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Unpacking the concept of Land Degradation Neutrality and addressing its operation through the Rio Conventions

Abstract

The world's commitment towards land degradation neutrality (LDN) became enshrined in various international agreements and decisions throughout the year 2015. The challenge now becomes one of addressing its operation, in order to achieve these new policy goals and targets by the year 2030. Advancing LDN demands attention to what the concept seeks to achieve, as well as unravelling the perspectives of the key multi-lateral environmental agreements through which progress can be made. The three Rio Conventions (the UN Convention to Combat Desertification, the UN Framework Convention on Climate Change and the Convention on Biological Diversity) all play key roles in shaping the international LDN governance and implementation context. Their different but related foci create a number of challenges and opportunities for advancing LDN. In this paper we critically analyze the literature to elucidate potential challenges and opportunities in moving LDN towards implementation, considering the mandates and objectives of all three Rio Conventions. We first unpack the concept of LDN's aspirations. We highlight the importance of the definitions and terminology used, and the relationships between those definitions, terms and the actors using them, as well as their implications in framing the range of policy actions and synergies that could benefit progress towards multiple Sustainable Development Goals. We then examine the LDN pilot project spearheaded by the UNCCD to identify key lessons for LDN implementation. Synthesising these lessons, we present a portfolio of blended interventions that seeks to address the aspirations of the UNCCD, UNFCCC and CBD in the LDN space, identifying synergistic options for national actions to move towards LDN. Overall, our analysis provides insights in advancing LDN from its current position as a policy target, towards synergetic action.

Keywords: UNCCD, restoration, rehabilitation, sustainable land management, CBD, UNFCCC

1. Introduction

On 25th September 2015, the Sustainable Development Goals (SDGs) were formally adopted by the UN General Assembly. SDG 15 includes a target (15.3) to: *"combat desertification,* restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral *world"* by 2030 (UNGA, 2015). This target builds upon political momentum that initiated in 2011 to tackle issues of land degradation, when leaders of Member States at the UN General Assembly High-Level Meeting noted that: *"… if the international community was serious in its commitment about reversing lan*d degradation and desertification, the time had come to commit for building a land degradation neutral world, **…"** (UNGA, 2011). While the centrality of land in addressing a number of sustainable development challenges has now been politically recognized (including challenges

relating to poverty, food, water and energy security, human health, migration, conflict tackling climate change and biodiversity loss and so on (Thomas et al., 2012)), the next step is for the world to operationalize its new commitment to LDN. The 2030 deadline set by political decision makers is less than 15 years away, leaving a challenging timeframe for action. It will be difficult to raise such political insterest again should substantial implementation fail to materialize in the coming years.

One important step towards LDN has been taken by the United Nations Convention to Combat Desertification (UNCCD) in decisions adopted at its twelfth Conference of the Parties (COP), held in Ankara, Turkey in October 2015. Parties decided to integrate LDN into the implementation process of the UNCCD, noting that: *"striving to achieve SDG target 15.3 is a strong vehicle for driving the implementation of the UNCCD"* (UNCCD 2015a, decision 3). At the same time, SDG target 15.3 is relevant to the other Rio Conventions: the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC). LDN implementation underpins and catalyzes achievement of other SDGs and their related targets (see Figure 1). For example, SDG 13 on climate change is particularly relevant to the UNFCCC, while multiple relationships and feedbacks between land and climate are noted in the literature (e.g. Reed and Stringer, 2016). Biodiversity related targets under SDG 15 show clear links to the CBD, with biodiversity supporting many of the processes that underpin the ecosystem functioning of land. Developing interconnected actions that span the interests of the Rio Conventions will be vital in moving towards LDN, especially at national level where cross-compliance in actions will be necessary. Such interplay creates a number of challenges and opportunities, many of which are well-rehearsed in the existing literature, particularly regarding the meaning of LDN and what is meant by land degradation more generally.

Insert Figure 1 here: Sustainable Development Goal target 15.3 on achieving a land degradation-neutral world as a catalyst for achieving other SDG targets

In this paper, we take the complex relations between the three Rio Conventions as our starting point to identify ways forward in advancing along an LDN trajectory. Examination of LDN through the tripartite lens of the Rio Conventions provides a practical, implementation-oriented approach that accepts that the different Conventions have both distinct and complementary objectives. Through analysis of the academic, policy and grey literature, we elucidate potential challenges and opportunities for synergy between the three Rio

Conventions in addressing LDN. Our assessment highlights the importance of the definitions and terminology used, and the relationships between those definitions, terms and the actors using them, as well as their implications in framing the range of policy actions and synergies that could be delivered. We then draw on important lessons from the UNCCD's LDN pilot project to develop a portfolio of blended options that can help operationalize LDN, in the context of both the mandates of the three Rio Conventions and the findings from our literature analysis.

