



Forest resource utilisation and rural livelihoods: insights from Chobe enclave, Botswana

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ABSTRACT

For centuries, developing countries have been immensely dependent on environmental resources, forests included. Despite the established contribution of forests to livelihoods, the level of communities' reliance on forest resources, as well as the uses and value of these resources in rural livelihoods, has not been adequately explored in Botswana. This paper assesses the extent of households' reliance on non-timber forest products and their contribution towards the livelihoods of Chobe Enclave communities. Primary data were collected through the administration of a survey instrument to a random sample of 183 households from three Chobe Enclave villages. Descriptive statistics were used to analyse the data. Results indicate that about 75% of the households reported being highly dependent on forests for their livelihood. Forest products are critical in providing for household energy needs, construction materials, agricultural inputs and dietary needs. Among the various products collected from the forest, firewood was the most collected while fodder was the least. About 86% of 157 households reported collection and use of firewood, while fodder was cited by only five households (2.7%). In promoting sustainable use of forest resources, this study recommends a shift towards key alternative strategies and technologies such as species domestication and energy efficient firewood stoves.

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Introduction

For centuries, the majority of people in developing countries have been immensely dependent on environmental resources, particularly forests (Mukul, Rashid, Uddin, & Khan, 2016). On that account, forests are considered a vital resource for human well-being; especially for communities living adjacent to forested areas (Córdova, Wunder, Smith-Hall, & Börner, 2013; McElwee, 2010; Uberhuaga, Smith-Hall, & Helles, 2012). Forests provide a vast array of ecosystem goods and services to the human and natural environment (Howe, Suich, Vira, & Mace, 2014). Ecosystem services are classified into four typologies: provisioning, regulating, cultural and supporting services (Millennium Ecosystem Assessment, 2005). Contrary to the 'fortress' conservation approach of establishing protected areas – which are mainly skewed towards the pristine

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preservation of resources and is characterized by the alienation of local people (Wells, Brandon, & Hannah, 1992) – scholars have argued for alternative integrative management approaches which recognize that forests and human needs are inextricably intertwined (Ros-Tonen, 2000). On that note, non-timber-oriented forest management approaches are promoted as a viable strategy for conservation, due to their arguably low detrimental effects on the forest structure (Ros-Tonen, 2000). These approaches recognize the contribution of forests to human well-being, but also note the role they themselves play in conserving the resources. According to the World Bank (2004), forests provide support to nearly half of the 2.8 billion people living on USD 2.00 or less a day. In light of this, the growing body of empirical evidence demonstrates the functional role that forests play in rural livelihoods.

Globally, numerous studies have quantified the contribution of forests to rural household economies. A meta-analysis of 51 case studies from 17 developing countries has revealed that forest environmental income contributes, on average, 22% of the total household income (Vedeld, Angelsen, Bojö, Sjaastad, & Berg, 2007). In North and South America, studies have revealed that annual forest income contributes between 14% and 20% of the total household income (Córdova et al., 2013; Uberhuaga et al., 2012). Studies conducted in Asia have found that communities are strongly dependent on forests for their livelihood and overall well-being. Gautam (2006) states that over 95% of the Nepalese population depend on forests for both timber and non-timber forest products (NTFPs). In India, 400 million people are regarded as reliant on NTFPs (MoEF Report 1999 cited in Bhavannarayana, Saritha, Usha, & Rao, 2012), while in Bangladesh, NTFPs cash benefits range between 10% and 20% of the total household income (Mukul et al., 2016). Findings from Mamo, Sjaastad, and Vedeld (2007) have revealed that in sub-Saharan Africa, in the Dendi district, Ethiopia, forest income occupies a share of 39% of the total household income. In Ghana, forest income accounts for 38% of the total household income (Appiah et al., 2009). In southern Africa, forest income contributes between 30% and 45% of the total household income (Kalaba, Quinn, & Dougill, 2013).

Drawing upon the review above, it is evident that forest resources are integral to local livelihoods, and they contribute substantially towards household economies. Forest resources form part of livelihood diversification, but they may also serve as the only source of livelihood, especially in the poorest households. Households harvest forest resources for both subsistence and commercial consumption. Uberhuaga et al. (2012) note that forests provide an important source of subsistence and cash income to rural households. Through the use of forests resources, households generate cash income, which in turn contributes towards their household economies. Moreover, some studies have observed that the contribution of forest resources to household economies is often higher than other income generating mechanisms such as agricultural activities (see McElwee, 2010).

Substantial scholarly works have explored the contribution of forests to rural livelihoods. However, most studies conducted on the forest-livelihood nexus have been undertaken in tropical rainforest regions (Ezebilo & Mattsson, 2010; Shackleton, Shackleton, Buiten, & Bird, 2007). Of the few studies conducted in Africa, a limited number of them placed focus on the dry forests of southern Africa. Furthermore, the knowledge and understanding of forest reliance patterns among households – in terms of

the quantity collected as well as the medium of the collection – is still inadequate, despite this being paramount to resource management and planning. In Botswana, there is little knowledge of the intricate relationship between forests and people – specifically the level of reliance on forest resources, and the uses and value of these resources in rural livelihoods. Taylor, Mateke, and Butterworth (1996) contend that very few governments in Africa are aware of the extent of use or the value of NTFPs in the informal sector. The low level of recognition of the forestry sector in Botswana may downplay the potential role of forests in both local and national economies. Against this backdrop, this study assesses the extent of households' reliance on NTFPs and their contribution towards the livelihoods of Chobe Enclave communities. Specifically, this study determines the level of households' reliance on forests, and it establishes and quantifies the number of forest resources harvested from the Chobe Forest Reserve (CFR).

