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A social-ecological systems approach is necessary to achieve land degradation neutrality

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ABSTRACT

Viewing humans as drivers of change operating outside the natural environment is unhelpful for defining interventions that effectively manage change and complexity. Indeed, there is now broad agreement that environmental governance needs to consider integrated social-ecological systems (SES) in order to tackle the world's grand challenges of land degradation. This requires a more differentiated, innovative approach that considers how changes in SES shape the functioning of land systems as a whole, and the synergies and trade-off these changes may produce. In this study, we identify and discuss some of the ways SES science and practice can inspire progress towards land degradation neutrality (LDN) outcomes in an integrated manner, through synthesis of literature and relevant documents related to the United Nations Convention to Combat Desertification (UNCCD). We do these by considering: (i) how LDN has been approached to date and the challenges likely to undermine progress towards achieving it; and (ii) an SES-based LDN approach relevant to the neutrality agenda, in particular, by describing how LDN might be thought of differently through an SES lens. We argue that an SES approach focusing on: (i) "people as part of nature", not "people and nature"; and (ii) the frame of reference against which neutrality can be assessed across temporal and spatial dimensions, is necessary to both inform policy and guide actions of the different groups involved in avoiding and combating land degradation. Such an (integrated) approach adds a dimension (to achieving neutrality goals) not previously explored in sustainable land management and LDN research. Important next steps in operationalising the SES-based LDN approach involve empirical and field case studies, requiring interdisciplinary, mixed method techniques.

1. Introduction

Humanity depends on land-based natural capital for life support, but anthropogenic activities are modifying land resources and the ecosystem functions and services they deliver in profound ways across the globe (Verburg et al., 2013). Tackling land management challenges in the 21 st century requires a new understanding of the complex interactions between land systems and human societies, as well as an appreciation of the evolving notion of *humans as nature* (Torday and Miller, 2015). In particular, the sustainability of the world's land systems cannot be achieved without considering land degradation neutrality (LDN) interventions in social-ecological systems (SES) contexts (Cowie et al., 2018). LDN is enshrined in target 15.3 in the Sustainable Development Goals (SDGs) and can be defined as a state where "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" (UNCCD, 2016; 8). An SES context presupposes that promoting and maintaining well-functioning land ecosystems depends not only on politically-driven initiatives to avoid, reduce and/or reverse land degradation, but also requires land managers/institutions to ensure humans relate to, care for, and value ecosystems under efficient allocation of rights and privileges across time and locations (Orr et al., 2017). Indeed, sustainable land management (SLM) cannot be achieved separately from the livelihoods of land-dependent communities (Reed et al., 2015), or from the management of other socio-economic sources of

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wellbeing (such as financing green urbanisation) (Liu et al., 2013). More than ever, integrated SES approaches are needed to foster the achievement of LDN within a rapidly re-aligning global environmental change and sustainable development policy context.

The concept of social–ecological systems (Ostrom, 2009) - also referred to as coupled human and natural systems (Liu et al., 2007) or coupled human–environment systems (Turner et al., 2003) - offers a powerful lens for framing interlinked human and ecological systems, putting into focus people's dependence on nature and their ethical obligations towards it (Fischer et al., 2015). An SES itself is a type of complex adaptive system composed of two primary subdomains: a human society and economy on the one hand, and a biological ecology on the other (Chapin et al., 2009). Using an SES approach implies engaging the coupled human–natural systems in ways that are useful to the different communities of resource managers. A concern for many of these communities is an improved state of human society and ecosystems. Indeed, an SES approach offers a novel interdisciplinary platform to integrate different views and dimensions of global land system changes (Leslie et al., 2015). This approach in the context of LDN is predicated on the notion that SLM resides in the condition and operation of human systems and ecological systems, including the response capacities and system feedbacks from land restoration and rehabilitation interventions (Verburg et al., 2015). The approach has matured during recent decades giving rise to new insights about synergies and trade-offs between human society and nature across different scales (Lambin and Meyfroidt, 2010), as well as advancing linkages between science and policy/practice (Liu et al., 2013).