Consideration of the mandates of the Rio Conventions is particularly pertinent in view of paragraph 74(f) of the UN General Assembly resolution 2030 Agenda for Sustainable Development, which explicitly states that SDG implementation "will build on existing platforms and processes, where these exist, avoid duplication and respond to national circumstances, capacities, needs and priorities" (UNGA, 2015). Synergies between the Rio Conventions in general are covered in detail elsewhere in the literature (see e.g. Cowie et al., 2007; Cowie et al., 2011; Chasek et al., 2011), so we focus specifically on synergies relating the achievement of LDN. Overall, by presenting novel and original insight through a rigorous analysis of the current state-of-the-art literature and application of the findings to the UNCCD's LDN pilot project, we provide a significant contribution to the global effort to tackle land degradation and reorient activities along a trajectory towards LDN.

2. Materials and methods

Our methodological approach required identification, review and analysis of published scientific peer reviewed literature, as well as grey literature (i.e. accessible information, reports and briefs of institutional or governmental actors and of independent, non-governmental stakeholders). Starting with searches using Google and Google Scholar to identify and review recent articles published close to SDG adoption in 2015, we then refined the search with temporal records of topical keywords in scientific articles. For this we used search engine WorldWideScience.org (2016) and the Scopus database, allowing for simple multi-temporal listings of articles and disciplines containing the keywords. Searches showed that the literature began to focus much more on natural capital in the context of land degradation and desertification following the Desertification Synthesis of the Millennium Ecosystem Assessment (MA, 2005a). Publications rapidly increased after 2010, containing ideas about Zero Net Land Degradation and the concept of LDN from 2012. Articles at this time also identified a need to enhance synergies between the Rio Conventions in the context

of the debate and negotiation of the then proposed Sustainable Development Goals. Consequently, the main timeframe considered in our analysis of peer reviewed articles and grey literature was 2005-2016, with a large number of articles published from 2010 onwards, given that year marked the start of the development of the post-2015 development agenda.

Noting the entry and evolution of the LDN concept in the global sustainable development debate, initial ideas to define an approach to achieve Zero Net Land Degradation (ZNLD, Lal et. al., 2012) followed similar terminology for configuring measures to reduce carbon dioxide in the atmosphere, thereby striving to achieve carbon neutrality as an option for the use of the Clean Development Mechanism (the latter established as a component of the Kyoto Protocol) (UNFCCC, 2016). Emerging from ZNLD, LDN first appeared in the context of the Open Working Group's preparations for the Rio+20 Conference in 2012 and its resolution to further elaborate the SDGs. The dynamic process to establish and finally adopt the wording "land degradation-neutral world" under SDG target 15.3 triggered specific research and discussion of implementation aspects within a relatively short time period. Our literature search focusing on LDN used keywords: "LDN definition", "LDN implementation", "LDN operationa*", "LDN legal frameworks", "LDN multi-level" and "LDN stakeholders". Further search terms included: "land degradation", "desertification", "mitigation", "natural capital", "ecosystem services", "sustainable land use", "degraded land", "degrading land", "restoration" and "rehabilitation". Terminology covering specific multi-sectoral and multi-level policy frameworks for implementing measures to "assess" and "combat" different forms of land degradation, as well as "implementation frameworks" and "methodologies" for land restoration, rehabilitation, "conservation" and the implementation of "sustainable land management" was also used. In searches focusing on the Rio Conventions using search terms "LDN and climate", "LDN and biodiv*" "LDN and UN*", we considered the period from their initiation in 1992 until 2016, though as for searches on LDN, articles from 2010 onwards were found to be most relevant and numerous. Documents were reviewed with a view to identify potential and actual synergies between the three Rio Conventions in the context of LDN implementation.

We also assessed the specific role of the UNCCD and the preliminary results of its LDN pilot project. The project envisaged to elaborate and test with participating countries a common concept, based on the three land-based UNCCD progress indicators, which would facilitate LDN target setting and reporting as new elements in the implementation of the Convention. The concept included standardized reporting by participating countries to enable the

extraction of lessons. 13 countries had been able to implement the full target setting and reporting process such that all country reports included: statement of aims and objectives; description of degradation drivers; mapping of trends in land cover, land productivity and soil organic carbon; elaboration of corrective measure and targets; analysis of strength, weaknesses, opportunities and threats (SWOT analysis) of National Action Programmes (NAPs); description of hotspot sites; list of national coordination body members; sometimes an analysis of relevant laws and regulation; and a budget outline. The analysis of these country reports in this paper was qualitative in nature and mainly focused on the outcomes of the SWOT analysis with a view to better understand the available national legal financial, and administrative frameworks and identify typical gaps or limitations in the countries' capacities required for LDN monitoring and implementation.

3. Results

This section presents the findings of our analysis. It first sets out the mandates and foci of the three Rio Conventions and highlights five important considerations in relation to the only currently available definition of LDN. It then highlights key lessons from the UNCCD's LDN pilot project. Opportunities for synergy between the Rio Conventions relating to LDN are considered in section 4.

