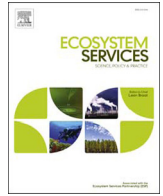




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Dependencies on natural resources in transitioning urban centers of northern Botswana

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ABSTRACT

Investigations into natural resource use and access are often limited to rural areas; such use is not considered an integral part of urban livelihood strategies, especially amongst the poor. With growing urban food insecurity, poverty, and unequal access to services, natural resource use may provide a viable alternative to cash-based resources, thus, allowing households to navigate the rural–urban continuum as they address livelihood needs. This may be especially pertinent for growing, but small, urban landscapes that are in transition. We investigated the use of and access to natural resources in households in rural (Lesoma), peri-urban (Kazungula), and urban (Kasane) settlements in northern Botswana. Semi-structured questionnaires for 85 households were used to investigate household demographics, variety of natural resources used, the availability, use, and importance of natural resources, threats to resources, harvesting locations, and extent of resource commercialization. Significant differences were identified in the mean number of resources used by households across the three settlements (Kruskal–Wallis Chi-squared = 9.29, $df = 2$, $p = 0.01$). Using the post hoc test Conover with Bonferroni adjustment, mean natural resource use between the urban and peri-urban villages did not differ significantly ($p = 1$). However, both types of villages differed from the rural village in mean resource use (urban $p = 0.007$ and peri-urban $p = 0.012$). Nevertheless, urban and peri-urban households reported use of a broad range of natural resources, highlighting the importance of these products in transitioning landscapes. Across the study villages, natural resource harvesting occurred predominantly on communal land. Primary barriers to resource access were perceived to be strict government regulations and decreasing resource availability. Natural resource commercialization was identified as a potential opportunity but was often carried out only on a small scale. The use of natural resources is intuitively thought to be associated with rural areas, but our results suggest that such resources form an important part of livelihoods across urban and peri-urban landscapes as well. This continued reliance on natural resources raises important planning questions about how to ensure both the ongoing conservation of forested and other natural areas, and the availability of associated resources for urban livelihoods. In this regard, small urban towns that are rapidly transitioning from rural landscapes provide a targeted opportunity for early intervention. Our findings underpin the vital role that natural areas play in supporting the livelihoods of the urban poor and highlight the need to encourage land designation and management of such areas not only for conservation but also as a safety net for vulnerable urban households.

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1. Introduction

Over 65% of Africa's 1.2 billion inhabitants are reliant on natural resource harvesting for subsistence use or as an alternative to cash incomes (Timko et al., 2010). These products, sourced from extensive areas of forests, wetlands, and mountains (Shanley et al.,

2014), afford important livelihood security by providing food, income, building materials, fuel, medicines, social networks, and ecological services (Shackleton et al., 2000; Kaimowitz, 2003). Harvested natural resources are used directly for subsistence purposes or are traded in small quantities as an alternative source of household income (Belcher et al., 2005). However, their use varies widely among communities and households due to resource accessibility and availability, population size, institutional controls, employment status, income levels, access to alternatives, and cultural and personal preferences (Shackleton et al., 2001). Harvesting

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limitations can also determine the extent of use, including the availability of harvesting tools, labor, post-harvesting production, and market opportunities (Bennett, 2002).

Attention to date has been directed at natural resource use in rural environments, but our understanding of their use in shifting, urban landscapes is limited (McHale et al., 2013; McLain et al., 2014; Kaoma and Shackleton, 2015; Schlesinger et al., 2015). Enhancing knowledge of natural resource linkages across these landscapes is an urgent matter given that more than half the world's population live in urban areas in transition (Allen, 2003). Moreover, household livelihoods have increasingly diversified to incorporate both subsistence use and cash economies with a greater reliance on activities that stretch across the 'rural-urban continuum' (Shackleton et al., 2000; Stoian, 2005; McHale et al., 2013). Understanding the use of natural resources in transitioning urban landscapes is fundamental to achieving resource sustainability, food security, and community resilience as it broadens the options for enhancing livelihood capabilities and conservation across heterogenous landscapes (Carney, 1998; Chamberlain et al., 2004). High levels of poverty and unemployment, which characterize the rapidly urbanising Global South, further underpin the importance of improved knowledge regarding changes in natural resource use patterns and urban livelihood needs.

