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Fruits of our labour: contribution of commercial baobab (*Adansonia digitata* L.) fruit harvesting to the livelihoods of marginalized people in northern Venda, South Africa

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Abstract Baobabs (*Adansonia digitata*) provide products, mainly bark, leaves and fruit, which are used for subsistence purposes and traded to generate cash. Recently, demands for baobab fruit derivatives on the global organic market, namely pulp and seed oil, have increased rapidly, leading to concerns that this may have negative impacts on subsistence users, particularly in areas where there is an existing high dependence on these products, such as West Africa. In contrast, in southern Africa baobab fruit are probably 'underutilized' and commercialization would help reduce poverty. This study evaluated the direct-use (subsistence) and income (cash) value of baobab fruit on the livelihoods of baobab fruit harvesters in South Africa. Harvesters were mostly women (98 %), many of whom were unemployed (98 %) and uneducated (70 %). The majority (68 %) received social grants and were involved in informal occupations (55 %), which contributed 35 and 18 % to total annual income respectively. The trade and direct-use value of non-timber forest products contributed 14 and 33 % to annual income, of which, baobab fruit made up 38 and 4 % respectively. Baobab fruit was the only non-timber forest product that had a higher income value (4×) than direct-use value. Cash earned was used to buy food (73 %) and invest in small businesses, suggesting a move from subsistence to cash economy. It is suggested that commercialization of baobab fruit will have far-reaching benefits; and that secured access to trees and investment in local beneficiation will further increase the value of the resource for many marginalized people in southern Africa.

Keywords Subsistence use · Non-timber forest products (NTFP) · Women · Venda

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Introduction

Many marginalized and poor communities around the world rely on non-timber forest products (NTFPs) for their survival (Shackleton and Gumbo 2010). NTFPs refer to any wild biological resource harvested by rural households for domestic consumption or trade (Shackleton et al. 2007). NTFPs are important for health, food, nutrition, religion, shelter and energy and through their economic contribution provide a safety-net when other sources of income fail to meet household needs (Dovie et al. 2002; Shackleton et al. 2002).

Rural livelihoods are often supported by diverse income streams. These include, among others, income from employment, grants, trade and NTFPs. The

income contribution of NTFPs includes cash derived from sales of these products and their value through direct- or subsistence use. Valuation techniques create a monetary value for direct-use products which allow comparisons to be made between income streams (Clarke and Grundy 2004). In this way the contribution of NTFPs to total livelihood can be evaluated (Dovie et al. 2002). The cash value and direct-use value of NTFPs has been calculated to be worth several hundred dollars per annum per household (Dovie et al. 2005; Shackleton and Gumbo 2010).

Increasingly, rural dwellers are selling products that were previously used for subsistence purposes (Dovie et al. 2005). This change is driven at a local level by a greater need for cash as people become more integrated into a market economy and face economic hardship and unemployment (Belcher et al. 2005). Generally, returns from the sale of NTFPs are modest, but the low entry barriers to trade means that they provide an important option for poor and marginalized people with minimal education and skills (Shackleton and Gumbo 2010).

Baobabs (*Adansonia digitata*) provide a number of NTFPs that are used for subsistence and are also sold to generate income. All parts of the plant are used, with over 300 uses of baobab products recorded (Buchmann et al. 2010). In particular, the composition and nutritional value of the bark, leaves, fruit pulp and seeds make it an important tree for subsistence as well as commercial use (Gruenwald and Galizia 2005; Chadare et al. 2009). The bark is high in fibre and is used for making ropes and weaving while the leaves are eaten as spinach or used in relishes. The fruit contains two distinct products, the seed and the surrounding pulp. The seed is pressed to yield an oil used in cosmetic formulations while traditionally it is eaten roasted and pounded. The tart fruit pulp, a dry powder that surrounds the seed, is also used as a food ingredient (Sidibe and Williams 2002).

In southern Africa baobab fruit are considered to be relatively underutilized, and by commercializing this resource a significant contribution could be made to alleviating poverty in rural areas (Gruenwald and Galizia 2005). Over the last decade, locally-based companies have started to buy the seed and fruit of a number of tree species from rural communities in Botswana, Malawi, Mozambique, Namibia, South Africa and Zimbabwe. The demand for baobab fruit is driven by cosmetics and food companies, locally and internationally lobbying to increase the value and market share of its products, and to get better returns for producers, which has taken many years (Welford and Le Breton 2008). Baobab oil has been sold in European and US markets for some time: in 2008 the European Union approved baobab fruit pulp as a novel food ingredient (Vassiliou 2008), and in 2009, the Food and Drug Administration in the United States of America (USA), gave approval for importation (Tarantino 2009).

Despite the potential benefits associated with the commercialization of baobab products, it is feared that this commercialization of the resource on the global market may have serious consequences on the subsistence use of baobab products, particularly in West Africa where there is heavy dependence on leaves and fruit for daily nutrition and income (Buchmann et al. 2010). There is thus a need to also determine its value (income and subsistence) and to describe positive and negative effects of commercialization of the fruit on local people. This study evaluates the direct use-value (subsistence) and cash-value of baobab fruit in a rural community in South Africa, and compares this to other income streams received by harvesters. It describes the socio-economic background of the harvesters involved in collecting baobab fruit and their perceptions of the ecology and management of the resource. Based on these findings, the implications of commercializing baobab fruit are discussed and recommendations regarding sustainable and equitable commercialization are made. In this study the following key questions were posed:

1. Who are the baobab harvesters in terms of gender, age and education relative to the rest of the population in the area?
2. What is the cash value of income from baobab fruit compared with other NTFPs and how does this compare to income from social grants and employment?
3. What is the direct use-value of baobab fruit compared with other NTFPs?
4. What are the implications of the commercialization of baobab fruit?
5. What are the harvesters' perceptions regarding the ecology and management of baobab trees, and how do they compare with the results of ecological studies?

Materials and methods

Study area

The study area falls in the Mutale District Municipality, also known as northern Venda, a remote rural area of Limpopo Province. Limpopo Province is one of the poorest provinces in South Africa (Limpopo-Provincial-Government 2009). The area centres on 22°50′S and 30°45′E, with Zimbabwe to the north, Botswana to the west and the Kruger National Park (KNP) to the east (Fig. 1). The area falls within the Savanna Biome and more specifically within the Mopane and Lowveld Ecoregions (Mucina and Rutherford 2006).