3.1 LDN in relation to the three Rio Conventions

Each of the Rio Conventions has a different politically defined mandate, with its own particular objectives (Table 1). Ways in which the mandates and objectives of the different Conventions interplay shape the possibilities for the implementation of joint LDN actions. In addition to the mandates and objectives presented in Table 1, the ways in which each Rio Convention conceptualizes land and ecosystems is important in understanding the variety of political interests in and approaches towards LDN. Land comprises a variety of ecosystems which provide a range of different essential functions and services to humans. Land, including soil, biodiversity and water resources, is essential for food production and the delivery of other benefits or ecosystem services to support humans. Ecosystem services thus flow to society through the land, which can be conceptualized as natural capital: those components of the natural environment that provide benefits to people (Costanza and Daly, 1992).

Insert Table 1: Politically defined mandates of the three Environmental Rio Conventions (Authors' emphasis)

The ecosystem-based approach used in the CBD (CBD 2000, decision V/6) is the primary framework for its actions. The land-based approach used by the UNCCD considers that land comprises a multifunctional ecological system *"*whose natural capital... supports human *wellbeing by securing the life and livelihood of individuals and communities"* (UNCCD, 2015b: 7). Although the difference between these approaches is an expression of the differences in foci of both agreements, both CBD and UNCCD are critical for the effective implementation of the UNFCCC in terms of adaptation to climate change. Adaptation provides a clear bridge between the Rio Conventions. The CBD looks for means for nature to adapt to climate change; the UNCCD looks for land-based adaptation to climate change by enhancing the adaptive capacity and resilience of ecosystems and human populations. Both approaches are required to address UNFCCC's approach: *"*As part of an adaptation strategy, approaches that integrate healthy and intact ecosystems (including aquatic ones) can deliver…benefits...Ecosystem-based approaches…may be more cost-effective…than measures based on hard infrastructures and engineering*"* (UNFCCC, 2011: 4).

The land-based adaptation approach of the UNCCD addresses all terrestrial ecosystems that are used by humans and which, in most cases, have been transformed through human activities and management. UNCCD's brand is "land". Land-based approaches, as outlined in the mandate of the UNCCD, have the potential to support not only adaptation to climate change, but also mitigation.

While important scientific debate took place prior to LDN's formal adoption regarding the scientific definition and viability of the concept (e.g. Grainger 2015; Welton et al. 2014; Lal et al. 2012; Caroli, 2012) and this touched on several core aspects, LDN to date has been viewed largely through a UNCCD lens. Welton et al. (2014) and Chasek et al. (2015) observe that to achieve LDN, land-based activities have to be implemented that consider ecological, social, cultural and economic realities at local, national and regional scales. This gives humans a role at the centre of LDN, in line with the UNCCD's approach (Table 1). Nonetheless, Reed and Stringer (2016) link efforts to tackle land degradation with those to mitigate and adapt to climate change in order to achieve and maintain human wellbeing over the medium and long term. Thus, it remains clear that the LDN concept has the potential to provide multiple wins, both across a range of development and environmental sectors at the national level and for several Multi-lateral Environmental Agreements.

Unpacking the definition of LDN

At the time of writing (Feb 2016), the UNCCD was leading the way as the only Convention to have established a definition of LDN. The definition was provided by the UNCCD's Intergovernmental Working Group (IWG), endorsed by the UNCCD's 12th Conference of the Parties (UNCCD, 2015a, decision 3), and was politically as well as scientifically agreed. It defines LDN as a *"state whereby the amount and quality of land resources necessary to* support ecosystem functions and services and enhance food security remain stable or increase *within specified temporal and spatial scales and ecosystems"*.

Several operational aspects feature in this definition, in terms of both their presence and absence. First, use of the words *"amount and quality"* suggests that both qualitative and quantitative measures and indicators would lend themselves to assessing progress towards LDN. Second, the LDN definition uses the words *"ecosystem functions and services"*, common in the CBD and UNFCCC arena, but which are rather complex expressions for application by land users operating at the level of actions to prevent, reduce, and reverse degradation. Whereas the term 'ecosystem functions' conveys a focus on the system level, the term 'ecosystem services' highlights land-based ecosystems as production systems. This anthropocentric focus is further enhanced through the mention of food security. This contrasts with a focus on ecosystem processes and structures and conservation, which is generally seen as the core business of the CBD.

Following the Millennium Ecosystem Assessment (MA, 2005a and b), ecosystems are include systems changed by humans, thereby recognizing agricultural ecosystems as key in offering provisioning services. Such recognition has been reinforced in the ongoing assessments of the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES) (IPBES, 2014a), which emphasize agriculture as both a beneficiary and provider of ecosystem services. Such a stance fits well with UNCCD's anthropocentric approach as well as CBD's increasing focus not only on ecosystem conservation but also on the sustainable use of ecosystems.

