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The Integration of Stakeholder Knowledge — How Do Namibian Farmers Perceive Natural Resources and Their Benefits?

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Introduction

Maladapted land use can be a crucial driving force for the degradation of savannahs and related ecosystem services (ESS), e.g. via increased erosion and bush encroachment. Degradation of ESS has become a serious challenge, exerting negative impacts on the ecosystem, livestock production and livelihoods (Kassahun et al. 2008). About 50 per cent of Namibia's savannahs are already suffering from negative effects (de Klerk 2004; Joubert et al. 2013), prompting the Namibian Government to call for urgent action to halt degradation and restore productive and resilient savannahs (MAWF 2012). In 2005, after a four-year research campaign the Millennium Ecosystem Assessment (MA) offered the most commonly used definition of the term 'ecosystem services': "[ecosystem services are] the functions and products of ecosystems that benefit humans, or yield welfare to society" (Lele et al. 2013).

Key ecosystem services at risk include net primary production (NPP), corresponding livestock production, and biodiversity with related (eco-) tourism as well as water yield and quality (Blaum et al. 2009a, 2009b; Lindsey et al. 2013; NAU 2010). Rangelands form a major part of Namibia's savannahs under threat, so their sustainable management would lead to benefits beyond farm borders.

One important prerequisite for developing sustainable rangeland management schemes is an improved understanding of the feedback mechanisms that link the geo- and biosphere, such as vegetation cover dynamics and soil moisture/groundwater recharge (Dimple et al. 2011), and an understanding of the social sphere evoking impacts from different kinds of land use. Since savannahs are home to a large proportion of the world's human population, any disruption to these feedbacks poses a risk to the livelihood of millions of households that depend on a sustainable provision of a variety of ecosystem services. This provision is under extreme threat due to both climate change and the increasing pressure on land resources. To successfully tackle the challenge of finding sustainable solutions for savannah management, it is thus crucial to appreciate that this is a problem characterized by closely linked human-environment interactions in social-ecological systems (SES). Management is partly driven by societal factors, including the knowledge of practitioners. When it comes to local knowledge, the past years have seen a growing recognition that its integration into scientific research is highly important, particularly with regard to the sustainable use of natural resources (Pierotti/Wildcat 2002). Concerning ecosystem processes, local users can offer alternative knowledge that surpasses the one held by researchers. Local land users often have an implicit knowledge of interrelated stochastic and deterministic processes. The greatest progress towards understanding complex social-ecological systems can therefore be achieved via a combination of local and scientific knowledge (Kaschula et al. 2005). Furthermore, an understanding of the reasons and motivations for using and managing ecosystems in a certain way enables research to focus on sustainable management options that seem feasible and relevant in a given context.

Farmers have a special place in this system of social-ecological interactions as they work in the nexus of ecosystems and human interferences with nature, directly harvesting the benefits of ESS. Thus, our approach is to link local ecological knowledge and scientific results to find management strategies best suitable in the face of climate change, drought and degradation. While the economic side of climate change and its effect on agriculture has been discussed frequently (Reid, H. 2007; Coetzee, M. 2010; Kuvare, U/G. Kamupingene 2008) the question of how local cattle farmers assess their situation has been discussed more rarely (Olbrich et al. 2009; Lamarque et al. 2011). Yet, farmers are key stakeholders that influence the largest and most extensive man-made ecosystem, namely agriculture (Zang et al. 2007). The farmers' motives and the question if they are aware of their position in the ecosystem and the benefits they receive from it "… have received limited attention…" as Lamarque et al. (2011) observed.

The aims of this study are to assess how cattle farmers in Namibia perceive ESS and which benefits they receive, to link this perception to their actions, and to take a look at farmers' management options.

Study area and local actors

With our field work we are focusing on two case studies taking place in an African savannah in the eastern part of Namibia. Three farms are situated in an area with a mean annual precipitation of 450 millimetres, and deep, sandy, dystrophic Kalahari soils. Six more farms are situated near a wildlife reserve with a mean annual precipitation of 250 millimetres and sandy soils. Rainfall variability exceeds 40 per cent. The biome is an Acacia tree and shrub savannah, and the vegetation structure is a mosaic of shrubland and woodland.

Research was conducted on private commercial cattle farms. Private land owners hold full title of their land. On private land, grazing is controlled entirely by the landowner as the sole manager. In most cases, animals are kept under a system of extensive rotational grazing in fenced camps (Mendelsohn et al. 2003).

