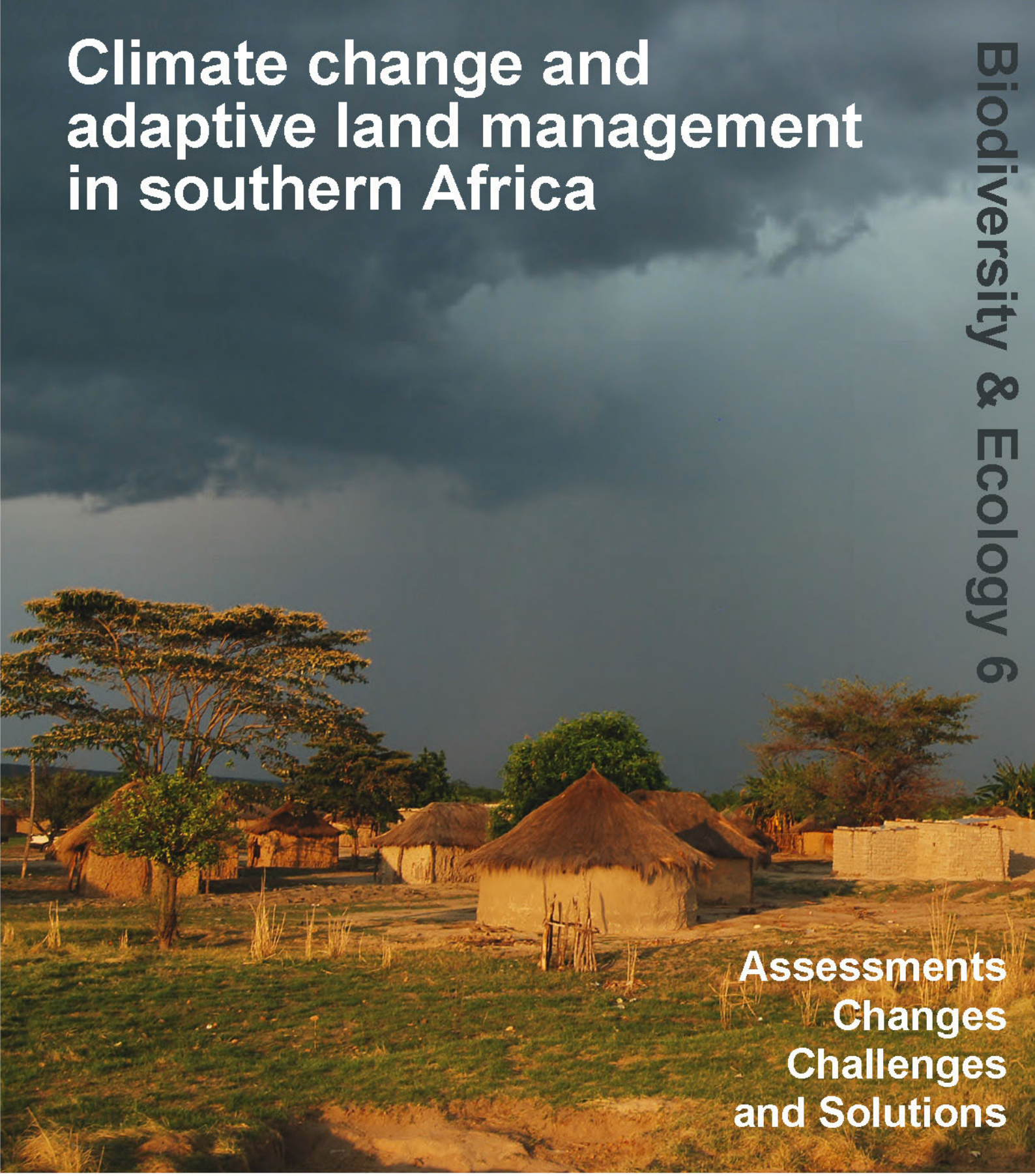
Climate change and adaptive land management in southern Africa

Biodiversity & Ecology 6



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Climate change and adaptive land management in southern Africa

Assessments, changes, challenges, and solutions

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Farmer-wildlife conflicts in rural areas of eastern Zambia

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Abstract: Agricultural production of smallholder farmers can be significantly impacted by wildlife activity. In this study, we describe the forms of crop damages in the Lumimba Game Management Area in Lundazi District, Eastern Province of Zambia. Semi-structured questionnaires were administered to 131 randomly selected respondents. Crop damages are most frequent close to protected areas and decrease with increasing distances from these areas. As people invade habitats originally reserved for wildlife in order to cultivate food crops to support the growing human population, farmer-wildlife conflicts are likely to occur. Apart from conflicts over crops, local farmers illegally kill wild animals for bushmeat for economic reasons. A combination of countermeasures against crop damages may be effective at the farm level.

