



Defining core areas of ecological infrastructure to secure rural livelihoods in South Africa



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ABSTRACT

Indigenous communities in South Africa are severely affected by land degradation and global climate change, which lead to decline in the provision of multiple ecosystem services (ES) important for rural livelihoods. Spatial planning towards functional ecological infrastructure (EI) for sustainable rural livelihoods requires evidence-based knowledge about what land covers are of most importance, why, and where they are located. This study identifies potential core areas of EI that deliver ES necessary for livelihoods of rural communities, as well as those land covers that provide disservices using the Tsitsa catchment in Eastern Cape, South Africa as a case study. Face-to-face structured interviews (n=308) were conducted to define rural and urban people's desired ES in the catchment's 23 land covers and the most unwanted land covers. Both urban and rural respondents from indigenous communities view rivers, grasslands and forest plantations as the most wanted land covers that provide multiple ES important for their livelihoods. The most unwanted are dongas, grasslands in poor condition, and barren rocks. We discuss the need for landscape restoration in order to sustain the provision of ES important for livelihoods of rural communities and develop strategies for EI management in communal lands.

1. Introduction

Ecosystem degradation is significant in South Africa (Stocker et al., 2013). Approximately 38% of South Africa's population lives in ecologically degraded areas (Bai and Dent, 2007) with projected drastic economic impacts of global climate change (UNICEF, 2011). Thus, South Africa is a striking illustration of great threats that humanity faces (Millennium Assessment, 2005; Brown et al., 2007; Raleigh and Urdal, 2007) where human populations prone to multiple social and environmental pressures live under vulnerable conditions, and the effects are evidenced by increased poverty and water scarcity (Rosegrant et al., 2003). In response to this complex portfolio of socio-ecological problems, the South African government has developed strategies that need to be employed to mitigate against land degradation and climate change (SA Government, 2011). One of these is to maintain ecological infrastructure (EI) (Adger et al., 2005; Demuzere et al., 2014; SANBI, 2014) aiming at supporting naturally functioning ecosystems that deliver valuable ecosystem services (ES), reducing risk and vulnerability for humans (Cadman et al., 2010; Grundling and Grobler, 2005). This can be done through conservation,

restoration and protection of valuable natural and semi-natural areas and maintenance of appropriate land management. The inter-relationship between ecosystems and human well-being has been extensively documented (Daily, 1997; Wainger et al., 2001; Polasky et al., 2005; Boyd, 2006; Carpenter et al., 2006; Boyd and Banzhaf, 2007; Barbier et al., 2008), reflecting a growing human demand for multiple ES (De Groot et al., 2002; Zakri and Watson, 2005).

Indigenous rural communities are particularly severely affected by land degradation and global climate change as it leads to reduced drinking water, subsistence food, and fodder (Millennium Assessment, 2005), and thus, to a decline in the provision of multiple ES important for their livelihoods. Rural development linked to the class structure of poverty in South Africa (Carter and May, 1999) has been one of the central programs for the South African government since 1994, with poverty alleviation and job creation being the main national development objectives (ANC, 1994; Cewuka, 2013; National Planning Commission, 2013). Due to the disproportionate access to natural resources among different social classes, rural communities become deprived of basic essentials and necessities for a minimum standard of living. The issue of land dispossession is deeply embedded in the

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colonial history of the continent. Since the 19th century, many social engineering endeavours were systematic and ruthless in monopolising land ownership for the ruling ethnic group (e.g., [Brookes and Hurwitz, 1957](#)). The net result was that the majority of indigenous South Africans were relocated to relatively small portions of the country (~8%) with semi-autonomous homeland governments, while most white people retained the bulk of title deeded lands ([Hamman and Tuinder, 2012](#)). The high human population density in the former rural homelands and the high population growth rates during apartheid period further increased the pressure on the land, evidenced through extensive pastoral grazing culminating in pervasive vegetation degradation and excessive soil erosion ([Vetter et al., 2006](#)). Since 1994 the South African government has been attempting to use rural development and poverty reduction as one of the key economic frameworks of the country ([Twala, 2012](#)). The development of EI is seen as an approach to rehabilitation of degraded lands, which has either highly impaired or transformed ES important for sustainable livelihoods of rural communities. According to a national assessment ([DEA, 2014](#)), the three provinces Limpopo, KwaZulu-Natal, and the Eastern Cape, suffer the most extensive land degradation, which includes soil degradation, decreased vegetative cover, bush encroachment, alien plant invasions, and changes in species composition ([Palmer and Bennett, 2013; DEA, 2014](#)). All of these come at a high cost ([Palmer and Bennett, 2013](#)). As an example, soil degradation alone costs the national budget nearly \$ 140 million US per annum ([Hoffman and Ashwell, 2001](#)).

