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HOUSEHOLD PERCEPTIONS ON COMMERCIAL CULTIVATION OF BAOBAB TREE (ADANSONIA DIGITATA) IN THE SOUTH-EAST LOWVELD OF ZIMBABWE

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ABSTRACT

The perceptions of possible commercial cultivation of the baobab tree (*Adansonia digitata*) between two rural communities (Wengezi and Gudyanga) in Zimbabwe's southeast Lowveld: were investigated. The need to investigate household perspectives arisen due to poor baobab tree regeneration. From 2016 to 2018, a cross-sectional study was conducted utilizing a mixed-method technique for data collection. Questionnaires were issued to 68 households for quantitative data and 51 responded. Semi-structured interviews were used to collect qualitative data that will be analysed using thematic analysis. From the questionnaire respondents, 41 households (80%) supported the commercial cultivation of baobab trees, eight households (16%) were not sure, and four households (4%) did not support the idea. Qualitative results show that households view baobab cultivation in their community as a future possibility. The awareness to propagate the baobab and the prospect of increasing and exporting its production should be encouraged and prioritised. Based on the data, it is recommended that these communities should be trained on the application of modern technologies to shorten the maturity period of the trees through propagation.

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INTRODUCTION

The baobab (*Adansonia digitata*) is a giant and peculiar tree that earned the name ‘upside-down tree’ due to its root-like branches (Van Wyk & Van Wyk, 2013; Wickens & Lowe, 2008). It is an indigenous tree that grows naturally and is well-adapted to the arid to the semi-arid conditions of

sub-Saharan Africa (Sanchez *et al.*, 2011; Venter & Witkowski, 2011). The tree is economically significant and highly valued in African food, medicine, cultural rituals, craftwork and income generation (Meinhold *et al.*, 2016). Every part of the baobab - leaves, fruit pulp, seeds, fruit shell, bark and roots - are harvested for different purposes by communities where the tree is found.

In West African countries (Benin, Mali and Burkina Faso), the high mucilage baobab leaves are commonly used to make and thicken the soup. In the northern and southern parts of Africa, the fruit pulp is the main component valued for preparing porridge, drinks, ice-lollies and sweets as well as to flavour yoghurt. The baobab fruit pulp is rich in vitamin C (1.690 mg/ kg^{-1}), which is six times more than in the same quantity of oranges (Charade *et al.*, 2009; Rahul *et al*., 2015). Calcium, phosphorus, carbohydrates, iron, and soluble and insoluble fibres are also available in fruit pulp and leaves (Rahul *et al*., 2015). The European Union and the United States of America endorsed and accepted the pulp of baobab fruit as a food ingredient in July 2008 added commercial value to this indigenous tree (Anjarwalla *et al.*, 2017; Charade *et al.*, 2009). The baobab fruit pulp is more appealing to health-conscious consumers in developed countries (Jensen *et al.*, 2011). The pulp and seed oil exhibit antioxidant properties, making them useful for therapeutic purposes (Rahul *et al*., 2015). In Zimbabwe, approximately 20 000 litres of baobab seed oil costing US$100 000 is produced annually (Venter, 2012).

In Kenya, cultivating the baobab tree commercially involves a participatory approach with local rural farmers (Keding *et al.*, 2017). Limited studies have been done in North African countries on the cultivation of the baobab tree, except for its importance in poverty alleviation in rural communities (Adam, 2017). A study carried out on baobab fruit pulp consumption in Sudan revealed that rural communities regarded it as a 'safety net' during periods of planted crop failures (Keding *et al.*, 2017). Studies were undertaken on baobab seed germination and grafting in Malawi, Tanzania and Kenya for commercial cultivation (Anjarwalla *et al.*, 2017; Sanchez *et al.*, 2011). However, despite its local utility and economic importance, the baobab tree takes a long time to reach maturity and has a poor generation capacity. To sustain local and international demands for fruit pulp, there is a need to improve baobab cultivation techniques to assist in raising the dwindling young trees in Botswana, Namibia and South Africa (Lisao *et al.*, 2017; Venter & Witkowski, 2013). Patrut *et al.* (2018) observed that nine out of 13 of the oldest baobab trees died in Africa. The cause is unclear, but climate change causing frequent droughts was indicated as the probable cause. Considering the high death rate of old baobab trees and the low establishment rate of young ones, cultivating new baobab trees is crucial (Lisao *et al*. 2017).