Third, *"*food security*"* is specifically mentioned in the UNCCD's LDN definition, again, emphasizing that people are at the center of its agenda. From an ecosystem service perspective, this prioritizes provisioning services. Indeed, one of the major findings of the Millennium Ecosystem Assessment (MA, 2005b) was that humans have increased the flow of provisioning services at the expense of regulating and cultural services of ecosystems. Such findings are supported elsewhere in the literature as well. For example, Favretto et al. (2016)

examined cattle production on Botswana's rangelands, finding land privatization prioritizing provisioning services reduced the overall range of ecosystem services delivered from the land. The major trade-off in need of consideration in relation to LDN is between provisioning and regulating services. For example, water regulation provided by forests and shrublands, particularly in drylands, is vital in directing rainfall to surface and sub-surface water reservoirs that become irrigation water. Without this service, water would run to the ocean (Safriel, 2014). If water regulating services are diminished then it ultimately impacts upon provisioning services. Movement towards LDN will require the ability to forecast trade-offs between ecosystem services resulting from particular interventions and decisions, and will need to balance these trade-offs with restoration and rehabilitation costs and demands.

Fourth, the terminology at the end of the UNCCD's definition of LDN is necessarily ambiguous on the question of who should define *"spatial and temporal scales"*. This leaves countries to formulate voluntary LDN targets according to their specific national circumstances and development priorities. Attention needs to be paid to the interactions of LDN efforts across different scales and the distributions of 'winners' and 'losers': who benefits and who is disadvantaged by LDN activities, across different stakeholder and social groups. How this should happen is not immediately clear from the definition.

Fifth, the UNCCD's LDN definition states that the amount and quality of land resources should *"remain stable or increase"*. However, in order to assess 'stable' or 'increase' a baseline is required to monitor the direction of any change. Conservative estimates from 2005 suggested that 10-20% of global drylands are degraded with medium certainty (MA, 2005a). A recent review by Caspari et al. (2015) highlights the shortcomings of currently available global estimates of degraded land, noting the range of different systems and components of focus, and the variety of different methods and indicators used. At the same time, global information and statistics about the overall extent of the areas that are currently following a degradation trajectory are available (Cherlet et. al., 2013; Le et al., 2014; Yengoh et. al., 2015) but limited due to the finite number of regularly measurable parameters and the short time span covered in the data archives.

To assess and monitor options to achieve neutrality, the adequate definition, planning and monitoring of efforts to achieve LDN requires both conceptual and technical ability to distinguish between already degraded but stable land and land on an active degradation trajectory. This aspect is particularly important because it will shape the priorities required for

concrete actions. Although not mutually exclusive, priorities for concrete actions should determine where focus is to be put on preventing, halting and reversing land from degradation e.g. through SLM practices, and/or where more attention to intervention measures to rehabilitate and/or restore already degraded land is justified. What exactly constitutes degradation then becomes important, as change and degradation are sometimes treated synonymously. For example, it could be argued that for millennia, natural land-based ecosystems worldwide have been degraded for the purpose of food production. This suggests that as land use is highly dynamic (particularly as we see increasing urbanization, soil sealing, deforestation and so on), degraded land is continuously increasing, preventing the possibility of ever achieving a 'stable state'. LDN therefore cannot be achieved without responding to degradation with counter-measures, which have or will have a cost implication, because operationalization of LDN implies that the rate of restoration and rehabilitation measures equal the rate of degradation (in temporal and spatial dimensions). The essence of LDN is thus the need to ensure that the rate of land restoration and rehabilitation and sustainable land management should at least match and ideally exceed the rate of ongoing degradation of land under degrading use. In this way the amount of productive land remains stable or even increases within the domain of focus. However, rehabilitating the productivity of degraded rangeland for example, cannot offset ongoing degradation for instance of a cereal cropland. This is because the quantity and productivity of rangelands differ from those of croplands. This suggests that *"*Some provision for balancing land degradation within (rather than across) ecosystem types is therefore essential*"* (UNCCD, 2015c: 13).

The UNCCD defines SLM 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"* (UNCCD, 2016a: 32). The CBD defines sustainable use as *"*The use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and *aspirations of present and future generations"* (CBD, 2008: 292). This suggests that CBD puts more emphasis on the value of biodiversity and biodiversity conservation (in most cases, nature conservation), while UNCCD's core interest is in preventing land from being degraded to ensure the use of land in order to harness benefits (e.g. food and water) for people.

Evidence suggests that prevention of degradation is most cost effective over the medium to long term (ELD Initiative, 2015) and likely more appealing to developing countries whose

populations are severely affected by land degradation. However, due to extensive land degradation, achievement of LDN is impossible in the absence of a portfolio of place-based rehabilitation and restoration measures that are appropriate to context.