Terminology

It is important to define some of the recurring key terms in this paper. This study, as well as Botswana's Forest Policy, adopts the forest definition as outlined by FRA (2015). FRA (2015) defines a forest as 'land spanning more than 0.5 hectares with trees higher than 5 metres and a canopy cover of more than 10%, or trees able to reach these thresholds *in situ*' (p. 3). It, however, excludes land reserved for purposes such as agriculture or urban use.

With regard to the term NTFPs, this study accepts the definition outlined by Shackleton et al. (2007) as 'any wild biological resource (animal or plant) harvested from forested lands...by rural households for domestic consumption or small-scale trade, with no, or limited capital investment' (p. 560). This definition is more holistic and encompasses various resources extracted from the forests by rural communities. This study, however, focuses only on plant resources.

The term forest dependency has diverse definitions, and a consensus on one, single definition has not yet been reached. Córdova et al. (2013) and Uberhuaga et al. (2012) define forest dependency as the proportion of forest income over total household income basket. The income includes both absolute and relative forest income. Other definitions incorporate employment within the forest manufacturing industry, such as in timber extraction and processing (Stedman, White, Patriquin, & Watson, 2007). Byron and Arnold (1999) offer a nuanced exposition of the term forest dependency. Their seminal paper expounds forest dependency as belonging to one of the following three groups or demographics:

- (1) People living inside forested areas such as hunter-gathers and shifting cultivators who derive a living primarily from the forest;
- (2) People living adjacent to the forests and deriving part of their livelihood from it. Although not exhaustive, it comprises small farming communities who can either be poor or wealthy, and be landowners or landless; and
- (3) People working as small-scale forest product traders and processors on a part-time basis, including those employed in the forest industry.

Newton, Miller, Byenkya, and Agrawal (2016) expands on the above and offers a systematic forest-dependency compendium which presents multiple dimensions of the forest-people relationship. This study is framed within the two dimensions of forest-people taxonomy, the 'forest' and the 'dependent' (Newton et al., 2016). The 'forest' dimension entails the goods and services derived from the forest by the people. Particularly, our study is interested in the physical collection of NTFPs by the Chobe Enclave community, from their proximate forest reserve. The 'dependent' dimension constitutes the forest-livelihood nexus, that is, how people are reliant on forests, and the extent to which their livelihoods may suffer if access to forests is curtailed or removed (Byron & Arnold, 1999). This study operationalizes the 'dependent' dimension in terms of forests contribution to subsistence livelihood needs, such as energy, diet, health, construction, and agricultural inputs. Drawing from the above exposition, this study contextualizes forest dependency in terms of collection and use of forest resources, and the importance of these resources to people's livelihoods.

Conceptual approach

This study is informed by the Sustainable Livelihood Framework (SLF). According to Ellis (2000), a 'livelihood comprises the assets (natural, physical, human, financial and social capital), activities, and access to these (mediated by institutions and social relations) that together determine the living gained by an individual or household' (p. 19). Assets are stocks of capital that households draw on for their well-being and sustenance (Ellis, 2000). Institutions are '...humanly devised constraints that shape human interaction' (North, 1990, p. 3). Social relations are relationships among people within a society, stratified according to factors such as gender, caste, class, age, ethnicity and religion (Ellis, 2000). Following Ellis (2000), 'social relations, institutions and organisations are critical mediating factors for livelihoods because they encompass the agencies that inhibit or facilitate the exercise of capabilities and choices by individuals or households' (p. 39). A sustainable livelihood is a function of its ability to cope with – and recover from – stresses and shocks, without diminishing the resource base (Chambers & Conway, 1992). In the context of this study, SLF is used to understand the contribution of forest resources (assets) towards rural livelihoods (strategies/activities) of the Chobe Enclave communities.

Materials and methods

Study setting

This study was conducted in the Chobe District, northern Botswana (Figure 1). The Chobe District borders three countries: Namibia on the north and west, Zambia on the north, and Zimbabwe on the east (CDDP, 2003). The district is comprised of protected areas: a national park, wildlife management areas, forest reserves and trans-boundary waterbodies. The Chobe District is endowed with the only six gazetted forest reserves found in Botswana (see Garekae, Thakadu, & Lepetu, 2016, for a detailed description). The Chobe forests reserves and Chobe River are integral to people's livelihood in the Chobe District. The forest reserves provide various resources for domestic use,

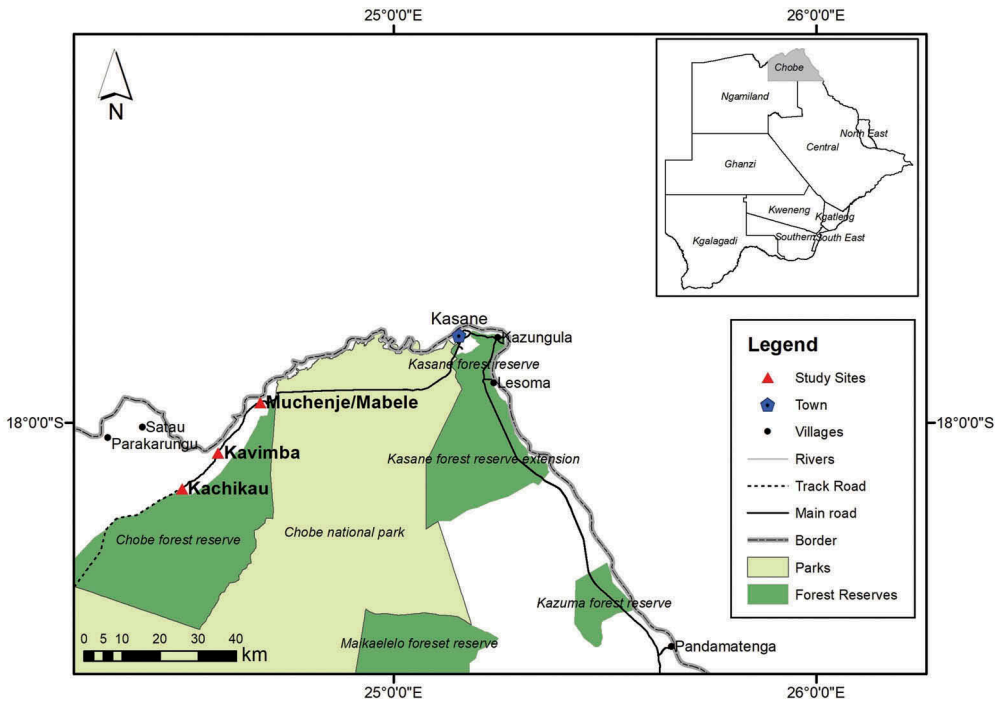


Figure 1. Map of Chobe District depicting the study areas.

