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## Research article

## Land Degradation Neutrality: Concept development, practical applications and assessment

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## ABSTRACT

The paper explores the background and scientific basis of Land Degradation Neutrality (LDN), a new paradigm reflecting the inter-related aspirations and demands of land-related sustainable development goals. The paper draws on academic literature, field observations, insight from development researchers and practitioners, professional meetings, and agency reports to describe the LDN concept and its relationship with sustainable land management (SLM). We discuss the potential for LDN to facilitate the adoption and assessment of SLM, and to provide a framework to achieve the “land degradation neutral world” goal of the Sustainable Development Agenda 2030. We present insights relevant to the implementation of LDN. These include the need to: consider quality as well as quantity of land degraded and restored; apply an ecosystem-based approach for LDN assessment; consider land degradation risks; recognize different uses of land and approaches to reach the LDN target; and define the LDN baseline and indicators. We discuss the contradictions of using two different modes for evaluating land degradation and successes in land restoration, which we name the “Anti-degradation view” and “Production-advocacy view”. To harmonize these approaches we propose that LDN be considered as a phenomenon of equilibrium of the land system, in terms of the balance between deterioration and improvement of terrestrial ecosystems’ qualities, functions and services. Indicators to reflect this balance can use different approaches relevant to the various countries and areas, and to the types of land use. Two examples of using this approach are described. The first shows the assessment of the state of LDN based on the homeostasis of land cover and is based on assessment of distribution of ecosystems, and the dynamics of the land cover pattern in the areas prone to land degradation. The second is based on the combination of the well-known principle of Leibig’s Law of the Minimum (1843), and Shelford’s Law of Tolerance (1911), and focuses on the balance of the components as the major determinant of a sustainable system. Both approaches are illustrated using schematic diagrams to represent different balanced or destabilized situations. We conclude that the comprehensive assessment of the components of land systems and their mutual equilibrium, which determine the potential for sustainable functioning, therefore can be a basis for the development and selection of the most appropriate indicators and measures of LDN at global, regional and local levels, and that LDN could serve as a target and indicator of SLM. Nevertheless, LDN as a phenomenon of equilibrium of the land system needs further scientific research, and development of effective methods to measure the balance between different terrestrial ecosystems’ qualities, functions and services.

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## 1. Introduction

Land degradation as a result of the poor management of land

resources is central to the interconnections and feedbacks addressed by the three “Rio Conventions” (United Nations Framework Convention on Climate Change, The Convention on Biological Diversity, and United Nations Convention to Combat Desertification (UNCCD)), and sustainable land management (SLM) offers a synergistic solution.

SLM is commonly considered as the main approach to prevent, mitigate and reverse land degradation. Although the principles and

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practices of SLM are well known and SLM has been widely promoted through many land use projects in different countries, land degradation is growing to become a major global threat. There is a wide gap between acknowledgement of the need for SLM and implementation of successful SLM practices. The slow adoption of SLM is at least partly because the SLM targets and indicators are mostly site- and nation-specific.

The UNCCD considered that the problem of slow adoption of SLM could be addressed by inclusion of Land Degradation Neutrality (LDN) as a Sustainable Development Goal (Lal et al., 2012). The concept of LDN was first raised at the Rio+20 conference of the United Nations and recorded in the resulting document “The Future We Want” (UN, 2012): “206. We recognized the need for urgent action to reverse land degradation. In view of this, we will strive to achieve a land-degradation neutral world in the context of sustainable development.”

The LDN initiative grew out of the concept of Zero Net Land Degradation, which was promoted by the UNCCD (2012), as discussed in recent scientific literature (Chasek et al., 2015; Tal, 2015; Stavi and Lal, 2015).

After being widely discussed as a political issue (UNCCD, 2015b), the LDN aim is now fixed in goal 15 of the Sustainable Development Goals (SDGs) as: “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”. The target 15.3 of this goal is: “by 2030, combat desertification, and restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land-degradation neutral world” (UN, 2015).

In 2015 the twelfth Conference of Parties (COP 12) of United Nations Convention to Combat Desertification adopted achievement of LDN as an overall UNCCD target (UNCCD, 2015a). COP 12 defined 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’. The LDN concept is based on the definition of land degradation given in the text of the UNCCD (1994): “reduction or loss of the biological or economic productivity and complexity of lands in arid, semi-arid and dry sub-humid areas”. The reference to the “arid, semi-arid and dry sub-humid areas” reflects the geographic mandate of the UNCCD, and does not imply that land degradation cannot occur in other areas. The LDN concept is applicable to all areas affected by land degradation.