The baobab tree's ability to survive under conditions of limited moisture makes it a fruit tree of importance in the modern-day, given that it can produce fruits even during *El Nino*-induced droughts experienced in East Africa (Meinhold *et al.*, 2016). Legwaila *et al.* (2011) report that indigenous tree cultivation or domestication could be a strategy to improve food security and cash income for rural communities as well as a contribution to climate change mitigation. The World Agroforestry Centre researched the domestication and commercialisation of wild fruit trees to improve rural livelihoods in Mali, Burkina Faso and Niger (Leaky & Akinnifesi, 2008). The indigenous fruit trees can be propagated and have been observed to alleviate poverty (Gebauer *et al.*, 2016). Market and financial analyses by Ramadhani (2002) showed that indigenous trees contribute to family income, while women and children are the major beneficiaries. Commercial cultivation of baobab trees is a viable option to reduce competition between subsistence and commercial farmers (Lisao *et al.*, 2017; Sanchez *et al.*, 2011). The baobab tree was identified as one of the most valued indigenous trees that should be domesticated and conserved in Africa (Gebauer *et al.*, 2016). By using the Maxent modelling framework with the main variable as annual precipitation and temperature variability, baobab trees can be cultivated in most southern African countries (Sanchez *et al.*, 2011).

In Zimbabwe, rural communities ranked the baobab tree as the most valued species for food security and income generation. The baobab trees grow naturally in the southeast Lowveld of Zimbabwe and are in forested areas. Family utilisation practices and the indigenous knowledge of baobab products are passed on from one generation to another (Adam, 2017; Mugangavari, 2019). Households harvest fruit for the pulp, which they use for making porridge, ice-lollies and a drink by mixing the pulp with water (Mugangavari, 2019). These items are consumed by households or sold for income. Seeds from the fruits are roasted and consumed as a coffee substitute (Codeiro, 2013; Venter & Witkowski, 2013). Tender baobab leaves are rich in calcium, iron, magnesium, and vitamins A, B and D, and are cooked as vegetables (Keding *et al.*, 2017). Baobab bark fibre is harvested for craftwork, which is sold locally and in the nearby towns (Chikodzi *et al.*, 2013; Mugangavari, 2019). Local customs and traditions revere the baobab tree because it is used for medicinal purposes and traditional rituals (Keding *et al.*, 2017; Mugangavari, 2019). Traditional leaders, together with the Forestry Commission of Zimbabwe, monitor the harvesting of baobab products by community members to prevent overharvesting (Venter & Witkowski, 2013). However, limited studies have been done in the country on rural communities' perceptions on possible commercial cultivation of the baobab. Crop failure and rural poverty are very common in communities in the southeast Lowveld of Zimbabwe.

Afiari-Sefa *et al.* (2016) state that perceptions are driven by the previous needs and experiences of individuals. Family influences the utilisation of indigenous resources; hence views should be collected at a household level (Adam, 2017). Although the baobab tree was ranked as a keystone species at local and regional levels in Zimbabwe, there have been limited studies on its cultivation. Community perceptions may change over time due to socio-economic and environmental factors. Hence, this study was aimed at obtaining information that might be used by government departments to formulate strategies and policies to improve the commercial cultivation of baobab trees.

MATERIALS AND METHODS

Study area

The study was carried out in two rural communities (Wengezi and Gudyanga) located in the southeast Lowveld of Zimbabwe. The study commenced in June 2016 and ended in November 2019. The area falls under the

