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Traditional uses and local perspectives on baobab (*Adansonia digitata*) population structure by selected ethnic groups in northern Namibia

K. Lisao [a,b,*], C.J. Geldenhuys [b], P.W. Chirwa [b]

[a] National Forest Research Centre, P.O. Box 396, Okahandja, Namibia
[b] Postgraduate Forest Programme, Department of Plant Sciences & Production, University of Pretoria, South Africa

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ABSTRACT

The aim of this study was to document local traditional uses on *Adansonia digitata* (baobab) among the Herero, Ovambo, San and Masubiya ethnic groups in northern Namibia. Data was collected by oral interviews using a semi-structured questionnaire. A total of 64 respondents were interviewed. Indigenous knowledge on baobab is transferred from older generations to younger generations through word of mouth. The information that was captured includes local traditional use and benefits of baobab, use value, and perceptions on baobab population dynamics. Findings from the current study revealed that baobab uses go beyond provision of food, medicine and spiritual needs in Namibia. It is also used as feed for chicken. The bark was also recorded to be useful as fodder during drought. The fruit is the most used part of the baobab, but the use value of bark was generally high among all ethnic groups. The study revealed that the Ovambo people use more baobab products than the Herero, San and Masubiya communities. Destructive uses of seeds were identified as a factor contributing to the lack of regeneration of baobab. It is recommended that destructive uses of baobab, especially use of seeds, need to be regulated to sustainable levels for conservation of baobab in Namibia. Furthermore, the benefits from the baobab tree need to be promoted in order to fully utilize its potential in improving livelihoods of rural communities in Namibia.

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1. Introduction

Baobab (*Adansonia digitata*) trees are not only of esthetic and ecological significance; they also provide goods and services to the livelihoods of rural society. A significant number of people in developing countries depend on non-timber forest products (NTFPs) for their livelihoods (Timko et al., 2010). NTFPs are an integral part of rural communities through provision of medicine, food, shelter, spiritual and cultural benefits (Shackleton et al., 2015). According to Gadgil et al. (1993), this dependence on forest products has enabled indigenous communities to develop extensive knowledge about plant resources in their surroundings. Such knowledge is critical for conservation and sustainability of NTFP-providing species.

In recent years, indigenous local knowledge has emerged as an important aspect of conservation because it aids the understanding of the ecology of resources, which contributes to sustainable conservation of forests (Daou, 2000; Shackleton et al., 2015). In addition, indigenous knowledge reveals important information relevant for pharmacology and food industries (McClatchey et al., 2009; Arnold and Ruiz Pérez, 1998). Traditional knowledge is passed orally from older to younger generations, and this trend has also been observed in Namibia. On the other hand, there is a continuous loss of indigenous knowledge due to change from traditional to modern lifestyles (Cunningham, 1992); and this continuous loss of diverse local knowledge has been reported in Namibia (Mapaure and Ndeinoma, 2011). This warrants a need to preserve such knowledge in order to enhance conservation of NTFP providing species.

Adansonia digitata provides a wide range of NTFPs to rural communities in some parts of the African savanna, including Namibia (Buchmann et al., 2010; Venter and Witkowski, 2010; Cuni Sanchez et al., 2011; Schumann et al., 2011; Munthali et al., 2012; Mashapa et al., 2013). Every part of baobab is believed to be useful as a food source, medicine or for spiritual welfare (De Caluwe

* Corresponding author at: National Forest Research Centre, P.O. Box 396, Okahandja, Namibia.
E-mail address: klushetile@gmail.com (K. Lisao).

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et al., 2009; Buchmann et al., 2010; Kamatou et al., 2011). It is mainly used as food and medicine in Namibia and is rooted in spiritual values (Le Roux, 1971; Rodin, 1985; Leffers, 2003; Munyebvu, 2015). There is a well-developed international trade for *A. digitata* pulp and oil in South Africa and Malawi (Buchmann et al., 2010; Venter and Witkowski, 2011), where it is mainly traded for use in the food and cosmetic industries (Kamatou et al., 2011; Gebauer and Luedeling, 2013). Furthermore, demand for baobab products has grown since the approval of fruit pulp as a novel food ingredient by the European Commission (Vassiliou, 2008). Despite the benefits to local communities in Namibia, baobab uses are poorly documented. A study by Munyebvu (2015) is the only formal study on indigenous knowledge of *A. digitata* in Namibia, but was conducted only among the Ovambo ethnic group in Omusati Region. Other studies merely included baobab in compilation of lists of indigenous plant uses and local names (Rodin, 1985; Le Roux, 1971; Leffers, 2003). The current study extends and documents indigenous information on *A. digitata* from various ethnic groups.

