and contributes to climate change mitigation" (SLM) and "reduces vulnerability to climate variability, drought and other extreme events" (LDN). CA supports farm households by reducing the need for expert inputs and labor, cutting costs while increasing long-term yields (i.e., relative to conventional agricultural systems). This means the approach is regarded as economically profitable (Kassam and others, 2019; Jiban and others, 2020; Friedrich and others, 2012; Sapkota and others, 2015). CA also promotes the reduction of carbon emissions from agriculture and, most importantly, increases soil carbon sequestration (Kassam and others, 2014; Sapkota and others, 2015; Jat and others, 2020). Similarly, the approach builds farm-level resilience to extreme weather events by promoting soil health and crop diversity (Steward and others, 2019; Jayaraman and others, 2021). These are particularly helpful in mitigating yield losses from deviations in rainfall (Michler and others, 2019; Corbeels and others, 2014).

The alignment assessment also found that the approach's focus on improving soil features (with their cascading social and economic benefits) aligns with many criteria within the human well-being pillar, as well as some related cross-cutting criteria. These, however, may not always be evident. For example, in the context of the LDN criterion "is gender responsive", little evidence from many existing CA projects points to a systematic integration of gender as an important component. Only a few integrate gender-sensitive safety nets (Tittonell and others, 2012) or target women and youth, as is the case with the African Conservation Tillage (ACT) Network. However, gender is increasingly acknowledged in narratives surrounding CA projects, pointing to an emerging trend toward better alignment with this criterion (Whitfield and others, 2015). Lastly, CA is an approach that can be adapted to local contexts through targeted CA practices (Page and others, 2020; Mitchell and others, 2019).

The assessment of CA found that five of the 15 SLM criteria and six of the 20 LDN criteria show **gaps in alignment** (Figure 6).

Among these gaps are shortcomings in the context of two criteria of the food security pillar— "increases food security and livelihoods" (SLM) and "improves food productivity" (LDN)— as well as with the LDN criterion "protects all human rights and right to property" of the **human well-being** pillar. In many cases, CA has the capacity to increase crop yields in comparison to conventional agricultural systems, keep production costs low and enhance crop and systemic resilience to external pressures, including extreme weather (Sapkota and others, 2015; Monjardino and others, 2021; Steward and others, 2019; Hobbs and others, 2008). However, yield increases in CA projects are not universal, with yield stagnation and decreases also evident in some cases. This appears to depend on both CA implementation (i.e., choice of practices) and regional climatic conditions (Jayaraman and others, 2021).

The apparent gap in alignment in the context of the LDN criterion "protects all human rights and right to property" (LDN) reflects a lack of explicit integration of human rights and land tenure rights into some CA projects. In some cases, such those involving semi-nomadic communities, CA adoption may result in confining practitioners to the land to ensure increased productivity.

Another gap in alignment was found in the context of the SLM criterion "integrates indigenous, local and traditional knowledge".

Herb garden outside Hội An, Vietnam, February 2020.
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Although CA is sometimes described as a blend of indigenous and exogenous farming knowledge that can be applied to a variety of landscapes through locally-adapted practices (Mitchell and others, 2019), CA projects often fail to adequately integrate this knowledge on the ground. In Malawi, for example, Chinseu and others (2019) suggest that—despite the active promotion of CA by international donors, advisory bodies, governments and nongovernmental organizations—CA projects are often not adopted by local smallholders who feel the approach fails to consider co-design and the incorporation of local knowledge leads. These concerns are exacerbated by a lack of technical support for implementing CA and by a narrow focus on economic benefits that are often not achieved once donor organizations move out.

Other gaps in alignment relate to the SLM criterion “involves multiple levels of governance and stakeholders” and the LDN criterion “is inclusive, representative and participatory”. These also result from the indifference of some CA projects to local input. Without local support from farmers willing to adopt a co-designed approach, CA misses an important opportunity for sustainable implementation to ensure SLM and LDN. Evidence reviewed for this report was unclear concerning the extent of the involvement of multiple levels of governance and stakeholders in participatory decision-making. Some of the evidence, however, showed CA is becoming increasingly integrative, promoting more participation by multiple key stakeholders, such as farmers, researchers and non-governmental organizations to harness synergies (Monjardino and others, 2021; Tittonell and others, 2012).

Gaps in alignment with respect to the **cross-cutting** SLM criterion "integrates biophysical, sociocultural, and economic needs and values" and the LDN criterion "balances economic, social and environmental objectives and manages trade-offs" (LDN) are similarly affected by the failure of CA to address social factors (Chinseu and others, 2019). Although CA is expected to consider the broader economic drivers and social constraints influencing the adoption and success of the approach at the farm level (Monjardino and others, 2021; Tittonell and others, 2012), the evidence for this consideration among CA projects is limited.

Other gaps in alignment of CA were found for criteria associated with the ecosystem health pillar, including the twin SLM and LDN criteria "supports biodiversity, ecosystems and ecosystem services and functions" and "maintains or enhances soil properties." Despite results that suggest that CA is generally beneficial for the environment, concerns exist regarding the use of glyphosate to remove the weeds that often propagate with no-till ahead of seeding. The United Nations Environment Programme (UNEP, 2018) reports that an increasing number of fields employing a CA approach in South America, the United States and Europe are treated with the herbicide, despite growing evidence of its potential negative environmental impacts. These impacts include alteration and disruption of soil biodiversity as well as the pollution of plots near water bodies.

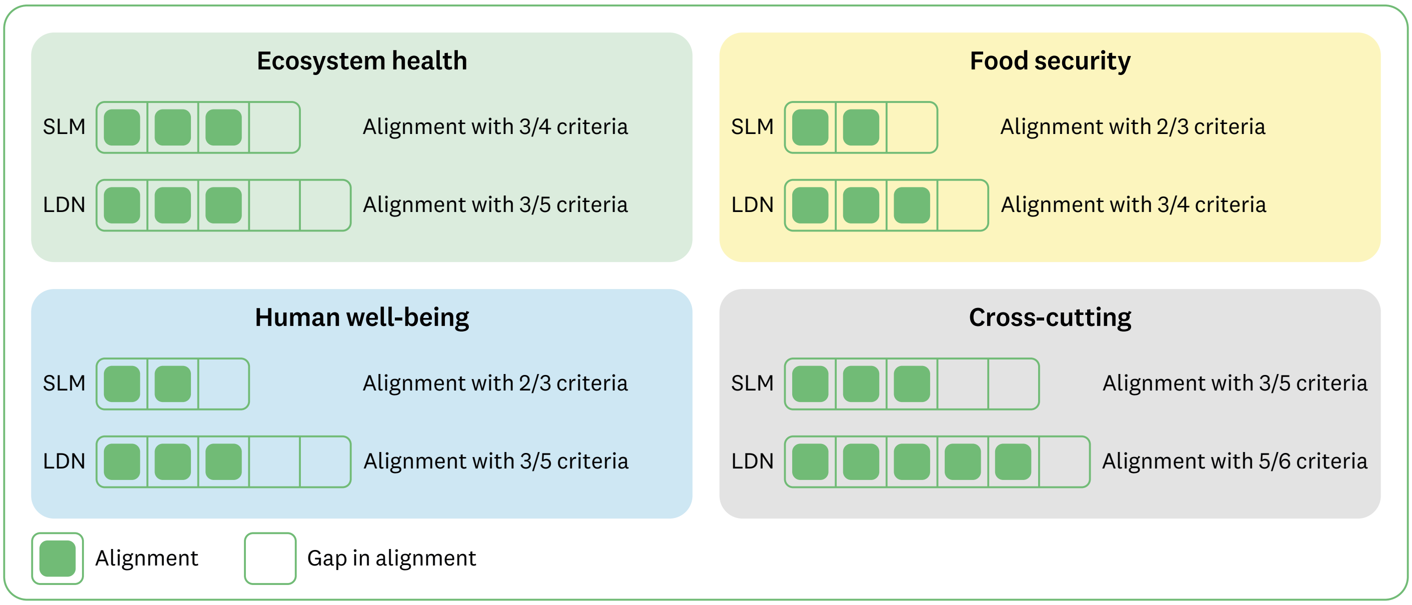

Figure 6: Summary of the alignment of conservation agriculture (CA) with SLM and LDN criteria.

3.4. Forest landscape restoration

3.4.1. Definition and characterization of forest landscape restoration

Forest Landscape Restoration (FLR), also known as Forest and Landscape Restoration, is an approach that seeks to restore a degraded landscape through various means of forest-related management interventions and to maximize environmental, cultural and economic benefits to meet the immediate and future needs of communities. The term “forest landscape restoration” was coined in 2000, and since then, the approach has been increasingly adopted by governments committed to the Bonn Challenge and other initiatives seeking to halt land degradation and biodiversity loss (International Institute for Sustainable Development, 2002; Laestadius and others, 2015). The approach is defined as “a planned process that aims to regain ecological functionality and enhance human well-being in deforested or degraded landscapes” (Mansourian and others, 2017, p. 179; Besseau and others, 2018), and it is used by the Global Partnership on Forest and Landscape Restoration (GPFLR) and many international conservation, development and scientific organizations. In its effort to further define the approach, the GPFLR (2024) suggests that “as a process, FLR is not an end, but a means of regaining, improving, and maintaining vital ecological and social functions, in the long-term leading to more resilient and sustainable landscapes” and that FLR is “an active process that brings people together to identify, negotiate and implement practices that restore an agreed optimal balance of the ecological, social and economic benefits of forests and trees within a broader pattern of land uses” (GPFLR, 2024).

FLR is characterized by six principles: (i) it applies at landscape scales; (ii) it maintains and enhances natural ecosystems within landscapes; (iii) it engages stakeholders and supports participatory governance; (iv) it is tailored to local contexts; (v) it restores multiple functions for multiple benefits, and (vi) it encourages adaptive management for long-term resilience (GPFLR, 2018). FLR is characterized by a generally holistic philosophy that considers the biophysical and broader social-ecological system, with an emphasis on the long-term viability of restoration efforts.

Practices adopted under FLR include restoration and rehabilitation through protective measures (e.g., protection from fire or overgrazing and erosion control), measures to accelerate natural regeneration (e.g., through direct seeding or by planting seedlings in degraded primary or secondary forests), measures to assist natural regeneration (e.g., through weed control on degraded lands and marginal agricultural sites) and the planting of native or introduced trees in single-species or mixed-species plantations in agroforestry production systems and as trees outside forests (Sabogal and others, 2015; Höhl and others, 2020). Other techniques can be introduced to FLR on a project level, depending on the goals and needs of local stakeholders. These may include farmer-assisted natural regeneration, fire reintroduction and native recolonization (César and others, 2021; Noulèkoun and others, 2021; Stanturf and Mansourian, 2020; Sabogal and others, 2015; International Union for Conservation of Nature (IUCN), 2014). FLR accommodates a variety of land uses at the landscape scale, including agriculture, protected wildlife reserves, riverside plantings, managed plantations and more (IUCN, 2024).

3.4.2. Alignment of forest landscape restoration with SLM and LDN criteria

The assessment of FLR found that the approach is in **alignment** with 11 of the 15 SLM criteria and 15 of the 20 LDN criteria (Figure 7).