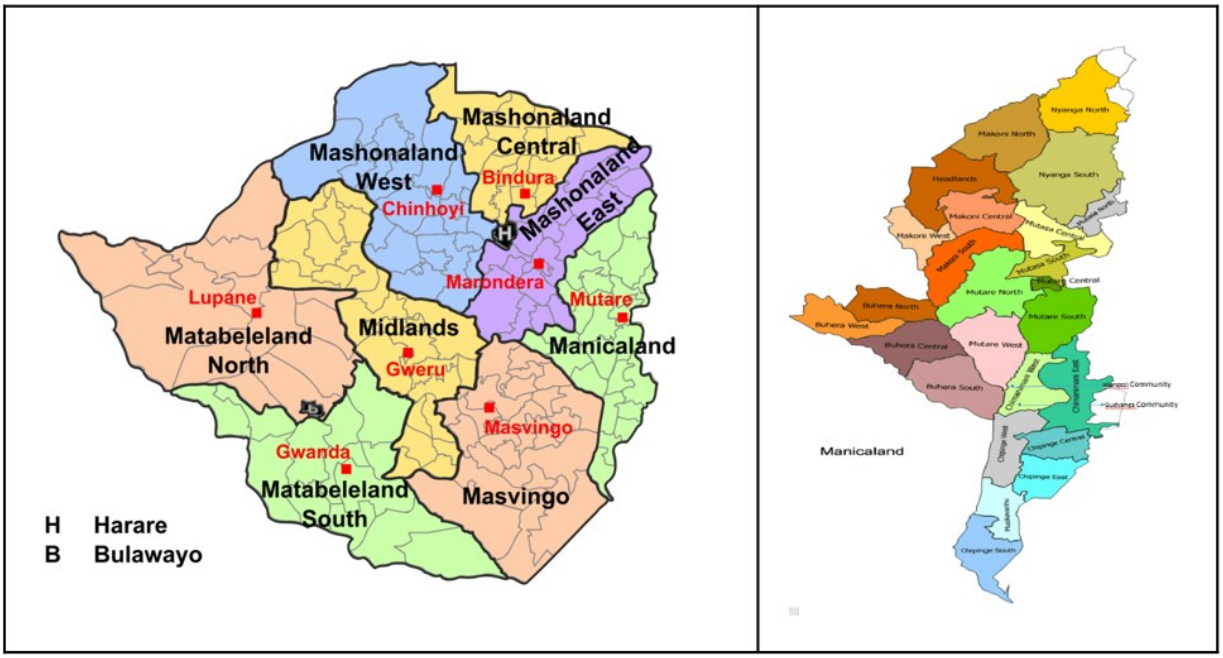

FIGURE 1: FIGURE 1: MAP OF THE STUDY AREA

Chimanimani district of Manicaland province (19° 30' S 32° 32' E) with an elevation of 600 m above sea level (Mutambara, 2014). A map of the study area is shown in Figure 1.

Soils here are deep calcareous alluvial material with scattered areas of shallow gravel. Rainfall is low and erratic, ranging from 250 to 300mm per annum and has become unpredictable (Chikodzi *et al*, 2013). Rain-fed subsistence farming is the main economic activity in the area. Irrigation schemes run by the government have been rendered dysfunctional because of the country's economic challenges (Coomer & Gstraunthaler, 2011). Maize, sorghum, bulrush millet, melon and cowpeas are some of the crops grown by households in the study area. Cattle, goats, sheep, donkeys and chickens are reared.

The vegetation type is dry savannah woodland dominated by *Colophospermum mopane* (mopane). Other common tree species include *Terminalia sericea*, *Acacia nilotica*, *Berchemia discolor* and *Adansonia digitata* (baobab). Baobab trees are scattered in the area. They are often found around homesteads, making them semi-domesticated species (Simbo *et al.*, 2013).

Ethical clearance

The research proposal and instruments were approved by the Research Ethics Committee of the College of Agriculture and Environmental Sciences of the University of South Africa.

Data collection

Letters of consent were issued to all households in the study area. Participants were made aware of their right to withdraw from the study at any time and that their contributions would be anonymous. After the collection of signed consent forms from 68 households, pre-tested questionnaires were hand-delivered to each residence by the researcher with the aid of trained enumerators. The enumerators and principal researcher were fluent in local languages to prevent communication breakdown. The questionnaires comprised of both open-ended and closed questions to collect the necessary data and cover the complex nature of the study (Creswell, 2014). The researcher conducted face-to-face interviews with four households that were carefully chosen to elicit their perspectives. Each interview session lasted 30 to 45 minutes, and each participant was interviewed in a location that was convenient to them. The study objectives were used to create an interview guide with open-ended questions (Creswell, 2014). When distributing surveys and conducting interviews, the focus was on household heads and adults (Saunders et al., 2016). In the absence of such a person in the household, the most influential or knowledgeable man or female aged 21 and above participated. To safeguard minors and vulnerable persons, the study eliminated people under the age of 20, as well as those who were mentally challenged or ill.