Human population increase results in increased pressure on the environment and plants that are intensely utilized will inevitably become rare and may eventually become extinct (Schippmann et al., 2002). A common example in Namibia is that of *Harpagophytum procumbens* (devils claw) that became overexploited due to high demand as a source of active medicinal ingredients (Cunningham, 1992). This warrants studies on species of high value such as *A. digitata* for conservation and preservation for future generations.

The local communities, as the custodians of the forest products, are an important part of the management of forest resources such as *A. digitata* resources. Local communities utilize baobab resources at a local scale for cultural, spiritual and traditional purposes (Sidibe and Williams, 2002). Hence collation of the knowledge of local people of *A. digitata* use and population structure is critical for management decisions. Therefore, the aims of the current study were to document traditional uses of *A. digitata* from the Herero, Ovambo, San and Masubiya people. This will preserve valuable indigenous knowledge that would guide specific management strategies for *A. digitata* conservation in different parts of Namibia.

2. Methodology

2.1. Study areas

The study was conducted among the OvaHerero in Kunene, Ovambo in Omusati, San in Otjozondjupa and Masubiya in Zambezi [former Caprivi] Regions in northern Namibia (Fig. 1). Environmental parameters for the different study areas are summarized in Table 1. Generally, Namibia is a hot and dry country with high climatic variability. The average annual rainfall increases from the west to the east: Kunene Region, 166 mm; Omusati, 285 mm; Otjozondjupa, 617 mm and Zambezi, 740 mm (Namibia Meteorological Services, 2015). Omusati region is the hottest with an average maximum temperature of 32 °C. Kunene Region is the coldest with an average minimum temperature of 5 °C. It has two major geomorphological areas: The western part characterized by diverse rock features exposed in landscapes where the Herero people are settled; and the flat eastern part which is part of the Kalahari basin where the Ovambo, San and Masubiya are settled (Miller, 2008). Namibia's vegetation is strongly influenced by rainfall such that plant life is tallest in the north-east, and progressively more sparse and short in the west and south (Giess, 1998; Mendelsohn et al., 2002). The majority of people in the rural communities are dependent on natural resources for their wellbeing (Byers, 1997). The land tenure system is communal in all sampled regions. Communal land belongs to the state, however, community based

