

# Responses to dynamics in ecosystem service provision in semi-arid Bobirwa sub-district, Limpopo Basin part of Botswana

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## Abstract

This research investigates the drivers of ecosystem degradation and the associated consequences on rural livelihoods, including how the local people have been responding to fluctuations in key provisioning ecosystem services in Bobirwa sub-district, Botswana. Household survey, participatory mapping exercises and a review of national policies were used to assess local adaptation responses. From the findings, we conclude that current individual responses are reactive, haphazard and unsustainable in the long-term, while government initiatives are constrained by several technical capacity and implementation challenges.

*Keywords: Provisioning Ecosystem Services, Semi-arid regions, Barriers, Transformation, Botswana*

## Introduction

The close connection between human well-being and local ecosystem services depends on well-functioning ecosystems. However, alterations in cultivated lands, woodlands, grasslands, wetlands, water bodies and built up areas imply variable consequences on the delivery of local ecosystem services and hence livelihoods, well-being and adaptive response capacity to additional impacts emanating from climate change. Among other consequences, changes in the provision of ecosystem services modify the close connection and dependence between human livelihoods and their surrounding environment in significant ways. Environmental change is also modifying ecosystem functioning, human-nature relations as well as both human and ecological systems.

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In Bobirwa sub-district (and Botswana in general), smallholder farming (crop and livestock production) and exploitation of the natural environment remain the most dominant livelihood activities among the rural people, and significantly contribute towards employment, food and income for many households (UNDP-UNEP PEI, 2013). Like much of Botswana, Bobirwa sub-district is a semi-arid hot spot, with mean annual rainfall ranging from 300-400 mm, while mean annual temperature is often greater than 22°C. Previous research has shown that there is growing evidence of ecosystem deterioration and degradation (Dube and Sekhwela, 2007, 2012).

Using Bobirwa sub-district as a case study, this research identifies ways through which local people in semi-arid regions have been responding to recent changes in the delivery of local provisioning ecosystem services and assesses the effectiveness of their responses to both the impacts and the drivers of recent changes. A special focus is given to the challenges and barriers to current adaptation initiatives at the local level, which consequently constrain their adaptive response capacity. Lastly, some concrete measures which may be implemented in order to transform current adaptation initiatives at the local level to modes which are more effective, widespread and sustainable are outlined.

## **Methodology**

This research aimed to understand how shifts in the delivery of provisioning ecosystem services affects livelihoods of semi-arid communities and to understand how the local communities are responding to these shifts in ecosystem services.

This paper uses a case study approach. Eight participatory mapping exercises and focus group discussions, 310 household interviews and numerous field visits were conducted in 8 villages in Bobirwa sub-district in the Limpopo Basin part of Botswana between February 2016 and March 2018. Data analysis for participatory mapping, focus group discussions and key informant interviews was achieved through thematic analysis, while Statistical Package for the Social Sciences (SPSS) ver. 24 was used to summarise and analyze data from the household interviews. A review of related government policies and programmes was carried out to further understand local adaptation initiatives.

## **Results**

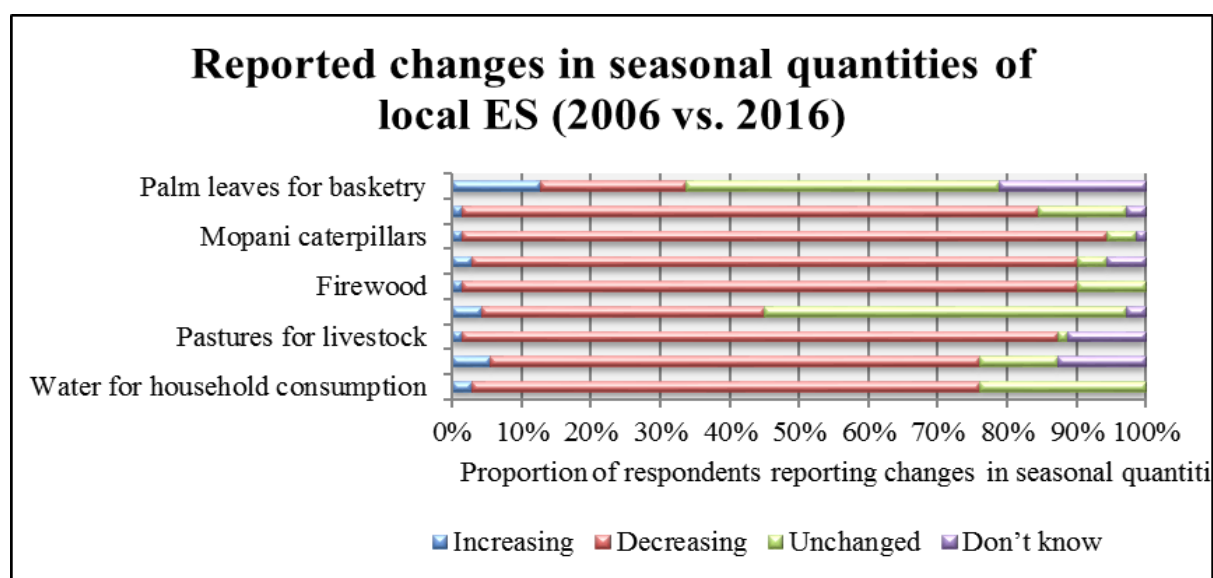
Changes in ecosystems in Bobirwa sub-district over the past decade can be summarised by these trends:

