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Reorienting land degradation towards sustainable land management: Linking sustainable livelihoods with ecosystem services in rangeland systems



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ABSTRACT

This paper identifies new ways of moving from land degradation towards sustainable land management through the development of economic mechanisms. It identifies new mechanisms to tackle land degradation based on retaining critical levels of natural capital whilst basing livelihoods on a wider range of ecosystem services. This is achieved through a case study analysis of the Kalahari rangelands in southwest Botswana. The paper first describes the socio-economic and ecological characteristics of the Kalahari rangelands and the types of land degradation taking place. It then focuses on bush encroachment as a way of exploring new economic instruments (e.g. Payments for Ecosystem Services) designed to enhance the flow of ecosystem services that support livelihoods in rangeland systems. It does this by evaluating the likely impacts of bush encroachment, one of the key forms of rangeland degradation, on a range of ecosystem services in three land tenure types (private fenced ranches, communal grazing areas and Wildlife Management Areas), before considering options for more sustainable land management in these systems. We argue that with adequate policy support, economic mechanisms could help reorient degraded rangelands towards more sustainable land management.

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1. Introduction

Drylands occupy approximately 41% of the world's land area and support the livelihoods of around 2 billion people (Middleton et al., 2011). Between 10 and 20% of the world's drylands are considered degraded (medium certainty) (Millennium Ecosystem Assessment, 2005a). However, land degradation is subject to a range of different definitions and measurements. Conceptualisations range from those that focus more on biophysical functions and changes (e.g. Holling, 1986; Dean et al., 1995; IPCC, 2001), to those based primarily on changes in the productive potential of the land for human use (e.g. UNEP, 1992, 1997; Kaspersen et al., 1995; ELD Initiative, 2013). The former tends to emphasise biophysical assessments of natural capital stocks (e.g. using ecological and soil-based

approaches and remote sensing) and approaches to tackling land degradation based on techniques such as soil stabilization and revegetation. The latter focuses more on assessing flows of ecosystem services,¹ and considers the perceptions of local communities and economic indicators (e.g. productivity trends based on livestock census data). Increasingly, assessments are combining biophysical and socio-economic approaches to provide a more holistic and contextualised picture of dryland degradation (e.g. Milton et al., 2003; Katjiua and Ward, 2007; Klintonberg et al.,

¹ Ecosystem services are the benefits that humans derive from the natural environment. They are typically grouped as: supporting services (necessary for the production of other ecosystem services e.g. soil formation, photosynthesis and nutrient cycling); provisioning services (ecosystem products e.g. food, fibre and water); regulating services (including processes such as climate stabilisation, erosion regulation and pollination); and cultural services (non-material benefits from ecosystems e.g. spiritual fulfilment, cognitive development and recreation) (Millennium Ecosystem Assessment, 2003).

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2007; Reynolds et al., 2007, 2011; Reed et al., 2008). Such combined assessments are essential for policy development, enabling decision-makers to assess the likely socio-economic and environmental impacts of different policy options (Arntzen, 2001), and identify policy mechanisms that can realistically be implemented to tackle land degradation and help shift practices towards sustainability (Schwilch et al., 2011).

This paper presents new ways of moving from land degradation towards sustainable land management (SLM)² through the use of economic mechanisms. The paper fuses insights from the ecosystem services framework with Sustainable Livelihoods Analysis, to identify economic opportunities arising from the ecosystem services provided by SLM. This is explored using a case study of bush encroachment³ in Botswana's Kalahari sandveld, with focus on livestock producing areas of Kgalagadi District. This is an area in which land tenure is varied, providing a context from which insights may be applied across a range of international situations. On a global scale, bush encroachment has been described as “the most widespread problem on dryland pastures” (Warren and Agnew, 1988: 6). It reduces the availability and heterogeneity of forage resources (Scoones, 1995) by reducing grass production whilst increasing the abundance of invasive species that are unpalatable to cattle (Perkins and Thomas, 1993). Such land degradation can therefore lead to a reduction in economic outputs in cattle-based livelihood systems (Quan et al. 1994; Scholes, 2003).