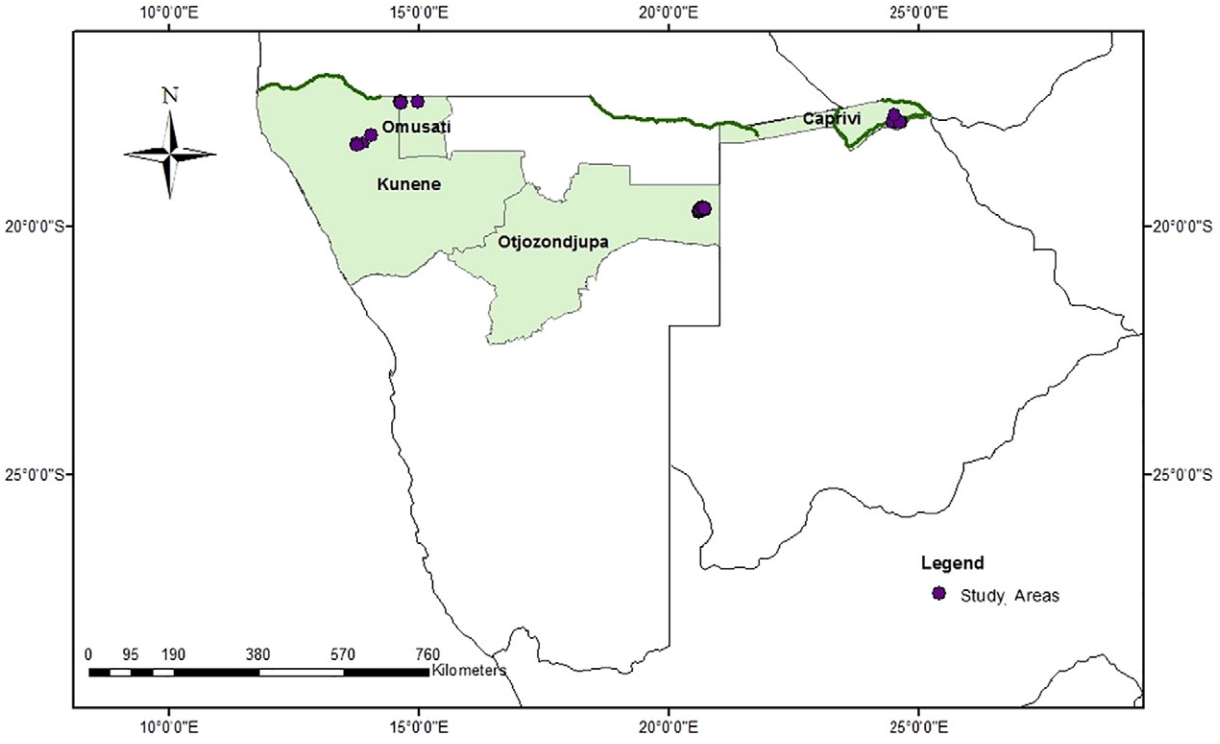

Fig. 1. Study areas in the different Regions in northern Namibia.

Table 1
Main features of the land and population demographic of the study areas.

Characteristic	Kunene Region	Omusati Region	Otjozondjupa Region	Zambezi Region
Landscape features	Rocky mountains, wildlife	Seasonal water bodies	Water pans	Rivers and associated flood plains, wildlife
Vegetation types	Mopane savanna	Mopane woodland	Savanna, woodland and forest	Savanna, woodland and forest
Livestock	Donkeys, cattle, goats and pigs	Donkeys, cattle, goats and pigs	Donkeys and cattle	Cattle and goats
Population density per km^2	0.8	9.2	4.6	6.2
Population in rural areas	75%	94%	71%	69%
Main language spoken (Study area)	OtjiHerero	Oshiwambo	Ju-Hoansi	Subiya
Employed %	77	58	63	38

(Mendelsohn et al., 2002; Namibia Statistical Agency, 2011).

initiatives have been developed for rural communities for management of natural resources. These include community forests and conservation areas. Community forests were established to give rights to local communities to utilize and manage forests and woodlands as per the Forest Act No 12 of 2001.

The Herero are predominantly livestock farmers and only a minimal number practice crop farming (Malan and Owen-Smith, 1974). The Ovambo people are heavily dependent on forest resources but crop and livestock farming are their major means of livelihood (Marsh and Seely, 1992). They are situated in areas that have become overgrazed and degraded with low species diversity (Mapaure and Ndeinoma, 2011). The San communities in North-east of the Otjozondjupa Region are hunter gatherers and well adapted to the harsh environmental conditions of the Kalahari (Botelle and Rohde, 1995). They are highly dependent on and knowledgeable in indigenous forest resources (Leffers, 2003). Historically, the San had a nomadic lifestyle (Botelle and Rohde, 1995). However, settlements have become permanent in recent years. According to Leffers (2003), hunting by the San is still permitted and regulated through a local conservancy (Nyae-Nyae Conservancy). The Masubiya are subsistence farmers with fishing as another major contributor to their livelihoods (Tvedten, 2002).

2.2. Research design and sampling

Initially, informal conversations were held with forestry staff and local conservancy officials about general use of baobab in their areas. Study sites for interviews on local uses were purposely selected in communities adjacent to areas where the population structure of baobab was studied (Lisao, 2016). The population structure of baobab was sampled from four baobab clusters in each of the four geographical regions in the north and north-eastern parts of the country. Human settlements closest to the selected baobab clusters sampled for population structure in each region, were identified. Then four respondents were randomly selected from the identified human settlements for interviews. Hence a total of 64 individuals were interviewed through a semi-structured questionnaire between February and May 2015.

The ethnobotanical procedures by Martin (1995) were applied to collect local knowledge in each region. Data collection was done with assistance of local forestry officers. The initial activity was to seek permission and communicate objectives to local headmen to conduct the study in different areas. Verbal consent was further obtained from each respondent and objectives of the study explained before proceeding with interviews. Life stages of baobabs were described to respondents as young (plants that were less than 5 m tall, normally without a well-developed crown), sub-adult (plants with developed crown but had not reached the fruiting stage) and adult (plants that had reached fruiting stage). Respondents were asked to rate the occurrence of the baobab in their surroundings as rare, occasional, common and abundant.