- Adverse impacts of climate and weather variability e.g. frequent droughts,
- Increased demand of agricultural land and other forest resources leading to land-use changes and over exploitation, and
- Degradation of the natural environment leading to declining ecosystem capacity.

Through fieldwork undertaken, almost all the key ecosystem services considered were reported to be declining (see **Figure 1**). Several factors interacting in different ways ranging from adverse weather, droughts, land-use and land-cover change, overexploitation and overgrazing were identified by local communities as the major drivers of change.

The linkages between several drivers of change and key provisioning ecosystem services often results in several adverse impacts on both the delivery of ecosystem services and local livelihoods, as shown in **Figure 2**.

**Figure 2** shows the various drivers of change (column 1), which were reported to be driving changes in key local ecosystem services (column 2). The influence of one or more of these drivers of change were reported to directly or indirectly result in fluctuations in the delivery of important ecosystem services (column 3), with several adverse consequences on local livelihoods and well-being (column 4).



*Figure 1. Reported changes in seasonal quantities of selected local provisioning ecosystem services (Source: Authors fieldwork, 2016)*

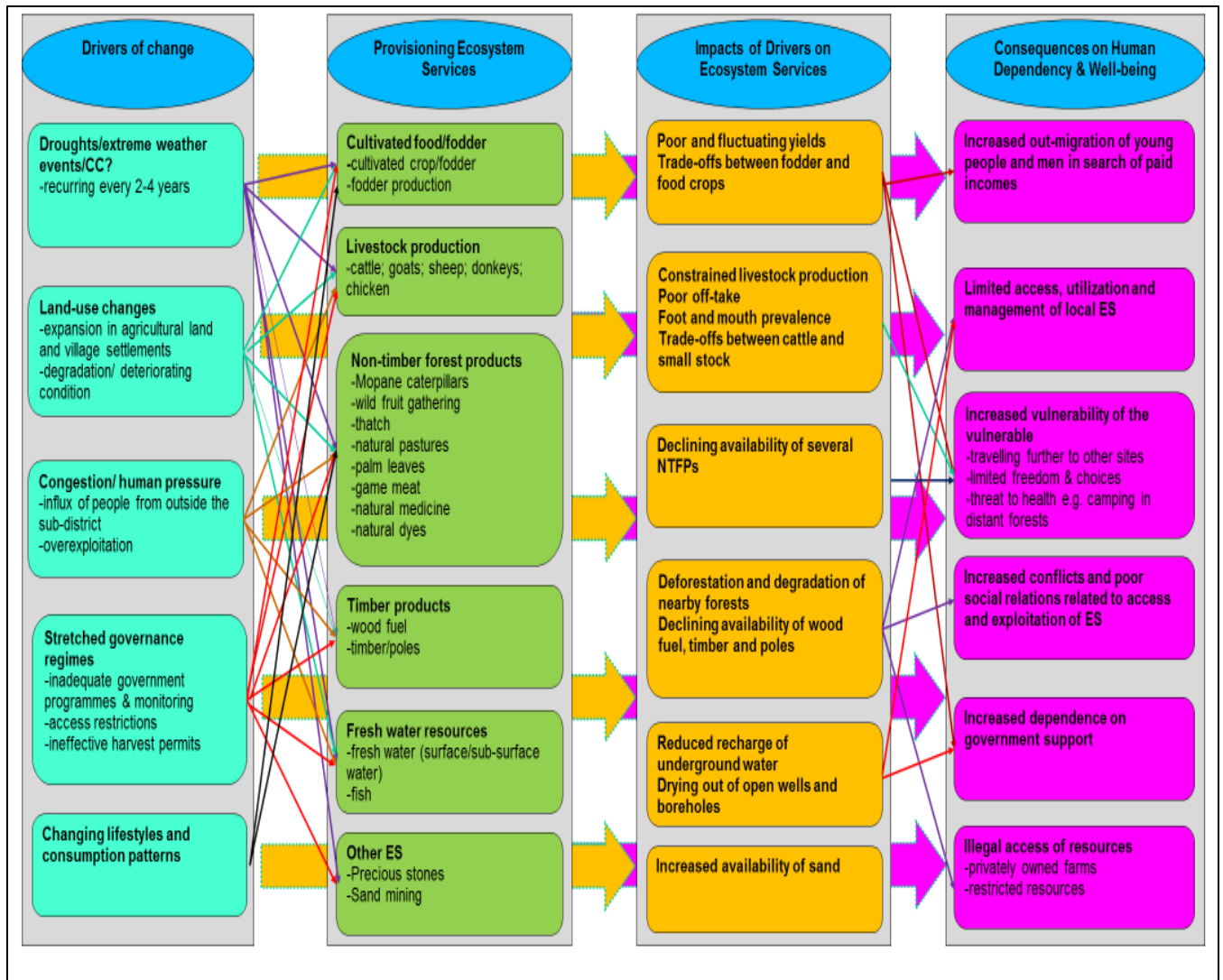


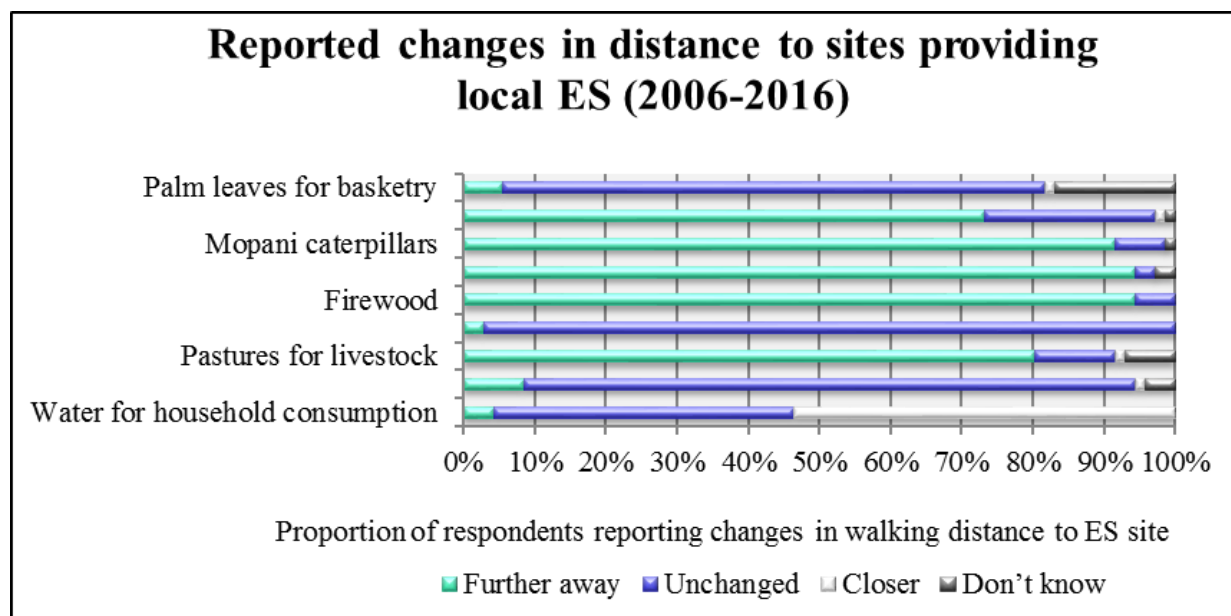
Figure 2. Linkages between drivers of change, provisioning ecosystem services, human responses and well-being consequences (Source: Authors fieldwork, 2016)

Similar to other semi-arid regions, Figure 2 simplifies what in reality are complex interactions and feedback mechanisms which often result in unanticipated and undesirable consequences on local livelihoods and human well-being. Consequently, this often triggers individual, haphazard, reactive and uncoordinated responses by local people - some of which further expose their livelihoods and well-being to climate impacts, as explained in the next section.

### Community level responses to changes in provisioning ecosystem services

As evidence and consequence of adverse changes in local ecosystems, local people now need to walk longer distances to sites providing some of the key provisioning ecosystem services (Figure 3). Such changes often affect women and children, who are typically more vulnerable and exposed to various risks. For instance, as ecosystem service sites become further and further away, locals end up spending more days and weeks camping

in distant forests to collect food resources, such as Mopane caterpillars. This exposes them to harsh weather conditions, snake bites, conflicts around resource access and diseases due to a lack of sanitation facilities.