household energy needs, building materials and agricultural inputs. The Chobe River provides riverine resources for food, building and crafting materials. The Chobe District is made up of 10 settlements, with the township of Kasane serving as the district's administrative centre. The rest of the settlements are categorized into two distinct cluster communities: east (Kazungula, Lesoma, Pandamatenga) and west (Mabele, Kavimba, Kachikau, Satau, Parakarungu). The western cluster is commonly known as the Chobe Enclave. The major economic activities in the Chobe District include crop production (rain-fed and flood recession), livestock production, tourism-based industries, wage employment, small-medium enterprises and commercial arable farming (CDDP, 2003).

Since the Chobe District is endowed with varied natural resources, a partnership between the Botswana Government and the local communities' has been in existence since the late 1980s, in the form of Community-Based Natural Resource Management (CBNRM). Community-Based Organizations (CBOs) were formed to implement the CBNRM programmes in the area: Kalepa, Seboba and the Chobe Enclave Conservation Trust (CECT). The Kalepa and CECT CBOs contain the eastern and western cluster communities, respectively, while Seboba contains the Kasane community. The Chobe District is multi-ethnic, with the BaSubiya being the largest group and entirely found in almost all of the Chobe Enclave settlements but dominant in Satau and Parakarungu (CDDP, 2003). The BaTawana and Basarwa live in Kachikau and Pandamatenga, respectively. There is also a notable presence of the BaNabjwa, BaTebele,

BaHambukushu and Bakalaka, albeit in smaller proportions, within Chobe's ethnical composition.

Study area

The study participants were drawn from the Chobe Enclave community. The Enclave is comprised of a stream of five villages spanning along the Chobe River basin (Figure 1). The total population size of the Enclave was 4182 (Statistics Botswana, 2011b). Three villages: Mabele, Kavimba and Kachikau were purposively selected to form part of the study area (Figure 1). The villages were chosen based mainly on their proximity to the CFR. The key economic activities in these villages are agriculture (crop and livestock production) and wage employment, supplemented by small-scale businesses (beer making and the sale of natural resource products) (Jones, 2002).

Data collection and analysis

A cross-sectional design was employed where observations of the sampled population were made at a single point in time (Babbie, 2016). This study draws largely from a combination of households' survey and in-depth interviews. The two combined techniques were complemented by the review of secondary data sources (published and unpublished documents) and observation. A standardized, semi-structured questionnaire was used to solicit data from the household survey participants. The questionnaire was administered to a sample of 183 households, randomly selected from the villages of Mabele, Kavimba and Kachikau. This sample accounts for approximately 34% of the total households from the study villages. Household heads were targeted for interviews. In exceptional cases, a household member 18 years and above was considered to represent the household head. The questionnaires were administered to the respondents through face-to-face interviews, conducted by one of the researchers at the interviewees' homes and at convenient times. All ethical protocols were observed.

The survey questionnaire tapped on the following information: the respondent's profile and their forest resource use. The quantity of forest products harvested was assessed through various mediums, including headload, wheelbarrow load, cartload, sledge load, re-used bags, and the actual count of bundles and logs. Although the use of the localized mediums for quantification may limit the generalizability of the study findings, these mediums are common throughout Botswana and other parts of southern Africa (such as South Africa and Zimbabwe). The variable forest dependency was assessed in three forms:

- (1) The frequency of visiting the forest and collection of forest resources;
- (2) The actual quantity of each forest product collected; and
- (3) The respondents perceived rating of their overall level of dependence on forest resources and individually specific forest products.

The respondents perceived rating of forest dependency was their evaluative response and the degree to which they consider themselves to be dependent or not dependent on forest resources. The perceived rating of overall forest dependency and specific forest products was assessed through statements bearing Likert-type responses, where

respondents were asked to rate the level of their agreement or disagreement on a five-option point scale. The perceived dependency was classified into five groups: very low dependency (coded 1), low dependency (coded 2), moderate dependency (coded 3), high dependency (coded 4) and very high dependency (coded 5). The classification was explained to the respondents in terms of frequency of collection and use of forest products. 'Very low dependency' denotes the collection and use of forest resources on a rare basis, 'low dependency' represents once in a while, 'moderate dependency' represents occasional collection and use, 'high dependency' denotes regular collection and use, and while 'very high dependency' depicts frequent collection and use. The description was explained to the respondents in order to facilitate their rating of the overall level of forest dependency.

Information on the various types of forest resources collected was obtained through respondents' listing, based on a 12-month-long recall period. Some products were seasonal, while others were only obtained when required, examples of this include wild fruits, thatching grass and poles. This study acknowledges the ambiguity associated with recall studies (Jagger, Luckert, Banana, & Bahati, 2012), particularly when using overly long recall periods. Consequently, this may impinge on the reliability of the reported quantities of forest products. However, L'Roe and Naughton-Treves (2014) argue that despite the limitations of a 12-month-long recall period, the study could still yield comparable trends in results to those sourced from two time recall periods. Although this problem could have been circumvented by collecting data on a quarterly basis, it was not possible in this study. Hence, data collection was condensed to a once-off activity. Therefore, the study results should be interpreted within this limitation.