Resumo: A produção agrícola dos pequenos agricultores pode ser bastante afectada pela vida selvagem. Neste estudo, descrevemos os vários danos às culturas na Área de Gestão Cinegética de Lumimba, no distrito de Lundazi, Província Oriental da Zâmbia. Questionários semi-estruturados foram realizados a 131 pessoas seleccionadas aleatoriamente. Os danos às culturas são mais frequentes perto das áreas protegidas e diminuem com o aumento da distância a estas áreas. Uma vez que as pessoas invadem habitats originalmente reservados à vida selvagem, a fim de cultivarem culturas que possam suportar a população humana em crescimento, é provável que ocorram conflictos entre os agricultores e a fauna selvagem. Para além dos conflictos devido às culturas, os agricultores locais matam ilegalmente animais selvagens para consumo por questões económicas. Uma combinação de contramedidas contra os danos agrícolas poderá ser efectiva ao nível da quinta.

Introduction

Conflicting land uses are often due to competing claims by users such as farmers and natural resource stakeholders such as wildlife agencies and conservation organisations (Giller et al., 2008). Rising human populations in wildlife-agrarian landscapes increase the chances of inconsistent access to land, food availability and quality, and economic stability (FAO, 2008). If human activities are not regulated, they are likely to lead to overexploitation of wildlife resources for food and commercial purposes.

The framing and implementation of any potential solutions to this issue must be transformative, thus changing the mindset and self-reflections of the local communities. Locals' wish to improve their economic situation results in overexploitation of natural resources to meet the needs of the growing human population, even more so given the threats of crop damages and climate change, which can cause crop failure due to extreme weather conditions like floods and droughts (Takasaki et al., 2004). In resolving the issue of crop damages, there is a need for broad-based participation by local communities and other stakeholders in planning and decision making (Shackleton & Campbell, 2000). Therefore, local stakeholder participation such as practicing effective land management for sustainable agriculture should be viewed in the broader context of adaptive governance (Folke et al., 2005). Governance can be defined as a process and structural framework for exercising rights and responsibilities by the stakeholders over public concerns (Graham et al., 2003). The objective of this study was to investigate the nature of farmer-wildlife conflicts and how such conflicts influence food security in wildlife-agrarian landscapes as found in the Luangwa Valley.

Methods

The underlying study was conducted in the Lumimba Game Management Area (GMA), which occupies 4 500 km^2 in the Luangwa Valley, eastern Zambia (Fig. 1). Lumimba GMA is surrounded by four national parks (NPs): North Luangwa, South Luangwa, Luambe, and Lukusuzi. GMA policy permits multiple land uses such as agriculture, infrastructure, and commercial trophy hunting in designated land-use zones within the area. As of 2012, the Lumimba GMA had 8 679 inhabitants com-

