



Using participatory mapping and a participatory geographic information system in pastoral land use investigation: Impacts of rangeland policy in Botswana



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ABSTRACT

Since the 1980s, the spatial extent of communal grazing lands in Botswana has been diminishing due to rangeland privatisation and fencing associated with animal health policies. Spatial comparisons of pastoral land use transformations are particularly important where accessibility to grazing and water resources remains at the core of sustainable pastoralism policies. Achieving success in pastoral development research requires a sound understanding of traditional pastoralists' information systems, including the nature of local spatial knowledge. This study explores local spatial knowledge through participatory mapping and a Participatory Geographic Information System to understand and analyse pastoralists' grazing patterns, spatial mobility and the impacts of subdivisions and privatisation policies in Botswana's Ngamiland rangelands. The study uses focus group discussions, historical analysis through key informant interviews, and participatory mapping exercises along with community guided transect walks. The resulting maps provide insights into the traditional tenure patterns of land use and the impacts of rangeland policy on traditional livestock spatial mobility and access to grazing lands. Privatisation and rangeland enclosures have resulted in the restricted movement of livestock and overstocking of floodplains and riparian rangelands, with some natural water pans becoming inaccessible to local communities. We conclude that the integration of local spatial knowledge can be used to foster better articulation and understanding of pastoralists' tenures, which are often lacking in communal land administration systems. Such integrated analysis can contribute to sustainable pastoral land management policy toolkits in semi-arid rangeland environments and enable better land tenure and management decision making for sustainable land management.

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1. Introduction

Policies and regulations that govern communal grazing lands have important implications for pastoral livelihoods and traditional pastoralism characterised by flexible herd mobility (Benjaminsen et al., 2009; Rohde et al., 2006; Chanda et al., 2003). In sub-Saharan Africa, the consequences are particularly significant (Galaty, 2013; Tache, 2013; Mwangi, 2007; Peters, 1994) as many countries have undergone rapid tenure transformations (Toulmin, 2009). The need to establish private and secure property rights, avert land degradation, and to modernise and commercialise agricultural production has been used to justify numerous land privatisation programmes undertaken through bilateral and multilateral aid agencies (Peters,

2009). The form and content of these rangeland management policies is a result of the modernisation process based on a model of development established in developed countries (Rohde et al., 2006). Enclosure and privatisation of the commons, including a shift from traditional institutions of land management to modern ones, was the policy recommendation to emerge from this modernisation process (Rohde et al., 2006). Pastoralism became a major target of the modernisation model and its subsequent policies (Peters, 1994).

Pastoralism in arid or semi-arid lands is characterised by substantial spatial heterogeneity in land use, resource access, management regimes and the ways in which pastoralists respond to environmental constraints (Tsegaye et al., 2013). Pastoral land tenure needs secure land use rights that accommodate flexibility in resource access (Fernandez-Gimenez, 2002). The rationale for traditional pastoralism of herd mobility and flexibility has been reinforced by the recognition that drylands systems are non-equilibrium in nature and that resource sustainability is largely a

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function of spatial and temporal variability in rainfall and/or fire regimes (Dougill et al., 2016; Kakinuma et al., 2014; Dougill et al., 1999). The survival of herds depends on the pastoralists' ability to respond to variability or uncertainty and hence move to better areas with available fodder (Vetter, 2005). Therefore, extensive spatial scales of exploitation become a prerequisite for a successful pastoral production system (Moritz et al., 2013; Notenbaert et al., 2012). For example, in Kenya the need for more spatially extensive rangelands has led some Maasai pastoralists to recombine some private parcels of land to improve mobility strategies (Coleman and Mwangi, 2015).

Pastoral societies are also characterised by a high dependency on local knowledge (Adriansen and Nielsen, 2002). The spatial knowledge systems held by herders help them determine what the temporal and spatial distribution of resources might be in any given year and are central to sustainable pastoral herd mobility (Oba, 2013). However, changes in statutory land tenure systems through privatisation have interrupted pastoralists' capacity to utilise customary land rights, including traditional mobility strategies, to cope with eventualities such as drought and disease incidences (Kaye-Zwiebel and King, 2014; Lengoiboni et al., 2010). Most rangeland privatisation policies have not yet yielded the intended benefits. Where land degradation existed it has not been halted (Dougill et al., 2016) and traditional livestock management institutions have been disoriented, undermining traditional livelihoods and rangeland management systems (Peters, 1994).