Methods

From April 2015 to April 2016 25, in-depth interviews with Namibian commercial cattle farmers were conducted. The farmers were questioned with regard to management options for their rangelands, ESS and the benefits they derive from their farm, as well as concerning options for knowledge exchange. Management strategies should accord to the way that the farmers influence the ecosystem and it's ESS. ESS on the other hand present the influence of the ecosystem on the farmers (Bischofberger et al. 2015). Since ESS is a scientific wording not applied in the farmers' day to day lives, they were asked for benefits they derive from their farm. Additionally keyword cards were introduced for 12 interviews in April 2016 to get a ranking of ESS by farmers.

In order to evaluate future management scenarios, the scientists of the OPTIMASS project develop eco-hydrological models and analyse experiments on seeding thus filling the knowledge gaps on the effects of herd rotation, de-bushing and re-seeding. In joint workshops, local and scientific knowledge for applicable management strategies are merged.

Results – Farmers perceptions and actions

Farmers ranked the ESS water and vegetation as most important (100 per cent), followed by forage and seeds (92 per cent, respectively) and erosion protection (75 per cent). Traditional life (83 per cent) and natural environment (42 per cent), especially with regard to tourism, were also perceived as important. Most of those ESS can be categorized as provisioning services (MA 2005), while traditional life and natural environment are important cultural services. Looking at the management options, the three most important ones, mentioned by farmers were de-bushing, herd rotation and re-seeding.

In a next step we linked the mentioned ESS and the management options to analyse possible feedbacks between ecosystem and actors.

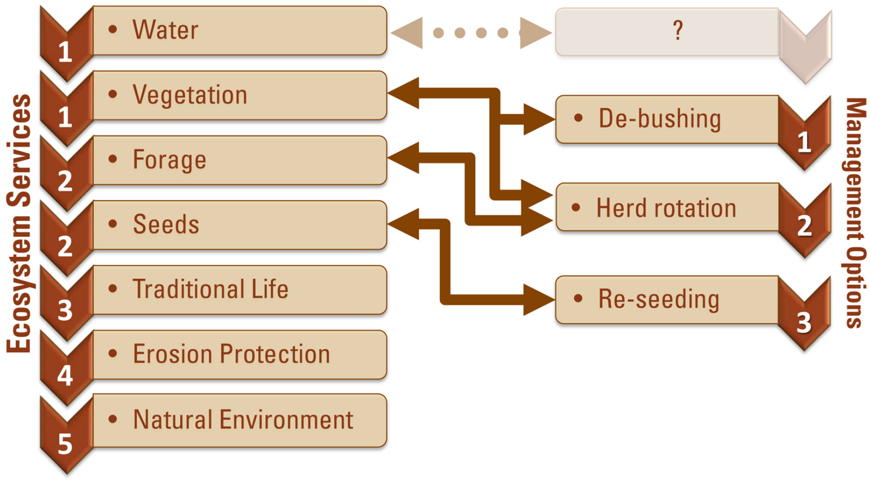

Figure 1: Perception and actions: Ranking of ESS and management options by farmers (n=25)

Water was mentioned as one of the most important ESS but water management was not considered important, not even water monitoring, such as documenting the off take by watering the cattle. This is rather surprising since water is the most limited resource in this area, and will be analysed in a next step.

The ESS vegetation and forage would be directly influenced by the management options de-bushing and herd rotation, taking off shrub and grass biomass. As de-bushing measures most farmers use herbicides or manual techniques. The manual way of de-bushing is to chop the bushes with an axe. About 75 per cent of the interviewees use this method sometimes or as their only technique. Another method of de-bushing is to poison the plants with herbicides which will intrude their photosynthesis. This method can be applied selectively by hand or extensively by plane. The method 'by plane' is only rarely used; just about 33 per cent of our farmers have tried it. About 84 per cent of the farmers who mentioned this method prefer to spray or scatter the herbicides by hand. Targeted spraying/scattering causes less destruction of other plants and also makes sure that animals and humans are not accidentally affected.

The livestock farmers practice herd rotation, dividing their land into fenced camps, defined areas of rangeland where the livestock graze for a defined period before the farmer herds them over to the next one. The camp sizes and numbers vary a lot. There are small farms with only seven or eight camps, each of which with a size of about 125 ha and other farms comprising 60 camps with sizes varying between 45 and 330 ha per camp. The applied herd rotation is very varied, almost all interviewed farmer apply a different type of herd rotation with resting periods between two weeks and four years.