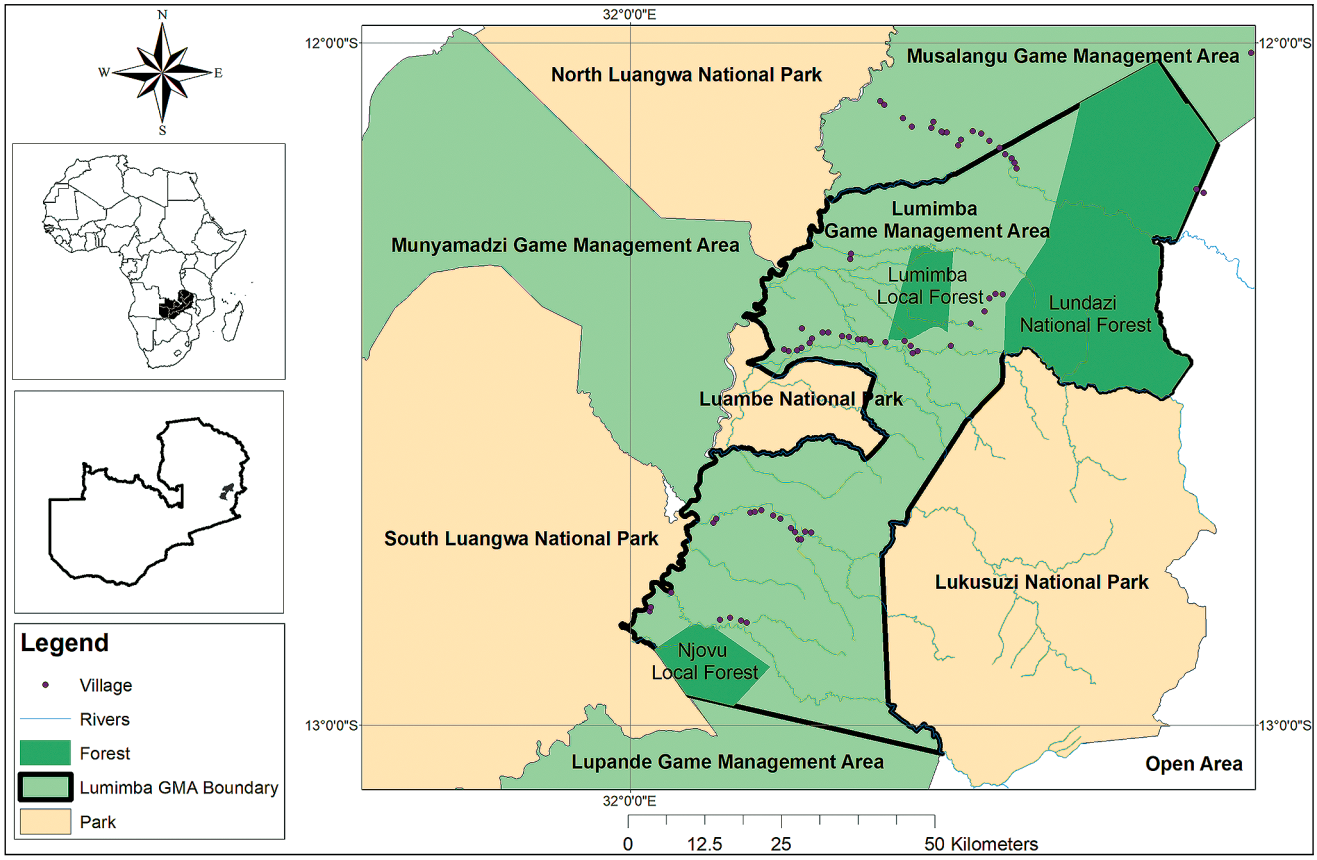

Figure 1: Location of Lumimba Game Management Area, eastern Zambia.

prising a total of 1 654 households and an annual average rate of population increase of 3% (Central Statistical Office, 2012). In the Luangwa Valley, local farmers face pervasive crop depletion from wildlife (Nyirenda et al., 2011).

Perception data was gathered in 2014, a year with average environmental conditions, using semi-structured questionnaires (Tab. 1) administered to 131 randomly selected participants drawn from different households in 44 out of 53 villages within the Lumimba GMA. Selection of participants was based on the village registers. Several households of closely related people, usually sharing family or clan ties, constituted these villages. Male- and female-headed households were interviewed in exclusive interviews (Fig. 2). Each interview lasted about 50 minutes. Open questions (Tab. 1) were administered to respondents to gather in-depth data on crop damages (Patton, 2002). We sought prior, free, and informed consent from the participants at the beginning of the interviews (Bradburn et al., 2004). We also assured them of the confidentiality of their responses.

Table 1: Excerpt of semi-structured questionnaires conducted in Lumimba Game Management Areas, Luangwa Valley, Zambia in 2014

a)	What is the nature of the farmer-wildlife conflicts in Lumimba GMA?
b)	Which of the existing land use types conflict with each other in Lumimba GMA?
c)	Using your memory, what do you perceive as the status of crop raiding, whether decreasing, increasing or stable, in the last five years in your area?
d)	In contrast to the existing land use types, what do you perceive as your main source of livelihood?
e)	What are your coping and alleviating strategies against crop damages?
f)	What are the drivers of farmer-wildlife conflicts in Lumimba GMA?
g)	Which animals cause the most crop damages?
h)	What methods do you employ or practice to tackle crop damages?
i)	How effective are they in stopping or reducing crop damages?
j)	What remedial actions do you propose against crop damages?
k)	What external and internal solutions would you propose to strengthen local collective actions against crop damages?