The terms "restoration" and "rehabilitation" are often used interchangeably and distinguishing between them is a longstanding challenge. However, there are no formally adopted definitions for rehabilitation or restoration within the UNCCD. Working definitions have been included in the UNCCD's glossary for reporting, which sees land rehabilitation as a process that puts the *"landscape to a new* or *altered use to serve a particular human purpose"*. The same glossary sees restoration as a process aiming to *"return an ecosystem to a former natural condition"* (UNCCD, 2016a: 10). However, it is unclear which former state should be used as a reference point for restoration, and who should be involved in deciding. These questions are especially important in many regions suffering from land degradation that are characterized by old cultural landscapes in use for millennia. In order to maintain a restored state, this could, in certain contexts, imply exclusion of human activities such as food production from some areas, and could be said to be at odds with the UNCCD's anthropocentric approach that appreciates current and future productive land use systems.

The CBD formally defines restoration as the "return of an ecosystem or habitat to its original community structure, natural complement of species, and natural functions" and rehabilitation as the "recovery of specific ecosystem services in a degraded ecosystem or habitat" (CBD, 2008: 291). Use of the term "habitat" in both definitions used by the CBD already underlines the different foci of the CBD and the UNCCD. As we argue below, the UNCCD tends to emphasize rehabilitation, while the CBD tends towards restoration, although scientists have been calling for a review of the concept of restoration, to focus on rehabilitation of ecosystem functions (Choi, 2007). The work of the IPBES which is undertaking a Thematic Assessment on Land Degradation and Restoration (IPBES, 2014b) also tends towards restoration as the title of its assessment implies. SDG 15 uses the word "restore" only. The Intergovernmental Working Group on LDN of the UNCCD considers the need for SLM, rehabilitation and restoration (UNCCD, 2015d).

Rehabilitation and restoration require different stakeholders, decisions and approaches. It should therefore be clear within LDN political processes what LDN is striving for because each of these terms demands different types of interventions, supported by different funding approaches and partnerships.

Binding resources and excluding certain human activities will need careful consideration when implementing LDN, especially if restoration concerns land comprising several ecosystems (Society for Ecological International Science & Policy Working Group, 2004). This is because multiple stakeholders would need to be considered, and restoration of different ecosystems may require different approaches and timescales (e.g. installation of measures for specialized species). Implementation of any long-term restoration measures will have to show clear benefits/incentives for local populations in order to ensure their acceptability. On radically disturbed sites it is not practical to aim for the restoration of historical ecosystems.

Rehabilitation measures aim to repair damaged or blocked ecosystem functions, processes, and services, with the primary goal of raising ecosystem productivity for the benefit of people (Aronson et al. 1993; Society for Ecological International Science & Policy Working Group, 2004) (see Table 2 for illustrative and referenced examples of rehabilitation measures that do not preclude further use of land over a long time period, and which demonstrate the complexity and overlaps of components that come under the LDN umbrella). Rehabilitation thus seems to align to the UNCCD's definition of LDN if it is followed by SLM practices of sufficient magnitude to counterbalance ongoing degradation. Rehabilitation measures are usually designed to achieve results as rapidly as possible, but the type of rehabilitation intervention and its temporal span will vary between locations depending on the types and severity of degradation and the dominant land use/livelihood system. The illustrative examples of rehabilitation in Table 2 show the diversity and the extent to which resources are bound through active intervention measures to combat land degradation, thus, reinforcing preventive SLM as a key action in implementing and maintaining LDN. Essentially, rehabilitated landscapes will always require some intervention, ideally minimizing resource requirements while optimizing ecosystem services (Doley and Audet, 2013). The first step towards action therefore involves careful analysis of the biophysical environment and socio-economic aspects, followed by identification and consideration of possible interventions (e.g. analysis of legal, economic, social and political enablers), and the progressive development of a manageable final landscape.

Insert Table 2: Illustrative rehabilitation measures to reverse degraded or degrading land

The five challenges identified in this section relating to the definition of LDN and its links to the different mandates of the three Rio Conventions provide an important backdrop for the

next part of our analysis, as they impact upon the possible synergies and interactions that can be harnessed between the Rio Conventions during operationalization of the LDN concept.

3.2 Putting LDN into operation: lessons from the UNCCD and opportunities for synergy between the Rio Conventions

The previous section focused on definitions, considering how words and actions are being defined and used in the quest for LDN. However, as noted by Chasek et al. (2015), putting LDN into operation needs to occur across scales from the local to the international, and it is the aggregation of efforts that determines progress along an LDN trajectory; this includes the aggregation of efforts between the Rio Conventions. In this section we first present key lessons from an LDN pilot project spearheaded by the UNCCD secretariat at the national level. Based on these findings, in section 4 we explore entry points for the Rio Conventions to work together to advance their goals and the LDN concept.

LDN: from pilot to scale under the UNCCD

In 2015, the UNCCD secretariat facilitated a pilot project to support a sample of countries to translate the LDN goal into national voluntary targets. The project sought to demonstrate how LDN can be applied in practice and helped create political momentum for its official adoption. The pilot project's approach for setting LDN targets was anchored in the UNCCD´s implementation framework and established monitoring and assessment mechanism. Indicators adopted by the COP in 2013 (UNCCD 2013a, decision 22) were used to identify negative trends indicating signs and risks of land degradation (see below), while countries' NAPs were reviewed to ascertain if their legal, financial, scientific and administrative frameworks, and land management options, would be appropriate to stop and/or reverse the identified negative trends.