With the aim of addressing this lacuna, we investigated the use of natural resources in northern Botswana, across urban, peri-urban, and rural settlements. As Botswana is the second most urbanized country in Southern Africa (Acquah et al., 2013), the study provides insight into the challenges facing urbanization and natural resource management in Africa, particularly in small centers that are transitioning from rural communities to urban landscapes and are increasingly isolated from natural environments. In so doing, we aim to contribute a greater understanding of more effective approaches to integrating urban planning and natural resource management, particularly in Botswana.

2. Methods

2.1. Study area

Botswana is a semi-arid country located in Southern Africa. The total population of the country was 1.4 million in 1990, increasing 62% to 2.25 million people in just 26 years (Bank, 2016). Household income sources include crop production, animal husbandry, wage employment (particularly in the form of government employment), social grants, remittances, and self-employing businesses (Wikan, 2004). Crop agriculture is risky due to low yields and unpredictable conditions associated with erratic and limited rainfall and surface water in this dryland country (Padoch et al., 2008). There are three types of land tenure, namely state (42% of total land area), communal (55%), and freehold (3%) (Matsa and Mutekwa, 2009). Seventy-nine percent of communal land is used for residential, pastoral, and arable activities (Botswana, 2013) and includes areas considered to be tribal.

Study villages were located in northern Botswana (Fig. 1) and incorporated one urban settlement (Kasane, 9008 people), one peri-urban settlement (Kazungula, 4133 people), and one rural village (Lesoma, 613 people) (Botswana, 2014). Kasane, which borders the Chobe National Park, is the administrative center for the Chobe District and is connected by paved roads to urban centers in the rest of Botswana, Zambia, and Zimbabwe. All three areas are located adjacent to protected areas. State-owned forest reserves surround each of these settlements. Both the forest reserves and the communal land included in this study, occur within the Zambebian *Baikiaea* Woodlands ecoregion which is a *Baikiaea plurijuga* – dominated forest, woodland, thicket, and

secondary grassland region with a hot, semi-arid climate (Burgess et al., 2004).

2.2. Natural resource data collection

For the purposes of this study, natural resources were defined as all plants, trees, and fauna present within the ecosystem, including river resources. Data on natural resource use were collected through household interviews using a semi-structured questionnaire. Eighty-five interviews were conducted in total: 30 in Kasane (urban), 30 in Kazungula (peri-urban), and 25 in Lesoma (rural). These represented 1.4%, 3.1%, and 17.2% of the estimated total number of households in each settlement, respectively. Due to logistical constraints, households were surveyed only during business hours. Survey households were selected by first choosing a household on one side of the road/track, followed by a household two houses further on, on the alternating side, and so on. If no one was present at the chosen household, then the household was skipped, and the sample selection process continued until the sample size was met. One respondent provided information for the whole household with interviews conducted in English, Setswana, or the local dialect (with the use of a translator) based on the preference of the respondent. Each interview took about one hour to complete. The purpose of the study was explained before each interview began, and respondents were assured of confidentiality and anonymity. If the respondent agreed to participate, an informed consent form was signed. Information was collected on household demographics, the variety of natural resources used, the availability, use, and importance of natural resources, threats to resources, harvesting locations, and the extent of resource commercialization.

2.3. Statistical analysis

Statistical analyses were conducted in the R code environment (Team, 2015). Exact binomial confidence intervals with Bonferroni adjustment were calculated using the *epitools* package. Village comparisons of count data were made using the Kruskal–Wallis test in the *pgirmess* package with post hoc evaluations conducted using the Conover test with Bonferroni adjustment in the *conover* test package.

We used the *chordDiagram* function in the package *circlize* to create a clustering visualization of the relationships between natural resources, allowing an assessment of the similarities within the dataset. The width of the lines between resource type then represent the relative frequency that both resources were used together within a household.

3. Results

3.1. Household demographics

Across villages, respondents participating in the study were more likely to be female and unemployed (Table 1). This may possibly reflect the time of day when interviews were conducted (standard business hours). However, instructions and questions were designed to obtain responses that represented the household rather than the individual being interviewed, mitigating gender bias to some extent. As surveys were conducted during business hours in all three villages, any bias associated with the time of interview was common to all households.

While not significant, survey household demographics highlighted a tendency towards a higher youth profile in both the urban and peri-urban areas versus an aging population in the rural setting (Table 1). Respondents in all three areas showed a high rate

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