Given the qualitative data gathered, a thematic content analysis technique was adopted to obtain interpretive sources of local social constructs (Guest, 2012).

Results

The interviewees' responses explained local land-use conflicts between agriculture and wildlife. Most of the respondents (95%; n=117) reported habitat loss due to inappropriate agricultural practices, as well as depletion of wildlife from bushmeat harvesting for subsistence and commercial purposes. Retaliatory hunting of wildlife was also reported to occur as a byproduct of crop damages. Further, respondents perceived crop damage levels as reflected in Figure 3. All the participants indicated that farming of crops such as maize (*Zea mays*) comprised the

Figure 2: Interview session with a household head.

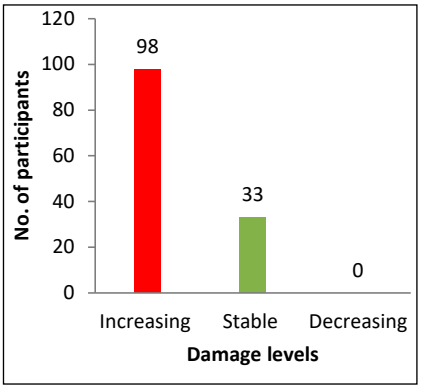

Figure 3: Interviewees' perceptions of crop damages in Lumimba GMA, 2014.

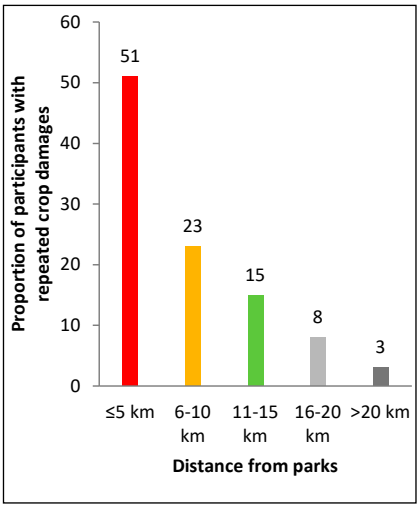

Figure 4: Varying crop damages with distances from the parks, affecting food availability within Lumimba GMA communities, 2014.

mainstay livelihood in the area. Other crops grown included rice (*Oryza sativa*), cotton (*Gossypium hirsutum*), cassava (*Manihot esculenta*), pumpkins (*Curcubita maxima*), groundnuts (*Arachis hypogaea*), sweet potatoes (*Ipomoea batatas*), cabbages (*Brassica oleracea*), rape (*Brassica napus*), onions (*Allium cepa*), and tomatoes (*Lycopersicon esculentum*). The crops most heavily impacted by wildlife were ranked in order as maize, rice, cotton, cassava, and pumpkin. Most respondents (52%; n=64) indicated that African elephants (*Loxodonta africana*) caused the most crop damages, primarily adjacent to the Luambe, South Luangwa,

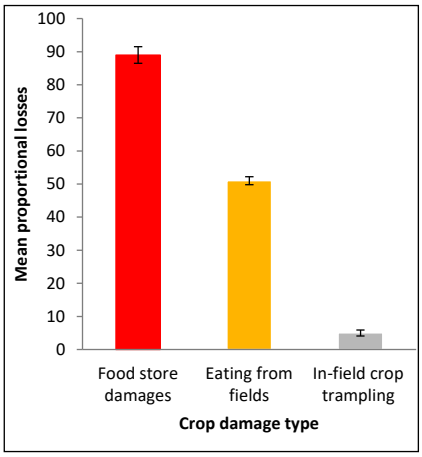

Figure 5: Perceived proportional crop losses to wildlife across crop damage types in Lumimba GMA, 2014.

and North Luangwa NPs. Lukusuzi NP was considered largely depleted of wildlife. Other wildlife species causing crop damages in Lumimba GMA were ranked as rats (*Rattus rattus*), hippopotamus (*Hippopotamus amphibious*), bushpig (*Potamochoerus larvatus*), warthog (*Phacochoerus africanus*), greater kudu (*Tragelaphus strepsiceros*), yellow baboon (*Papio cynocephalus*), eland (*Taurotragus oryx*), and porcupine (*Hystrix africaeustralis*). The annual median time for the local populace to run out of food as a result of crop damages and other reasons such as crop failure was three months (range: 1 month–4 months), depending on proximity to the parks (Fig. 4), especially approaching and during the rainy season. More crops were lost to raiding of food stores by wildlife than to raiding in the fields (Fig. 5). Food stores, which were temporary structures made of mud, wood, and thatch, concentrated the crops and made these stores easily accessible to elephants and rats. The local communities coped with crop losses and alleviated food shortages by poaching to obtain bushmeat for both subsistence and commercial purposes. They also acquired relief food from the government and the World Food Programme based on issues of widespread food shortages in the area. Further, they exchanged valuable items such as on-farm labour for food, and received funds remittances from urban-dwelling relatives and friends.