In Botswana, the policy arrangement that has most significantly impacted communal rangelands is the TGLP of 1975 (Magole, 2009; White, 1992; Childers, 1981). TGLP allowed for the fencing of communal grazing lands for commercial ranches (Adams, 2013). Claims related to the overstocking and degradation of communal grazing lands, including the tragedy of the commons theory (Hardin, 1968), were used to structure and justify policy objectives (Rohde et al., 2006; Cullies and Watson, 2005). The assumption was that the effect of unregulated communal grazing coupled with perceived increases in livestock numbers was responsible for rangeland degradation and that the consequences would become severe (RoB, 1975). Livestock needed to be regulated based on ecological carrying capacity, and the only way this was to be achieved was through privatisation since it was assumed that communal land tenure arrangements fail to regulate pastoralists' access to resources (APRU, 1976; RoB, 1975). TGLP assumed that there was ample unoccupied land available for privatisation (RoB, 1975). However, implementation was far more difficult than anticipated (Peters, 1994). Many parts of the country that had been assumed to be unoccupied contained substantial numbers of people, some of whom were not cattle herders, such as hunter gatherers (Childers, 1981). Despite these shortcomings, TGLP implementation continued and by 2009 a total of 342 ranches, each measuring approximately 6400 ha, had been allocated (Mathuba, 2009). The TGLP objectives were expanded and continued by the National Policy on Agricultural Development (NPAD) (RoB, 1991). NPAD targeted the land around communal grazing areas or cattle posts¹ owned by individuals or syndicates (Cullies and Watson, 2005). An additional 552 ranches, each measuring approximately 3600 ha, were demarcated and allocated under NPAD by 2009 (Mathuba, 2009).

Local communities do not have much say in the ranch allocation process, as it is controlled by the Land Boards and Ministry of Agriculture (Adams, 2013). The allocation process gives those who previously had only *de facto* rights to grazing around their boreholes

exclusive rights to previously communal grazing lands (RoB, 1991). The large costs of drilling and equipping a borehole ensures that owning a borehole remains a privilege of the wealthy, hence most beneficiaries belong to the wealthier echelons of society (Magole, 2009; Perkins, 1996). In a few instances, some poor pastoralists were incorporated into syndicate ranches and granted water and pastures as hirers who paid fees (Peters, 1994). Today, communal pastoralists find themselves surrounded by private ranches and disease control fences which bisect rangelands and separate communal pastoralists from critical grazing resources.

To date, few studies have proposed integration of pastoralists' spatial knowledge, spatial comparisons and/or participatory mapping approaches and a Participatory Geographic Information System (PGIS) to analyse pastoral management systems and the impacts of such transformations as described above. Studies have emphasised the overarching need to generate spatial landscape knowledge regarding pastoralists' tenures and land use in order to develop the capacity of local communities to help governments to reconcile pastoral tenure conflicts and manage resources in dry-land areas (Turner et al., 2014; Bennett et al., 2013; Lengoiboni et al., 2010). This study draws on participatory research methods and geospatial technology to explore local spatial knowledge to understand traditional pastoralists' spatial mobility and the impacts of subdivisions and privatisation policies in Botswana's Ngamiland district. Local spatial knowledge is the unique knowledge held by local communities, acquired through practical experience and developed around specific geographic areas (Mccall and Dunn, 2012). This study provides important spatial information based on local pastoralists' knowledge that could potentially be used to inform planning. This approach emphasises the involvement of local communities in producing distinctive spatial knowledge of their communities (Smith et al., 2012; Dunn, 2007).

The aim of this study is to explore local spatial knowledge through participatory mapping to understand and analyse pastoralists' grazing spaces and patterns of spatial mobility prior to the 1975 rangeland policy and after policy intervention. The study objectives are to (1) investigate the spatial extent of communal grazing, past patterns of transhumance, and regulatory mechanisms for accessing grazing lands from before land tenure transformation to the current situation in Ngamiland District, Botswana; and (2) determine current land use patterns and the spatial impacts of rangeland policies on access to grazing and water resources based on respondents' spatial knowledge.

2. Materials and methods

Participatory research methods were used to collect primary data in seven study villages between April and August 2015. Study sites were selected based on proximity to ranches and/or veterinary cordon fences to determine the impact along a gradient. The sites were categorised as follows depending on their locations: Toteng/Sehithwa/Bodibeng Bothatogo (located adjacent to the ranches and Lake Ngami: Lake villages), Kareng, located 42 km southwest of Lake Ngami, and Semboyo/Makakung, located 34 km northwest of Lake Ngami and adjacent to the Setata veterinary fence (Setata villages) (see Fig. 1).

2.1. Study area

The study area is located on the southern fringe of the Okavango Delta (Fig. 1). Ngamiland was chosen because the number of ranches (approximately 200) demarcated in the district (both through TGLP and NPAD) makes it relevant to the problem being investigated. In addition, the Okavango Delta and the surrounding rangelands are host to a large diversity of natural resources,

¹ Cattle post is a traditional Tswana livestock management system that involves routine herding confined to kraaling of animals around a water point at dusk and their subsequent release in the morning (Perkins, 1996).

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