In practical terms the LDN concept is clear enough: land use and management should not disrupt the existing balance between “not yet degraded” and “already degraded” such as to cause a net increase in degraded land. Ideally restoration of degraded land should swing the balance toward net reduction in degraded land. Thus, LDN can be considered as a policy instrument to balance processes of land degradation and restoration/rehabilitation/reclamation at global, regional, national and local levels. LDN could create a common framework within which efforts to assess and manage land degradation can be harmonized, and results made comparable.

Although LDN aims at the attractive goal of global land conservation, this is a vague target with many unknown aspects and an insufficiently clear scientific basis. In this context the attempts of countries to establish voluntary LDN targets can be considered, from scientific viewpoint, as a global experiment, which needs adequate validation. The “science of LDN” should be well defined, to articulate how it is new and innovative, and used as the basis for selection of indicators of LDN.

In this paper we review the concept of LDN, particularly its scientific development and practical application. We consider: (i)

the scientific background and origin of the LDN concept, (ii) how LDN is different from and complementary to the well-known concepts of sustainable land management, (iii) how the possible new science of LDN could be used to address land-related global challenges, e.g. desertification, climate change and biodiversity conservation.

Our findings are based on literature review and the authors’ experience in Eastern Europe, Central Asia, and work on the development of the Russian “Healthy Soil” initiative (Position Paper, 2014), and deliberations of the UNCCD Intergovernmental Working Group on the follow-up to Rio+20 (IWG) which devised the definition of LDN presented above.

## 2. The LDN concept

Conceptually the LDN idea is clear and expresses the desire to prevent a further degradation of lands. As the UNCCD has described, this “neutralizing” of land degradation would come about through “a global shift in land stewardship such that degradation of new areas is avoided, and unavoidable degradation is offset by restoring an equal amount of already degraded land ...” (Gnacadjia, 2012).

LDN has two linked dimensions: (i) reducing the rate of degradation of non-degraded land; and (ii) increasing the rate of restoration of degraded land. Rather than a global equilibration, global neutrality should be considered the sum of neutralities achieved by local communities and nations around the globe.

While the concept is superficially simple, there are many aspects related to its implementation that should be taken into account. Based on review of literature on management of land degradation and the concept of LDN we have discerned the following insights relevant to the implementation of LDN:

- Assessment of neutrality must consider two co-linked dimensions: changes in the available land quantity and quality, that is, the severity of degradation as well as the land area involved (Kust, 1997; Savich et al., 2003; UNCCD, 2012, 2014a; EC JRC, 2014);
- LDN promotes an ecosystem-based approach with two umbrella pathways of action: (i) addressing current and future land degradation (avoiding/preventing/minimizing land degradation processes): e.g. transition to SLM; (ii) redressing past degradation: e.g. rehabilitating working landscapes and restoring natural ecosystems (Colls et al., 2009; IUCN, 2009; Vignola et al., 2009; Uy and Shaw, 2012; Girod et al., 2013; WWF, 2013; Aronson and Alexander, 2013; Kust and Andreeva, 2014; Schipper et al., 2014; UNCCD, 2014b, 2014c; Reid, 2015);
- The LDN concept encourages consideration of spatial and temporal scales of actual changes in land quantity/quality *pari-passu* with evaluation and mitigation of land degradation risks/threats (Oldeman et al., 1991; GEF, 2011; Salvati et al., 2013; UNCCD, 2012, 2014a; EC JRC, 2014; Caspari et al., 2015);
- Land quality (both natural and anthropogenically enhanced) is a multi-faceted term, which encompasses productivity, functions, ecosystem services and their resilience, regeneration capacity, soil and ecosystem health, land potential, etc., individually and in combination, (FAO/UNEP, 1984; Savich et al., 2003; Dobrovolskiy and Kust, 2012; Aronson and Alexander, 2013; Grunewald and Bastian, 2015; USDA, 2015; Stavi and Lal, 2015);
- LDN recognizes the different uses of land and considers various approaches and methodologies to reach the LDN target, and as such it is about negotiating trade-offs and taking advantage of synergies in the management of these resources for multiple benefits, (Blaikie, 1989; Saiko and Zonn, 2000; John et al., 2005;

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