As the intensity of interactions between humans and nature increases in scale and scope, understanding of the roles that SES can play in the pursuit of LDN is becoming more and more important (Orr et al., 2017). This is necessary to successfully overcome mounting land degradation threats and the associated social and economic challenges. Although SES offers guidance on how to think about the dynamics of land systems within human-social and ecological systems, it rarely (if ever) has been integrated in approaches to advance LDN in multiple localities in a clearly explicit manner that considers humans as part of nature. We argue that viewing humans as drivers of change operating outside the natural environment is unhelpful for defining interventions that effectively manage change and complexity. As such, a step-change is needed in re-defining how LDN is pursued, as well as how human society and nature are conceptualised, in order to guide actions of the different actors involved in avoiding and combating land degradation. In this study, we identify and discuss ways in which SES science and practice can inspire progress towards LDN outcomes in an integrated manner, through synthesis of literature and relevant documents related to the United Nations Convention to Combat Desertification (UNCCD). We do these by examining how LDN has been approached to date, and the challenges likely to undermine progress towards achieving it (Section 2). We then introduce an SES-based LDN approach relevant to the LDN agenda, in particular, by describing how LDN might be thought of differently through an SES lens (Section 3). Findings from this study (summarised in Section 4) are useful for land management professionals and development actors that seek to utilise an SES-based LDN approach in their work, as well as researchers keen to advance the theoretical underpinnings of SES science to guide practical actions towards a well-functioning environment.

2. Land degradation neutrality as a new paradigm for sustainable land management

Land degradation covers at least 23% of terrestrial areas globally, increasing at the rate of 5–10 million ha annually (Stavi and Lal, 2015), and affects about 1.5 billion people globally (Gnacadja, 2012). Degradation is a state whereby the quantity and quality of land remain unstable or decline within specific spatiotemporal scales and ecosystems (Lal et al., 2012). Degradation involves the reduction of current and/or future biological productivity and decrease in capacity of land ecosystems to produce benefits from a particular land use under a specified form of land management (Grainger, 2015). This encompasses deterioration in quality and/or decline in quantity, leading to partial or total loss of one or more land ecosystem functions/services (UNCCD, 2017). Land Degradation Neutrality (LDN) represents an urgent and comprehensive politically-driven action to address degradation. It is an essential SDG target (15.3) requiring on-going or existing land degradation to be balanced by restoration/rehabilitation and sustainable land management, on-site or off-site. LDN aims to advance sustainable protection of land ecosystems and biodiversity and stabilise (or even increase) the amount of productive lands globally by 2030, and as such increase food security and reduce poverty among highly ecosystem-dependent populations (Barkemeyer et al., 2015; Safriel, 2017).

Before LDN emerged in the international political arena in 2012, the UNCCD considered SLM as essential to prevent, mitigate and reverse degradation. But SLM has experienced slow uptake, partly because its targets and indicators are largely project-, site-and nation-specific (Lal et al., 2012). The inclusion of LDN as an SDG target helps to address the problem of slow SLM uptake, as well as enabling the merging of SLM and restoration/rehabilitation actions (Orr et al., 2017). Thus, neutrality is promoted to catalyse a global shift in land stewardship to avoid degradation of new land areas, and to ensure unavoidable degradation is offset or balanced by restoring/rehabilitating an equal amount of already degraded land (Gnacadja, 2012).

Previous management approaches related to land view humans as external drivers (masters and users of natural capital) of change that damage natural resources. A utilitarian and exploitative perspective emphasising limitless resources and human dominion over nature shaped the management of natural systems before the mid-20th century (Margerum, 1995). This traditional command-and-control management approach enabled reactionary, top-down hierarchal processes, and was thought to encourage maximum sustainable yield of resources and a somewhat steady-state resource management (Born and Sonzogni, 1995). From the 1980s there was a transformation in worldview which spurred global awareness of the finite nature of the natural resource base. This led to social re-orientation and research on new approaches for environmental conservation and sustainability (Westley et al., 2011). Integrated environmental management (IEM), grounded in a theoretical view that ecological systems, including land, are complex, dynamic and constantly evolving, heralded a shift in management that conflicts with previous conventional, prescriptive management approaches. IEM supports the use of holistic, adaptive, and inclusive approaches to manage natural resources as a component of human/social-systems (Margerum, 1999).

As such, IEM led to the emergence of: (i) co-management approaches - emphasising stakeholder participation and collaboration for effective governance, and the sharing of power and responsibilities in environmental stewardship between institutions, managers and resource users, often located at different governance levels (i.e. the polycentric system mentioned in Ostrom (2010)); and (ii) adaptive management - based on learning-by-doing as a way to overcome uncertainty and complex challenges inherent in human-nature systems. The latter is fuelled by: complex, progressing and unforeseen climate change impacts on land-based systems that will increasingly need a precautionary approach to regulate land uses (Reed and Stringer, 2016); and anticipation of a likely increase in climate uncertainties, making quantitative judgements to regulate land use difficult in the short- to medium-term (see also European Commission, 2000). The precautionary approach is therefore maturing "into an ethical principle" in dealing with environmental issues (COMEST, 2005) and in this particular case, with LDN; (iii) a combined adaptive co-management approach, which is a bottom-up, emergent and self-organising process emphasising local stakeholder collaboration, social learning and knowledge co-generation as key to adapting management plans, actions and objectives over time to maximise their relevance (Armitage et al.,