On the other hand, in-depth interviews were conducted with six purposively sampled key informants. The informants were chosen based on their position, expertise and knowledge of issues regarding natural resource use, management and conservation (Marshall, 1998). The informants were comprised of three local chiefs (being traditional or tribal authorities), one community trust member and two officials from the Department of Forestry and Range Resources (DFRR). These informants were responsible for the management and conservation of natural resources at the community level (trust member), and district and/or country level (DFRR officials). The informants provided information on communities' reliance on forest resources and, most importantly, regulatory instruments governing access to the resources. The interviews lasted between 30 and 60 min.

It was ensured that the data collection instrument was valid and reliable. The formulation of the instrument items was guided by the existing literature; followed by the review of the instrument (for content validity) by a team of experts from the author's respective institutions. Statistical Package for Social Sciences (SPSS) version 23 was used to manage the data. Descriptive statistics such as frequencies, proportions, measures of central tendency and dispersion were used to analyse quantitative data, while thematic analysis was used to analyse qualitative data. In this study, the thematic analysis procedure outlined by Braun and Clarke (2006) is followed. Furthermore, some excerpts from the transcribed data items were used as a thick description to demonstrate the respondents' viewpoints.

Results

Respondents' profile

Of the 183 respondents in the sampled population, 61.2% were females. Most of the respondents were middle-aged ($M = 49.33$, $SD = 17.28$). About 44.8% of 183 respondents had some primary education, while some had attained a tertiary education (5.5%). Contrarily, 13.1% of the respondents reported that they had never received any form of education. The majority of the respondents were unemployed (54%), followed by those employed on a full-time basis (12.6%) and those who considered themselves to be self-employed (14.2%). Monthly household income varied between two extremes, with the majority reporting an average income of less than USD 45.00¹ (42.8%), while others indicated USD 270.00 or more (3.9%). The mean household size was 4.85 ($SD = 2.64$), ranging from one to 16 household members.

Household's forest dependency

The majority of the respondents (86.3%) indicated having visited the CFR within the past three years. Almost all of the visitations were primarily for collection of NTFPs (99.4% of 157 households). The study findings indicate that households were highly dependent on forest resources, as evidenced by the respondents' perceived rating of the overall level of dependence on forest resources. More than half (54.1%) of the 157 respondents reported a very high forest dependency, while a quarter (20.4%) reported a high forest dependency. This suggests that the respondents were collecting and using forest products on a regular basis. The findings regarding the perceived forest dependency level are buttressed by the quantities of forest resources collected by each household, per year, across the study villages (Table 3). This level of dependency, however, varied with households' place of residency (Figure 2). Cross-tabulation

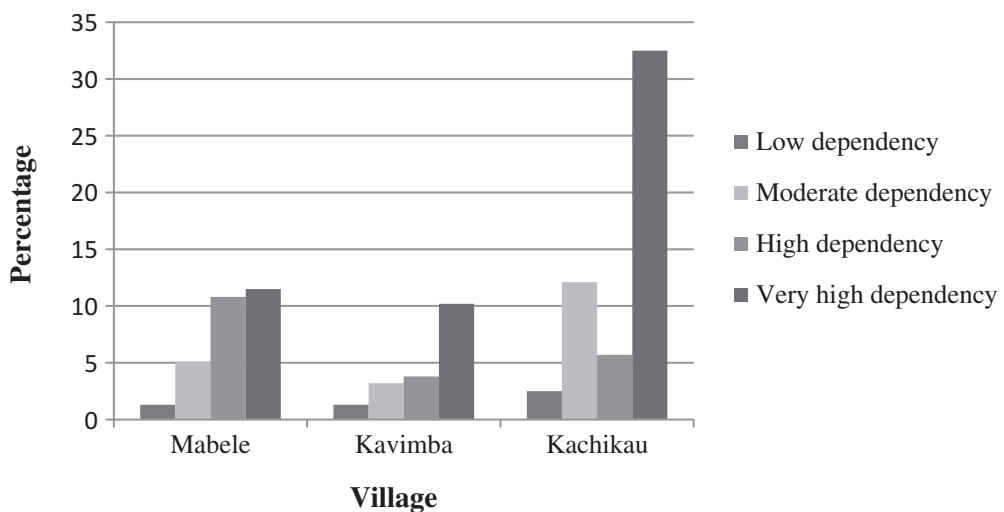


Figure 2. Proportion (%) of household forest dependency across the study areas.

analysis demonstrates that residents of Kachikau were comparatively more dependent on forest resources (38.2%, $n = 60$) than the residents of Kavimba (14%, $n = 22$) and Mabele (22.3%, $n = 35$). The resources were mainly collected, either regularly or occasionally, for subsistence use. The commercialization of forest products was not pronounced in the study villages. Only a few respondents indicated that they collect forest products for commercial use – mainly through selling the products among locals and a few institutions – albeit at a small-scale level. [Figure 2](#) demonstrates the proportion of households' forest dependency across the study areas.

Collection, use and importance of forest resources for communities' livelihoods

This section outlines the various types of forest product collected, and the household's perceived level of dependency on, and importance of, each forest resource for their livelihoods. The findings indicate that the Chobe Enclave's communities used several forest products for various purposes such as domestic use, household energy needs, building materials, agricultural inputs, sources of food and health products.

Among the products collected from the forest, firewood was the most prominent while fodder was the least prominent ([Figure 3](#)). About 86% of the 157 households reported collection and use of firewood, while fodder was cited by at least five households (2.7%). [Table 1](#) demonstrates that the majority of the respondents were highly dependent on firewood, mainly as a primary source of household energy, and they considered firewood to be extremely important for their livelihoods ([Table 2](#)). Firewood was used mainly for heating, especially during the winter season, as well as cooking. Although some households maintained that they also use alternative energy sources, they resorted to using firewood for cooking some meals which tend to take a longer time to prepare. [Figure 3](#) depicts the frequency distribution of the forest products collected by the respondents.