FLR’s focus on the health and long-term viability of forest ecosystems and land-related development objectives ensures its alignment with the criteria of the **ecosystem health** pillar, for example “supports biodiversity, ecosystems and ecosystem services and functions” of SLM, or “maintains or enhances soil properties and geomorphological features” and “enhances ecosystem resilience” of LDN. FLR aims to restore structure and ecological processes within forested ecosystems while providing benefits to people and biodiversity (IUCN, 2014; ITTO, 2020; GPFLR, 2020; Stanturf and Mansourian, 2020). For example, FLR can sustain soil health (Page-Dumroese and others, 2021) through reforestation of local tree species, which reduces soil erosion and loss of soil fertility (GPFLR, 2020). A strategic use of tree planting in combination with natural regrowth can protect tree cover over watersheds and improve local and regional water availability (Mansourian and Vallauri, 2014). In West African woodlands, for example, groundwater recharge is maximized with moderate tree cover (Guariguata and others, 2021). Young, regenerating tropical forest vegetation can improve locally important hydrological ecosystem services by reducing evapotranspiration rates and improving streamflow between rainfall events (van Meerfeld and others, 2020). Reforestation also improves infiltration and soil moisture recycling (Bruijnzeel and others, 2023). Through these processes—in addition to others, such as prescribed fire regimes (Halpern and others 2022)—FLR boosts ecosystem resilience, including in the face of extreme events such as flooding (Halpern and others, 2022; Guariguata and others, 2021; van Meerfeld and others, 2020).

The assessment also found that FLR aligns with four cross-cutting criteria, namely “enables adaptation to climate change and contributes to climate change mitigation” (SLM), “reduces vulnerability to climate variability, drought and other extreme events” (LDN), “contributes to progress on policy targets and institutional goals” (SLM) and “leverages existing strategic planning and development processes” (LDN). FLR tends to be well integrated in national and international policy frameworks for sustainable development. It also contributes to climate change mitigation, adaptation and reduced vulnerability to extreme events. FLR is said to be a natural climate adaptation pathway with a high mitigation potential, particularly through carbon sequestration and through building ecosystem resilience to disasters and climate change (Garrett and others, 2022; Nave and others, 2018; Beatty and others, 2018). Evidence suggests atmospheric carbon is sequestered through FLR projects encompassing planted woodlands, mangrove restoration, agroforestry and natural regeneration (Bernal and others, 2018). FLR also contributes to climate change adaptation by reducing vulnerability and fostering rural economies (Stanturf and others, 2015). Consequently, FLR is considered a key contributor to global policy targets related to climate change and biodiversity loss, such as the UNFCCC Paris Agreement, the SDGs, the UN Decade on Ecosystem Restoration, Initiative 20x20 and the Kunming-Montreal Global Biodiversity Framework (Murcia and others, 2016; GPFLR, 2020). Of particular interest for the alignment assessment, the International Union for Conservation of Nature (IUCN) has already highlighted the policy convergence of FLR and LDN (Gichuki and others, 2019; see also UNCCD, 2019).

FLR also aligns with the SLM criterion “ensures the long-term productive potential of land” and the LDN criterion “aligns with the potential of the land” (LDN) among the criteria of the **food security** pillar. This alignment reflects the integration of agroforestry practices in FLR projects that support local food production and the satisfaction of nutritional needs (Vira and others, 2015; Ickowitz and others, 2022; Guuroh and others, 2021). Moreover, FLR aims to re-establish the productive functions of ecosystems and, thus, increases the productivity of landscapes (Garrett and others, 2022). Experts emphasize the importance of considering a broad range of relevant biophysical and social indicators concerning land potential when implementing FLR (Besseau and others, 2018; Chazdon and Guariguata, 2018). Case studies show that FLR integrates restoration and conservation practices in community-centered approaches, contributing to the long-term maintenance of the productive potential of land resources (ITTO, 2020). However, the alignment of FLR with several other criteria within the food security pillar is only supported by limited evidence and appears to be context specific, depending on the specific objectives of the FLR activity.

Notably, FLR also aligns with the SLM criterion “integrates indigenous, local and traditional knowledge” of the human well-being pillar. Examples of FLR projects include indigenous community-based restoration projects, and an important success factor in past FLR projects has been the use of local knowledge on soils, species interactions and species selection appropriateness (ITTO, 2020; Kamelamela and others, 2022). A recognition of the importance of integrating indigenous and western knowledge can help FLR projects better address diverse stakeholder needs (Lake and others, 2018).

The assessment of FLR found that four of the 15 SLM criteria and five of the 20 LDN criteria show **gaps in alignment** (Figure 7).

As with many other approaches assessed, gaps mainly concern criteria of the **human well-being** pillar. This stems from the mixed record of FLR projects in contributing to the protection of land-user rights and land ownership, gender responsiveness and the active inclusion of stakeholders, particularly local farmers. Challenges with tenure and land ownership often reflect the complex relationship between rights to property and rights to tenure in many contexts. This complexity can create difficulties for implementing FLR projects (Stanturf and Mansourian, 2020; McLain and others, 2021; Mansourian and Stephenson, 2023). Tenure rights are especially important in the context of forests, and unless there is clarity concerning long-term use and rights and ownership, the success of FLR can be compromised.

Gaps in alignment of FLR also occur in the context of the SLM criteria “involves multiple levels of governance and stakeholders”, “is inclusive, representative and participatory” and “is socially accepted”. These gaps are frequently the result

A woman holds a sapling that will be planted in a reforestation area in Tigray, Ethiopia.
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of FLR practices that use a top-down approach that clashes with local, productivity-oriented objectives, neglecting local needs and dissuading local acceptance of FLR in specific contexts (Höhl and others, 2020; Stanturf and Mansourian, 2020). Not properly involving communities in project implementation also conflicts with FLR’s own principle to engage stakeholders and to support participatory governance. Stanturf and Mansourian (2020) acknowledge that “in practice, initiatives are still in their infancy when it comes to fully adhering to the objectives of this approach, and many initiatives that are labelled FLR would not qualify under its definition or principles”. In some cases, excluded communities are women and minorities. Although FLR purports to consider gender issues and to ensure that stakeholder engagement is gender-responsive and addresses power imbalances (GPFLR, 2020; Besseau and others, 2018; Djenontin and others, 2021; Chazdon and others, 2020), evidence suggests that women, along with other marginalized groups, are often excluded from REDD+ projects intended to enhance carbon capture in forest landscapes (Sarmiento Bartletti and Larson, 2017).

On the other hand, success stories of women in leadership positions in FLR projects exist. In Cameroon, for example, FLR projects have the active support of women through existing non-government organizations, higher-level networks of stakeholders and knowledge centers (Mbile and others, 2019). The gap related to the SLM criterion "involves multiple levels of governance and stakeholders" may reflect a lack of coordination in governance and policies affecting different elements of landscapes and their uses (for agriculture, conservation, water, minerals, transportation, forestry, etc.). Intersectoral coordination and overlapping governance arrangements are a common challenge, due to the transboundary nature of landscapes. FLR is shaped by "diverse elements of governance" that can make it difficult to establish policies that reflect the often-conflicting interests of a multitude of actors (Noulèkoun and others, 2021, p. 6).

Other gaps in alignment of FLR were found in the context of two related **cross-cutting** criteria, "integrates biophysical, sociocultural and economic needs and values" (SLM) and "balances economic, social and environmental objectives and manages trade-offs" (LDN). These gaps—like the gaps in alignment with criteria of the human well-being pillar—reflect the failure of many FLR projects to account for social factors and to integrate the needs and values of local stakeholders. While some FLR examples, such as the Africa Great Green Wall project, successfully encourage community participation and balance environmental welfare and food security (Sacande and others, 2015), other FLR projects have been known to fail because they disregard local communities during their planning and implementation. FLR projects that actively generate co-benefits for stakeholders are more sustainable than those with narrow objectives, such as sequestering carbon (Metcalf and others 2015).

Lastly, another gap in alignment of FLR was found in the context of the LDN criterion "establishes mechanisms for learning and adaptive management". Although this criterion is reflected in the FLR principles and the need for it is well-established to track the successes and failures of FLR projects, it is often overlooked. The time needed for an adaptive management process is often not budgeted or properly allocated into many project timelines. In addition to limited budgets, loosely defined indicators and technical challenges are also obstacles to deploying adaptive management strategies (Höhl and others, 2020).

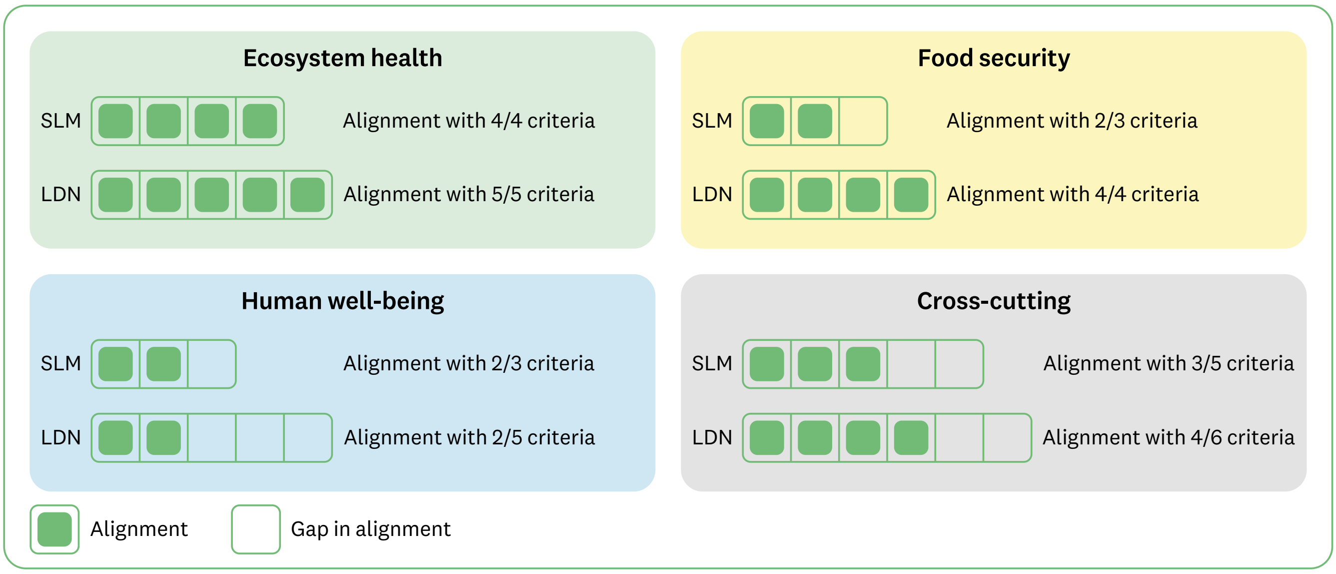

Figure 7: Summary of the alignment of forest landscape restoration (FLR) with SLM and LDN criteria.

3.5. Integrated agriculture

3.5.1. Definition and characterization of integrated agriculture

Integrated agriculture (IA) refers to agricultural production systems characterized by the operational integration of multiple separate, interconnected enterprises, resulting in synergistic interactions and resource transfers among them (Hendrickson and others, 2008). IA is known in academic arenas as a resource management strategy for sustainable agricultural production, while meeting the requirements of farm households and preserving the environment and the available resource base (Liebig and others, 2017). IA emphasizes the importance of synergistic resource transfer and the sustainable delivery of ecosystem services (Dar and others, 2018). Unlike many of the other land and water management approaches assessed in this report, IA lacks a clearly-defined identity and has no representative organization or network of practitioners and stakeholders. Instead, it is an overarching set of principles centered on the idea of integration both at the farm level and at greater scales. Consequently, IA manifests itself in very distinct sets of practices when applied on the ground, and it often involves the integration of a broad range of processes and systems, including agroforestry, horticulture, livestock, fisheries, sericulture, apiculture, biogas and others (Dar and others, 2018).