The main challenge faced by the pilot project was one of monitoring. As suggested by the LDN definition, a blend of qualitative and quantitative measures and indicators is required, alongside means of assessing the status of land degradation (i.e. distinguishing between already degraded land, and land on a degradation trajectory) at different spatial and temporal scales. In light of climate change impacts, monitoring land degradation and LDN also requires differentiation between human- and climate-induced degradation so that the key drivers responsible for particular impacts can be identified and addressed. This differentiation would ensure that any efforts are not just addressing the impacts themselves but the drivers of those

impacts, thereby also providing a basis to analyse the interaction between both processes (UNCCD, 2015c).

The UNCCD monitoring and assessment framework offers a flexible approach to monitoring and reporting. It merges top-down and bottom-up approaches and datasets, is open to both quantitative and qualitative information, draws on existing data, and emphasizes stakeholder participation (UNCCD, 2013a and b). It is centered on six global indicators, but recognizes that their assessment needs to take place within the context of broader monitoring and accountability strategies and be complemented by indicators relevant to specific national contexts. Out of the six global indicators, three land-based indicators (land cover, land productivity and carbon stocks above and below ground) were used by the pilot project to understand the status of land degradation and the potential for measures to halt and reverse land degradation (including SLM and other actions for land rehabilitation and restoration).

Land productivity, disaggregated by land use/cover, responds to the focus on provisioning ecosystem services embedded in the LDN definition. Temporal and spatial land productivity dynamics were derived from remotely sensed data, particularly time series of Normalized Difference Vegetation Index (NDVI), as these data are highly correlated with vegetation characteristics such as photosynthetic capacity and primary production (Yengoh et al., 2015; Ivits et al., 2013). For the indicator on carbon stocks (where the above-ground component can be assessed using NDVI as well), soil organic carbon (SOC) was used as a metric that focused on just one of five carbon pools in order to indicate overall soil quality. It has been further suggested that the indicator on carbon stocks can help quantify the benefits of achieving LDN in terms of climate change mitigation (UNCCD, 2015e; UNCCD 2015f). The UNCCD monitoring and assessment framework and its indicators suggest a generically applicable and pragmatic approach to establishing a baseline and tracking progress towards LDN targets, which would broadly support the objectives of the CBD and the UNFCCC (see section 3.1). However, the three land-based indicators do not fully capture the complexity of land degradation processes and will need to be supplemented with national or sub-national indicators, data and assessments to more fully account for national circumstances and contexts (UNCCD 2016b). Moreover, the indicators in the UNCCD LDN pilot project do not necessarily enable a clear distinction to be made between land that is degrading and land which is already degraded and holds potential for restoration or rehabilitation.

Building on the LDN pilot project, in late 2015 the UNCCD COP decided to officially invite Parties to "formulate voluntary targets to achieve LDN [and] explore options on how to

integrate the voluntary LDN targets in their NAPs" (UNCCD 2015a, decision 3). In response to this decision the UNCCD's Global Mechanism established the LDN Target Setting Programme (TSP) which will support interested countries in establishing LDN targets and identifying measures to achieve LDN. In scaling up the LDN target setting exercise the TSP can build on the experience gained from the pilot project, providing an opportunity to address the identified challenges.

One important lesson from the pilot project is that more comprehensive technical guidance is needed to support interested countries in implementing LDN. To obtain this first requires clarity in the concept of LDN itself. As noted in section 3.1, uncertainties remain as to what neutrality means in the context of land degradation. Another key question refers to the appropriate scale for LDN interventions and to what extent national LDN targets can be broken down to smaller scales of action, whether through UNCCD-led efforts, initiatives spearheaded by the other Rio Conventions or by countries themselves, who would decide and implement the actions at appropriate scales according to national priorities. These and other key questions will be addressed by the UNCCD Science-Policy Interface (SPI) which is developing a conceptual framework on LDN to provide a scientifically-sound basis for understanding LDN, and to inform the development of practical guidance for implementing and monitoring progress towards achieving the LDN target (UNCCD 2016c).

Additional technical guidance is necessary also with regard to the indicators (e.g. relating to frequency of measurement, resources required etc.) and respective requirements for data processing and interpretation. This needs to consider the availability, accessibility and reliability of data and information- these are crucial for operational monitoring in support of policy formulation, implementation and evaluation. Technical guidance documents on the respective LDN indicators need to include details such as:

The rationale and precise definition of each indicator, including references to statistical and other standards and classifications, relying on international agreed definitions; the method of computation, including mathematical formulae and descriptive information on computations made on the source data to produce the indicator; a description of existing and recommended sources of data (both remote and in situ) for addressing different scales, including the methods used for data acquisition and processing; and examples and guidance on each indicator's correct implementation in terms of frequency of derivation and interpretation, also placing it in context with additional indicators and at different scales.