The population in Mutale District Municipality is just over 100,000 people, of which 59 % are women. Of these, 86 % are unemployed and 6 % receive state pensions (Fig. 2). Education levels are low, with 33 % of women and 14 % of men having never been to school Statistics SA Census 2001 (unpublished data). The study area is semi-arid, receiving from 334 to 423 mm annual rainfall with a high coefficient of variation (CV = 25–40 %) (Schulze 1997), thus attempts at subsistence agriculture result in very

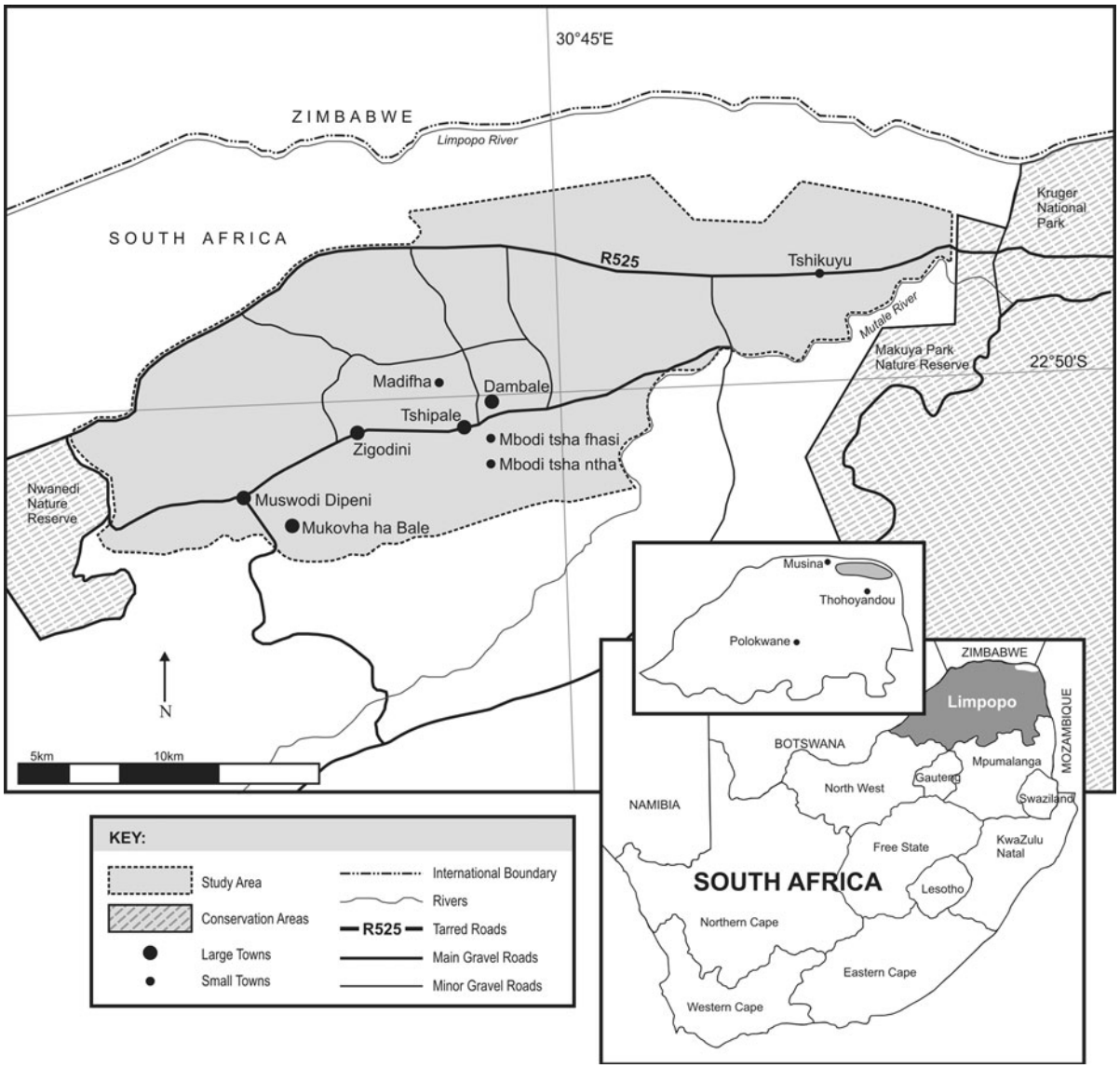

Fig. 1 Map indicating location of villages in the study area

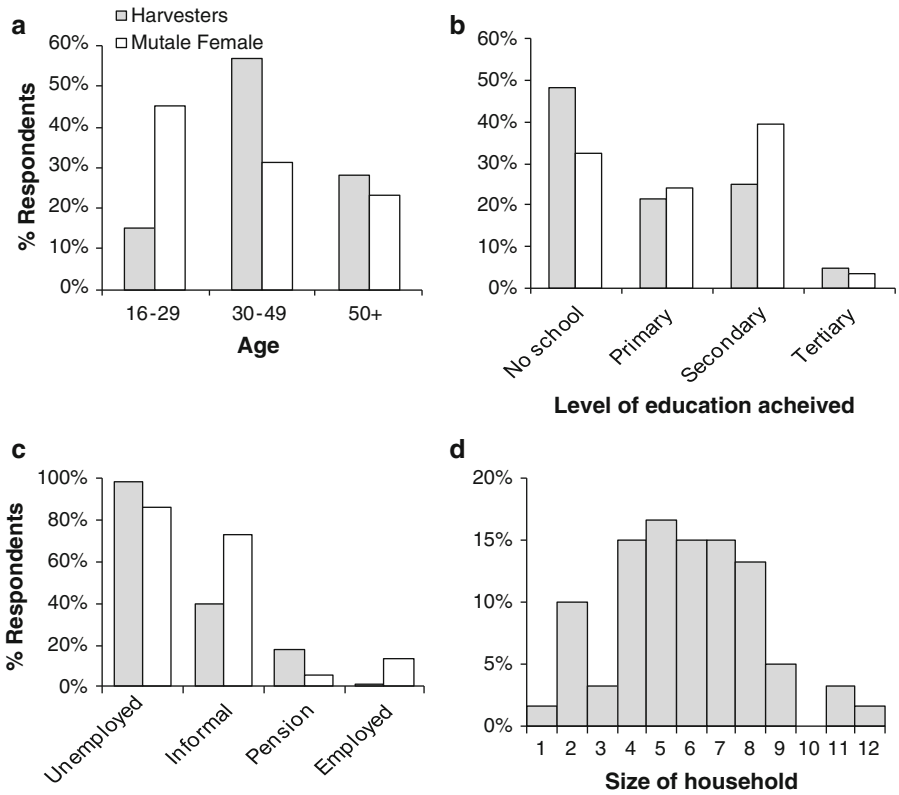

Fig. 2 Percentage of respondents ($n = 60$) and females in the Mutale municipal area of different age classes (**a**), levels of education (**b**) and income streams (**c**), plus the percentage of respondents with household sizes that range from 1 to 12 people (**d**)