The most common practical expression of an IA approach is an integrated crop-livestock system (ICLS). ICLS is characterized by the operational integration of plants and animals in agriculture (FAO, 2010a; Sekaran and others, 2021). In a broader sense, IA incorporates sustainable practices associated with other land management approaches as part of its integration process, such as intercropping and relay cropping (Chai and others, 2021) or, at larger scales, using biogas plants to generate energy from waste in an integrated system (Dar and others, 2018). IA occurs at multiple scales, from the scale of individual farms up to scales the encompass entire landscapes.

The integration of disparate enterprises and the consequent synergistic transfer of resources forms a central core principle of IA (Dar and others, 2018; Hendrickson and others, 2008; Liebig and others, 2017; Soni and others, 2014; Chai and others, 2021; Gabathuler and others, 2009). This principle ensures IA is more adaptive to both climate and market variability. The approach is inherently site-adapted and encourages the sustainable delivery of ecosystem services (Liebig and others, 2017). IA also encompasses key social elements, namely increasing local farmer incomes and improving the living standards of smallholders (Dar and others, 2018). Integration within IA is not necessarily limited to operational mechanisms, but it also involves an integration of the natural environment, including soil, animals and plants, with economic considerations and energy supplies (Dar and others, 2018; Gabathuler and others, 2009; European Initiative for Sustainable Development in Agriculture, 2001).

3.5.2. Alignment of integrated agriculture with SLM and LDN criteria

The assessment of IA found that the approach is in **alignment** with 14 of the 15 SLM criteria and with 17 of the 20 LDN criteria (Figure 8).

IA, as an approach that targets improving biophysical conditions, was found to align with all of the criteria of the **ecosystem health** pillar of the SLM and LDN frameworks, as well as with the majority of criteria of the **food security** pillar, such as “maintains and enhances the quality of land resources” (SLM) and “improves food productivity” (LDN). In particular, evidence shows that IA promotes food productivity (Hendrickson and others, 2008; Liebig and others, 2017; Dar and others, 2018; Chai and others, 2021; Gabathuler and others, 2009; European Initiative for Sustainable Development in Agriculture, 2001). Integrated soil fertility management, which integrates multiple organic (i.e., mainly from animal sources) and inorganic fertilizers, contributes to food security by ensuring the long-term viability of soils and the long-term productive potential of land resources (Vanlauwe and others, 2010; Adams and others, 2020). IA also maintains and enhances the quality of land resources through integrated landscape management (Amede and others, 2023; Dar and others, 2018; European Initiative for Sustainable Development in Agriculture, 2001). These practices also ensure IA contributes to ecosystem health, supporting biodiversity and maintaining ecosystem services. For example, IA's integrated systems that incorporate agroforestry and some integrated crop-livestock systems is known to increase biodiversity, soil health and ecosystem function (Leite-Moraes and others, 2023; Alves and others, 2020; Paramesh and others, 2020; Garrett and others, 2020a; Rufino and others, 2021) as compared to conventional farming. In Brazil, the IA approach appears to reduce agriculture's negative impact on the environment (Garrett and others, 2020a; Paramesh and others, 2020).

IA was also found to align with **cross-cutting** criteria and criteria of the human well-being pillar. In particular, IA—which focuses on agricultural systems and farmers as a whole—was found to align with the LDN criterion "supports, enhances and diversifies livelihoods" and the SLM criterion "is economically viable". This reflects the capacity of the approach to boost employment and income (e.g., through dairy-crop collectives in Europe) while reducing economic risks. In Ethiopia and Rwanda, for example, IA projects have improved local livelihoods (Regan and others, 2017; Amede and others, 2023). In Europe, the IA approach's integration of dairy and crop production has helped encourage cross-farm cooperation to improve access by individual farmers to resources and valuable by-products, such as animal manure, and to improve resource efficiency and greater resilience to economic and environmental shocks (Regan and others, 2017), such as climate change. In Australia, for example, crop-livestock integration has emerged as a direct response to growing climate variability (Bell and others, 2014). In Brazil, IA has been shown to contribute directly to climate change mitigation through the use of ICLS to reduce farm-level carbon emissions (Salton and others, 2014).

IA's simultaneous focus on both environmental and economic dimensions also ensures the approach aligns with the cross-cutting criteria "integrates biophysical, sociocultural and economic needs and values" (SLM) and "balances economic, social and environmental objectives and manages trade-offs" (LDN). IA-based farming systems often pool resources across separate smallholder farms, contributing to improved social security, resilience against climate change and lower agricultural costs (Dar and others, 2018; Liebig and others, 2017; Seo, 2010). However, the social aspects of this approach have received little attention in the IA literature, creating uncertainty concerning how well IA practices integrate and balance different social needs and objectives (Hendrickson, 2020).

The alignment assessment of IA found that one of the 15 SLM criteria and three of the 20 LDN criteria show **gaps in alignment** (Figure 8).

These mainly relate to LDN criteria associated with the LDN **human well-being** pillar, namely "protects all human rights and right to property", "is gender-responsive" and "improves adequate access to water". The gaps reflect the fact that human rights and gender considerations are beyond the scope of most IA projects. In practice, however, efforts to actively address these criteria—by, for example, consulting and applying the FAO's *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* (FAO, 2019b; Orr and others, 2017)—can improve alignment. IA projects may also consult the FAO's *Gender and Land Rights Database* (FAO, 2010b) to address the political, legal and cultural context and factors affecting land rights for women, employ gender experts early in the project development and collect gender-disaggregated data to help projects contribute to improved gender equality (Orr and others, 2017).

The gap in alignment in the context of the LDN criterion "improves adequate access to water" reflects the fact that improving water access generally lies outside the scope of IA. Efforts by IA projects to consider water conservation and retention practices across landscapes and as part of broader, integrated land-use processes could improve alignment. These practices could include promoting soil cover to increase water retention, planting tree lines, improving water harvesting, taking advantage of swales and encouraging agroforestry and practices from agroecology (Peterson and others, 2019).

Another gap in alignment was also identified in the context of the SLM criterion within the food security pillar "is socially accepted". Although the benefits of IA are widely recognized in some regions (e.g., Brazil) and ICLS is practiced across 43 per cent of the total farm area in Canada, Argentina and Australia, the approach is not considered socially accepted on a global scale (Garrett and others, 2020a; Garrett and others, 2020b). In particular, experts suggest that a perception within the United States that IA provides fewer economic benefits than conventional agriculture hampers its acceptance in that country. In some cases, the low social acceptance of IA is linked to low public awareness of agricultural systems in general.

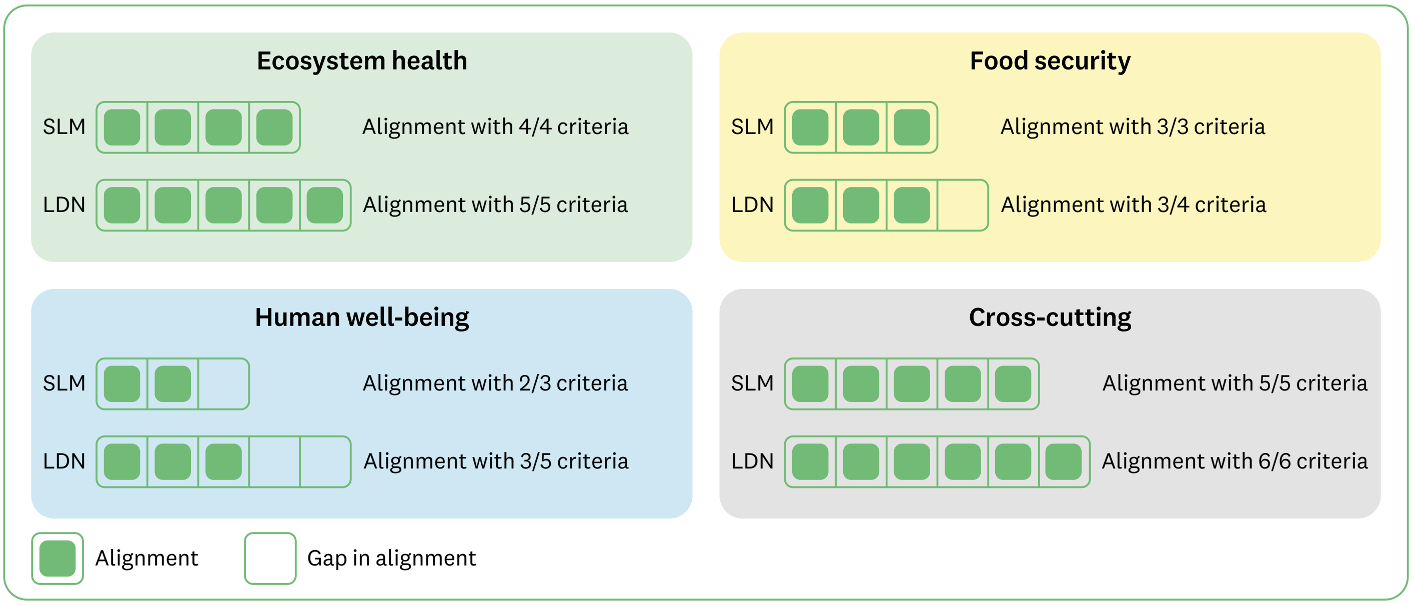

Figure 8: Summary of the alignment of integrated agriculture (IA) with SLM and LDN criteria.

3.6. Regenerative agriculture

3.6.1. Definition and characterization of regenerative agriculture

Regenerative agriculture (RA) emerged from regenerative organic agriculture, a sustainable agriculture approach developed by the Rodale Institute in the 1980s (Tittonell and others, 2022). RA possesses no universally applied definition, but several candidate definitions exist in the academic and grey literature (Tittonell and others, 2022). The Regenerative Agriculture Lab at Yale University (formerly, the Regenerative Agriculture Initiative) defines RA as a "holistic land management practice" that aims to improve soil health, nutrient density and the resilience of crops, while supporting climate change mitigation through improved soil carbon sequestration and the restoration of degraded soil biodiversity (Regenerative Agriculture Initiative and The Carbon Underground, 2017). Schreefel and others (2020) emphasize the importance of RA (and its soil-conservation focus) to regenerating ecosystems and their services while addressing social and economic aspects of sustainable food production. Similarly, Giller and others (2021) note the approach addresses economic and biological stability and minimizes environmental impacts beyond farm boundaries while reducing reliance on non-renewable resources.