The information of respondents that were captured included: gender, source of income and age. Benefits of the baobab, parts of the baobab used, local traditional use, mode of preparation, folklore and perceived factors that impact on the baobab were captured.

2.3. Data analysis

Data was presented in tables and graphs. The Plant Part Value (PPV) of different parts of the baobab were expressed as percentages (Gomez-Beloz, 2002). The PPV was calculated using: $PPV = RU_{Plant\ part} / \Sigma RU$, where RU is the total number of reported uses for baobab and $RU_{Plant\ part}$ is the total number of reported uses for each baobab part. Majority of the data was descriptive and therefore explained directly.

3. Results

3.1. Socioeconomic characteristics of respondents

All respondents were from rural communities and directly dependent on the baobab for various uses. The socio-economic characteristics of respondents across the sampled regions are summarized in Table 2.

Table 2
Socio-demographic characteristics of respondents in different study areas.

Regions		Kunene	Omusati	Otjozondjupa	Zambezi
Total number of respondents		16	16	16	16
Respondent characteristics		Number of respondents by respondent characteristics (%)			
Gender	Female	75	70	62	80
	Male	25	30	38	20
Age (Years)	16–30	6	6	19	11
	31–50	31	38	31	23
	>50	63	56	50	66
Level of education	None	85	52	80	50
	Primary	13	38	19	44
	Secondary	2	10	1	6
Main source of income	Farming (subsistence)	70	44	6	65
	Business (non-farming)	2	25	5	5
	Grants (pension/ disability)	23	13	30	20
	Wages and salaries	0	6	4	5
	Other	5	12	55	5

Table 3
Uses of baobab by different ethnic groups in northern Namibia.

Baobab part	Ethnic group/uses			
	OvaHerero (Kunene)	Ovambo (Omusati)	San (Otjozondjupa)	Masubiya (Zambezi)
Flowers		Eaten by goats.		
Fruit	Fruit pulp eaten raw, mixed with water or milk to form a paste.	• Fruit pulp taken to halt stomach pain or diarrhea. • Fruit shell used as fuel for fire.		
Seeds		• Oil extracted for cosmetic use. • After crushing seeds for oil, the remaining hard shells are used as feed for chickens. They are also mixed in feed for goats and cattle. • Seeds are crafted into necklaces for children. • Seeds are soaked in water and taken as a remedy for cough and stomach pains.	• Roasted and crushed for use as coffee substitute. • Seeds are roasted and taken as a snack.	
Bark	• Bark is immersed in water for treatment of inflammation or swollen body. • Ropes from fiber used in construction of traditional houses. • A thread is made from the inner bark and tied around women belly after giving birth. The belt is passed from the mother from one generation to the next. It also serves as a sign to indicate that a woman has given birth.	• Harvested and fed to cattle, donkeys and goats during drought. • Bark is placed in milk for fermentation. • A concoction of bark and leaves taken for treatment of swollen ribs and knees • Bark is mixed with leaves in water and taken as a cure for stomach pain.	• Swollen feet or legs are dipped in a solution of bark in water as treatment.	• Bark harvested for making ropes that are used in making traditional mats. • Bark is soaked in water and new-born babies are washed in the solution for healthy babies. • Threads made from bark are tied around hands, legs and waist for healthy babies.
Leaves	Used together with bark for treatment of inflammation.	• Smoke from burnt leaves are used as insect repellent. • Used as feed for cattle, goats and donkeys.		• Leaves may be mixed with bark for bathing babies for general health.
Roots	• Roots are boiled in water and taken as a cough remedy.	• Exposed roots are chopped and used as fuel for fire.		• Roots are boiled in water and taken as a cough remedy.
Entire plant		• Rotten fibrous material from dead trees is used as fertilizer. • Carries historical importance - local people used to hide from the enemies in the hollow stems of baobabs during the war. • Used as shade for human and livestock.	• Tourism attraction due to the unique and massive structure.	• Useful as a shade tree for humans and livestock.

The majority of the respondents were female and above 50 years with the youngest age group (16–30 years) making up the smallest proportion in all regions. The majority of respondents had no formal education. They were mainly unemployed and survive on subsistence farming (46%), non-farming businesses (9%), government grants (22%), wages and salaries (4%) or depend on other activities such as fishing and hunting (19%).