inconsistent and at best, low yields. Furthermore, livestock overstocking has led to widespread overgrazing and general degradation of the environment (pers. obs.). There are few industries in the area, thus job opportunities are extremely limited.

The people of this region are part of the BaVenda ethnic group (Stayt 1931). The region comprises a series of villages, each with its own traditional leader, who form part of a larger traditional hierarchy with democratically-elected representatives known as 'civics' sharing leadership responsibilities. There are no banks or national supermarket chains in the area and 'spazas' or 'supas' are the small local shops and stores where groceries and implements are purchased. Informal saving and credit associations, such as burial societies known locally as 'stokvels', are a means of facilitating savings amongst women (Bouman 1995). The South African government pays 'pensions' to people of >60 years and 'child grants' to the guardians of children <16 years. These are non-contributory grants to unemployed South Africans, who qualify for pensions on the basis of age or for child grants if they have young children.

Initiated by a locally based company, the commercial harvesting of baobab fruit began in 2006 and by 2010 over 1,500 harvesters where involved. Cleaned seed was collected and cold-pressed with a screw press to extract the seed oil. The oil was sold as an ingredient to the cosmetics market in South Africa, Europe and the USA.

Study species

Baobabs (*A. digitata* L.; Malvaceae, subfamily Bombacoideacea) occur widely across Africa and are found in most countries south of the Sahara (Sidibe and Williams 2002). Baobabs are associated with savanna vegetation and have a wide tolerance to variations in rainfall, temperature and altitude, but are generally found in drier, low-altitude plant communities receiving between 200 and 800 mm of rainfall annually (Wickens 1982). The population density of baobabs in

the study area varies between land-use types, with human-modified landscapes having higher baobab tree densities (1.65 ± 0.36 plants/ha) than natural landscapes (0.90 ± 0.17 plants/ha) (Venter and Witkowski 2011b).

Baobabs are deciduous, bearing leaves and flowers in the wet season. Flowering lasts 4–6 weeks with a few flowers opening every night (Baum 1995). The fruit takes up to 6 months to mature and is usually ready for harvest at the peak of the dry season (Sidibe and Williams 2002). Fruit production averages 77 ± 14 (SE) fruit per tree with wide variation between years, land-use types and individual trees (Venter and Witkowski 2011a). The fruit is a hard indehiscent capsule, containing a dry powdery pulp and 24–194, highly viable (>89 %) seeds, which form persistent seed banks (Venter and Witkowski, in review). However, many populations show a positively skewed size-class distribution with poor natural regeneration, which appears to be severely hampered by poor rainfall and domestic livestock browsing (Venter and Witkowski 2010). In South Africa baobabs are listed as a protected species by the National Forest Act (DWAF 1998) and by provincial regulation (LEDET 2004).

Methods

There were approximately 400 harvesters who regularly harvest baobab fruit in the study area (S.M. Venter, unpublished data). Sixty, of these harvesters, were randomly selected, to be interviewed. Interviews were conducted from June to September 2009, in nine villages across the collection area (Fig. 1). Two questionnaires were used, both covering five topics, the first in more detail and which took more than an hour to complete per interviewee. The second was shorter and quicker and allowed more than one person to be interviewed per hour. Thirty interviews were conducted using each type of questionnaire (30 + 30 = 60). Both questionnaires were vetted and approved by the University of the Witwatersrand Human Research Ethics Committee (H0 90302). The topics covered were: (1) respondent information and income, (2) household information, (3) NTFP use and income, (4) baobab product use, and (5) baobab ecology and management. The first questionnaire, covered all the topics listed above, collecting detailed information on income derived from NTFPs and baobab products. The second questionnaire covered broader perceptions of baobab use and management. Income values were recorded in South African Rands and converted to United States Dollars (USD) at the prevailing exchange rate of USD1 = ZAR7.19.

Analysis and interpretation was done by categorizing the data by village type (large versus small); respondent age (16–29, 30–49 and 50+ years), income stream (social grant, informal, NTFP income-value, NTFP use-value), NTFP type and baobab product type. ‘Large’ villages had facilities such as shops, petroleum stations, clinics and schools. ‘Small’ villages were more remote and lacked these facilities. ‘Social grants’ refer to pension and child grants. ‘Informal’ income refers to income from part-time, non-skilled work and the vending of various goods as opposed to ‘formal’ income from full-time employment. ‘NTFP income’ refers to respondents who earn an income from collecting and selling NTFPs. In this context distinctions were made between income from baobab products in general (bark, fruit) and income from the sale of baobab seed for commercial purposes.

Following Dovie et al. (2002), the monetary value (direct-use value) of NTFPs was calculated. Locally quoted prices for each product were based on quantities such as a 250 ml cup, a litre bottle, head-load or pickup vehicle load, whichever was appropriate. This value was multiplied by the general frequency of use (or collection) of that portion over the course of the year and by the number of respondents using the product. Depreciation was not included in the calculation because it only applied to two products (poles and thatch), the majority were food products which were used quickly. The following formula was used:

$$\begin{aligned}\text{Annual use-value} = {} & \text{sale value/portion} \\ & \times \text{frequency of use/year} \\ & \times \text{number of users.}\end{aligned}$$

T tests, Mann–Whitney *U* tests, Wilcoxon matched pairs test and Fishers exact tests were used to compare differences between village types, between NTFP income and baobab seed income and between grouped income streams. ANOVA followed by Fishers least significant difference (LSD), Kruskal–Wallis tests and Pearson χ^2 tests were used to compare differences between age groups and income streams. Regression analysis determined if there was a relationship between baobab seed income and other NTFP income. Only one respondent was male, therefore analysis by gender was not done.