Poverty (i.e., inability to secure basic life requirements such as daily food) among the growing human population in the area was ranked first by many of the respondents (91%; n=112) as the key driver of crop damages after elephants. Habitat loss was ranked second. Weak local institutional governance (for instance, feeble decision making, irregular conduct of public meetings to address crop raiding, inability to protect resources from abuse, and inability to implement punitive measures against rule infractions) was ranked third. The farmers in the Lumimba GMA employed traditional countermeasures against wildlife damages, such as crop guarding including the use of watchtowers, fires, cans, shouting, drumming and clapping, chilli pepper balls/bombs, and fences. Because

these countermeasures were considered ineffective due to elephant habituation (96%, n=126), participants preferred to employ long-term and large-scale private and donor investments, for instance, electric fencing installed through public-private-community partnerships (72%, n=88) and joint ventures (25%, n=31). Some funds have been generated from commercial wildlife hunting that takes place annually in the area. While the government retains some portion of the funds generated by commercial wildlife hunting, the local community is also given part of these funds for community priority projects such as provision of water for domestic uses, construction of health posts and community schools, and resource protection. The interviewees perceived that enhanced capital funding would be critical input into remedial actions regarding crop damages. A preponderance of respondents (72%, n=88) indicated they received waning cooperative support from local organizations such as the Community Resources Board (CRB) at the time of the study. The CRB is a local policy body, constituted by democratically elected members of the local community with a fixed tenure of office of three years within the Community Based Natural Resource Management (CBNRM) approach. Its main function is to spearhead rights-based participation of the local community in resource protection and rural development. The desired actors for the future implementation of interventions to address crop damages included government, community-based organizations, local farmers, commercial trophy and indigenous hunters, and non-governmental organizations.

Discussion

In the Lumimba GMA, farmers practice traditional farming using basic implements and inputs, with modest crop management. They seek new, seemingly fertile lands through agricultural expansions and clearing of savannah woodland, where they also establish new human settlements in the form of villages. Their crop fields are also placed in areas that were originally wildlife habitats. Inevitably, such areas become conflict zones in which crops suffer incursions by wildlife. Farmers' failure to effectively protect crop fields and storage facilities has contributed to crop losses. In addition, farmers' failure to comply with zoning restrictions such as prohibition of crop cultivation in wildlife protection zones stipulated in the management plans for the area (developed with farmers' input in multidisciplinary and participatory processes) renders the area vulnerable to continued human encroachment into wildlife habitats. The management plans are a legal provision in Zambia's wildlife legislation to ensure effective management of natural resources in the protected areas while providing for rural development and fostering local livelihoods. In the GMA, the primary land use is wildlife management, although regulated additional land uses such as agriculture and human settlement are also permitted. At the time the GMA was established in 1972, only a few villages existed in the area; these have since grown in number due to splitting of households within the area and the influx of settlers from outside the GMA. Implementation of land-use plans can be a helpful management tool in reducing conflicting multiple land uses (FAO, 2006) and protecting sensitive wildlife habitats (Green & Higginbottom, 2000), as such plans are intended to guide where, when, and how specific anthropogenic activities should be conducted across a landscape. A land-use plan would typically include zones dedicated to specific purposes such as agriculture and wildlife habitat management. The establishment of zones is intended to be consensual and transformative in nature, whereby vulnerable or degrading areas are protected and benefit from positive change in human behaviour and attitude towards the environment. Further, local communities can play self-empowering roles to relieve potential pressures from overuse of natural resources through employing alternative livelihoods (Child, 2009; Fernandez et al., 2009). Bushmeat overexploitation, especially in times of famine, has the potential to reduce wildlife populations available for trophy hunting and photographic purposes (Rosenblatt et al., 2014). However, bushmeat hunting for subsistence and commercial purposes is a lucrative social safety net for some members of local communities (Lindsey et al., 2013). The wildlife populations may also decline from retaliatory killings by farmers over their crop losses (Hoare, 2012). Such occurrences may potentially render GMAs less productive (Lindsey et al., 2014), alongside the impact of animal die-offs as an effect of droughts. The funds generated from commercial wildlife hunting, based on limited animal quotas, are considered too small to offset the crop losses experienced in the area. Zambia does not have a direct compensation policy in the form of individual dividends paid to farmers for the crop losses caused by wildlife.