A combination of bottom-up and top-down approaches is needed to fill data gaps at national level. In order to ensure longevity and thus success of any measures for attaining LDN, there is a need to strengthen the capacity of national statistical offices and data systems to ensure access to high-quality, timely, reliable and disaggregated data. It is also essential to promote coordinated actions of global, regional and national Earth observation data providers. This will allow exploitation of a wide range of data sources, including remote sensing, field observatories and national statistical records, in order to map and monitor degrading and degraded lands, and the effects of measures implemented to achieve LDN.

The aim of the LDN pilot project was to test and demonstrate the operationalization of LDN within the UNCCD framework. While potential synergies with the objectives of the other Rio Conventions were not the focus, several countries participating in the LDN pilot project used the opportunity to identify linkages between their tentative LDN targets and their climate and biodiversity policies.

As mentioned, the indicator on carbon stocks allows countries to directly link LDN activities with climate change mitigation targets. For instance, the pilot country Belarus directly integrated its LDN target on increasing the area of restored peat lands into its Intended Nationally Determined Contribution (INDC) under the UNFCCC (Republic of Belarus, 2015). Ethiopia made LDN a key tenet of national climate change action plans (UNCCD, 2015g) while Italy's approach to setting LDN targets successfully used IPCC methodologies to model stock changes in SOC based on land use/cover change (UNCCD 2015h). As regards synergies with the objectives of the CBD, all 14 pilot countries included LDN targets relating to forest and wetland conservation. In some countries progress, towards LDN targets is thus also likely to contribute to the target of increasing the number of habitats of rare and endangered species (UNCCD 2015h).

With regard to institutional aspects, pilot countries expressed the need for national LDN working groups which may include different public and private sector agencies as well as the National Focal Points from the Rio Conventions. For instance in Grenada, the pilot project reinforced an existing intention to move towards a single National Coordinating Body for all Rio Conventions (UNCCD 2015g).

Another key aspect in scaling-out and scaling-up LDN target-setting and implementation involves financing and resourcing. Addressing SDG target 15.3 will require extensive mobilization of additional financial resources but also in-kind resources at the country level.

Next to established funding sources such as the Global Environmental Facility (GEF), LDN activities are likely to become eligible under the Green Climate Fund and other climate financing mechanisms in view of their significant benefits for climate change adaptation and mitigation. Furthermore, the Global Mechanism is in the process of establishing a LDN Fund aiming at attracting blended financial assistance (UNCCD 2015a, decision 3).

4. Discussion: Enhancing synergy through efforts to implement actions that support LDN

Building on the lessons learned from the UNCCD pilot project and synthesizing these with the five definition-based challenges identified from our analysis in Section 3.1, Figure 2 illustrates key potential complementarities and entry points for the development of synergies in UNCCD, CBD and UNFCCC actions, to advance towards LDN.

Insert Figure 2: Key complementarities and entry points for the development of synergistic actions between UNCCD, CBD and UNFCCC. Note: EI: Expected Impact; DLDD: desertification, land degradation and drought; SLM: sustainable land management; DLD: desertification/land degradation; NAP: National Action Programme; NBSAP: National Biodiversity Strategies and Action Plans; NAPA: National Adaptation Programmes of Action; REDD+: Reducing Emissions from Deforestation and Forest Degradation in Developing Countries.

Two key entry points for potential synergy are observed: 1) on-the-ground operationalization actions and instruments that promote rehabilitation and/or restoration of degraded lands/ecosystems and advance Conventions' goals, and 2) synergy of processes. While several opportunities exist, it is important that the definition based challenges identified in section 3.1 are also addressed.

For example, Figure 2 includes CBD's Aichi Biodiversity targets 5, 7, 14 and 15, which are crucially important milestones on the way to LDN. Target 15 intends that by "2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification." (CBD, 2010:9). The CBD nevertheless fails to mention specific ecosystems it addresses with its target 15. This target also does not mention "rehabilitation", and could restrict the CBD solely to participate in joint restoration measures with UNCCD, thus providing little scope for synergistic action. Conversely, the UNFCCC mentions "rehabilitation" (UNFCCC, 1992, Article 4e). The UNFCCC further advocates for cooperation in research, training, information compilation and sharing on nationally

appropriate mitigation actions to be implemented by developing country Parties, thereby considering both restoration and rehabilitation (UNFCCC, 2013). This indicates that the UNFCCC consciously differentiates between restoration and rehabilitation, offering opportunities to pursue joint activities with the UNCCD (rehabilitation) or the CBD (restoration; see previous section).

The impacts of climate change, such as changing precipitation patterns and increased instances of severe weather events (including drought) will impact biodiversity and ecosystems and thus also affect long-term trends in land productivity and its resilience. Regarding discussions on climate change adaptation and mitigation, the CBD may face challenges with its restoration focus. "Restoration" or "conservation" are difficult under climate change conditions because as noted earlier, it is unclear to what state biodiversity/ecosystems should be restored, and how durable the implemented measures might be under future climates. In many areas it may be unrealistic/illogical to try to restore biodiversity or other ecosystem functions that land provides to an original condition, or to invest substantially and then try to maintain a status quo ("conservation") if a region is exposed to climate change (see also Welton et al., 2014).