Results

Demographics of baobab fruit harvesters

Harvesters tended to be unemployed women, mostly aged between 30 and 49, with little or no schooling and with household sizes that varied between 1 and 12 people (Fig. 2). Many respondents were involved in the informal sector, working as labourers (20 %) and vendors (35 %) (Fig. 2). Social grants were received by 68 % of respondents either in the form of pensions (18 %) or child grants (50 %) (Fig. 2).

Income from social grants and employment

There was no significant difference in annual income between social grants and informal income ($t = 1.69$, df = 34, $p = 0.1004$), each making a 35 and 18 % contribution to total income respectively (Fig. 3). The average social grant income in small villages was significantly higher than in large villages (Table 1), due to proportionally more elderly people receiving higher pensions as opposed to child grants in small villages (55 and 25 % respectively). In contrast, respondents in large villages tended to earn more from informal income than respondents in small villages, probably because of increased opportunities. Respondents >50 years of age received a significantly higher income from social grants than the 'middle-aged' (30–49 years) and 'young' (16–29 years) (Table 2). This is expected, as pensions are higher than child grants. Middle-aged respondents tended to earn more from informal income than young and elderly respondents (Table 2).

Income-value of NTFPs

The average annual income from the sale of NTFPs (including baobab seed) was significantly lower than

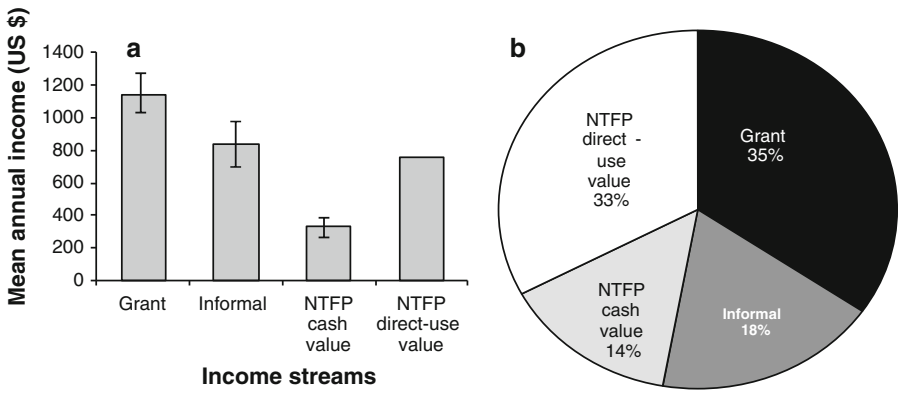

Fig. 3 Annual income (mean ± SE) and direct-use value received by harvesters that have social grants, informal income (traders and vendors), who sell NTFPs and who use NTFP (**a**). Proportional contribution of each income stream to all harvesters (**b**)

Table 1 Comparison of income streams between small and large villages

	Annual income (US$)				Fishers exact test	Mann–Whitney *U* test	
Village sizes:	Small villages		Large villages				
Income stream	Mean ± SE	*n*	Mean ± SE	*n*	*p*	*Z*	*p*
Grant income	1292 ± 123	17	829 ± 95	24	0.4803	2.7891	0.0062*
Informal income	596 ± 95	7	916 ± 133	21	0.0246*	0.8895	0.373
NTFP income	312 ± 133	9	252 ± 64	15	0.2035	−1.0257	0.305
Baobab income	167 ± 26	13	108 ± 10	17	–	1.668	0.0953
Total income	1656 ± 211	13	1521 ± 228	17	–	0.4813	0.6301

Fisher's exact test indicates differences between the numbers of people involved in each income stream between villages. Mann–Whitney *U* test indicates differences in the amount earned from each income stream between villages

* $p < 0.05$ refers significant difference value

Table 2 Comparison of income streams between age groups

Age groups:	Annual income (US$)				Annual Income (US$)				Kruskal–Wallis	
	Age 16–29 years		Age 30–59 years		Age 50 + years		Pearsons χ^2			
Income stream	Mean ± SE	*n*	Mean ± SE	*n*	Mean ± SE	*n*	χ^2	*p*	*H*	*p*
Grant income	787 ± 96	7	787 ± 81	21	1,525 ± 142	13	1.5691	0.4563	14.8648	0.0006*
Informal income	431 ± 97	6	1,024 ± 151	17	684 ± 93	5	3.6318	0.1627	6.4791	0.0392*
NTFP income	443 ± 201	6	233 ± 59	14	267 ± 49	4	6.3095	0.0427*	1.2906	0.5245
Baobab income	81 ± 12	7	154 ± 22	15	139 ± 23	8	–	–	5.3037	0.0705
Total income	1,361 ± 245	7	1,482 ± 257	15	1,954 ± 241	8	–	–	3.1842	0.2035

Pearsons χ^2 indicates differences between the number of people involved in each income stream between age groups. Kruskal–Wallis test indicates differences in the amount earned from each income stream between age groups A

* $p < 0.05$ refers significant difference value

from social grants ($t = 7.2742$, df $= 49$, $p < 0.0001$) and informal work ($t = 4.0381$, df $= 43$, $p = 0.0002$) (Fig. 3). The overall cash contribution made by NTFP sales was 14 % of total annual income, far less than social grants but close to the contribution from informal income (Fig. 3). There was no significant difference in income from NTFPs between income groups ($H = 2.56$, $p = 0.4643$) (Fig. 4). The highest proportion (43 %) of NTFPs sales were to outside traders. Otherwise 33 % sold NTFPs to people from the same village and 20 % to neighbouring villages. A significantly lower proportion (7 %) of respondents were traders themselves (i.e. travelling to towns or cities outside the area to sell products) versus those who sold locally or to traders who came from outside ($\chi^2 = 13.38$, df $= 3$, $p = 0.0039$). A similar proportion of respondents were involved in selling NTFPs in small and large villages and the income earned from the sale of these products tended to be higher in small than large villages (Table 1). A significantly higher proportion of respondents aged 30–49 years were involved in selling NTFPs (excluding baobab seed) than younger and older respondents (Table 2), yet younger respondents tended to earn more than older age groups (Table 2).