Despite wild fruits being an integral component in the dietary composition, households were fairly dependent on them. Slightly more than half (63.1%) considered wild fruits to be important for their livelihoods ([Table 2](#)). Across the study sites, wild fruits were harvested mainly from Bird-plum (*Berchemia discolor*) and Baobab (*Adansonia digitata*) trees. *Adansonia digitata* fruits were mainly collected for subsistence usage, while *Berchemia discolor* was collected for both subsistence and commercial usage. The

Table 1. Frequency distributions (%) of households' level of dependency on forest products.

Forest products	SCALE					<i>n</i>	
	0	1	2	3	4		5
Fuelwood	0.6	4.5	3.2	14.6	5.1	72.0	157
kraal	59.9	1.3	1.3	5.7	8.9	22.9	157
Poles	50.3	2.5	3.8	6.4	10.2	26.8	157
building	48.4	4.5	4.5	8.3	7.0	27.4	157
Handicraft materials	89.8	2.5	1.3	1.9	1.9	2.5	157
Thatching grass	50.6	7.1	2.6	10.3	9.0	20.5	156
Fodder	97.4	-	-	-	0.6	1.9	156
Wild fruits	30.6	7.6	8.3	13.4	15.9	24.2	157
Wild vegetables	96.2	0.6	-	1.3	0.6	1.3	157
Medicinal plants	88.5	5.1	1.9	0.6	1.9	1.9	157
Other (Specify)	98.7	0.6	-	0.6	-	-	157

0, 1, 2, 3, 4, and 5 are Likert-type scale options: not applicable, very low dependency, low dependency, moderate dependency, high dependency, and very high dependency, respectively.

Table 2. Frequency distributions (%) of the level of importance of forest products to household livelihood.

Forest products	SCALE						
	0	1	2	3	4	5	
Fuelwood	1.3	-	1.3	-	10.2	87.3	157
kraal	59.2	-	-	-	10.8	29.9	157
Poles	51.6	-	-	0.6	12.7	35.0	157
fencing	49.0	-	0.6	1.9	10.8	37.6	157
building	87.9	0.6	-	1.3	2.5	7.6	157
Handicraft materials	50.3	0.6	0.6	1.9	19.7	26.8	157
Thatching grass	96.2	1.3	-	-	0.6	1.9	157
Fodder	33.1	-	-	3.8	30.6	32.5	157
Wild fruits	96.2	-	-	0.6	1.3	1.9	157
Wild vegetables	87.9	-	-	0.6	7.0	4.5	157
Medicinal plants	98.7	-	-	-	1.3	-	157
Other (Specify)							

0, 1, 2, 3, 4, and 5 are Likert-type scale options: not applicable, extremely unimportant, unimportant, neutral, important, and extremely important, respectively.

Table 3. Mean annual amount of forest products per household across the study areas.

Forest products	Collection medium	Locality			Mean total (SD)
		Mabele (SD)	Kavimba (SD)	Kachikau (SD)	
Firewood	Headload	82.20 (50.05)	94.36 (79.71)	76.43 (71.62)	82.23 (69.20)
	Wheelbarrow	61.33 (27.13)	60.00 (31.75)	32.00 (26.83)	48.57 (29.99)
	Cartloads	8.33 (5.78)	6.36 (3.83)	6.59 (2.94)	7.04 (4.10)
	Sledge loads	13.33 (10.07)		6.00	11.50 (9.00)
Fencing poles	Cartloads	1.57 (0.98)	1.00 (0.00)	1.00	1.31 (0.75)
	No. of logs	157.29 (223.45)	90.71 (35.64)	61.32 (57.17)	92.94 (131.57)
	Sledge loads	25.00		1.00	13.00 (16.97)
Building poles	Cartloads	1.00 (0.00)	1.00 (0.00)	1.00	1.00 (0.00)
	No. of logs	16.33 (11.73)	23.33 (5.77)	16.70 (12.13)	16.98 (11.75)
	Sledge loads	1.00		1.00	1.00 (0.00)
Kraal poles	Cartloads	2.00 (2.24)	1.00 (0.00)		1.42 (1.44)
	No. of logs	113.13 (132.11)	73.13 (95.50)	113.00 (146.06)	103.39 (126.23)
	Sledge loads	65.00 (49.5)		1.00	43.67 (50.90)
Thatching grass	Bundles	40.00 (27.95)	55.00 (8.66)	66.81 (122.37)	62.86 (112.02)
<i>B. discolor</i> fruits	Bags	2.00 (1.73)	3.00	3.00 (3.23)	2.87 (2.99)
<i>A. digitate</i> fruits	Bags	4.00 (6.14)	3.45 (3.50)	2.72 (2.95)	2.94 (3.44)

two tree species are common in the study areas. Tables 1 and 2 provide a summary of the frequency distribution of households' dependency level on each forest resource, and the equivalent perceived level of importance for livelihood, respectively.