RA can be said to be characterized by four principal practices. These primarily concern the use of on-farm practices to promote soil health and agricultural productivity, while linking RA to global sustainability objectives concerning climate change, global hunger and soil restoration (Giller and others, 2021; LaCanne and Lundgren, 2018; Tittonell and others, 2022; Newton and others, 2020; Lal, 2020; Natural Resources Defense Council, 2021). They include the following: i) abandoning or reducing excessive tillage to reduce soil disturbance (Newton and others, 2020; LaCanne and Lundgren, 2018; Ewer and others, 2023); ii) reducing or eliminating bare soil through cover crops and crop rotations (Newton and others, 2020; Rhodes, 2012; Ewer and others, 2023); iii) actively improving on-farm plant diversity; and iv) integrating crop and livestock production through practices such as managed grazing (LaCanne and Lundgren, 2018; Tittonell and others, 2022; Schreefel and others, 2020), manure and composting (Rhodes, 2017), or agroforestry techniques, such as alley-cropping and silvopasture (Africa Regenerative Agriculture Study Group, 2021; Ewer and others, 2023). RA may also include landscape-level interventions for water harvesting and erosion control, including "keylines", infiltration strips, hedges, terraces and ponds. Thus, RA combines, in a synergistic manner, the integrative, beyond-farm practices of integrated agriculture with the soil-focused techniques of conservation agriculture and the tree- and crop-focused practices of agroforestry. The approach also has a key social dimension that is often overlooked (Schreefel and others, 2020; Sharma and others, 2022).

3.6.2. Alignment of regenerative agriculture with SLM and LDN criteria

The assessment of RA found that the approach is in **alignment** with 12 of the 15 SLM criteria and with 17 of the 20 LDN criteria (Figure 9).

RA mainly aligns with criteria in the **food security** and the **ecosystem health** pillars. In particular, RA aligns with the SLM criterion "increases food security and livelihoods and the LDN criterion "improves food productivity". This alignment reflects the focus of the approach on increasing food productivity in tandem with improving the nutritional content of produced food and contributing to the restoration and regeneration of ecosystems (Newton and others, 2020; Schreefel and others, 2020; Rodale, 1983; Regenerative Agriculture Initiative and The Carbon Underground, 2017). The soil and crop-focused practices of RA effectively improve biophysical conditions and ecosystem functions, such as those that ensure soil health, the delivery of ecosystem services and water cycle maintenance (Newton and others, 2020; Rhodes, 2012; Ewer and others, 2023). The approach uses targeted practices, such as no-till or cover crops, to sustain the natural resource base and the land's potential for higher crop yields in the short-term and more stable yields in the long-term. Thus, RA projects support the production of sufficient food of high nutritional quality (Giller and others, 2021; Schreefel and others, 2020; Newton and others, 2020) while improving farmer incomes and their quality of life (Rainforest Alliance, 2022). Rather than improving food productivity only by increasing yields, RA also improves productive efficiency and stability—although this depends on the local context and may require a significant transition time (i.e., years) to achieve. RA's strong focus on conserving and improving soil health and restoring degraded soils directly contributes to the LDN response hierarchy (Schreefel and others, 2020; Giller and others, 2021; Africa Regenerative Agriculture Study Group, 2021; Regenerative Agriculture Initiative and The Carbon Underground, 2017).

The alignment assessment also found RA aligns with certain criteria belonging to the human well-being pillar, including the LDN criteria "inclusive, representative and participatory" and "protects all human rights and right to property". RA has experienced a significant growth in interest in the past few years, extending beyond the academic sphere to include the voices and perspectives of other stakeholders, including practitioners, non-government organizations and farmers. Studies of the perspectives and outlook of RA-participating farmers and potential beneficiaries suggest the approach often includes those who might otherwise be marginalized by conventional agricultural discourse (Sharma and others, 2022; Soto and others, 2021; Wilson and others, 2022). In this way, RA is seen as being shaped by discussions around social justice and redressing historical colonial wrongs and inequalities (Fassler, 2021; LaCanne and Lundgren, 2018; Wilson and others, 2022). Indeed, the inclusion of multiple stakeholders in the implementation of RA is described as a key principle of the approach by Giller and others (2021). While how this principle is implemented in practice is not always clear, RA is known to actively build on and integrate local and indigenous farming techniques (Sharma and others, 2022; Wilson and others, 2022). Engaging a broad range of stakeholders is especially important when upscaling RA projects, because multiple barriers exist for cooperatively implementing RA across the private and public sectors (Kenny and Castilla-Rho, 2022).

The assessment of RA found that three of the 15 SLM criteria and three of the 20 LDN criteria show **gaps in alignment** (Figure 9).

These gaps mainly correspond to two **cross-cutting** criteria, "integrates biophysical, sociocultural and economic needs and values" (SLM) and "balances economic, social and environmental objectives and manages trade-offs" (LDN). Although the approach is said to promote the holistic integration of soil and ecosystem health, community well-being and agricultural productivity, social and economic considerations are not always included in RA projects (Giller and others, 2021; Kenny and Castilla-Rho, 2022; Regenerative Agriculture Initiative and The Carbon Underground, 2017). RA's strong focus on the use of conservation agriculture and agroforestry practices and its focus on soil and ecosystem functioning suggests an imbalance favoring environmental objectives over social and economic ones. This can result in challenges when implementing RA projects.

Other related gaps in alignment were found in the context of the cross-cutting SLM criteria "is economically viable" and "is socially accepted". These gaps also reflect RA's limited consideration of social and economic concerns, as well as from its status as a relatively new and unestablished approach with little reliable evidence for these criteria so far (Khangura and others, 2023; Kenny and Castilla-Rho, 2022; Tittonell and others, 2022). Different understandings of RA also influence to what extent social and economic objectives are pursued under the approach. Efforts are being made to address the lack of cohesion of RA definitions and their outcomes. Efforts are also being made to upscale the implementation of RA by agribusinesses

A farmer stands in a rice paddy field where ducks bath and eat snails, an example of regenerative agriculture in Bali island, Indonesia. © Shutterstock / Em Campos

through, for example, (i) the development of frameworks and matrices that align RA objectives and help assess progress (One Planet Business for Biodiversity, 2021; Regen10, 2023; World Business Council for Sustainable Development (WBCSD), 2024a), (ii) the creation of additional levers, such as financial incentives (Terra Carta and Sustainable Markets Initiative, 2023), (iii) the use of dedicated certificates for RA adoption (Regenerative Organic Alliance, 2024), and (iv) initiatives that advocate for transitioning to RA, such as the COP28 Action Agenda on Regenerative Landscapes (WBCSD, 2024b). Tools that evaluate economic, environmental and social trade-offs can be used by RA approaches (and by others) to balance different objectives. These tools include InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs, Natural Capital Project, 2019), SHARP (Self-evaluation and Holistic Assessment of climate Resilience of Farmers and Pastoralist, FAO, 2014), SAFA (Sustainability Assessment of Food and Agriculture Systems, FAO, 2013b) or TAPE (Tool for Agroecology Performance Evaluation, FAO, 2019a). Choosing an appropriate tool can be informed by the meta-analysis of Sanou and others (2023) and by the RA guide published by Cusworth and others (2022). Many of these tools, however, do not accurately account for the value of environmental benefits and social trade-offs and may skew these evaluations toward economic benefits. The difficulties performing these evaluations are also quite demanding, and balancing economic, social and environmental aspects in a manner similar to that of agroecology may be more feasible.

Another gap in alignment of RA was found in the context of the cross-cutting criterion “encourages landscape-scale implementation tailored to local contexts”. This gap reflects RA’s strong farm-level focus, with less emphasis on landscape-scale implementation. From a farmer’s perspective, however, RA is a process of thinking globally while acting locally, resulting in projects that address landscape-level concerns as well (Schreefel and others, 2020; Giller and others, 2021; Tittonell and others, 2022; Ewer and others, 2023). To ensure RA projects are effectively scaled up in this way, practitioners should consult resources, such as the FAO's *Landscapes for Life* (FAO, 2017b) and 1000 Landscapes for 1 Billion People (1000L, 2023), for best-practice examples of integrated landscape management and tools and practices that support bottom-up landscape-scale implementation. Farmers should lead these innovations and the development of bottom-up initiatives to ensure RA does not become too prescriptive as it develops into the future.

Lastly, one gap in alignment of RA was found to concern the criterion "is gender-responsive" of the **human well-being** pillar. While gender responsiveness is considered an important element of RA, this responsiveness tends to be highly context-specific and is often beyond the scope of farm-level RA projects in practice. Experts recommend consulting and applying *The Gender and Land Rights Database* (FAO, 2010b) to understand the political, legal and cultural context and factors influencing the realization of women's land rights. They also suggest employing gender experts early in a project's development and collecting gender-disaggregated data to help ensure projects contribute to improved gender equality (Orr and others, 2017).

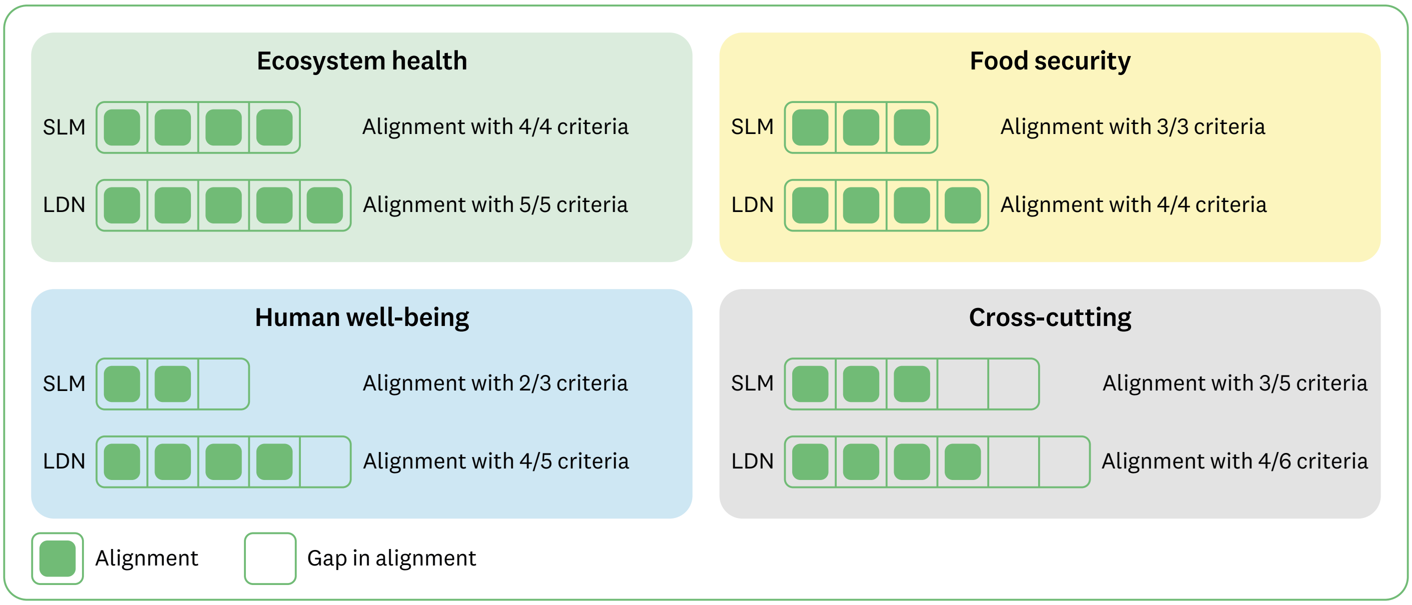

Figure 9: Summary of the alignment of regenerative agriculture (RA) with SLM and LDN criteria.

3.7. Rewilding

3.7.1. Definition and characterization of rewilding

Rewilding focuses on the restoration of functioning by self-sustaining ecosystems with no or minimal human interference (Carver and others, 2021). It has its origins in the early 1990s in North America and uses ideas developed by disciplines such as conservation biology and ecosystem restoration (Fisher and Carver, 2023). In a recent attempt to unify a variety of rewilding definitions, Carver and others (2021) describe the approach as “the process of rebuilding, following major human disturbance, a natural ecosystem by restoring natural processes and the complete or near-complete food web at all trophic levels as a self-sustaining and resilient ecosystem with biota that would have been present had the disturbance not occurred.” This definition has been adopted by the IUCN (2022b).