Weak institutional governance has long been recognised as a contributing factor to a number of environmental challenges, including human encroachment into wildlife habitats and illegal wildlife killings among the local communities (Barrett et al., 2001). There is a need for local communities to be much more involved in environmental management. They must seek and implement solutions to crop damages through such interventions as decision making, regularly conducting public meetings to address crop raiding, resource protection, and implementing countermeasures against crop damages. The Department of National Parks and Wildlife, which is the key player in wildlife management in the region, faces a number of challenges, such as inadequate funding and staffing, which hinder it from productively contributing to the resolution of farmer-wildlife conflicts. Therefore, the area may benefit from effective partnerships that would build capacity among the key players to address crop damages.

Though often deemed ineffective, farmers commonly apply traditional countermeasures as mitigation methods against crop incursions. Traditional methods are inexpensive to implement and knowledge about these techniques is passed across human generations. Use of traditional countermeasures potentially reduces transaction costs over time through collective action, such as in the case of mobilisation of crop guards for the benefit of contemporary users.

Collective action entails horizontal collaboration (community members working with each other) and vertical collaboration (community members networking with outsiders) in planning and implementing farmer-wildlife conflict countermeasures. Vertical collaboration may further include strengthening the practice of such local initiatives as the Community Markets for Conservation (COMACO) model, which promotes the nexus of conservation and agriculture (Lewis et al., 2011). Under the COMACO model, farmers are grouped into farming cooperatives. Within these cooperatives, they receive training on farming best practices such as conservation farming and crop protection. Farmers are also linked to appropriate markets for their produce, where they earn premiums upon satisfactorily participating in the conservation of natural resources through various compliances.

Further, local capacity can be built through partnerships within the relational social capital realm (i.e., trust, commitment, cooperation, and connectedness) among local farmers and other stakeholders. The partnerships may take various forms, including public-private partnerships (PPP) and joint ventures (JV), in addition to supportive and enabling policy changes. For instance, increased benefits from neighbouring parks can include contractual arrangements for ecotourism concessions by wildlife agencies partnering with local communities (Nelson, 2004). Such interventions offer competitive advantages for involved parties such as farmers, tour operators, and the Department of National Parks and Wildlife and may include benefits such as growing wildlife populations. As public entities, local communities, including farmers, have the added value of possessing indigenous knowledge regarding resource management and may offer readily available labour, to which requisite technical skills can be imparted by other partners such as tour operators and the Department of National Parks and Wildlife. The private sector may play an important role in attracting additional investments and tourists for increased revenue generation, and may even provide supportive models for wildlife management and agriculture. Farmers are likely to support conservation efforts and produce positive ecological, socioeconomic, and governance impacts if they perceive increased benefits from such activities (Jones & Weaver, 2009).

Conclusion

Our study reveals that crop damages inflicted by wildlife deprive farmers of their food security in the Lumimba GMA. The currently employed countermeasures remain ineffective. Improved mitigation methods and GMA management models are urgently needed in the region. Experimentation with novel methods in order to provide farmers with more options will be critical due to habituation by some wildlife species such as elephants. Adoption of the appropriate methods and models by the farmers will also be paramount. Though wildlife- and agriculture-based land uses seem antithetical to one another in much of Africa (Lamarque et al., 2009), parks—people relationships can foster wildlife conservation and agriculture beyond park boundaries through provision of intemperance benefits (Anthony, 2007). Harnessing benefits that would encourage local support relies on increased levels of relational social capital generated by stronger local institutions than those that exist at present (Barrett et al., 2005). Therefore, there is a notable need for training and re-training the local communities in new livelihood alternatives. Currently, agriculture still remains farmers' main source of food and income, and is the livelihood activity of which farmers have the most adaptive knowledge. In tackling the challenges posed by crop damages, there is also a need to emphasise relational social capital in addition to other forms of capital such as financial capital to keep wildlife away from the crop fields and food stores. Proper zoning of wildlife and agriculture areas and use of cluster wire fencing may be some of the more effective measures available to farmers at the farm level.

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