3.2. Traditional uses of *A. digitata*

The uses of baobab by different ethnic groups are summarized in Table 3. All parts of the baobab were recorded as useful. In all regions the reported benefits derived from baobab were food, medicine, fiber, fodder, materials for crafts, esthetic, and spiritual. It was recorded as a source of fodder only in Omusati region. Respondents admitted to

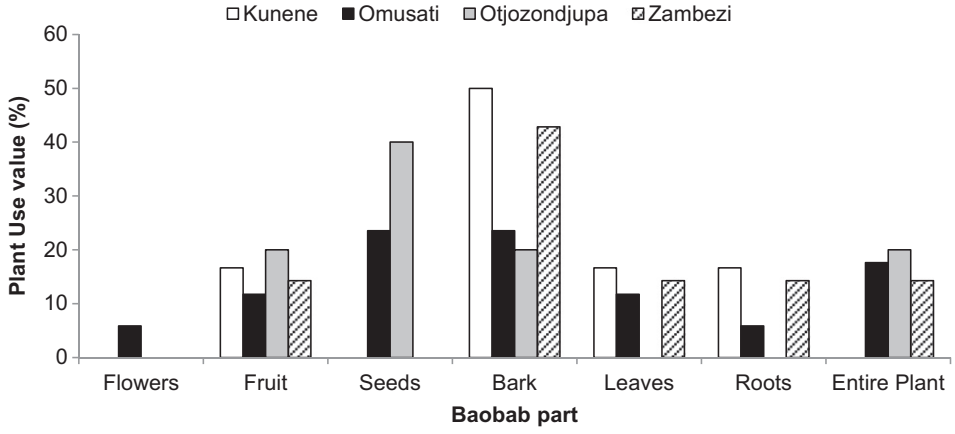

Fig. 2. Plant part use value per region.

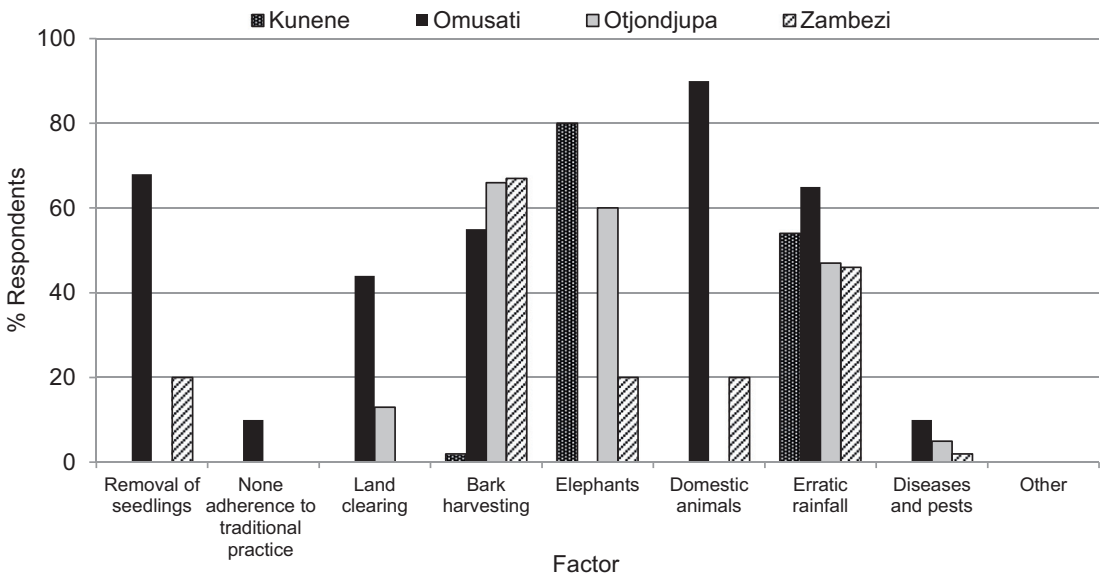

Fig. 3. Factors that negatively impact on baobab population status.

using the baobab as shade (an environmental service) in Kunene, Omusati and Zambezi Regions.

Hollow baobabs were particularly significant to the Owambo communities due to their historic importance. They were used as hiding places during the fight for liberation and declaration of some baobab trees as heritage sites proves their importance in that regard (National Heritage Council of Namibia, 2010). There is a belief that, because of the succulent trunk, bullets cannot penetrate the stem. Baobab has a wider range of uses in Omusati region in comparison to other regions, with 58% of the uses being unique to the Owambo communities. The mode of preparation was simple and required mixing of different parts in some cases. Roots were used as a source of medicine mainly in Otjozondjupa and Zambezi regions. After harvesting the roots, the soil is normally covered back and is not supposed to be noticed as harvested by other people; supposedly in the belief that the medicine may not work. In Omusati region, the majority of trees had roots that were exposed above soil level due to soil erosion caused by frequent floods. These were observed to be cut and used as firewood.