Due to the differences in cash value and proportion of people involved in the sale of NTFPs, the proportional contribution made to total income differed between products (Fig. 5).

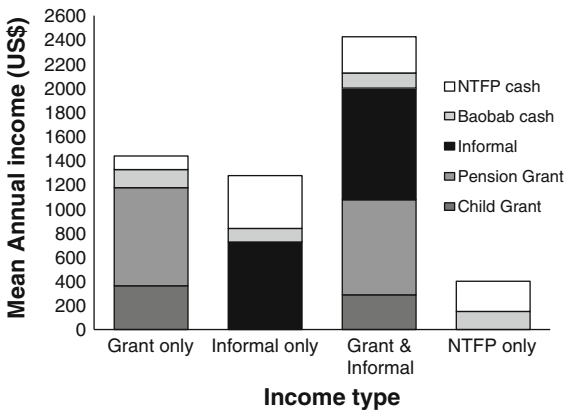

Fig. 4 Income [grant income, informal income, NTFP cash income (excluding baobab seed) and cash income from baobab seed] by income type (those receiving annual grants only, involved in informal employment only, those receiving both grants and informal income and those that have neither grants nor informal income and thus depend on NTFP for their cash income)

Income-value of baobab products

Income from 'other' baobab products (mats, ropes, snuff holders and whole fruit), were sold by 16 % of respondents and earned significantly less than from commercial 'baobab seed' sales ($t = -2.09$, df $= 33$, $p = 0.0447$) (Fig. 5). The mean annual income from baobab seed (USD136 ± 14) was not significantly different to the combined mean annual income from other NTFPs (USD220 ± 54) [$T = 190.50$, $Z = 0.5838$, $p = 0.5593$ (Wilcoxon matched pairs test)] (Fig. 5), and made up 38 % of total NTFP cash income (Fig. 6). No significant relationship was found between baobab seed and NTFP income ($p = 0.3260$, $R^2 = 0.0340$), indicating that concentrating on baobab seed did not result in a lower (or higher) income than from other NTFPs. Respondents in small villages tended to earn

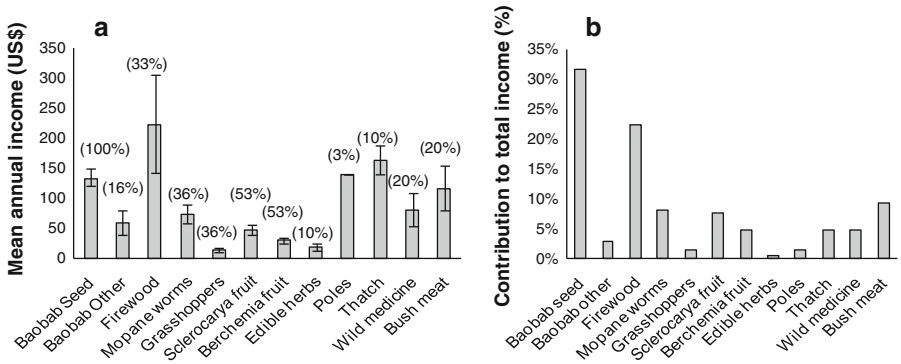

Fig. 5 Annual cash income (mean ± SE) from NTFPs and percentage (%) of respondents who sell these products in *brackets* above *each bar* (**a**). The proportion of total cash income received from the sales of NTFPs across all respondents ($n = 30$) (**b**)

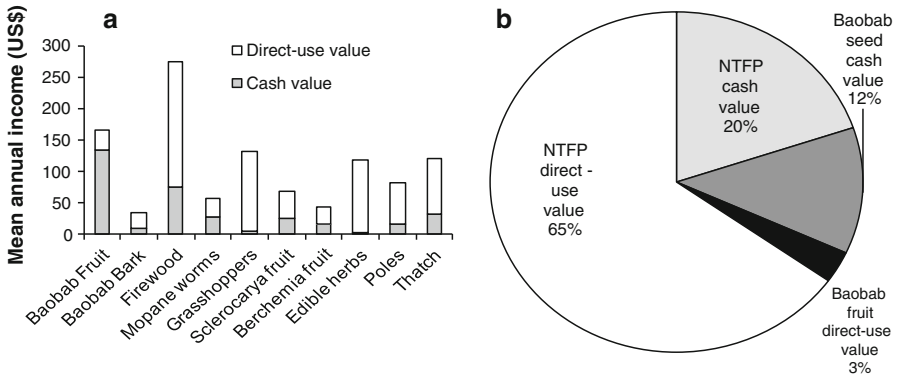

Fig. 6 Cash value and direct-use value of NTFPs (**a**). The proportional cash value and direct-use value of NTFPs and baobab seed and fruit (**b**)

more from the sale of baobab seed than respondents in large villages (Table 1) and middle aged and elderly respondents tended to earn more from the sale of baobab seed than young respondents (Table 2). There was no significant difference in income from baobab seed between respondents of different income types (Fig. 4) ($F_{(3,26)} = 0.28, p = 0.8385$).

Cash earned from the sale of baobab seed was used to buy a variety of goods in particular food (Fig. 7). Cash was spent by respondents in their village (45 %), neighbouring villages (40 %) and the large towns Thohoyandou and Musina (25 %) (Fig. 1).