The paper first describes the socio-economic and ecological characteristics of the Kalahari in southwest Botswana and a range of perspectives on the land degradation taking place. It then focuses on bush encroachment to explore how a focus on the flows of ecosystem services supporting livelihoods, could inform the development of new economic measures. It does this by evaluating the likely impacts of bush encroachment on ecosystem services in three land tenure types (including communal rangelands, privately owned rangelands and Wildlife Management Areas (WMAs)), before considering opportunities for more sustainable land management that would improve the provision of ecosystem services. By exploring the extent to which SLM is able to enhance ecosystem service provision, it is possible to systematically consider some of the costs, benefits and trade-offs associated with different ways of tackling land degradation. In particular, the paper assesses the potential for Payments for Ecosystem Services (PES) schemes to enhance livelihoods in semi-arid rangeland systems, to help pay for land degradation remediation and incentivise more sustainable land management.

2. Case study area: Kalahari rangelands

Our analysis focuses on the Kalahari rangelands, particularly Kgalagadi District in Southwestern Botswana (Fig. 1). We present a critical evaluation of ongoing integrated analyses from private game ranches (Tshabong and Bokspits areas), karakul sheep ranches (Bokspits area), communal livestock grazing (unfenced cattle posts) (Tshabong area) and the Kgalagadi Transfrontier Park and its surrounding WMAs. Information about each area is summarised in Table 1.

² 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, 2010).

³ Defined as “a directional increase in the cover of indigenous woody species in savanna” (O'Connor et al., 2014).

2.1. Existing perspectives on land degradation and sustainable rangeland management in the Kalahari

Botswana has been described as “one of the most desertified countries in sub-Saharan Africa” (Barrow, 1991: 191). However, assessments of land degradation severity and extent can vary significantly, depending on the methods and scales under consideration. This section briefly reviews the different approaches that have been used to date, underscoring the need for a more integrated approach.

Biophysical conceptualisations of land degradation tend to focus on ecological and abiotic functions and their changes over time, to assess changes in stocks of natural capital. This typically relies on ecological, soil-based and remote sensing methods to assess biophysical indicators of land degradation. For example, bush encroachment around water points has been observed in numerous ecological studies throughout the Kalahari (e.g. Perkins and Thomas, 1993; Moleele and Perkins, 1998; Dougill et al., 1999; Moleele et al., 2002). These zones generally occur across areas of between 1 and 4 km, but can extend much further. For example, in parts of south Kgalagadi district (e.g. between Tshabong and Omaweneno; Fig. 1), bush encroached zones around water points are coalescing, where they can extend up to 9 km from individual boreholes, resulting in impenetrable stretches of bush for tens of kilometres (Reed, 2005). Ecological studies have also documented the retreat of grass cover up to 18 km around the Matsheng villages (Moleele and Mainah, 2003; Moleele and Chanda, 2003; Chanda et al., 2003). The exact causes of bush encroachment remain contested, with dynamic ecological models assigning differing importance to variables such as grazing levels (Dougill et al., 1999), changing fire regimes (Joubert et al., 2012a,b) and the effects of CO₂ fertilisation (Bond and Midgley, 2000). The interaction of these driving forces and factors affecting ecological tipping points remains poorly understood (Sietz et al., 2011; Lohmann et al., 2012).

Using remotely sensed data, Tanser and Palmer (1999) noted significantly lower standing biomass, lower basal cover, and more bare soil in intensively grazed communal rangeland in comparison to WMAs and National Parks. However, it is not possible to determine vegetation height using satellite data alone, so it is difficult to distinguish between bush encroachment and natural tree cover. “Rangeland condition” maps based on Normalised Difference Vegetation Index readings are used by policy-makers to identify degradation extent and assess the extent of droughts and wildfire impacts (Reed, 2005). Although time series analysis of such data can shed some light on degradation issues, any interpretation should be based on a detailed understanding of how land use and land management has varied over time within the study area.

Socio-economic conceptualisations of land degradation tend to focus on changes in the productive potential of the land for human use. These generally rely on economic indicators, and opinions of local communities and other stakeholders. Most of the evidence based on this approach in the Kalahari has focused on changes in provisioning services, with a focus on trends in livestock populations, as the main source of livelihoods and Botswana's main agricultural export (e.g. Reed, 2005; Reed et al., 2007; Dougill et al., 2010).

Local perceptions are often at variance with published assessments of land degradation and SLM. For example, Thomas and Twyman (2004) and Reed et al. (2007) found that land managers (mainly owning goats and sheep) in southwest Botswana regarded the encroacher *Rhigozum trichotomum* as an important forage resource and windbreak. This was contrary to views in South African literature that bush encroachment by this species was a major problem in this region for communities whose livelihoods depend on cattle ownership (van Rooyen, 1998). Reed et al. (2008)

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