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Data sources and collection methods

A mixed-method approach was used for data collection and analysis. Primary data was gathered using interviews and questionnaires. A pilot study on the research instruments was carried out to correct flaws and validate them. The data collected was of both qualitative and quantitative nature, drawn at a household level. Face-to-face semi-structured interviews were used to collect qualitative data through open-ended questions. The questions were as follows:
1. Do you think the baobab trees are important

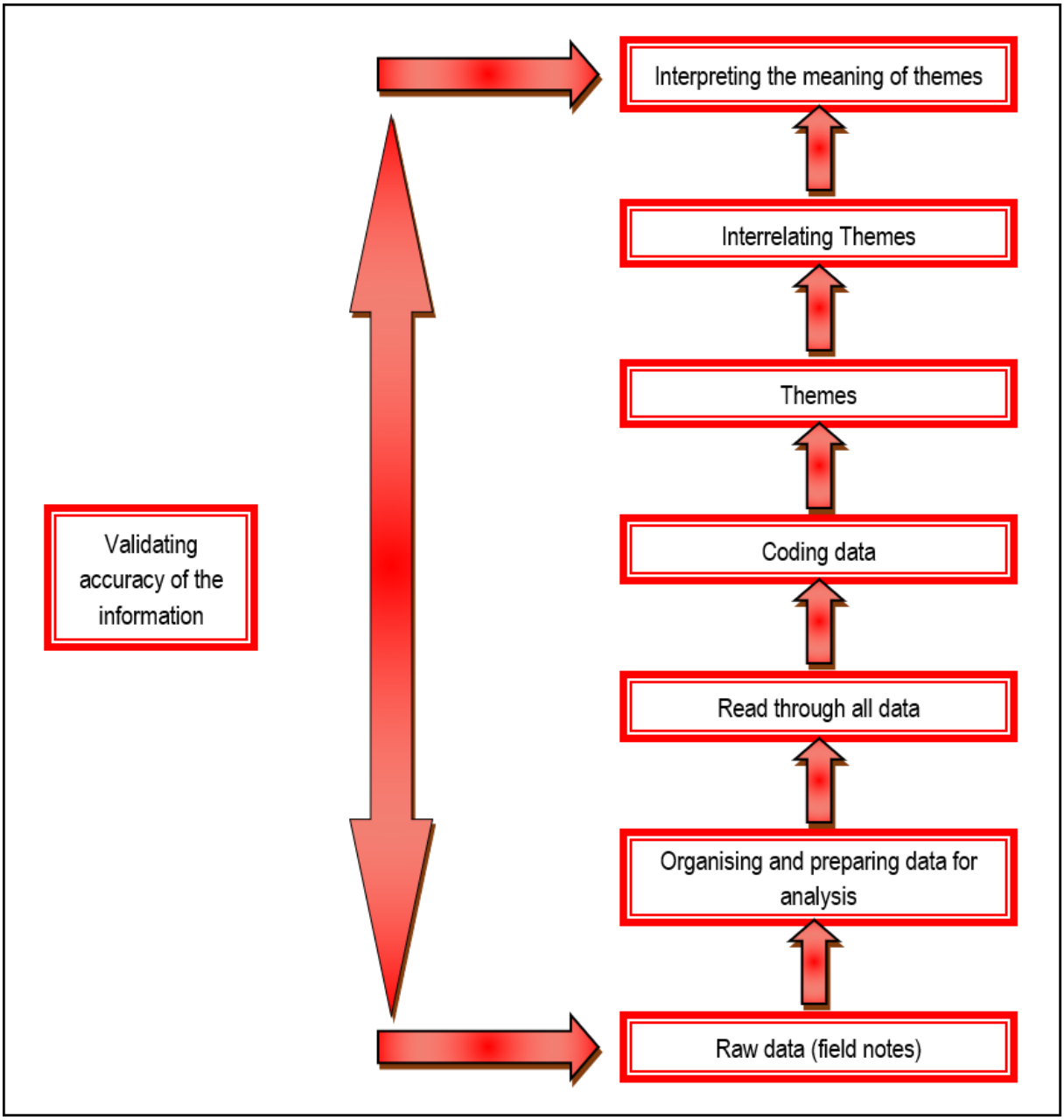

FIGURE 2: SUMMARY OF QUALITATIVE DATA ANALYSIS DESIGN EMPLOYED IN THE STUDY. SOURCE: CRESWELL

to the people in this area? Explain why.