According to the IUCN (2022b), 10 principles characterize rewilding as a land management approach. These range from the reintroduction of wildlife to restoring trophic interactions to recognizing the intrinsic value of all species and ecosystems. The principles also address social aspects to be considered in any rewilding project, such as the need to encourage local engagement and to include indigenous and local knowledge. While the principles mainly underpin the ecocentric focus of rewilding, the *Global Charter for Rewilding the Earth* also suggests that rewilding “support[s] human welfare by contributing to climate stability, clean air and water, pollination services, beauty, physical and mental health, moral satisfaction, and other life-supporting services that undergird flourishing human communities” (11th World Wilderness Congress, 2020, p. 5).

In practical terms, different types of rewilding exist. Trophic rewilding describes the reactivation of top-down trophic interactions (Beyers and Sinclair, 2023; Pettorelli and others, 2019) through active management, at least at the beginning of a rewilding intervention (Lorimer et al., 2015). Practices of trophic rewilding include species reintroductions and taxon replacement, as well as removing human infrastructure and restoring area connectivity (Carver and others, 2021; Lorimer and others, 2015). Passive rewilding describes the minimizing of human interference without active management, allowing natural processes to regain dominance (Pettorelli and others, 2019; Corlett, 2016). Pleistocene rewilding suggests restoring ecosystems to a reflect the ecosystems of the pre-human Pleistocene epoch and its historical processes. Many regard this third rewilding practice as not feasible in modern, dynamic socioecological systems (Nelson, 2023; Lorimer et al., 2015). Common to all three rewilding types is the need to understand the context of an intervention. Designing site-specific measures allows for the consideration of potential trade-offs, such as impacts from the introduction of certain species (Carver and others, 2021; Fraanje and Garnett, 2022).

3.7.2. Alignment of rewilding with SLM and LDN criteria

The alignment assessment of rewilding found that the approach is in **alignment** with 10 of the 15 SLM criteria and with 15 of the 20 LDN criteria (Figure 10).

The approach was found to show the greatest alignment with SLM criteria related to the **ecosystem health** pillar, reflecting its ecocentric focus and its goals to recover ecological processes and establish self-maintaining natural ecosystems. Rewilding’s emphasis on biodiversity and ecosystem services also means the approach aligns with four **cross-cutting** criteria: “enables adaptation to climate change and contributes to climate change mitigation” (SLM), “reduces vulnerability to climate variability, drought and other extreme events” (LDN), “contributes to progress on policy targets and institutional goals” (SLM), and “leverages existing strategic planning and development processes” (LDN). Restoration activities employed under rewilding projects promote ecosystem services that contribute to carbon storage and sequestration

(Carver and others, 2021; IUCN, 2021; Hawkins, 2023). Heterogenous habitats established through rewilding also have higher adaptive capacity and resilience to climate extremes (Wang and others, 2023). Rewilding is said to stimulate progress on policy targets and institutional goals related to biodiversity loss and climate change, such as the SDGs, the UN Decade on Ecosystem Restoration and the CBD's Kunming-Montreal Global Biodiversity Framework (Carver and others, 2021; CBD, 2022). By maintaining, restoring and promoting natural ecological processes, such as soil erosion control, rewilding also contributes to all outcomes of the LDN response hierarchy (Nelson, 2023; Carver and others, 2021).

Alignment was also found for criteria of the **food security** and human well-being pillars, including "increases food security and livelihoods" (SLM) as well as "supports, enhances and diversifies livelihoods" (LDN). While food security is not a specified goal of rewilding, the approach can nevertheless improve food productivity if agriculture is integrated into the approach at a landscape scale. For example, landscape-scale sustainable agricultural practices, such as regenerative agriculture, can be integrated and considered part of a larger rewilding context (Mikołajczak and others, 2022), supporting sustainable production and resource use, food security and livelihoods that depend on agriculture (Fraanje and Garnett, 2022). Indeed, Corson and others (2022) and Vogt (2021) use the terms "agricultural rewilding" and "agricultural wilding" to describe i) a gradient between agroecology and rewilding that restores ecological processes during agricultural production, particularly herbivore livestock and ii) the introduction and conservation of wild crops and plants for agricultural purposes. In many cultivated desert dryland regions that produce little, rewilding is viewed as a sensible way to reverse damage from intensive agriculture, such as depleted water sources and increased soil salinity (Butterfield and others, 2021). Ecological restoration efforts in rewilding projects can recover natural diversity while guaranteeing the long-term sustainability of the remaining farms and the communities they support. Nevertheless, rewilding is not farming, and there is a lack of agreement among the research and practice communities concerning how narrowly rewilding should be defined.

The assessment of rewilding found that five of the 15 SLM criteria and five of the 20 LDN criteria show **gaps in alignment** (Figure 10).

These gaps relate mainly to criteria of the **human well-being pillar**, namely "involves multiple levels of governance and stakeholders" (SLM), "inclusive, representative and participatory" (LDN) and "is socially accepted" (SLM). These gaps reflect an uncertainty regarding the role of humans in rewilded landscapes (Pettorelli and others, 2019). While the approach's 10 principles stress some social aspects (including a need to consult local knowledge and to involve multiple stakeholders through a participatory approach), limited evidence suggests these are rarely addressed in practice (Jones, 2022; Wynne-Jones and others, 2018; Martin and others, 2023). Despite many references to rewilding in the literature and among experts that suggest the approach "should" be inclusive (e.g., Carver and others, 2021) and must integrate community knowledge to succeed in the long-term, many existing rewilding projects exclude communities from the decision-making process, leading to a lack of social acceptance for rewilding interventions (Jones, 2022; Wynne-Jones and others, 2018; Martin and others, 2023).

Other gaps in alignment concern the **cross-cutting** criteria "integrates biophysical, sociocultural and economic needs and values" (SLM) and "balances economic, social and environmental objectives and manages trade-offs" (LDN). Like other conservation interventions, rewilding is often implemented without a clear assessment of likely social impacts (Pettorelli and others, 2019). The approach's strong focus on ecological goals may detract from actively including social aspects. Massenberg and others (2023) suggest participatory measures are broadly needed in conservation efforts, including rewilding, to consider the needs of local stakeholders, to ensure benefits both for biodiversity and local development and to increase local support and acceptance. In general, adhering to the approach's principles when implementing rewilding projects in practice can address social challenges and improve a project's likelihood of success (Corson and others, 2022).

Another gap in alignment was found in the context of the LDN criterion "protects all human rights and right to property" within the human well-being pillar. This gap is clearly illustrated by examples from United Kingdom of rewilding projects that neglect land property and land user rights and cause landholder displacement (Martin and others, 2023; Mikołajczak and others, 2022; Wynne-Jones and others, 2018). Ignoring tenure rights and community perspectives can result in challenges to livelihoods as a result of rewilding (Martin and others, 2023; Jones, 2022; Wynne-Jones and others, 2018). A recent report by the World Wildlife Fund (Dempsey, 2023) found that farmers in the UK fear the expropriation of their land for rewilding projects and express concern that rewilding ignores their identity as farmers. To address these issues, the author recommends considering rewilding as compatible with other land management forms and not as an approach that conflicts with farming. Dempsey (2023) also suggests that collaboration between rewilding experts and farmers can help achieve common objectives, especially with government and regulatory support and financial frameworks to incentivize this integration. Some suggest integrating legal considerations in rewilding projects is also needed (Eagle and others, 2023).

Findings of the assessment suggest, however, that this gap in alignment is somewhat particular to rewilding in the United Kingdom. Numerous examples from other parts of the world indicate that rewilding is often implemented with a strong human dimension. These examples include the following: i) Herding4Health of the Peace Parks Foundation is a community-driven livestock management project in southern Africa that supports the livelihoods of rural communities living in and around protected areas (Peace Parks Foundation, 2024); ii) Bush Heritage Australia is a conservation and wildlife protection foundation that works with aboriginal communities that are acknowledged as the guardians of nature and global diversity (Bush Heritage Australia, 2024); and iii) the Enonkishu Conservancy in Kenya is a project in which the Maasai community has set aside part of their land for rewilding while also introducing sustainable rangeland management and implementing a tourism model in which visitors help with the rewilding efforts (Enonkishu Conservancy, 2024). Many of these and other rewilding projects work with communities to empower them in terms of their rights and responsibility over land and in their role as equity shareholders in the resulting value chains. Some rewilding projects aim to transition tenure and governance to communities as much as possible, so these communities become the primary stewards and custodians of the natural capital on which they depend.

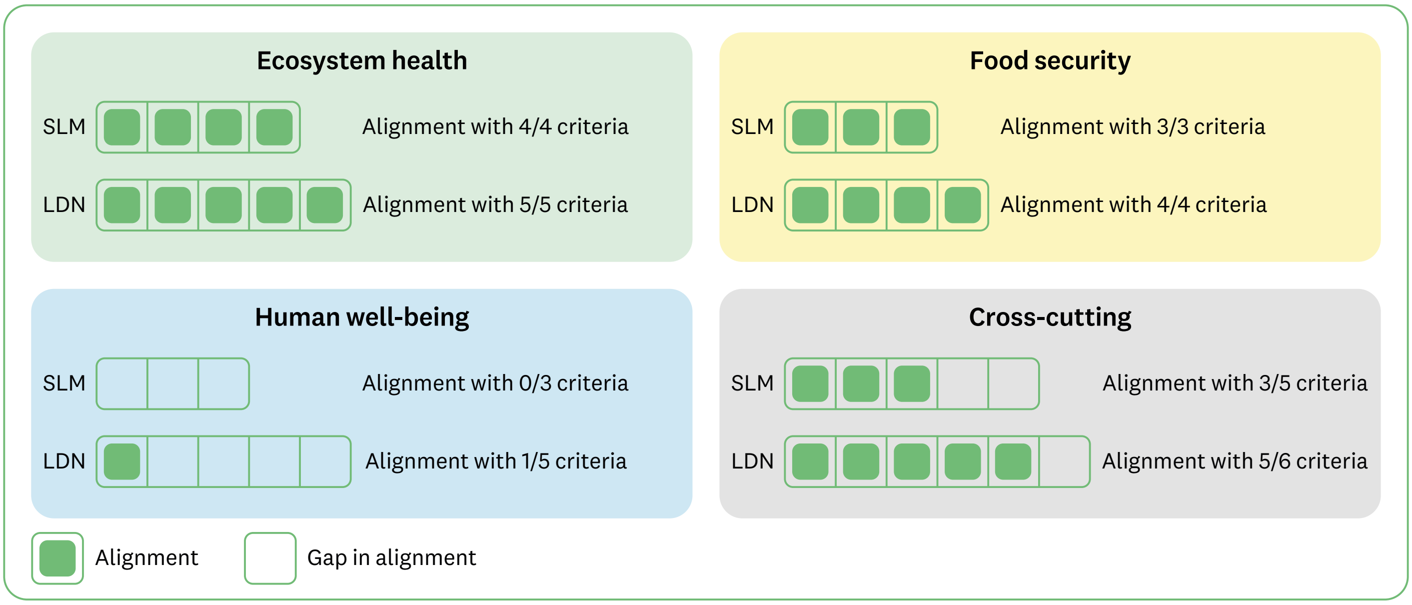

Figure 10: Summary of the alignment of rewilding with SLM and LDN criteria.