Direct-use value of NTFPs

Annual direct-use value of all NTFPs was substantially higher than from the sale of these products (Fig. 6), contributing 33 % to total annual income (Fig. 3). Except for baobab fruit, all NTFPs had higher direct-use values than income values (Fig. 6). The 'importance' of these products was determined by a combination of their frequency of use (subsistence value) and cash value (Fig. 8). A few respondents considered some NTFPs as 'not important', particularly those who did not sell or use the products. For

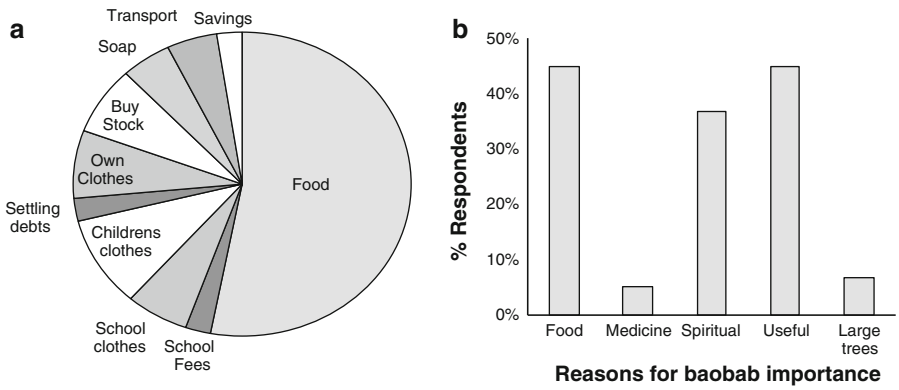

Fig. 7 Uses of cash from the baobab seed sales (**a**) and the importance of baobab trees (**b**) reflected in the percentage of respondents

example 10 % of respondents rated both mopane worms [phase of the mopane emperor moth *Imbrasia belina* (Kozanayi and Frost 2002)] and marula [*Sclerocarya birrea* subspecies *caffra* (Helm et al. 2011)] as 'not important' because it was forbidden by the church to eat worms or drink alcohol made from marula fruit. Poles and thatch were rated as 'not important' because traditional houses were being replaced with 'modern' houses made of corrugated iron roofs. Furthermore 70 % of respondents said that wild medicine was 'not important' because they went to government clinics (Fig. 8). These are interesting responses that possibly reflect a change in culture and economy.

Direct-use value of baobab products

Due to its commercial value, baobab fruit was the only NTFP that had a cash value higher than its direct-use value (Fig. 6), and indeed it was four times higher. The direct-use value formed 4 % of the total direct-use value of other NTFPs. All respondents said that baobab fruit was important both in the past and in the present (Fig. 9). Income generated, from the sale of seed, was important as a source of cash for all respondents and 22 % added that it helped alleviate poverty in the community. Its use as a food item was reported by 73 % of respondents. Fruit pulp could be mixed with milk to make 'yoghurt', with water to make ice lollies or added to porridge to give it a sour taste. The outer husk of the fruit was carved by 17 % of respondents to make a snuff holder. It was used by 7 % of respondents as kindling and 13 % burned the husk to make 'soda' which is added to spinach giving it a slimy texture.

The majority of respondents collected fruit from the extensive plains, rocky outcrops and crop fields in the communal rangelands, and significantly fewer obtained them from trees within the village ($\chi^2 = 47.95$, df = 3, $p < 0.0001$) (Fig. 9). Those that did collect fruit in villages tended to collect them from their own home trees rather than from general village trees (Fig. 9). All said that fruit was collected from under trees, and 3 % also threw sticks to dislodge fruit from trees. Most (90 %) respondents walked to collect fruit and far fewer (10 %) also used donkey carts, hired at R60 per day, to help transport the fruit back to villages.

All respondents said that baobab bark was an important product in the past, but 57 % felt that bark was no longer important because it had been replaced by nylon rope (Fig. 9). Seventeen percent of respondents used baobab bark rope for roof construction, 20 % for bundling firewood, tying domestic animals, making whips, weaving baskets and mats and the ends of palm-frond brooms. Three percent said that babies were bathed with a bark infusion to give them strength. All respondents who collected bark said that it was harvested from juvenile trees which have stronger fibres than adult trees. The cash value of baobab bark was lower than its direct-use value and most other NTFPs (Fig. 6).

Baobab leaves were not considered important (Fig. 9) as only 6 % of respondents ate young leaves and 40 % used the leaves as fodder for livestock in times of drought. No respondents collected baobab leaves to sell.

Concerning baobab seedlings, 23 % of respondents said that they could be eaten (Fig. 9), but that they were not an important product. Thirteen percent said children eat seedlings and two respondents (out of thirty) said they ate seedlings when they were thirsty, but very rarely.

No other baobab products were mentioned in the interviews.

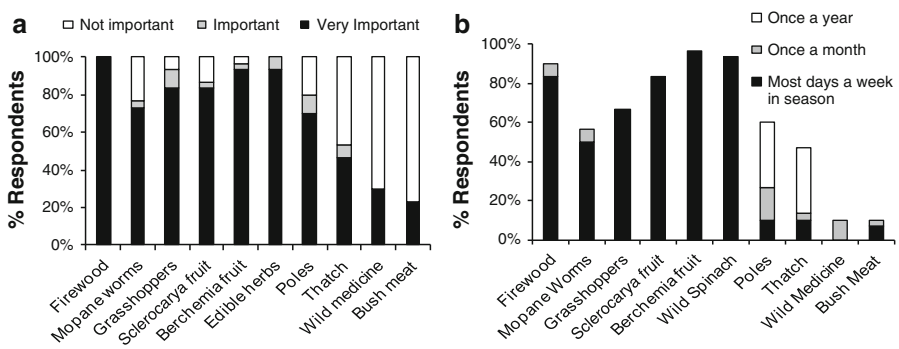

Fig. 8 Percentage (%) of respondents who indicated the relative importance (**a**) and frequency of use (**b**) of NTFPs