2. Do you have anything in your
   a) past
   b) culture
   c) socio-economic desire
   that affects your views on commercial cultivation of baobab trees?
3. Do you know anyone who has planted indigenous trees for commercial purposes in this community? If yes,
   Which tree/s?
   Was/were planted?
4. Do you think your household can grow baobab trees for commercial purposes? Explain why.
5. How would the cultivation of the baobab trees help you as a family and the community at large?

The interviews were conducted with the household head at each household at a time convenient for them. The interviews were audio-recorded and later transcribed. Thematic analysis of data was used for the raw data captured from the interviews (Figure 2).

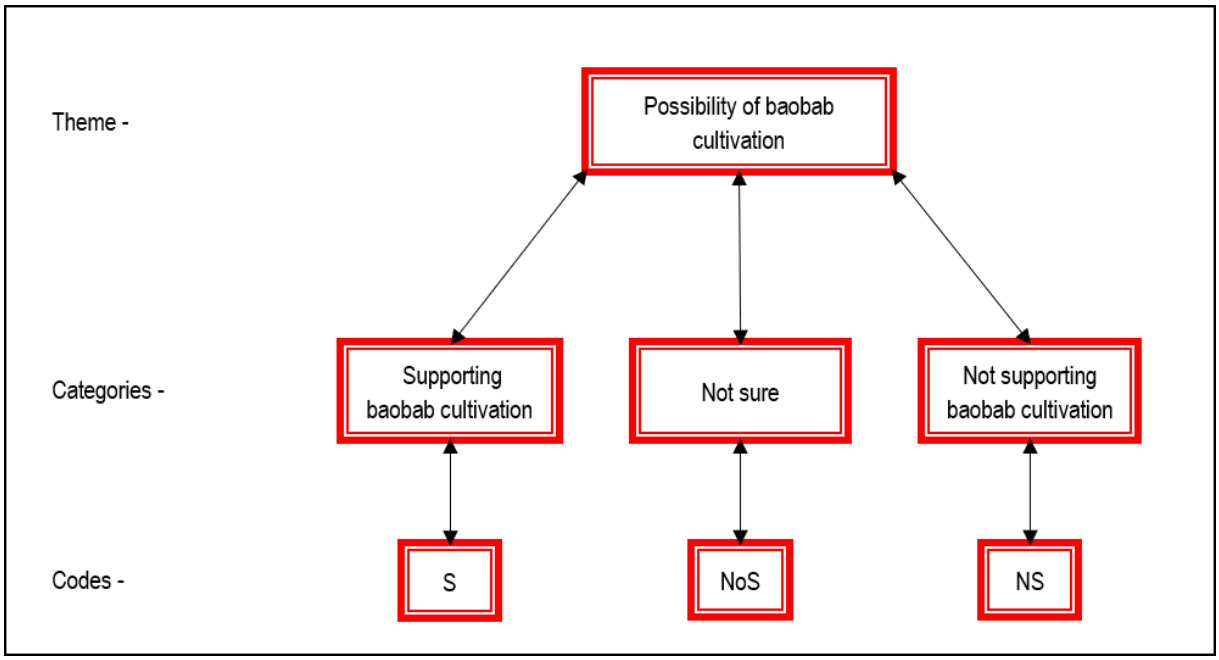

FIGURE 3: THEME, CATEGORIES AND CODES

Data analysis

Quantitative data were analysed using descriptive statistics while the qualitative data was analysed using thematic analysis (Maree, 2013; Saunders *et al.*, 2016). To ensure anonymity, each participant was given a pseudonym (Saunders *et al.*, 2016). Data was coded into thematic ideas, which were sorted into segments (Creswell, 2014). Coding was conducted back and forth between steps using the idea of saturation, which is achieved when gathering new data no longer reveals new properties to the themes (Saunders *et al.*, 2016). Enumeration and categorising were used in summarising the results. The regularity with which a word or code appeared assisted in making clarifications of how participants shared the same understanding. The following diagram shows how the codes were used to generate the themes.