A lush mountainside in Mila Province, Algeria. © Pexels / Noureddine Belfethi

4. Synthesis and key findings

4.1. Level of formal recognition

In addition to assessing alignment with SLM and LDN criteria, this study identified the level of formal recognition of the selected land and water management approaches. This responds to the UNCCD decision text providing the rationale for this report, which states that approaches may contribute to SLM and LDN “while not being formally recognized under the United Nations Convention to Combat Desertification or other intergovernmental processes” (Decision 19/COP.15/23/Add.1, UNCCD, 2022a). One aim of the alignment assessment is to give particularly not-well-recognized approaches a rationale for their wide consideration across international efforts concerned with SLM and LDN. Thus, identifying those among the selected approaches that are less formally recognized can help to increase their consideration.

The level of formal recognition of the selected land and water management approaches was determined by canvasing the number of international entities that provide a definition for each. Approaches with definitions that are regularly used by intergovernmental organizations are considered formally recognized. Approaches that are not defined by intergovernmental institutions but nevertheless have widely-used definitions developed by an international organization can be deemed to have a medium level of formal recognition. Land and water management approaches are regarded as less formally recognized when they are not addressed by intergovernmental or international bodies but a widely cited definition nevertheless exists in academic or grey literature. Figure 11 shows that three of the selected approaches — agroecology, climate-smart agriculture and conservation agriculture — are defined by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and are therefore regarded as formally recognized. Forest landscape restoration and rewilding are defined by international organizations and considered to have a medium level of formal recognition. Integrated agriculture and regenerative agriculture are defined in widely-cited academic publications, but they are not yet formally recognized by intergovernmental processes or international organizations.

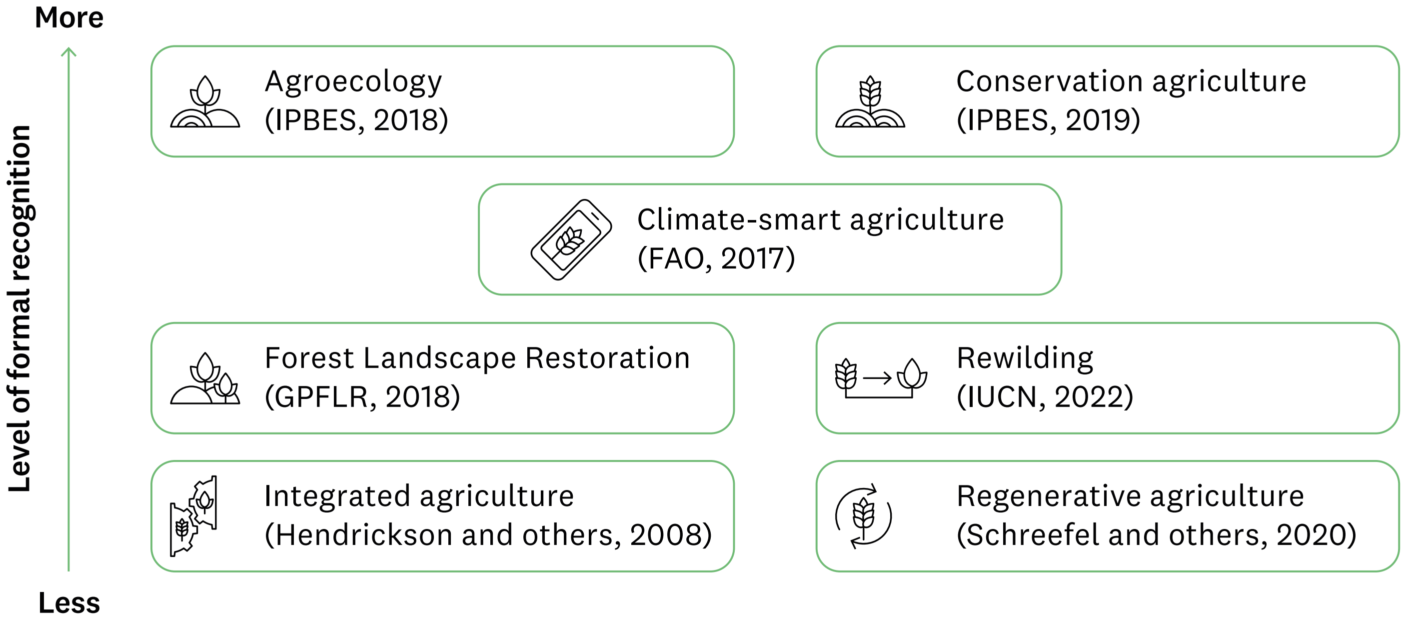

Figure 11: Level of formal recognition of the selected land and water management approaches.

4.2. Key findings of the alignment assessment

The assessments of the alignment of seven land and water approaches with SLM and LDN (described in Chapter 3) can be summarized by the key findings below.

1. **All seven selected land and water management approaches align with many, but not all, of the SLM and LDN criteria.**

Each of the selected land and water management approaches was found to contribute to SLM and to achieving LDN in different ways and to varying degrees.

Agroecology, as a holistic approach addressing a broad range of objectives, was assessed to have the highest degree of alignment with SLM and LDN criteria. Regenerative agriculture and integrated agriculture are approaches strongly aligned with many SLM and LDN criteria, especially those reflecting on the approaches' objectives to improve the biophysical conditions of agroecosystems and the synergistic and sustainable use of resources. Forest landscape restoration, which embraces multiple social and ecological objectives, also shows a high degree of alignment with SLM and LDN criteria. However, some gaps in alignment result from the mixed record of forest landscape restoration projects in addressing several criteria relevant to the human well-being pillar. Conservation agriculture was assessed to have a moderate degree of alignment. The approach aligns with criteria in all SLM and LDN pillars by addressing the biophysical conditions of agroecosystems through the application of soil conservation practices that also contribute to improving food security, livelihoods and climate. However, the approach's documented frequent use of environmentally detrimental glyphosate and a lack of attention to local knowledge and communities result in alignment gaps. Rewilding, which emphasizes natural processes, aligns with fewer of the SLM and LDN criteria addressing human well-being and cross-cutting criteria. However, some rewilding efforts include human activities and sustainable agriculture that increase their degree of alignment. Climate-smart agriculture, an approach that emphasizes greater productivity, emissions mitigation and adaptation of agricultural systems to climate change, has the narrowest objective among the approaches assessed. This narrow objective contributes to this approach's lowest degree of alignment with SLM and LDN criteria.

2. **All seven land and water management approaches show the most alignment with criteria comprising the ecosystem health and the food security pillars of SLM and LDN.**

Among the 15 SLM criteria and 20 LDN criteria against which the alignment of the seven approaches was assessed, all were found to align with LDN and SLM criteria of the **ecosystem health** pillar. All approaches assessed were found to align with SLM and LDN criteria pertaining to ecosystem health because of their emphasis on minimizing land degradation and on employing practices that improve ecological conditions. Importantly, this alignment suggests most of the selected approaches also contribute to the LDN response hierarchy that seeks to avoid, reduce and reverse land degradation. Five of the approaches directly embrace responses central to LDN, while the remaining two contribute to LDN by reducing land degradation (i.e., integrated agriculture and climate-smart agriculture; see Jiban and others, 2020; Schreefel and others, 2020; ITTO, 2020; Alvar-Beltrán and others, 2021; Amede and others, 2023; Carver and others, 2021). Further, almost all approaches were found to show the greatest alignment with those criteria relevant to the pillar **food security** (i.e., criteria for maintaining and enhancing land quality and potential).

Nearly all approaches were found to align with the following **cross-cutting** criteria that address all three pillars of the SLM and LDN frameworks: "enables adaptation to climate change and contributes to climate change mitigation" (SLM), "reduces vulnerability to climate variability, drought and other extreme events" (LDN), "contributes to progress on policy targets and institutional goals" (SLM) and "leverages existing strategic planning and development processes" (LDN) (see UNEP, 2021; Kassam and others, 2019; Lipper and others, 2014; Rhodes, 2012; Sinclair and others, 2019; Schmitz and others, 2023; Stanturf and others, 2015). The approaches mostly promote carbon capture and sequestration, which support LDN targets for maintaining and enhancing soil organic carbon as well as similar targets under the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement. Further, many approaches have dimensions that contribute to one or more of the SDGs (UN, 2015). In particular, the mostly agricultural focus of the selected approaches addresses SDG 15 and 2, "life on land" and "zero hunger", but also SDG 1 "no poverty", SDG 3 "good health and well-being", SDG 6 "clean water and sanitation" and SDG 13 "climate action" (Altieri and Nicholls, 2020; Carver and others, 2021). Another frequently cited example of the selected approaches addressing international goals is their significant contributions to the goals of the UN Decade on Ecosystem Restoration (see Box).

Box: Contribution of land and water management approaches to the UN Decade on Ecosystem Restoration

Adopting any of the selected land and water management approaches in this assessment not only contributes to SLM and to achieving LDN, but it may also contribute to the goals of the UN Decade on Ecosystem Restoration. This global programme addresses the need to "prevent, halt and reverse the degradation of ecosystems worldwide" (UNEP, 2021). Its aim is to encourage commitments to reduce ecosystem degradation, increase knowledge about the multiple benefits of ecosystem restoration and to promote ecosystem restoration (UNEP, 2021). The programme formulates 10 principles and numerous standards of practice that guide efforts for effective ecosystem restoration to maximize benefits for nature and people (FAO and others, 2021; FAO and others, 2023). It defines ecosystem restoration as "the process of halting and reversing degradation, resulting in improved ecosystem services and recovered biodiversity" (UNEP, 2021, p. 7). The UN Decade promotes a continuum of restorative activities depending on local conditions and societal choice, ranging from reducing societal impacts to fully recovering native ecosystems. It acknowledges that a return to the original ecological state is not always possible when, for example, farmlands are needed to satisfy human needs (UNEP, 2021; FAO and others, 2021). The selected land and water management approaches assessed in this report can help support the programme by targeting natural ecosystems and encouraging productive, crop-centered restoration efforts. Three approaches—forest landscape restoration, rewilding and regenerative agriculture—are explicitly mentioned as restoration approaches in the scientific report published to launch the programme (UNEP, 2021). Forest landscape restoration and rewilding, for example, directly support ecosystem restoration, addressing degraded ecosystems and recovering natural ecological processes. Forest landscape restoration also aims to provide socioeconomic benefits (Carver and others, 2021; Stanturf and Mansourian, 2020; United Nations Decade on Ecosystem Restoration 2021-2030, 2024b). Other approaches can also contribute to the goals of the UN Decade. For example, the soil restoring and conservation practices of agroecology, conservation agriculture and regenerative agriculture promote farmland restoration by rebuilding the soil's natural fertility while enhancing sustainable food production and livelihoods (United Nations Decade on Ecosystem Restoration 2021-2030, 2024a). Some selected approaches support the programme's restoration efforts indirectly by aligning with SLM and LDN criteria that meet the UN Decade's principles (FAO and others, 2021). For example, Principle 2 "Ecosystem restoration promotes inclusive and participatory governance, social fairness and equity from the start and throughout the process and outcomes" corresponds with the SLM criterion "involves multiple levels of governance and stakeholders" and the LDN criteria "is inclusive, representative and participatory" and "protects all human rights and right to property". These synergies are evidence that the selected land and water management approaches can simultaneously bolster several international goals of multiple global efforts and programmes to address the world's pressing environmental crises.

