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Determinants of semi-arid rangeland management in a land reform setting in Namibia

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ABSTRACT

To assess the ecological and economic implications of the redistributive land reform in semi-arid Namibia, we investigated to what extent land reform beneficiaries adjust herd size and herd composition according to environmental (rainfall, vegetation) and economic variables (herd size, financial assets, running costs). We performed model-based role-plays with Namibian land reform beneficiaries, simulating 10 years of rangeland management.

Our study revealed that the farmers surveyed mainly manage their herds according to their economic situation (herd size and account balance) but do not take environmental variability (rainfall and vegetation) into account. Further, our results indicate that, due to financial pressure, farmers are not able to apply their desired management strategies, and that owners of small farms face a higher risk of economic failure. However, farmers apply rather conservative and constant stocking rates and will thus, given the current economic limitations, likely not contribute to semi-arid savanna degradation.

We conclude that land reform beneficiaries need support to be able to apply straightforward and efficient management strategies. This could be achieved by facilitating cooperation between small farming businesses and by supporting initial investment in productive cattle herds at the time of redistribution of the land.

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1. Introduction

For decades, semi-arid African rangelands have been prone to degradation, mostly in the form of bush encroachment at the expense of palatable perennial grasses (Graz, 2008; Jeltsch et al., 2000; Skarpe, 1990). This form of rangeland degradation leads to severe declines in ecosystem services such as the production of grass and livestock biomass, groundwater recharge, carbon sequestration and prevention of soil erosion (Graz, 2008; Lehmann, 2010; UNCCD, 1994), and also leads to significant losses in biodiversity across taxonomic groups (Blaum et al., 2009a,b). This degradation is mainly attributed to unsustainable rangeland management (e.g. high livestock densities or fire suppression), which is aggravated by increasing pressure on the land due to human population growth (causing even higher livestock densities), as well as global changes such as climate change and rising atmospheric CO_2 levels (Lohmann et al., 2012; Reynolds et al., 2007; UNCCD, 1994).

Against this background of complex degradation dynamics, land reform policies of southern African countries also change the conditions of land use (Clover and Eriksen, 2009; Marchant, 2010). Amongst other things, land reforms are designed to redress past discriminative imbalances in the distribution of economic resources. In particular, reforms should improve nutritional self-sufficiency, bring small farmers into the mainstream economy, create employment, and alleviate human and livestock pressure in communal areas (Adams, 1993; Republic of Namibia, 1995). The success of these projects obviously depends on the application of ecologically and economically sustainable and viable land use strategies.

However, irrespective of the changes concomitant with the abovementioned redistribution of land, the fundamental question of how to manage semi-arid rangelands in a sustainable manner, i.e., how to avoid degradation while maintaining economic profitability, still has not been solved. There is an ongoing debate over whether management should be opportunistic, i.e., should track resource availability using animal numbers, or whether conservative strategies should be favoured, in which more or less fixed and

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low stocking densities are applied (Cowling, 2000; Illius and O'Connor, 2000; Sandford and Scoones, 2006). Different ecological theories have described semi-arid savannas as either 'equilibrium' or 'non-equilibrium' systems (Gillson and Hoffman, 2007; Jeltsch et al., 2000). However, recent studies show that savanna vegetation dynamics are most likely determined by a combination of top–down, non-equilibrium processes (i.e., fires and large herbivores) and bottom–up, equilibrium processes (i.e., strong competition for the scarce and variable key resource water) (Kambatuku et al., 2012; Kulmatiski et al., 2010; Nano and Clarke, 2010; Nano et al., 2012; Taylor et al., 2012). Consequently, one would expect different rangeland management strategies to be optimal, depending on which of the abovementioned ecological concepts is applied.

However, as rangeland management depends not only on ecological but also on economic conditions, further complexities arise. Alone on the scale of the individual farm, additional factors such as opportunity and transaction costs, risk aversion and discounting have to be considered (Buss, 2006; Quaas et al., 2007). In addition, we also need to understand the impact of political measures, e.g. redistributive land reforms, but also of social and cultural aspects of land use on land users' decisions (Ostrom, 2009). In order to identify viable sustainable solutions, all these aspects have to be considered in trans- and interdisciplinary research approaches that explicitly account for the different stakeholders' perspectives (Eriksen and Watson, 2009; Marchant, 2010; Neef and Heidhues, 2005).