*Figure 3. Reported changes in distance to sites providing local provisioning ecosystem services (Source: Authors fieldwork, 2016)*

In addition to the response in **Figure 3**, other reactive, haphazard, unplanned and unanticipated responses reported by the local communities include:

- Overexploitation of local resources such as firewood, Mopane caterpillars and thatch and stowing away for future use,
- Migrating to other villages to explore uncongested ecosystem services sites, or urban areas seeking alternative livelihood opportunities,
- Coping with the reduced quantities of local resources,
- Camping in distant forests/woodlands for longer periods than previous years,
- Spending more time and effort to harvest same or reduced quantities than before,
- Taking up government agricultural assistance programme packages, such as the Integrated Support Programme for Arable Agricultural Development (ISPAAD) and fail to utilise all inputs and/or to adhere to stipulated guidelines for improved yields, and
- Legal (area designated for crop fields) and illegal (area designated for communal grazing) clearing of woodlands to increase area under crops.

### Government support programmes

The Ministry of Agriculture Integrated Support Programme for Arable Agricultural Development (ISPAAD), initiated in 2008 with the aim of improving smallholder farmer

<http://openbooks.uct.ac.za/AF18/>

grain productivity and food security through input subsidies, is failing to yield intended results. Despite providing farmers with free inputs and extension services, grain yield has largely remained stagnant around 333kg/ha against a target of 1000kg/ha with previous study showing high preference for growing maize compared to the more drought tolerant sorghum, millet and cow peas (MOA, 2013). Failure to recognise the agro-ecology of crops grown, lack of adequate agronomic knowledge among farmers, inadequate extension services and underutilisation of inputs have been cited as the main challenges to this programme.

Another government Poverty Eradication Programme through the Department of Forestry and Rangeland Resources which assists poor households with food baskets, transport costs and harvesting materials to harvest Mopane caterpillars (*Imbrasia belina*) at distant communal grazing areas has its own challenges. Inappropriate human and other waste disposal around the camping sites has often led to conflicts with livestock farmers after their livestock consumed the waste, and thereafter the farmers suffered economic losses from livestock diseases and deaths. More so, the harsh weather conditions, unhygienic environment and snakes at the campsites increase the vulnerability of young children and women. Inadequate monitoring mechanisms and stretched resources implies overexploitation of Mopane caterpillars, thatch and firewood continues unmonitored, further threatening future availability.

## Conclusion

Evidence gathered in this paper is critical for local people, government and organisations interested in local adaptation initiatives to the impacts of climate change on the natural environment. Some of the outlined measures to influence specific action to respond to the adverse impacts of climate on the delivery of local provisioning ecosystem services can be an important entry point for influencing policy and practice with regards to the management of local ecosystem services. However, the extent to which this can be achieved depends on the level of government commitment to supporting local initiatives to addressing the climate change threat.

Our study shows that the current individual responses at community level are reactive, haphazard and unsustainable in the long-term. Unplanned and sporadic responses clearing of woodlands to increase area under dry land crops often create several adverse trade-offs on the delivery of other ecosystem services such as Mopane caterpillars (from Mopane woodlands), natural medicines, natural pastures and thatch. Although targeted at the poor, our study noted that government assistance programmes such as ISPAAD have been less effective and often suffer from sub-optimal utilisation of inputs as well as failure to adhere to recommended guidelines for better yields. If well-implemented, government assistance programmes have the potential to effectively support local communities adapt to changing climate while contributing towards rural development, including the well-being aspirations of the poor households and vulnerable social groups.

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## References

- Dube, O.P. and Sekhwela, M.B.M. (2007). Community Coping Strategies in Semiarid Limpopo Basin Part of Botswana: Enhancing Adaptation Capacity to Climate Change AIACC Working Papers. Available at: [www.aiaccproject.org](http://www.aiaccproject.org) (accessed 20 March 2017).
- Dube, O.P. and Sekhwela, M.B.M. (2012). Indigenous knowledge, institutions and practices for coping with variable climate in the Limpopo basin of Botswana. *Climate Change and Adaptation*, pp. 71–89.
- Ministry of Agriculture (MOA). (2013). *Integrated Support Programme for Arable Agriculture Development (ISPAAD)*. Government of Botswana. Available at: <http://www.gov.bw/en/Ministries--Authorities/Ministries/MinistryofAgriculture-MOA/Tools--Services/Support-Schemes-and-Initiatives/ISPAAD/> (accessed 1 June 2018).
- UNDP-UNEP PEI. (2013). *Support to Smallholder Arable Farmers in Botswana : Agricultural Development or Social Protection?* Gaborone. Reults and policy implications from a Poverty and Social Impact Analysis, pp.1-4.