Chobe Forest Reserve is a source of craft and construction materials. In this study, households mainly harvested construction materials such as thatch grass and poles. The findings indicate that households were fairly dependent on thatching grass (Table 1), and that it was considered somewhat important to their livelihoods (Table 2). This suggests that thatching grass was used occasionally – perhaps once or twice a year. This is not surprising, because the collection of thatching grass is not often done annually. A household may need thatching grass for a newly constructed hut or for renewing existing thatch, with an estimated longevity of five years or more. Thatching grass was harvested for both subsistence and commercial use. With regard to the latter, it was mainly practised at small-scale level: in local settlements and in settlements further away. As emerged from one of the key informants' interview, of late, Chobe Enclave residents

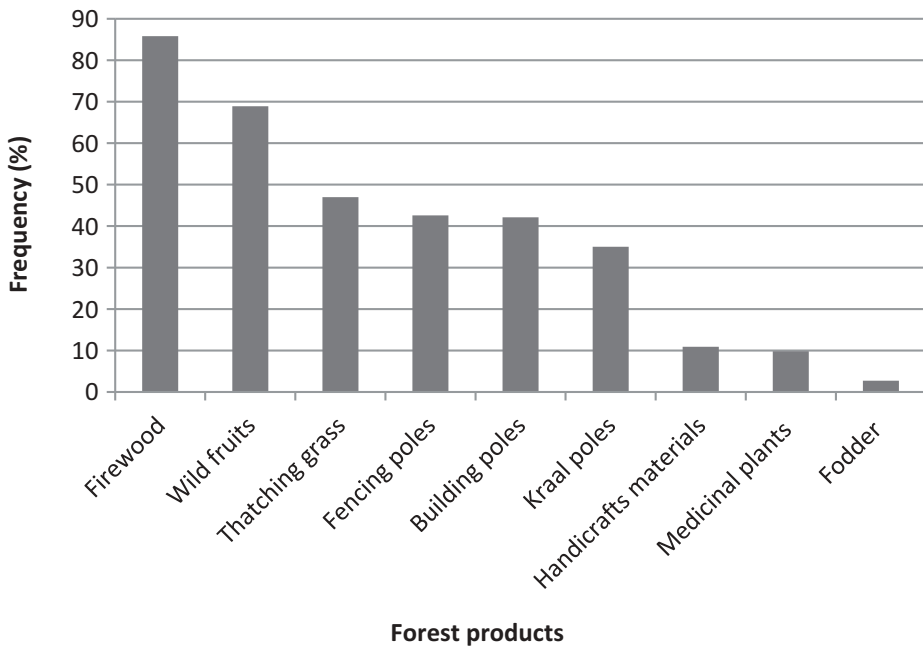


Figure 3. Frequency of forest products collection.

are in the process of forming a thatching grass association, aimed at regulating prices for the sale of thatching grass. This development occurred after Chobe Enclave communities aired their grievances on the irregularity of thatching grass prices. The communities' complained that some customers, especially those from distant settlements, purchased thatching grass from them at an imposed lower price. The same customers then make a profit, at the expense of the harvesters' labour, by selling the thatching grass at a remarkably higher price elsewhere, without any product value addition.

Households felled poles for fencing yards and fields, and for the construction of traditional household structures and livestock enclosures. From the observations conducted, it was noted that the majority of homesteads that were visited were fenced using poles that were extracted locally, as opposed to being fenced with treated poles purchased elsewhere and they had at least one structure roofed with poles and thatch grass. Almost a quarter of the respondents (42 of 157 households) indicated that they were highly dependent on fencing poles sourced from the forest (Table 1), and over a third (35%) considered fencing poles to be extremely important for their livelihoods (Table 2). This implies that fencing poles were sourced from the forest on a regular basis. Similarly, a quarter of the respondents (38% of 157 households) regarded building poles to be of great importance for their livelihood. Therefore, poles sourced from the forest were essential inputs for livelihood activities aimed at diversifying household economies – such as pastoral farming (construction of livestock enclosures).

Lastly, some of the products collected from the CFR included handicrafts materials, medicinal plants, fodder and wild vegetables. The quantities of resources collected are not quantified in this study, as they were extracted in small quantities and at irregular times. Furthermore, some respondents could not account for their collection. Since this

study conceptualizes forest dependency in terms of collection and use of forest products and their resultant perceived importance to livelihoods, it falls short of unravelling livelihood vulnerability due to unforeseen events such as restricted or halted access to forests. Hence, this study calls for further research aimed at uncovering the links between access to forest resources and livelihood vulnerability.

Quantity of harvested forest products

The quantities of forest products that were collected were quantified through the various localized mediums used, as reported by households; these include headload, wheelbarrow load, cartload, sledge load, re-used bags, and the actual count of bundles and logs. This study acknowledges that the use of prolonged recall periods might result in under or overestimating the reported quantities of forest products that were collected. Table 3 depicts a detailed account of the annual quantities of the forest products harvested across the study sites, with respect to the medium used. Among the forest products, firewood was the only product collected on a weekly basis and throughout the year; the other products were collected on a seasonal basis and when the need arose. Wild fruits and thatching grass were harvested mainly on a seasonal basis. *Berchemia discolor* fruits were harvested mainly between January and April, and *Adansonia digitata* fruits were harvested between July and September. Thatching grass was also harvested between July and September. Poles used for various purposes were normally sourced when the need arose, such as renewal and/or construction of livestock enclosures as well as paling yards and fields. The collecting of thatching grass and poles was regulated through the issuance of harvesting permits from the DFRR. Table 3 details the quantities of forest products collected across the study sites on an annual basis.

Discussion

The purpose of this study is to assess the extent of households' reliance on non-timber forest products together with its contribution to their livelihoods. In order to achieve the study purpose, key research questions were formulated to direct this study:

- (1) What is the level of households' reliance on forests?
- (2) Which types of forest product were collected by households? and
- (3) What is the quantity of each forest product harvested from the CFR by the Chobe Enclave communities?

This section discusses the study findings based on the set study purpose and key research questions. The findings demonstrate that the Chobe Enclave residents were dependent on the CFR for their various needs. Generally, the findings indicate that households were highly dependent on forest resources for their livelihoods. This observation is buttressed by some of the key informants residing at the study areas; to them, use of forest products '*forms part of Chobe Enclave community's lifestyle and they have been harvesting forest products since time immemorial*'. One of the key informants from Kavimba stated that:

'We are dependent on this forest, we are part of it and we live in it. There is life in this forest since they are many things which we harvest from it'.