3. **All seven land and water management approaches show the most gaps in alignment with criteria comprising the human well-being pillar of SLM and LDN, as well as with certain cross-cutting socioeconomic criteria that span all the pillars.**

The alignment study helped identify SLM and LDN criteria that were not addressed by each of the approaches assessed. While none of the approaches embrace principles or practices that directly conflict with the criteria of SLM and LDN, some gaps in alignment were identified where the specific objectives and methodologies of the approaches did not address particular environmental, social and economic criteria. This report considered gaps in alignment to occur where approaches were assessed to be *not* aligned with criteria by all or *any* of the literature and experts consulted for this study. This allowed the study to identify both unanimously identified gaps and gaps identified by only a few sources as requiring attention to improve alignment.

Gaps in alignment of the seven approaches with SLM and LDN criteria mostly relate to the **human well-being** pillar and some **cross-cutting** criteria that address all pillars. The most common gap in alignment relates to the LDN criterion "protects all human rights and right to property". Findings of the assessment suggest that several approaches (e.g., climate-smart agriculture, rewilding and integrated agriculture; see Sharma and Suppan, 2011; Jones, 2022) fail to explicitly safeguard land tenure. In some instances, an approach may suggest it is dedicated to secure land tenure rights in general, but it fails to do so in specific projects. Reasons for this varied in practice, but some projects are situated in locations where tenure is unclear or where existing land use agreements are not accessible (e.g., for forest landscape restoration; see Mansourian and others, 2020).

Other common gaps in alignment between the land and water management approaches and SLM and LDN criteria relate to the inclusive and representative participation of relevant stakeholders. These gaps were revealed through evidence that, in certain contexts, the needs and livelihoods of local communities, smallholders and/or vulnerable groups, such as women, were not considered in the design and implementation of approach-based projects (see Martin and others, 2023; Chinseu and others, 2019; Taylor, 2018; Autio and others, 2021; Basnett and others, 2017). The gaps include, for example, a lack of project focus on the LDN criterion "inclusive, representative and participatory" and on the SLM criterion "involves multiple levels of governance and stakeholders", the SLM criterion "integrates indigenous, local and traditional knowledge" or on the SLM criterion to ensure projects are "socially accepted" (see Martin and others, 2023; CIDSE, 2015). For many approaches, challenges exist in systematically identifying and bringing together all relevant actors and in accommodating individual interests and perspectives. This is particularly true for those approaches that do not incorporate these specific aims and related methodologies.

Another common gap in alignment shared by many approaches relates to the criteria "integrates biophysical, sociocultural and economic needs and values" (SLM) and "balances economic, social and environmental objectives and to manage trade-offs" (LDN). Several approaches were found to insufficiently integrate or prioritize context-specific social and economic needs. This was attributed to the narrow scope of some approaches. The LDN criterion "is gender-responsive" was also found to be a common gap in alignment. While the criterion is considered fundamental to project design and implementation for several of the approaches assessed (i.e., agroecology, conservation agriculture, rewilding and regenerative agriculture), experts consistently cautioned that, despite this formal recognition, gender responsiveness is not always translated into practice.

4. **Gaps in alignment of land and water management approaches with SLM and LDN criteria are best addressed during project planning and implementation by employing supplementary activities that directly target the gaps and by applying recognized principles and guidelines.**

Gaps in alignment of the selected approaches with SLM and LDN could be addressed in the following ways: First, identified gaps could be filled by including **supplementary, relevant, remedial activities** in the design and implementation of approach-based projects. For example, integrated agriculture may not explicitly address gender responsiveness, but this criterion can be embraced by integrated agriculture projects that embed gender equality and empowerment efforts within project design, implementation and monitoring. These efforts may include a well-designed gender assessment that identifies existing structures of gender inequality and actions to overcome it, such as helping women access resources or organizing capacity training specifically for women. Similarly, projects implementing crop-centered approaches, such as conservation agriculture and climate-smart agriculture, could assess social needs during the project planning phase to gauge the impacts of land tenure uncertainty, limited access to knowledge, unequal access to water and power imbalances in the food market.

Second, simultaneously **incorporating multiple site-specific but nevertheless complementary land and water management approaches at landscape scales** can also help address the identified gaps in alignment, synergizing their multiple strengths. Combining the practices from different approaches acknowledges that there is no one-size-fits-all approach (IPBES, 2018b). Integrating regenerative agriculture practices within rewilding contexts, for example, can ensure the objective to restore natural ecological processes can be achieved while contributing to livelihoods and food security (Mikołajczak and others, 2022; Fraanje and Garnett, 2022). Similarly, embedding climate-smart agriculture in landscapes shared with natural or rewilded ecosystems can promote the adaptation of agriculture to climate change while also promoting nature conservation and the provision of ecosystem services (Harvey and others, 2014). Meanwhile, agroecology water harvesting and water cycle management practices could be adopted by other approaches (e.g., climate-smart agriculture or integrated agriculture) to foster availability and access to water. Such synergies exist between the selected approaches but also with any other approach or practice that addresses gaps in alignment with relevant criteria, such as those related to food security, biodiversity, economic viability and livelihoods. This, in turn, can promote a greater contribution to SLM and to achieving LDN.

Third, some of the gaps identified could be addressed by **more rigorous adherence to the principles** of each approach by project designers and practitioners. While some approaches (e.g., agroecology, forest landscape restoration and rewilding) have defined principles that closely align with SLM and LDN criteria, findings show that these are not always translated into practice. Rewilding and forest landscape restoration projects, for example, are often criticized for not being participatory, with cascading impacts on other social aspects, affecting alignment with the SLM criteria “integrates indigenous, local and traditional knowledge” and “is social accepted” (Oteros-Rozas and others, 2019; Martin and others, 2023; Basnett and others, 2017). Disregarding an approach’s principles can result in not only less effective interventions, but it may also fail to meet the environmental, economic and social standards demanded under SLM and LDN. Project monitoring and evaluation for these approaches should track whether these principles are observed in each context. Other approaches, such as integrated agriculture and climate-smart agriculture, lack principles that align with social criteria (climate-smart agriculture, in particular, is criticized for not protecting human rights; Sharma and Suppan, 2011), but this shortcoming can be addressed by adopting social safeguards when implementing projects.

Finally, **established guidelines** for ensuring better alignment of approaches with SLM and LDN have already been vetted by the international community and can help to address the alignment gaps. These include the *Voluntary Guidelines on the Responsible Governance of Tenure* (FAO, 2019b) and the *Gender and Land Rights Database* (FAO, 2010b). These guidelines have to be actively applied to ensure they contribute to SLM and to achieving LDN. Further, case studies document how projects successfully address gaps in alignment. For example, the Terai Arc project in Nepal (Ministry of Forests and Soil Conservation, 2015) illustrates a rewilding project that is gender-responsive, serving as a model for other rewilding efforts. Hartmann and others (forthcoming) provide examples on databases and case study collections for each approach. In some cases, specific assessment tools can help evaluate the performance of an approach with regard to environmental, economic and social objectives. These tools, such as the Sustainability Assessment of Food and Agriculture Systems (SAFA, FAO, 2013b), identify benefits and trade-offs for each approach, revealing where changes are needed to align more with corresponding SLM and LDN criteria.

5. **Context matters. Conclusions about the degree of alignment or about gaps in alignment between each land and water management approach and SLM and LDN criteria should not be considered universal and may depend on where and how projects are implemented.**

The results of the alignment assessments for each approach were found to depend on its context of implementation. While one case study might show that practices of a land and water management approach align with certain SLM and LDN criteria, another might provide evidence that these criteria are not addressed. Thus, the alignment assessment conclusions of this report should not be considered universally valid.

Considering the context when implementing approaches can avoid unintended outcomes that arise when uninformed efforts try to better align an approach with certain SLM or LDN criteria. Certain practices that contribute to SLM and LDN in one context may be unsuitable in another and even increase land degradation. None of the approaches provides a one-size-fits-all solution. Instead, the effective application of each approach ultimately depends on high-quality, spatially explicit data on environmental, economic and social factors to ensure the evidence-based design and implementation of projects to achieve multiple benefits.

A woman collects palm fruit in San Martin, Peru.
© CIFOR / Juan Carlos Huayllapuma

5. Conclusion

This report responds to the UNCCD Decision 15/COP 19 para. 13[3] by identifying existing and emerging land and water management approaches and documenting their contribution to SLM and to achieving LDN through an assessment of their alignment with SLM and LDN criteria.

The assessment shows that the selected land and water management approaches align with most SLM and LDN criteria, particularly those related to land condition and ecosystem health. Gaps in alignment chiefly concern criteria relevant to human well-being and cross-cutting socioeconomic criteria. Addressing these gaps can be achieved by targeted, supplementary activities in project planning and implementation, by the synergetic use of different approaches within one project and through a more rigorous adherence to defined approach principles. Importantly, the context of implementation can significantly influence alignment of approaches with SLM and LDN criteria and should be considered when interpreting the findings of this report.

By demonstrating the alignment of selected land and water management approaches with SLM and LDN and by identifying entry points for addressing gaps in alignment, this report can guide UNCCD Parties in planning and evaluating land and water management projects that leverage policy and donor support to increase the potential to advance SLM and to achieve LDN.

Along with the key messages outlined in Chapter 4, this report offers the following additional recommendations:

- **Other important land and water management approaches may exist in specific regional contexts and may be important to SLM and LDN**. The land and water management approaches in this report were selected through a review of the scientific literature in English. However, these approaches may be known under different names, depending on the regional context. Forest Landscape Restoration, for example, is commonly known as Landscape Restoration in Latin America. Other approaches that are particular to distinct regions may not have English names. Thus, the total diversity of land and water management approaches in different languages and in different regional contexts is not accounted for in this report. However, future assessments similar to the one conducted here could be used for other, diverse approaches to determine their contribution to SLM and to achieving LDN.

3 The Parties of the UNCCD request "… the secretariat to conduct, subject to the availability of resources, a coherence and alignment assessment of the expanding number of approaches that may contribute to the sustainable management of land and water resources which, while not being formally recognized under the United Nations Convention to Combat Desertification or other intergovernmental processes, may contribute to addressing desertification/land degradation and drought and the achievement of land degradation neutrality" (UNCCD, 2022, Decision 19/COP.15/23/Add.1).

- **Other land and water management approaches in the context of rangelands should also be assessed for their alignment with SLM and LDN**. Rangelands—that is, land predominantly vegetated by grass and shrubs and used for keeping and grazing livestock—comprise the world's largest land cover and provide important livelihoods for millions of people, including pastoralists, crop farmers and other groups in mainly arid and semi-arid regions around the globe (IUCN, 2022a). However, overexploitation, unsustainable management practices and climate change are driving rangeland degradation. Up to a third of the world's rangelands have been degraded to date. Despite the urgent need to address this trend, the processes involved in rangeland degradation are not sufficiently understood, and many interventions are poorly-informed and ineffective (Onyango and others, 2022). Reports by the IUCN and FAO present approaches and practices for sustainable rangeland management to minimize and reverse rangeland degradation, such as grazing management and grassland rehabilitation. An alignment assessment of rangeland management approaches—similar to the assessments in this report—could help to understand how these approaches contribute to reducing land degradation and to the multiple environmental, social and economic goals relevant to SLM and to achieving LDN.