Planning for sustainable rural livelihoods requires evidence-based knowledge about what land covers are important for securing rural livelihoods, why, and where they are located. This applies to both the supply and demand of ES. However, the latter is often casually handled (e.g. [Villamagna et al., 2013](#)). The aim of this study is to identify potential core areas of EI that deliver multiple ES necessary for livelihoods of indigenous rural communities. We focus only on the demand side of the ES concept and therefore the beneficiaries of ES. In line with [Chan et al.'s \(2012\)](#) work this study is thus an attempt at elucidating people's 'appreciation' (*sensu* [Van Berkel and Verburg, 2014](#)) of a suite of ES linked to different land covers. We have opted to use 'appreciation' as opposed to the classical 'valuation', which has a tendency to invoke monetary value. Our study incorporates indigenous community resident views on the full set of ES important for their livelihoods, as well as those land covers that deliver the demanded ES. This study has been done in the Tsitsa catchment, which is part of current Ntabelanga and Lalení Ecological Infrastructure (NLEIP) programme that was launched in 2014 ([Fabricius et al., 2016](#)). The NLEIP is an 8-year programme with a budget of US \$32 million US. The vision is to support sustainable livelihoods for local people through integrated landscape management that strives for resilient social-ecological systems and fosters equity in access to ES ([Fabricius et al., 2016](#)).

Using the methodological approach presented in [Elbakidze et al. \(In press\)](#), first, based on 308 interviews we document what ES are acknowledged by the indigenous rural and urban inhabitants as important for their livelihoods. Second, we identify and map land covers as potential core areas of EI that are acknowledged as providers of multiple ES by the majority of both urban and rural respondents in the Tsitsa catchment. Thirdly, we map land covers that provide disservices. Finally, we discuss how EI can be enhanced to promote sustainable rural livelihoods.

2. Methods and materials

2.1. Study area

The Tsitsa River catchment (~ 4936 km²), a region hosting a government funded development project in the north-east corner of South Africa's Eastern Cape Province (NLEIP), was chosen as the study area ([Fig. 1](#)). The catchment is dominated by grasslands with common

thatching grass (*Hyparrhenia hirta*), redgrass (*Themeda triandra*), narrow-leaved turpentine grass (*Cymbopogon plurinoides*), weeping love grass (*Eragrostis curvula*), spear grass (*Heteropogon contortus*), Ngongoni grass (*Aristida junciformis*), and ratstail dropseed grass (*Sporobolus africanus*). Afro-montane forest is limited to isolated pockets in the mountain areas, and the savannah woodland is restricted to the drier southern section. Rainfall in the region occurs predominantly in summer with mean annual rainfall slightly higher (686 mm) in Maclear than in Tsolo (599 mm) due to the orographic effect. Snow is common in winter at the higher altitudes.

The Eastern Cape has two former independent homelands (namely: Ciskei and Transkei) inherited from apartheid defined by the Kei River. Transkei in the east literally means "across the Kei", which was the boundary between the former independent homeland and the Republic of South Africa under apartheid. Owing to the historical legacy of apartheid, the Tsitsa catchment is broadly divided into two distinct socio-cultural domains ([Fig. 1](#)). The western areas are entirely dominated by free-hold title tenure, while the eastern sections are communal areas, previously within the independent homeland of Transkei. The freehold title areas are typified by the combined land-uses of commercial agriculture (largely pastoral) and plantation forestry, while the communal areas are largely pastoral. The freehold title areas support the towns of Maclear (population = 10,521) and Ugie (population = 13,467), while Tsolo (population = 7794) and Qumbu (population = 4928) are the only large urban localities in the communal areas ([Frith, 2011](#)). In Ugie and Maclear the vestiges of apartheid are readily evident in the "township" communities, where low-cost housing, over-crowding and lack of facilities are starkly evident. In total, there are approximately 386 villages in the study area, with a combined population of ~ 2,20,980. The freehold part of the study area (2091 km² ~ 42%) had a human population density of 0.4–1.4 people km⁻² (excluding the urban centres of Maclear and Ugie) and the communal lands (2845.4 km² ~ 58%) had a mean human population density of ~ 78 km⁻², but with ranges from 1 to 240 people km⁻² ([Hodgson, 2016](#)). Many of the local residents in the communal areas are urban migrants in search of employment. However, such opportunities are extremely limited in the remote rural areas.

There are three local municipalities, Mhlontlo, Nyandeni and Elundini, in the study area. The primary sector for the Mhlontlo and Nyandeni municipalities is agriculture ([StatsSA, 2012](#)), which cannot even support the local community. In the Elundini municipality commercial agriculture and forestry are dominant ([StatsSA, 2012](#)). Traditionally, indigenous rural communities had been adapted to a subsistence form of living, with pastoral and rain-fed agricultural operations being the main sources of economic activities. In the recent history, however, there has been a decreased attention to these subsistence economic activities ([Tibesigwa et al., 2016](#)) evidenced by large number of fallow lands that would have been economically active in the past. There is no single factor that is the cause of this land abandoning. There are views that this can be attributed to dependency of rural people on government's social grants ([Chitiga et al., 2014](#)), which have been increasingly received by large numbers of people in the country, i.e. about 31% of the population in the 2012/13 assessment ([National Treasury, 2013](#)). Additionally global climate change, leading to reduced land productivity; depopulation of rural areas, ([Makiwane and Chimere-Dan, 2010](#)); and high cost of tilling the land in the context of increasing poverty in Transkei ([Westaway, 2012](#)) may be considered as additional factors in land abandonment.

The South African Government plans to construct large water impoundments (and associated extensive irrigation and hydropower) on the Tsitsa River as a component of the uMzimvubu Water Project (UWP) ([Van Tol et al., 2014](#)). The rationale of this plan has had the dual purposes of stimulating the local and regional economy as well as providing vital development for a previously disadvantaged sector of South Africa. The Department of Environmental Affairs (DEA), Chief Directorate of Natural Resource Management (NRM) seeks to support

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