Households' reliance on forests varied with the location of their residence. Households at Kachikau were more dependent on the CFR compared to households in Mabele and Kavimba. Kachikau village is closer to the forest reserve than the other two villages. The time required to collect forest products was shorter for Kachikau residents than for the residents of the other villages; therefore, it can be inferred that proximity promotes sustained harvesting. The finding resembles the observations of Mukul et al. (2016) in Bangladesh. Their study reveals that the level of forest dependency varies with a household's location; with those living within the national park (Tiprapara residents) being significantly dependent on forests for their livelihoods. Forest resources served various livelihood needs among the Chobe Enclave communities. These needs included: domestic use, household energy, building materials, agricultural inputs and dietary needs. Forest products for household energy included firewood and poles for agricultural inputs such as fencing fields and construction of livestock enclosures. For building and construction material, thatching grass and poles as roofing rafters were commonly used. Wild fruits contributed to dietary needs. Therefore, forest products were integral to local livelihoods in the study area. This finding is consistent with the ascertained substantial value that forest products contribute to livelihoods (Negash, 2007), particularly in providing food, fuel, medicine, and construction materials.

In this study, firewood and poles were continuously collected throughout the year, while thatching grass and wild fruits were only harvested during particular seasons. Across the study sites, firewood was the most collected and used forest product, while fodder was the least used forest product. As in many other developing countries, where provision and access to energy in rural areas is still constrained (Babulo et al., 2009), firewood remained an important source of energy among many households in the study area. It was used mainly for heating, especially during the winter season, and for cooking. Although some households maintained that they used alternative energy sources for either cooking or heating, they resorted to firewood for cooking some meals which tend to take a longer time to prepare.

Disaggregating the principal source of energy for lighting, cooking and heating in the Chobe Enclave corroborated the study findings. Statistics Botswana (2011a) outline that about eight sources of energy are used for lighting, cooking and heating in the Chobe District. These are electricity, solar power, liquefied petroleum gas (LPG), biodiesel, fuelwood, paraffin and charcoal. Specific to the study sites, fuelwood was the most frequently used source of energy for heating (68%, $n = 563$) and cooking (65%, $n = 449$), while electricity (45%, $n = 312$), paraffin (34%, $n = 237$) and candles (15%, $n = 103$) were used mostly for lighting. Also, electricity (17%, $n = 118$) and gas (16%, $n = 107$) were the second and third most used sources of energy for cooking, respectively (Statistics Botswana, 2011a). As evidenced by the Statistics Botswana (2011a) findings, as well as the findings of this study, firewood remains a vital energy source for many, if not all, the households in the study area. Firewood is one of the cheapest and most accessible sources of energy for most rural households (Panta, Kim, & Lee, 2009). Other energy sources such as electricity, coal, gas and kerosene may not be affordable to the majority of households, when compared to firewood, which is generally free. Given the extent of

households' reliance on fuelwood in the study area and elsewhere, it is important to encourage communities to share information on firewood collection with young people, so that current and possibly sustainable practices are transferred across generations.

These findings are consistent with studies conducted elsewhere. Studies conducted in South Africa (Mtati, 2014; Thondhlana & Muchapondwa, 2014) and Nepal (Panta et al., 2009) indicates that more than 80% of the households are reliant on firewood as a primary source of energy. As observed from this study and elsewhere, even the households with access to alternative energy sources were greatly dependent on firewood for meeting their energy needs. In the study conducted by Panta et al. (2009), households with access to electricity opine that they use it mainly for lighting purposes and powering electronic appliances. The predominant use of firewood is attributed to its cost-effectiveness, when compared to other energy sources. As reiterated earlier, around eight alternative energy sources are in use in the Chobe District (Statistics Botswana, 2011a). However, the conditions of abject poverty in the Chobe Enclave do not afford everyone access to alternative energy sources, such as electricity and gas, since this involves monetary transactions. Hence, people will continue to rely on firewood as it is a cheap and/or free commodity. On that note, the availability and access to alternative energy sources, such as electricity, do not seem to lure households away from using firewood. Subsequently, in some areas, firewood has become an important income generating activity during times of shocks, for example; during seasonal food shortages, some households rely on the cash income accrued from selling firewood (Mamo et al., 2007). Therefore, households may resort to selling firewood in order to complement their household cash income.

Wild fruits form an integral component of a household's dietary needs. Wild fruits serve as a safety net during times of shocks (drought, famine, and low agricultural productivity), because of their tolerance to adverse conditions, when compared to staple and domesticated crops (Makombe, 1994; Stadlmayr, Charrondi re, Eisenwagen, Jamnadass, & Kehlenbeck, 2013). For example, households that rely heavily on agriculture may resort to harvesting wild fruits during off-agricultural seasons. A key informant from Kavimba expressed that:

'Since rainfall was scarce this year (2015), farmers left their fields earlier and went into the forest to collect wild fruits for household consumption and also for selling'.

Hence, wild fruits are essential towards maintaining nutritional well-being and, most importantly, cushioning against seasonal deficiencies, such as food shortages. Furthermore, wild fruits are an important source of food to be had, while an individual is in pursuit of other livelihood activities, such as herding cattle (Makombe, 1994). Most importantly, wild fruits are very rich in important minerals and vitamins such as calcium, magnesium, potassium, copper, and vitamin C (Stadlmayr et al., 2013) and hence, have the potential of curbing undernourishment. Fruit processing was not common in the study area since the fruits were only consumed in their raw form. Elsewhere, the fruits of the *Adansonia digitata* are processed to derive products such as jam, ice lollies and edible oil (Venter & Witkowski, 2011). Therefore, the prospect of wild fruits value addition may be harnessed to diversify household economies in the study areas.