A Brazil nut producer in Peru, 2018.
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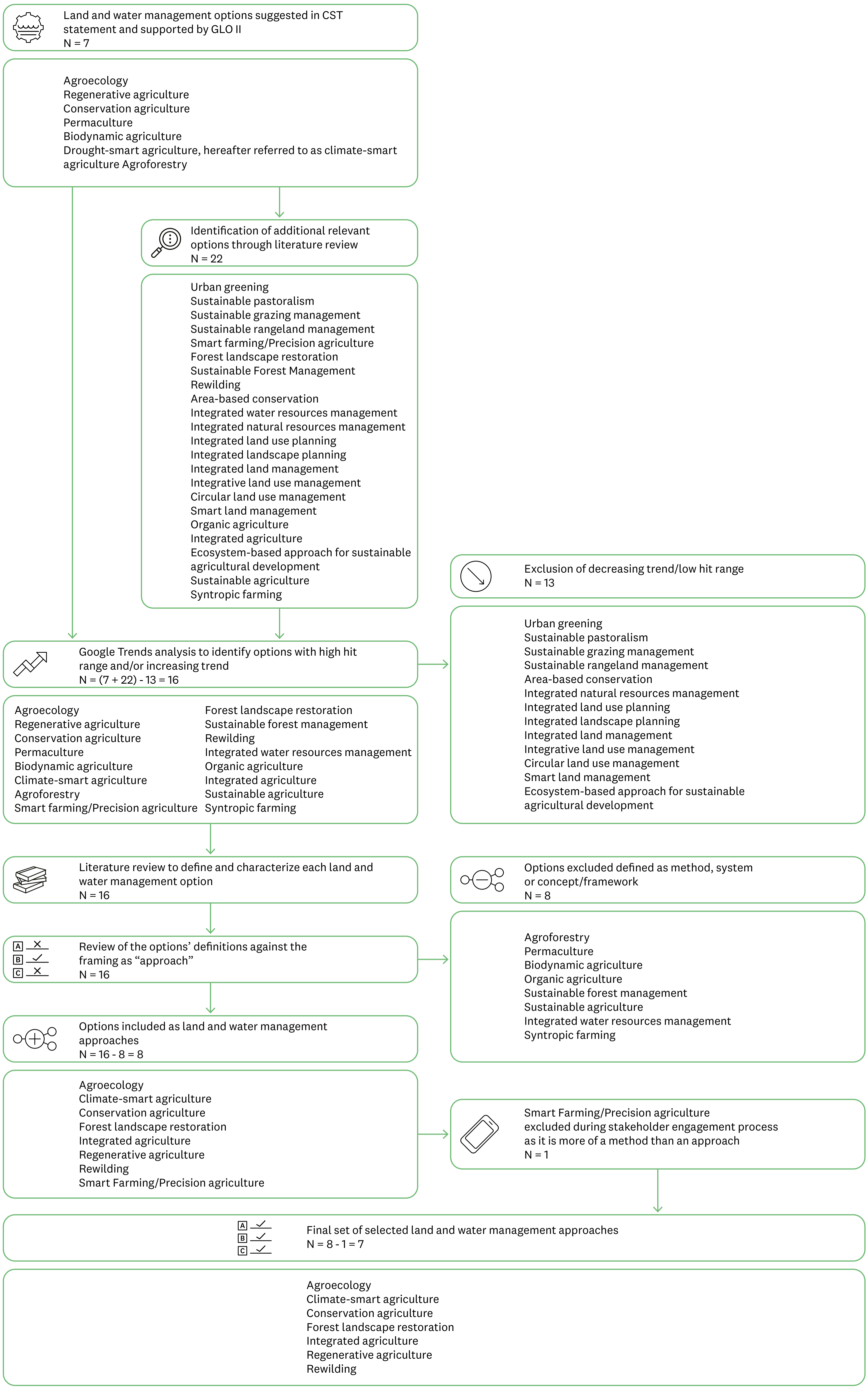
Annexes[5]

Annex 1 – Detailed process to select land and water management approaches considered in this report



5 based on Hartmann and others (forthcoming)

Annex 2 – Detailed description of SLM and LDN criteria

SLM criteria description

	SLM criterion	Description	Source(s)
Ecosystem health	Supports biodiversity, ecosystems and ecosystem services and functions	This involves supporting agricultural biodiversity (domesticated crop, livestock, fish, and wild relatives) and using practices that reducing current land degradation and increase ecosystem resilience to climatic variation and change	Liniger and others (2011)
	Prevents, mitigates and reverses land degradation	This protects the potential of natural resources and preventing degradation of soil and water quality	Walz and others (2021)
	Maintains and enhances the quality of land resources	Land resources refer to soils, water, animals and plants	Sanz and others (2017)
	Uses land resources sustainably, including soils, water, vegetation and animals	Sustainability is predicated on maintaining/enhancing productivity, reducing production risk, protecting the potential and quality of natural resources and preventing degradation of resources, being economically viable, and being socially acceptable	Smyth and Dumanski (1995)
Food security	Aims to increase food security and livelihoods	This encompasses maintaining or enhancing production/ services and reducing the level of production risk This builds on the six dimensions of food security: availability, access, utilization and stability, agency, sustainability	Smyth and Dumanski (1995), HLPE (2020)
	Ensures the long-term productive potential of land resources	Soils, water, animals and plants sustainably contribute to ecological and agricultural productivity	Sanz and others (2017)
	Reduces the risks of crop failure or production losses	The risk of losses at different stages of the production process are reduced	Description based on Sanz and others (2017)
Human well-being	Integrates indigenous, local and traditional knowledge	Local knowledge and scientific knowledge are integrated to identify best practices for implementation in a given context	Liniger and others (2011)
	Is land-user driven	Bottom-up approaches guide implementation and integrate local land users in the planning and decision-making process	Liniger and others (2011)
	Is socially accepted	Projects are socially accepted by academia, farmers/ practitioners and decision-makers, in addition to the public at large	Description based on Smyth and Dumanski (1995)

Cross-cutting	Contributes to progress on policy targets and institutional goals	This encompasses international sustainable development targets related to land and climate (such as the SDGs)	Sanz and others (2017)
	Integrates biophysical, sociocultural and economic needs and values	A holistic approach helps to achieve multiple goals concerning the long-term productive potential of ecosystems	Sanz and others (2017)
	Involves multiple levels of governance and stakeholders	Multi-stakeholder participation, strategies and processes involve stakeholders at all levels of decision-making and link bottom-up experience with science-based data and knowledge	Sanz and others (2017)
	Enables adaptation to climate change and contributes to climate change mitigation	Practices and techniques increase soil organic carbon stocks and soil health and fertility, in general	Sanz and others (2017)
	Is economically viable	Implementation is economically viable, and its medium to long-term economic benefits outweigh costs for practitioners/farmers	Description based on Smyth and Dumanski (1995)

LDN criteria description

	LDN criterion	Description	Source(s)
Ecosystem Health	Maintains land-based natural capital	Land-based natural capital encompasses the chemical, biological and physical properties of soil and geomorphological, biotic and hydrological features that determine the nature of ecosystem services provided by land	Orr and others (2017)
	Supports biodiversity and the delivery of all land-based ecosystem services	This involves the recognition of ecological functions of different ecosystems and the protection or restoration of vulnerable natural and managed ecosystems for the long-term sustainability of ecosystems and their services	Orr and others (2017)
	Maintains or enhances soil properties	Soil properties refer to the chemical, physical and biological aspects of the soil	Orr and others (2017)
	Maintains or enhances hydrological features	Hydrological features encompass all land-based features and processes related to water	Description based on Orr and others (2017)
	Enhances ecosystem resilience	This involves building natural capital and protecting ecosystems, thereby improving their capacity to withstand climate and other shocks	Orr and others (2017)

Food Security	Improves food productivity	This involves improving the productive potential of land resources and preventing further loss of productivity to enhance food security	Orr and others (2017)
	Aligns with the potential of the land	Land potential refers to the inherent, long-term potential of the land to sustainably generate ecosystem services. It reflects the capacity and resilience of the land-based natural capital in the face of ongoing environmental change	Orr and others (2017)
	Prioritizes appropriate land-use practices to minimize land degradation	This encompasses SLM and other practices that contribute to avoiding and/or reducing the process of land degradation	Orr and others (2017)
	Improves adequate access to water	This involves improving overall water access and water use efficiency, while addressing drivers of water scarcity	Orr and others (2017)
Human Wellbeing	Supports, enhances and diversifies livelihoods	This involves protecting livelihoods from the negative impacts of land degradation and contributing to improved and sustainable rural livelihoods	Orr and others (2017)
	Protects all human rights and the right to property	This concerns governing land for the benefit of all involved parties, with a focus on protecting land tenure rights of vulnerable and marginalized people. Land and human rights should not be compromised	Orr and others (2017)
	Is gender-responsive	Land use decisions should be both gender-sensitive and gender-inclusive	Orr and others (2017)
	Is inclusive, representative and participatory	The implementation process should include a broad range of stakeholders, including representatives of local stakeholders	Orr and others (2017)
	Enhances community resilience	This involves building social capital to improve the capacity of communities to cope with climate and other shocks and stressors	Orr and others (2017)
Cross-Cutting	Leverages existing strategic planning and development processes	Synergies can be identified and strengthened with other sustainability-related goals, such as climate change mitigation and adaptation	Orr and others (2017)
	Balances economic, social and environmental objectives and manages trade-offs	This involves finding and building synergies with other economic, social and environmental objectives. It involves safeguards (such as Red List Index and VGGTs) to limit negative impacts of trade-offs	Orr and others (2017)
	Embraces integrated land use planning	Integrated land use planning addresses the diversity of economic, environmental and social contexts of implementation across different areas and supports the inclusion of diverse stakeholder perspectives and interests	Orr and others (2017)
	Encourages landscape-scale implementation tailored to local contexts	Landscape-scale implementation considers all encompassed land units and their interactions, allowing for context-specific implementation while ensuring that actions causing degradation in one area are offset by restorative processes in other areas	Orr and others (2017)
	Establishes mechanisms for learning and adaptive management	This consists of a strategic and iterative approach to learning as part of implementation and monitoring, which involves local stakeholders	Orr and others (2017)
	Reduces vulnerability to climate variability, drought and other extreme events	This encompasses ways of increased systemic resilience of ecosystems and communities to climate change-related shocks and stressors	Orr and others (2017)

Imprint

Publisher
United Nations University Institute for Environment and Human Security (UNU-EHS), Bonn, Germany.

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Suggested citation
Hartmann, L., Hansohm, J., Vellozo, L., Walinder, E., Orr, B.J., Andreeva, O. and Walz, Y. (2024). The contribution of land and water management approaches to Sustainable Land Management and achieving Land Degradation Neutrality. UNU-EHS. Bonn, Germany.

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Charles Tumuhe – Alliance for Food Sovereignty in Africa

Layout and design
Imre Sebestyén

Acknowledgements
We would like to thank all participants of the interviews, focus group discussions and the expert workshop for their highly valuable input and reflections on the intermediate results. This participatory approach was essential to shape the final results and the messages of this report. Further, we want to thank Oscar Higuera Roa and Maria Paloma Noriega Jalil for their major contributions at the beginning of this project.

Funding
UNCCD received funding from the Russian Federation Voluntary Contribution.

United Nations
Convention to Combat Desertification
United for land

e-ISSN: 2304-0467
e-ISBN: 978-3-944535-85-2

https://doi.org/10.53324/XPJJ6498