3.3. Use value of different parts of the baobab

The use value of different parts of the baobab in each region is presented in Fig. 2. The bark is the most important part (PPV = 34%), followed by both fruit and seed (PPV = 16%), leaves (PPV = 11%), roots (PPV = 9%), entire plant (PPV = 13%) and flowers (PPV = 1%).

3.4. Perceptions on baobab population structure and conservation

All respondents had knowledge about the occurrence and population structure of baobab in their surroundings. The respondents admitted to the scarcity of young baobabs in their surroundings. Various threats were identified as causal factors for low numbers of seedlings (Fig. 3). Factors that were mentioned across all ethnic groups are bark harvesting and erratic rainfall. A higher percentage of respondents in all regions considered baobab in the sub-adult category to be abundant. It was perceived highest in Omusati region (80%) followed by Otjozondjupa region (70%). The baobabs in the adult category was also considered abundant in the Kunene (65%), Omusati (72%) and Otjozondjupa (65%) but commonly perceived as occasional in Zambezi region (80%). Though respondents indicated a scarcity of young baobabs; when asked if they propagate baobabs, all respondents admitted to have not actively planted baobab. The reasons for not propagating were because of its slow growth (all regions), difficult to propagate (all regions) or do not have space for the large baobab (Omusati region). Seedlings are uprooted when undesired, however, it is a taboo to destroy adult baobab trees among the Herero, Owambo and Masubiya communities due to its cultural uses (Fig. A.1).

4. Discussion

4.1. Traditional uses of A. digitata

Traditional knowledge on the baobab is passed from older generations in families to younger members of the family. However, passing information to people outside the family required trust. All respondents, regardless of their age, education or economic status, regarded baobab as an important plant with valuable traditional uses, indicating the significance of baobab in areas where it occurs. It is mainly used as a food source to rural communities, enhancing their diets. Munyebvu (2015) also observed that food use of baobab was the highest ranked benefit by the Ovambo people. This is consistent with information from plant use compilations by Le Roux (1971) (Ovambo, Kavango, Mbukushu) and Rodin (1985) (Ovambo), who indicated baobab fruit as commonly used for food. Harvesting of fruit may negatively impact the population structure when seeds are destroyed or when fruits are harvested prematurely or dispersed to areas where baobab may fail to establish (Venter and Witkowski, 2011). This may eventually result in low recruitment. Considering that there is no formal trade in baobab fruits, the current use of fruits may be sustainable in Zambezi and Kunene regions where seed uses were not recorded. However, where seeds are destroyed for use as craft (Omusati Region) and 'coffee beans' (Otjozondjupa region), there are seeds left for natural regeneration. This unsustainable practice may be a contributing

factor to the lack of regeneration as observed by Lisao (2016) in Omusati and Otjozondjupa Regions. Though there were no records of human consumption of baobab leaves in all regions, the Vitamin A and C in the leaves may enhance the diets of rural communities if promoted as food (Chadare et al., 2009). Additionally, baobab leaves contain up to 15% protein, 70% carbohydrate, 10% fat, 11% fiber and 16% ash and a range of minerals (De Caluwe et al., 2009).

Medicinal uses of baobab were recorded from all ethnic groups. However, certain medicinal remedies and spiritual uses were not shared to the researcher. The pulp and extracts of leaves, stem bark, and roots were used as medicine. Venter (2012) cautioned that the use of leaves and bark may be more destructive than the use of fruits. In this case though, medicinal use of baobab leaves in all regions only requires a handful of leaves and therefore may not be a concern. *A. digitata* is used to treat cough in Kunene, Omusati and Zambezi regions, conforming to the uses observed by Munyebvu (2015) among the Owambo communities. The use to treat inflammation was recorded across all ethnic groups except the Masubiya community.