Similarly, *Berchemia discolor* fruits were collected for subsistence consumption and for selling at the local level. The fruits were consumed fresh or dried and packaged in

order to be used at a later time. As highlighted earlier, some households were involved in trading of *Berchemia discolor* fruits in the local area and in nearby villages and towns. This implies that the use of wild fruits is important to household economies. However, respondents raised concerns that both weather conditions and dense wildlife in their area often damage the fruits before they ripen. This often leads to a decline in the numbers of some fruits during particular seasons. Future studies should examine the impact of climate change on wild fruits, as this may impact rural livelihoods.

Chobe Forest Reserve is a source of key inputs for households' undertakings, such as the provision of construction materials for varied activities. The forest provided thatching grass and poles for fencing and construction of dwelling structures and livestock enclosures. Although thatch grass was harvested for subsistence use, it was also traded in local settlements and in settlements further away. This supplied additional cash income to the households, to be used for other activities. The communities' heavy reliance on poles felled from the forest may be due to the limited availability of cash; as well as the unavailability of adequate infrastructure suppliers, such as hardware retail outlets, for providing alternative products, such as treated Eucalyptus poles.

Since extraction of poles and thatch grass is regulated through the issuance of harvesting permits, people are required to obtain a permit prior to any harvesting activities. The permit provides information on forest products collection inventory and appropriate harvesting guidelines. Despite this regulatory measure, informal discussions with the respondents indicated a prevalence of non-compliance regarding permit acquisition, as the respondents often embarked on harvesting activities without acquiring a permit. Lack of compliance was attributed to the time span of permit applications, centralized forestry services, and its perceived limitation on resource exploitation. Consequently, this non-compliance may give rise to resource over-exploitation and compromise on resource inventories. Therefore, the turn-around time for permit application and issuance, and the possibility of decentralizing some services to the locals, should be taken into consideration as a way of rectifying the non-compliance. There is a need for intensive education and awareness among locals on the importance of harvesting permits, in order to foster sustainable use of forest resources. This study posits that non-compliance of permit acquisition could be remediated by fostering active community participation in the management and conservation of forests. This could be achieved by incorporating forest management within the scope of the already established community trust (CECT) in the study areas, which has thus far largely focused on wildlife management and conservation. Lessons from CBNRM have shown that resource management, monitoring and enforcement can benefit most when it is implemented by the people living with and within the resources (Thakadu, 2005).

This study's findings – regarding households' relying on poles harvested from the forest – corroborates with other studies in southern Africa. Fencing and kraal poles are among the most frequently used forest products in South Africa (Cocks & Wiersum, 2003; Mtati, 2014). The two studies have revealed that of the sampled households, more than 80% and 50% extract fencing and kraal poles, respectively, from the forest. These study's findings demonstrate that poles felled from the forest are the primary inputs for both household and agricultural activities, especially in areas where alternatives are not available or not affordable. Other products such as handicrafts materials, medicinal plants, fodder and wild vegetables were also collected from the CFR. However, these

products were collected in smaller quantities and at irregular times. This could be attributed to the availability of alternative products from the market. Currently, households are more reliant on exotic vegetables than on indigenous vegetables.

Since the study results demonstrate that households were dependent on the CFR for various subsistence needs, any conservation programmes and strategies should take into account the functional role that CFR plays in the livelihoods of the adjacent communities. Conservation programmes which tend to jeopardize the inextricable links between the local people and their environment may culminate in a series of 'people-park' conflicts (Masofera & Alavalapati, 2004). Therefore, the protection and improvement of local livelihoods and ecological conditions is a cornerstone for sustainable conservation programmes (Ghimire & Pimbert, 1997). This postulates that understanding households' forest reliance is a fundamental step in the formulation of management strategies and planning.

Conclusion

This study substantiated the functional role of NTFPs in rural livelihoods – particularly that of providing household basic needs, and cushioning against natural shocks and seasonal food deficiencies. Firewood, poles, thatching grass and wild fruits play a vital role in rural livelihoods, as they provide household energy needs, agricultural inputs, building materials and dietary needs. During this study, firewood was the only forest product that was collected, by the communities, on a weekly basis and throughout the year, while wild fruits and thatching grass were collected on a seasonal basis only. Poles, used for various purposes, were collected only when the need arose. Of concern to this study was that some forest products, such as firewood and poles, were sourced from only one tree species. This renders that particular species vulnerable to over-exploitation and increases its risk of extinction, if remedial measures are not put into place expeditiously. Therefore, it is recommended that the Chobe Enclave locals explore the use of other species, which are not frequently harvested, in order to allow the trees that are predominately harvested an opportunity to recover and replenish their numbers.

In a bid to promote sustainable NTFPs use, this study suggests that the Chobe Enclave locals and communities elsewhere explore alternative key strategies and technologies, such as the domestication of preferred species; and shift towards emerging technologies, such as energy efficient firewood stoves. Species domestication will reduce the pressure exerted on forests, as communities will now have other resources, within their vicinity, to harvest from. Energy efficient firewood stoves are of great importance to biodiversity conservation, as the stoves reduce the amount of firewood consumed, when compared to the conventional open fire method currently employed. The use of firewood stoves will lead to fewer visits to the forest and will, ultimately, curb unsustainable harvesting practices. This study demonstrated that forest and communities' livelihoods are intertwined, which is consistent with the SLF and forests-livelihood body of literature. The SLF outlines that a livelihood comprises assets, activities and access – which together shapes the individuals or households' lifestyles'. Therefore, forest products provide assets which individuals and households draw on for their livelihood sustenance. On that note, management, planning and strategies should take into account the functional role of forests in sustaining the livelihoods of adjacent communities. Lastly, this study expanded

on the forest-livelihood literature, particularly in Botswana, which was scanty and biased towards biophysical research. Future research is needed to quantify the economic value of Botswana's forest resources, so as to inform policies and planning.

Note

1. BWP 1 = USD 0.09 (2016).

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