Within OPTIMASS, a simulation model "EcoHyd" which simulates the relation between rainfall, grazing, grasses, shrubs, soil type and soil water availability was developed (Lohmann et al. 2016). The model was based on a semi-arid camel thorn savannah with loamy-sandy soil and 400 mm of mean annual precipitation. Four different herd rotation scenarios were included. They were all based on relatively high livestock densities of 10 ha per livestock unit. The model shows the simulated long-term (200 years) development of plants based on a five camp rotation farm as an example. Values give the mean biomass of all camps. Best results were received with adaptive bi-weekly rotation and best camp first. Findings showed (i) an increase of perennial grasses resulting from recovery of healthy root reserves, (ii) an increase in soil moisture due to infiltration and shading, improved by presence of grass cover, (iii) the maintenance of healthy grass sward that strongly decreases the establishment of encroacher shrubs, and (iv) that higher livestock densities are possible in the long run with adaptive bi-weekly rotation and best camp first compared to continuous grazing and biweekly rotation.

The ESS seeds can be influenced by re-seeding measures. Experiments conducted by farmers and scientists are still on-going.

Discussion and Outlook

This study analysed interviews that were conducted with farmers on the topics of ESS and their benefits. The interviews offered an opportunity to investigate how Namibian farmers perceive the ecosystem and its services and which benefits they reap from them. We found that farmers´ management options are partly suitable for a sustainable use of their ESS provided by natural resources. However, knowledge gaps were determined by stakeholders and scientists alike. To fill these gaps mutual learning is needed and wanted.

Bennett et al. 2009 discussed the importance of considering ESS in a broader sense and called for an integration of a two-step mechanism to monitor the effects of multiple ecosystem services with particular regard to the varying degrees in which they influence each other. They described a unilateral interaction where one service affects the success of another and a bidirectional one where two factors influence each other. They describe the example of small scale farming in dryland areas in sub-Saharan Africa where over-usage and destruction of biomass leads to an increased pressure of land usage and further degradation of soil quality. The same issue was addressed in the interviews as well. Farmers and experts alike mentioned the increasing erosion on small farms that do not possess sufficient funds for financing anti-erosion and anti-bush encroachment measures. The issue was said to further accelerate due to overgrazing which leads to further soil destruction.

Knowledge gaps and mutual learning

Farmers expressed a clear need and openness for knowledge exchange. Several farmers stated that they would like to either receive more scientific support or converse on a scientific basis with experts as well as other farmers, especially when it comes to investigating the cause for and measures against bush encroachment. The introduction of the Namibian Rangeland Forum was positively mentioned but effective local facilities are still required. One issue that was indicated by farmers as well as experts was missing scientific expertise due to the deterioration of national extension offices.

Currently, farmers in Namibia do not always apply the available (scientific) information in their working routine, like the Namibian Rangeland Management Policy and Strategy (NRMPS) (MAWF 2012). The reason for not implementing scientific knowledge into the working routine seems to be multifaceted - ranging from simple unawareness to the opinion that some of the proposed guidelines are not practical on a day-to-day basis or are incompatible with the empirical knowledge of the stakeholders. One example which was repeatedly given was the usage of bushfires as a countermeasure to bush encroachment. While experts have developed a strategy for implementing bushfire into the working routine (Joubert et al.) the farmers were not open towards this option because of the scarcity of grass and the expected damage to infrastructure. Another point for farmers who were generally open to scientific consultancy but not to enter the currently proposed methods of the NRMPS was the inconsistency of such kind of advice during the last decades.

Especially on herd rotation and resting strategies the mutual learning process is in full progress and will be continued. Every farmer asked in the interviews used a different system, although the differences were only small at times. Variations differed from fast change every 10 to 14 days to a length of up to six months with rest times of a few months to a few years for the individual camp. The current results of the EcoHyd simulation model will be further validated in cooperation with the farmers in order to develop sustainable management scenarios. This topic of herd rotation and resting strategies has already been looked at in the NRMPS but more research as well as exchange with the farmers is required to investigate optimal growth conditions for grass species and better soil protection.

Understanding the farmers' role and actions might contribute to developing solutions for a more efficient usage of the ESS and buffering the impact of climate change on farming. Sustainable management of rangelands would lead to benefits beyond farm borders. For example, the thinning of encroacher bushes on rangelands to an optimal degree may improve groundwater recharge, with resulting benefits for urban and industrial water demand (MAWF 2012; NAU 2010). However, to derive applicable management strategies for a fair use of resources, local and scientific knowledge need to be jointly applied.

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