Use of baobab leaves and bark for fodder in Omusati region has significant benefits to farmers; whereby the health of livestock is sustained during drought spells. However, it is a concern for the baobab population in Omusati where the debarking of the stem is done during times of drought. Though baobabs can withstand severe drought, a combination of drought and damage to bark may be detrimental and damaged trees become susceptible to diseases (Cuni Sanchez et al., 2010; Stucker and Lopez-Gunn, 2015). In order to relieve pressure of harvesting from baobabs in Omusati region, farmers need to plant alternative fodder species to meet the demand for livestock feed.

Baobab is embedded in the cultures of the Herero, Owambo, San and Masubiya communities and regarded as a spiritually important tree. There was secrecy in revealing spiritual uses of baobab by most respondents. However, baobab is regarded as a superstitious tree and locals may therefore offer protection in order to preserve their heritage. The role that the *A. digitata* tree plays with regards to spiritual healing of diseases is vital because the benefits cannot be obtained from any other species. The baobab is revered for its spiritual presence by rural communities in Africa (Sidibe and Williams, 2002; Venter, 2012).

Use of baobab as oil is restricted to the Ovambo people. However, the tedious process of extracting *A. digitata* oil traditionally may be the reason why the practice is reportedly dying. Locals are rather extracting oil from *Sclerocarya birrea* which is easier to extract in comparison to *A. digitata* for oil. However, the extraction of oil using an oil processing machine, as observed in Omusati region, may revive the interest in local baobab oil. Since the machine was acquired, the price for *A. digitata* fruits has risen in areas around Onesi and Outapi. The increased demand may in turn motivate individuals to nurture *A. digitata* seedlings for future monetary benefits. However, extraction of baobab at a commercial scale may not be sustainable for the limited populations of *A. digitata* in Namibia. Therefore, planting of *A. digitata* may be required to sustain and maintain the market.

Use of synthetic alternatives, such as ropes, therefore relieves pressure of harvesting fiber from the *A. digitata* plants. However, the baobab bark is extensively used as a source of medicine in Zambezi Region. Regardless of the use as medicine, baobab bark is resilient and easily recovers from harvesting (Romero et al., 2001).

4.2. Use value of different parts of the baobab

Though the food use was the most common benefit of baobab, the PPV showed that the bark had more uses mainly due to its medicinal properties (Fig. 2). The PPV was lowest for flowers because they were not regarded as useful in areas where there is abundant fodder, except in Omusati Region where fodder alternatives are limited. The high use PPV of fruit in Omusati is as a result of a combination of uses, including use as firewood due to the lack of fuelwood. This practice was not observed in other regions. Leaves and roots are also important sources of medicine and therefore the PPV were relatively high.

4.3. Management of indigenous knowledge

The valuable information on baobab is passed by word of mouth. Documenting of such information is vital not only for this species but for all other useful plants in Namibia. Manda (2007) recommends scaling up of the education curricula to include fields that would promote indigenous knowledge values and conservation of biodiversity among the younger generations. Respondents admitted to a reduction in the use of baobab e.g. use of fiber due to modernization. Gomez-Beloz (2002) contends that information might be lost as it is not documented and the interactions with the natural environment is dying for younger generations to learn through observations.

5. Conclusion

It is evident from the results that local communities have a role in shaping the population structure of baobab. They contribute to the lack of regeneration observed and maintain older populations by protecting mature trees. Due to the interaction of local communities and baobabs, management of baobab resources need to involve local people. Furthermore, mitigation factors for natural disasters need to be developed to sustain baobab populations. Regardless of a variety of factors raised that negatively affect baobab populations, there are no proactive measures taken by locals to remedy the situation. Therefore, production of baobab plants through planting is recommended for conservation and promotion of sustainable use of baobab resources. For example, the practice of covering exposed roots after harvesting bark from roots is important for the recovery process of the excavated roots. However, the observed case of deliberate damage of *A. digitata* roots as well as harvesting roots for use as firewood, can be destructive and does not conform to traditional taboos in African communities. Traditional authorities as trusted leaders can promote and influence sustainable use of baobab resources.

The priority area for conservation of baobab are Omusati and Otjozondjupa Regions due to exposure to high numbers of negative factors as well as severe lack of regeneration. Based on the current findings, it cannot be concluded that the baobab is over harvested since most plant parts are used for medicine and these are required in small amounts and therefore the tree can easily recover from such damage, except for destructive uses of seeds.

Conflict of interest

The authors have declared that there is no conflict of interest.

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Appendix A. Appendix

Fig. A.1. An adult baobab tree in a cleared crop field in the Zambezi Region. The baobab is protected by local norms and forest regulations due to the benefits that it offers to local people.

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