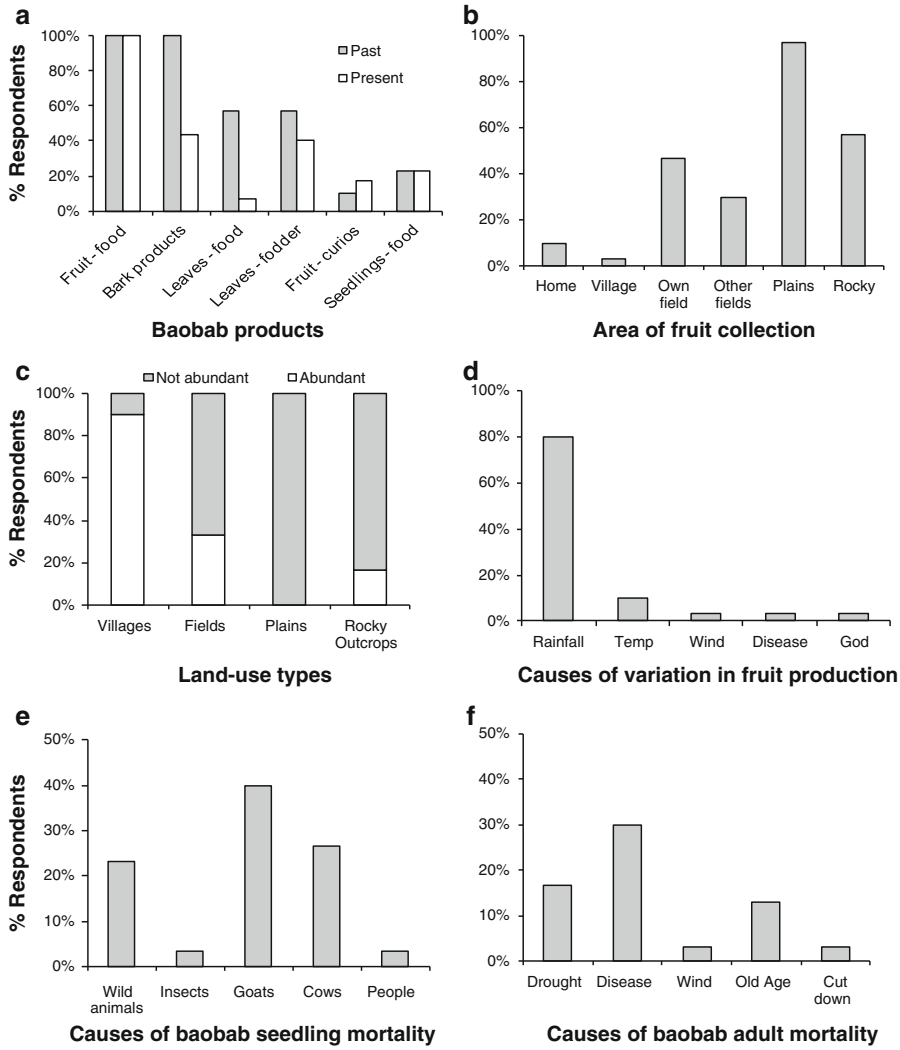

Fig. 9 The Percentage (%) of respondents who indicated importance of baobab products (**a**), who collected fruit in different areas (**b**), who indicated abundance of trees (**c**), causes of variation in fruit production (**d**), of sapling mortality (**e**), and of adult mortality (**f**)

Perceptions of baobab ecology and management

Apart from the cash earned from baobab seed sales, respondents said that baobabs were important for a variety of reasons (Fig. 7). All respondents said that cutting baobab trees down was not allowed by both government and traditional leaders.

Most respondents said that harvesting bark (73 %), leaves (77 %) and fruit (100 %) did not damage trees, while 13 % said that removal of fruit would affect recruitment. Respondents said that there were 'lots' of baobabs in the plains, rocky outcrops and fields, and 'few' in villages (Fig. 9). Baobabs were believed to live for over 1,000 years by 46 % of the respondents, and 27 % said that they lived forever. All respondents said that fruit production varies from year to year, and most felt this was because of rainfall (Fig. 9). In other words higher rainfall years resulted in higher fruit production. That not all baobabs produce fruit was believed by 92 % of respondents. Most, 92 %, recognised this was because there were male and female trees while 8 % could not give a reason.

All respondents said they regularly saw baobab seedlings and 37 % that the seedlings would disappear after the rains. Domestic animals (mainly cattle, goats and donkeys), followed by wild animals and lack of rainfall were believed to be the main threat to seedling survival (Fig. 9). Baboon predation of immature fruit was seen by 3 % as a problem for recruitment. As many as 70 % of the respondents had seen one dead baobab over the last ten years, most of which had died of disease or drought (Fig. 9).

Respondents said that baobabs in homesteads and fields were owned by the individuals on whose land they grew, and trees outside these areas were not owned by anybody. Only 3 % had planted a baobab, all of them at their homes. All respondents felt it was not necessary to plant baobab trees, but that if they were given a tree they would plant it either at their home (67 %) or in their own crop field (37 %).

Discussion

This study has shown that the cash value derived from the sale of baobab fruit for commercial utilization is four times higher than its direct-use value. The annual cash income received from baobab fruit alone made up 38 % of the total annual sales of all other NTFPs. Similarly, in other parts of southern Africa the sale of baobab fruit for commercial purposes has been reported to increase the monthly cash income of individuals by 250 % during the harvesting season (Gruenwald and Galizia 2005). Previous to commercialisation, the cash value from the fruit was negligible. As a subsistence product, the use of baobab fruit has diminished and now has a lower direct-use value than other NTFP food items.

All respondents said that income from the sale of baobab fruit was very important and helped alleviate poverty. In arid environments, such as where the research was done, the relative importance of this income may be higher than in moister areas, where there would be a greater variety of NTFPs available and where subsistence agriculture is more reliable. Cash is becoming more important in maintaining standards of living and access to cash helps move households out of poverty by giving them opportunities to participate in a more lucrative economy (Cavendish 2000). As was seen in this study, downward trends in the use of some NTFPs such as poles, thatch and wild medicinal plants indicate that there is a greater reliance on cash payments for many livelihood needs such as increasing costs of food, education and transport. Furthermore, it was seen that cash was used for investing in informal income sources by buying stock to expand businesses, and in savings, reflecting a trend found in communities moving from a subsistence into a cash economy (Belcher et al. 2005). Thus the contribution of commercial baobab harvesting plays an important role, not only in alleviating poverty, but also empowering marginalized people to keep up with a 'modern' world or as a stepping stone to a more secure livelihood.

The direct cash benefits from the commercialization of baobab fruit has been clearly shown in this study. However, the implications of commercialization need to be carefully considered. Firstly, does commercialization affect current, albeit low, subsistence use of baobab fruit? Secondly, how will commercialization affect access to the resource and the benefits currently enjoyed by the marginalized section of this community? Thirdly, how does commercialization affect sustainable harvesting; and lastly, can this value be improved for local harvesters?

In West Africa the value of baobab products for subsistence purposes, was rated by local people as much higher than its commercial value (Buchmann et al. 2010). However in Venda it was acknowledged that there was a much lower use of baobab products than in the past, independent of any commercial value. However, baobab fruit pulp is high in vitamin C and calcium, and its use contributes to a healthy diet (Chadare et al. 2009). Even though its use is very low, any large-scale sale of the fruit may result in scarcity and a lower intake of pulp and these negative impacts on health should be quantified.