Codes were pre-set, guided by the research questions. A list of categories was made, as shown in Figure 3. The data were analysed to discover the listed topics for data that matched the themes. Transcription texts were read and re-read several times to ensure the meaning of qualitative data was captured accurately (Creswell, 2014). Cross-checking within the research group was one of the validity strategies used. Data collected from interviews were compared with the quantitative data from the study, which provided a measure of triangulation. The purpose of this was to decrease the deficiencies of one method, thus increasing confidence in the findings (Leedy & Ormrod, 2010; Maree, 2013). Numerical data was collected using questionnaires issued to each household. Variables included demographic data (age, gender and occupation), support for baobab commercial cultivation and reasons for each decision as guided by the study objective.

RESULTS AND DISCUSSION

Of the 51 households that responded, 41 (80%) supported commercial baobab tree cultivation in the study area. Eight (16%) households were not sure, and four (4%) did not support the idea. Most households depended on rain-fed farming. The age group of respondents was shown to have a bearing on the response, as shown in Table 1.

Household heads in the age group 40 to 49 years supported the commercial cultivation of the baobab trees. It was to this age group that most households belonged, and they were all farmers by occupation. Those who were under the age of 40 years supported commercial cultivation, although few of them (20%) were

TABLE 1: PERCEPTIONS OF HOUSEHOLD HEADS OF DIFFERENT AGE GROUPS, GENDER AND OCCUPATION REGARDING POSSIBLE COMMERCIAL CULTIVATION OF BAOBAB IN THE STUDY AREA

Age group (years)	Gender	Number of household heads	Possible baobab commercial cultivation			Occupation
			In support	Not sure	Did not support	
20-29	Male	5	4	1	0	4-self-employed, 1-farmers
	Female	0	0	0	0	
	Total	5	4	1	0	
30-39	Male	3	0	2	1	1-civil servant, 5-self-employed, 4-farmers
	Female	7	7	0	0	All farmers
	Total	10	7	2	1	
40-49	Male	15	9	5	1	All farmers
	Female	9	2	5	2	All farmers
	Total	24	11	10	3	
50-59	Male	1	1	0	0	All farmers
	Female	1	0	1	0	All farmers
	Total	2	1	1	0	All farmers

There were more households supporting the commercial cultivation of baobab trees when the household head was 40-49 years old. Most households fell into this age group and all were farmers by occupation. Those who were under 40 years of age were also in support although few of them (20%) were farmers whereas the 80% of household in the group were employed.

predominantly farmers and 80% of the households were employed.

From the face-to-face interviews, qualitative data were collected using open-ended questions. The principal researcher tried to get households' views on the following research question:

What are the perceptions regarding possible commercial cultivation of the baobab trees by households in the southeast Lowveld of Zimbabwe?

What are the household perceptions on baobab trees cultivation in southeast Lowveld, Zimbabwe for economic purposes?

Different views can be illustrated through four selected interviewees. Extracts from the face-to-face interviews are given below:

"Baobab trees can be grown easily here because they grow on their own everywhere in this community."

"If we plant baobab trees, we would have more fruits to harvest and make more money through the sale of its products. Right now, there is a high demand for baobab fruit pulp drink in the nearby town, but we are unable to meet this demand."

"It might be possible to grow baobab trees, but adequate fencing would be needed for protecting the young baobab trees from grazing livestock. Cattle and goats graze freely in this community."

"A borehole must be sunk first before planting the baobab trees. This area receives very little rainfall during the hot summer months, and this can kill the young baobab plants."

"Planting baobab trees is not going to benefit us now. Maybe our children are the ones who would benefit because baobab trees take longer to reach maturity. Growing baobab trees is not a viable project."

"Baobab tree cultivation would create job opportunities and better livelihood for this community. It is understood that some companies produce products by adding baobab products and sell them to people for therapeutic purposes. If the government can assist this community, we want to sell baobab fruits directly to these companies so that the community can get income."

It was observed that those who were in support of the commercial cultivation of baobab trees anticipated job creation for the community and income generation through the sales of its products.