At the national level, research and forestry departments are already promoting the concept of climate-smart reforestation which considers climate change mitigation and adaptation, while in some locations climate analogue approaches are pairing sites so that the projected future climate in one location may learn lessons from the current climate experienced in another location (Locatelli et al., 2015; Ramírez-Villegas et al., 2011). Developing synergies between the three Rio Conventions in moving towards LDN may therefore pragmatically tend to lean more towards rehabilitation and not restoration, as restoration measures cannot durably enhance ecosystem resilience due to climate change.

The UNFCCC and the CBD have their own sets of existing proposals, agreed measures and targets to address climate change through mitigation and adaptation efforts and conserving and sustainably using biodiversity. Different regions and countries have their own sets of policies and actions to implement these at the national and local levels (see for instance UNCCD's NAPs (UNCCD, 1994, Article 10) or UNFCCC`s proposals for nationally appropriate mitigation actions (NAMAs) (UNFCCC, 2013)). Rehabilitation, restoration and SLM measures will have to be integrated (as appropriate) with these existing national policies and prioritized actions, which emerge from Parties' strategies to implement these multi-lateral environmental agreements. In theory, this presents a useful opportunity to: a) support the

consideration of measures to attain LDN in existing financial frameworks, b) strengthen cross-sectoral support for the measures, c) strengthen engagement with existing national, regional and international organizations, centers and networks in relevant fields such as ecology, agriculture and food security, socio-economics, infrastructure, and d) implement no regret actions with potential benefits for the goals of the UNCCD, CBD and the UNFCCC.

Synergies between the three Rio Conventions on rehabilitation and restoration measures could also be strengthened by first conducting a systematic assessment such as with the Resilience, Adaptation and Transformation Assessment (RAPTA) (O'Connell et al., 2015) or similar tools.

The engagement of a broad range of stakeholders will be key to the success of any nationally driven rehabilitation, restoration and SLM measures and will be vital in operationalizing LDN "within specified temporal and spatial scales and ecosystems". Table 3 summarizes and blends relevant priority actions that together address the foci of the three Rio Conventions. These actions would support synergies for timely operationalization of LDN measures, while supporting mitigation and adaptation to climate change and helping to conserve and sustainably use biodiversity and ecosystem services to sustain human well-being.

Insert Table 3: Portfolio of options for achieving LDN blending relevant priority actions of the three Rio Conventions.

Measures outlined in Table 3 comprise several small initiatives. They are not costly and could complement each other or be ordered in a timely step-wise sequence according to national socio-economic priorities and realities to move towards LDN. If, for example, cultivated land is to be addressed, then initiatives would target maintaining or enhancing the persistent level of net primary production, and could be assessed using its measurable proxy (vegetation indices such as the NDVI). This enables countries to better accommodate LDN efforts in their national agenda setting, in ongoing activities and accounting. Measures also have the strength of being easily adapted to local and national social, cultural and economic realities, thereby creating synergies in action for the implementation of all three Rio Conventions at national and local levels. Table 3 includes both rehabilitation and restoration measures, as some rehabilitation measures can also support the initialization of restoration, which would enable countries, if required, to carry on with a more *"holistic process not achieved through* the isolated manipulation *of individual elements"*, which would lead *"as* closely as possible to pre-*disturbance conditions and functions"* of degrading or degraded ecosystems (UNCCD, 2016a: 10).

5. Conclusion

Operationalizing LDN necessitates unpacking the concept and associated terms, as well as analyzing the mandates of UNCCD, UNFCCC and CBD in order that synergies in action may be developed at both national and international levels. Our analyses show that incompleteness in the definition of LDN is academically challenging due to its inherent ambiguity. However, its vagueness can provide flexibility in identifying practical opportunities: the definition leaves space for negotiation and compromise at national level to operationalize this voluntary target at spatial and temporal scales that are relevant to meet countries' needs and aspirations. Notwithstanding the ambiguity, the UNCCD definition of LDN remains anthropocentrically focused by including the aim to stabilize or increase food security by enhancing the provision of land's ecosystem services and thus enhancing human livelihoods.

UNCCD's land-based approach offers an appropriate anchor for blending relevant priority actions under the three Rio Conventions, especially given the links between land and biodiversity, and land and climate change (including the bridging role of adaptation across the three Conventions). Harnessing possible synergies in actions could lead to a pragmatic, integrated framework of complementary, rehabilitation, restoration and SLM measures to achieve LDN, as suggested in the portfolio of options presented in Table 3. It could also stimulate actions at the national level that enhance human wellbeing. Developing such synergy will be vital in the post-2015 development context as countries seek both policy alignment and cost-effective action.

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