It has been found elsewhere that income gained from the sale of NTFPs helps women increase their status in the community, as they make a contribution to household income and improve their personal circumstances. But if returns are recognized as high, these women could be edged out by men or by richer people in the community (Shackleton and Gumbo 2010; Lybbert et al. 2002). Ownership of individual baobabs is limited to trees found in homesteads and fields, however the large majority of trees are found on the extensive plains and are thus accessible to all members of the village. Although outsiders do not have access to these resources without prior permission of the chief, these rules are not clearly protected and commercialization may turn commonly-shared resources into resources 'owned' by businessmen, powerful elites or outsiders.

As baobab fruit becomes more valuable, clear and broadly-accepted rules of access will need to be established so that the harvesters currently benefitting from the resource continue to do so in a fair and equitable way. Regulatory frameworks should define who has access to which kind of resource and should

determine how benefits, collection and trade are shared among stakeholders (Shackleton and Gumbo 2010). In southern Africa, institutional structures that manage resources are weak, often leading to overharvesting and poor management of resources (Ticktin 2004). South Africa has instituted legislation that protects local people's benefits and rights to their resources (DEAT 2008) during commercial (or bioprospecting) activities. However, on communal land 'ownership' of resources is open to wide interpretation, making the rights of current beneficiaries vulnerable despite this legislation (Crouch et al. 2008).

If the livelihoods of rural people, who rely on NTFPs, is to be maintained, sustainable utilization is essential. Thus take-off rates should not damage the productive potential of the resource (Peters 1996). The term 'ecological tolerance' is used to describe the degree to which plant populations can recover from harvesting (Ticktin 2004). Many studies have found that the utilization of NTFPs is unsustainable (Boot and Gullison 1994; Ticktin 2004; Venter 2004). However, flowers, fruit and seed harvesting generally exhibits higher degrees of tolerance (Emanuel et al. 2005; Zuidema and Boot 2002). Once prevalent exception is with non-sprouting species with fire-prone ecosystems which rely on seed production to regenerate after fire (Witkowski et al. 1994; Lamont et al. 2001). This tolerance depends on three factors: firstly, the protection of parent trees; secondly, continuous recruitment; and thirdly, the longevity of the plant. Baobabs are long-lived trees and, once mature, can continue to produce fruit for many hundreds of years. Fruit harvesting neither damages nor kills trees, and thus annual harvests can be maintained. At the same time, recruitment is generally poor and sensitive to fluctuations in rainfall and browsing pressure (Venter and Witkowski, in review), so it can be argued that removal of seed may hamper recruitment. Fruit harvesting should thus be combined with a propagation and planting program to mitigate any adverse effects on recruitment.

Collection of other baobab products, notably bark and leaves, are more destructive and concerns have been raised about their sustainability (Schumann et al. 2010; Romero et al. 2001). Bark harvesting for subsistence use (low frequency) does not result in tree mortality, however, where bark harvesting is done for commercial purposes, frequencies are too high for trees to recover adequately, jeopardizing the survival of parent trees and affecting fruit production (Romero et al. 2001). Harvesting baobab leaves, and in so doing deliberately pruning trees to stimulate further leaf production, also hinders fruit production (Schumann et al. 2010). Without adequate institutional structures to manage and control harvesting, the commercialization of bark and leaf products should not be encouraged in Venda.

Trade channels for raw ingredients, fruit pulp and seed oil, are fairly short and simple, with processors buying directly from harvesters. A further way to increase benefits to rural people would be local beneficiation of the product whereby investment in local post-harvest processing and packaging is made. Currently this is not being done due to lack of knowledge and infrastructure available at the local level (Chadare et al. 2009; Welford and Le Breton 2008).

Domestication is another way to increase benefits, and it has been shown that grafting adult material onto seedlings can produce flowers within 10 years (Jensen et al. 2011). In many parts of southern Africa water resources are extremely scarce and, if successful grafting depends on irrigation, this may not be a practical solution in this semi-arid region. Nonetheless, as the value and demand for baobab fruit extracts increase, suitable sites could be found and southern Africa could follow the lead of West African initiatives in domestication and cultivation (Jensen et al. 2011). The downside is that large scale plantings in agricultural settings are likely to bring prices down, resulting in poorer returns for rural harvesters. Nonetheless, at this stage the harvesting of wild fruit is considered more cost effective than cultivation (Gruenwald and Galizia 2005) and has other benefits such as in situ conservation of communal lands.

Harvester's perceptions of baobab ecology and the results of ecological surveys (Venter and Witkowski 2010, 2011a, in review) were very close, indicating that both have a similar understanding of the resource base. Harvesters said that there were fewer trees in natural areas than in villages and fields and although population surveys show higher densities in the latter (Venter and Witkowski 2011b), the relatively small sizes of villages and fields would mean that there were indeed fewer trees in total. Respondents were aware that fruit production varied from year to year, and annual fruit production surveys found the same. Although ecologists could only speculate on the

causes of this variation, harvesters said it was due to lack of rainfall. Ecological surveys also found that many trees consistently produced fewer fruit than others (Venter and Witkowski 2011a) and harvesters confirmed this, and referred to these trees as 'male' trees. Such a perception was also recorded among people in West Africa (Assogbadjo et al. 2008). Respondents said they often saw baobab seedlings, especially in times of good rainfall, but that they quickly disappeared due to domestic animal browsing. This, too, is consistent with patterns found by Venter and Witkowski (in review).

Conclusion

Commercialization of baobab fruit is valuable to rural people in northern Venda, South Africa. Cash generated from the sale of baobab fruit helps alleviate poverty, improve livelihoods and allows participation of marginalized people in a growing cash economy. Direct-use value of the fruit is low and thus commercialization is not expected to have significant impact on subsistence use. Rights of access to the resource are not clearly defined and as the resource grows in value, the lack thereof may jeopardize current benefits to marginalized people, thus workable regulatory frameworks need to be put in place to secure these rights. Furthermore, benefits can be increased by investing in post-harvest processing. Lastly, fruit harvesting is non-destructive, and thus has high ecological tolerance, however the negative effect of seed removal on recruitment, requires investment in propagation and planting programs.

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