In southern Africa, redistributive land reform programmes change the conditions under which rangeland management takes place (Clover and Eriksen, 2009). After redistribution, land is often managed in smaller units (Werner and Odendaal, 2010). Previous land users are replaced by new ones who have a different cultural and economic background and who often start farming with little or no experience in commercial rangeland management (Falk et al., 2010). Only nine per cent of the beneficiaries in our sample owned a farm before benefiting from land reform. Another nine per cent gained farming experience as workers on commercial farms, 62 per cent have farmed on communal lands, and 20 per cent started farming without any farming experience (Falk et al., 2010). Since the farming expertise of many emerging farmers is mostly based on experiences in communal livestock farming, their farming goals might differ from those of established commercial farmers. Therefore, goals other than financial revenue, e.g. insurance or social status, could lead to a strategy of herd size maximization with all its accompanying ecological consequences (Allsopp et al., 2007; Cousins et al., 2007; Falk, 2008; Prediger et al., 2011). However, the success of southern African land reform programmes is often viewed critically (Adams, 1993; Clover and Eriksen, 2009) and there is still insufficient knowledge about how land reform beneficiaries cope with the challenges of managing a highly variable natural resource that is threatened by non-linear and partly irreversible degradation.

In light of the negative ecological implications of savanna degradation (e.g. Blaum et al., 2009b), it is not only of social and economic importance that land reform beneficiaries succeed in managing their rangelands. Besides identifying theoretically optimal management strategies, research should also assess the status quo for how land reform beneficiaries manage semi-arid rangelands to be able to provide decision makers (e.g. farmers, policy makers, extension services, NGOs) with useful information (Marchant, 2010). In particular, this should include an assessment of farmers' economic and ecological preconditions, as well as the question of how and to what extent they adapt to the environmental and economic conditions they experience.

In this study, we assessed the management decisions of Namibian land reform beneficiaries in the Omaheke region. In cooperation with the Emerging Commercial Farmers Support Program (ECFSP), the GIZ Namibia, the Polytechnic of Namibia, and the Namibian Ministry of Agriculture, Water, and Forestry (MAWF), we developed an agent-based ecological-economic simulation model of extensive cattle farms in a semi-arid African savanna. We used this model to conduct simulation-based role-plays with land reform beneficiaries to assess which factors influenced their decisions regarding alterations in the size of their herd. With this model-based approach, we created realistic scenarios replicating the real-life situations of the participants (i.e., regarding herd and farm size and variability of resources). We were particularly interested in the factors determining the farmers' decisions to buy or sell animals. This decision mainly characterizes the interaction between ecological and economic systems, as herd size is the fundamental determinant of rangeland management. In particular, we assessed to what extent their decisions are based on basic environmental (rainfall, vegetation) and economic variables (herd size, financial assets, running costs). Here, we discuss the implications of our findings for the future of redistributive land reform programmes in semi-arid Africa.

2. Methods

2.1. Study system

The research units of this experimental study were farms allotted to beneficiaries of the Namibian land reform (Republic of Namibia, 1995). According to this reform, the acquisition of land is based on the preferential right of the Namibian state to purchase agricultural land whenever any owner of such land intends to dispose of it (willing-seller willing-buyer principle). We included farms that were redistributed according to the two most important land reform instruments (Republic of Namibia, 1995, 2002), namely the Affirmative Action Loan Scheme (AALS), in which beneficiaries buy the land with subsidized loans, and the Farm Unit Resettlement Scheme (FURS), in which relatively small parts of land are allotted to mostly very poor people.

The study was conducted in the Omaheke region of Namibia (see Fig. 1). Our research concentrated on the eastern part of the region, where the vegetation is dominated by Acacia tree and shrub savanna of the Central Kalahari type (Mendelsohn et al., 2002). The mean annual precipitation (MAP) is between 300 mm and 400 mm and the region is considered to be a high potential livestock farming area. The vegetation module of the model applied here (Lohmann et al., 2012) was parameterized for the conditions found at the Sandveld research station (latitude 22°02′S, longitude 19°07′E) run by the Namibian Ministry of Agriculture, Water and Forestry (MAWF).

2.2. Study design

We assessed the responses of 65 land reform beneficiaries to different environmental (rainfall, vegetation, animal condition) and capital variables (costs, herd size and available funds). The survey consisted of a simulation-based interactive role-play in which participants were asked to simulate 10 years of farming. Respondents were requested to make decisions regarding the number and type of animals (i.e., cow, ox, male/female weaned calf or heifer) to buy or sell each year depending on the information given to them by the simulation model. The interaction between the computer model and the role-players was facilitated by the research team throughout the duration of the game. A comprehensive protocol for the simulation-based role-plays

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