Gebauer *et al.* (2016) echoed this sentiment that the development of baobab products including

added value have the potential to reduce poverty in the rural community. The increased interest in baobab tree products from international markets like Europe and the USA makes commercial production a wise option to meet the demand (Charade *et al*., 2009; Vermaak *et al*., 2011). Feasibility studies carried out by Meinhold *et al.* (2016) showed that baobab and other indigenous fruit trees can create small enterprises in sub-Saharan Africa and were proving to be profitable. The critical shortage of household income in the study area would be alleviated (Mutambara, 2014). A baobab tree growing in the yard of one household in Gudyanga was a motivation to other households, as shown in the extract from one of the interviews:

> *"If you go to Mr J's homestead, and you see a baobab tree he planted, and it is growing well just like other baobab trees in the wild. Will you plant your baobab trees"*

Although most of the households (Figure 4) supported the commercial cultivation of baobab trees in their community, 4% of respondents were against the idea. From the interviews, the long time it takes baobab trees to reach maturity, frequent droughts and damage from grazing animals were common concerns for not supporting the cultivation of baobab trees. In rural Malawi, Sanchez *et al.* (2011) observed that the maturity time of baobab trees is between 13 and 23 years, and for most farmers, this can prove unproductive. The same sentiments were echoed during the interviews in the study area.

Studies carried out in West Africa showed that the maturity period of baobab trees may be shortened by grafting (Akinnifesi *et al*., 2008; Jensen *et al*., 2011). Grafted material of baobab trees started flowering three to five years after grafting. Households interviewed in the current study were not aware of grafting as a method to speed up maturation, and its adoption may be against the community's indigenous knowledge system (Fujisawa, 2019; Sanchez, 2011). Like most African communities where baobab trees are found, they are used as part of traditional rituals, and their existence is safeguarded by community traditional leaders (Gebauer *et al*., 2016; Venter & Witkowski, 2013). Baobab trees were observed at the homesteads and growing alone in cleared crop fields.

Some of the interviewees were not sure if commercial cultivation of baobab trees would be productive for the community. Their doubts were based on the experience of frequent droughts that compromise the survival of young baobab trees (Sanchez, 2011; Venter & Witkowski, 2013). Some of the responses from those with doubts are as follows:

> *"I do not know if this would be practical given that there are no functional irrigation facilities in the area."*
>
> *"This is the first time I am aware of planting an indigenous tree for commercial production. We will support this action if it will work out."*

According to the respondents, the baobab trees would be the first indigenous trees to be grown by community households. During this research, no information was gathered on indigenous trees grown for commercial purposes. The sugar plum (*Uapaca kirkiana*) is the only indigenous tree currently grown for commercial production in the natural woodlands of Zimbabwe (Chirwa & Akinnifesi, 2008).

CONCLUSION

The 80% of households that supported baobab commercial cultivation anticipated it would enhance employment creation and increase household income in the area. Some participants (16% of households) were not sure of the viability of the project and based their arguments on a long time it took the baobab tree to reach maturity, as well as the current and frequent drought periods compromising its optimal growth and worth for the community. Those participants who did not support the idea of commercial cultivation were mainly concerned about a long time it takes the baobab tree to reach maturity and limited research on its management. Giving them an example of the success of such a project in West Africa did not help, as they argued that environmental conditions might be different.

RECOMMENDATIONS

Further studies should be conducted on how best to influence household perceptions that baobab trees cannot be cultivated usefully because they take a long time to reach maturity. The community should be trained on modern technologies that can be used to shorten the maturity period through propagation. The provincial Department of Education should include the management of baobab trees in the curriculum to introduce the positive perception on their commercial cultivation. Communities should be made aware of the long-term benefits of baobab production, its economic importance, and the possibility of earning foreign currency.

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REFERENCES

Adam, Y.O., 2017, 'Consumers' preferences and factors affecting urban demand for baobab (*Adansonia digitata L*) in Sudan', *Forestry Ideas*, 23 (2), 103–112.

Afiari-Sefa, V., Rajendran, S., Kessy, R.F., Karanja, D.K., Musebe, R., Samali, S. & Makaranga, M., 2016, 'Impact of nutritional perceptions of traditional African vegetables on farm household decision: A case study of smallholders in Tanzania', *Experimental Agriculture*, 52 (2), 300–313.

Akinnifesi, F.K., Sileshi, G., Ajayi, O.C., Chirwa, P.W., Kwesiga, F.R. & Harawa, R., 2008, 'Contribution of agro-forestry research and development to the livelihood of smallholder farmers in southern Africa', *Agricultural Journal,* 3 (1), 76–86.

Anjarwalla, P., Ofari, D., Owino, A., Matuku, D., Adikwa, W., Njogu, K. & Kehlenbeck, K., 2017, 'Testing different grafting methods for vegetative propagation of baobab (*Adansonia digitata L*) in Kenya to assist domestication and promote cultivation', *Forests, Trees and Livelihood*, 26 (2), 85–95.

Charade, F.J., Linnemann, A.R., Hounhouigan, J.D., Nout, M.J. & Van Boekel, M.A., 2009, 'Baobab food products: A review on their consumption and nutritive value', *United States National Library of Medicine*, 49(3), 254–274.

Chikodzi, D., Murwendo, T. & Simba, F.M., 2013, 'Climate change and variability in south-east Zimbabwe: Scenarios and social opportunities', *American Journal of Climate Change*, 2(3), 202–213.

Chirwa, P.W. & Akinnifesi, F.K., 2008, 'Ecology and biology of *Uapaca kirkiana*, *Strychnos cocculoides* and *Sclerocarya birrea* in Southern Africa', in F.K. Akinnifesi, R.R.B. Leakey, O.C. Ajayi, G. Sileshi, Z. Tchoundjeu, P. Matakala, & F.R. Kwesiga (eds.*), Indigenous fruit trees in the tropics: Domestication, utilisation and commercialization,* pp 322–340, CABI, London.

Codeiro, L.S., 2013, '*The role of African indigenous plants in promoting food security and health',* ACS Symposium Series 1127. North American Chemical Society, Washington DC.

Coomer, J. & Gstraunthaler, T., 2011, 'The hyper-inflation in Zimbabwe', *Journal of Austrian Economics,* 14, 311–346.

Creswell, J.W., 2014, '*Research design: Qualitative, quantitative and mixed methods approaches',* Sage, London.

Fujisawa, N., 2019, 'Production, consumption and culture of upland rice in Swiddes: A case study of a campesino community in Panama', *Human Ecology*, 47(4), 541–552.

Gebauer, J., Adam, Y.O., Cuni Sanchez, A., Darr, D., Eltahir, M.E.S., Fadl, K.E.M., Fernsebuer, G., Frei, M., Habte, T.Y., Hammer, K., Hunsche, M., Johnson, H., Kordofani, M., Krawinkel, M., Kugler, F., Luedeling, E., Mahmoud, T.E., Mainu, A., Mithofer, D., Munthali, C.R.Y., Nogu, F. North, R.O., Wiro, W.O., Prinz, K., Rimberio, F.K., Saied, A., Schuring, M., Sennhenn, A., Spath, M.A., Taha, M.E.N., Triebel, A., Wichern, F., Wiehle, M., Wrage-Monnig, N. & Kehlenbeck, K., 2016, 'Africa's wooden elephant, the baobab tree (*Adansonia digitata L*) in Sudan and Kenya: A review', *Genetic Resources and Crop Evolution*, 63, 377–399.

Jensen, J.S., Bayala, J., Sanou, H., Korbo, A., Raebild, A., Kambou, S., Tougian, A, Bouda, A., Larsen, A.S. & Parkouda, C., 2011, 'A research

approach supporting domestication of baobab (*Adansonia digitata L.*) in West Africa', *New Forest Journal,* 4 (3), 317–335.

Keding, G.B., Kehlenbeck, K. & McMullin, S., 2017, 'Fruit production and consumption: Practices, preferences and attitudes of women in rural western Kenya', *Food Security*, 9, 453–469.

Leaky, R.R.B. & Akinnifesi, F.K., 2008, Towards a domestication strategy of indigenous fruit trees in the tropics. in F.K. Akinnifesi, R.R.B. Leakey, O.C. Ajayi, G. Sileshi, Z. Tchoundjeu, P. Matakala, & F.R. Kwesiga (eds.*), Indigenous fruit trees in the tropics: Domestication, utilisation and commercialization,* pp 28–49, CABI, London.

Leedy, P.D. & Ormrod, J.E., 2010, *Practical research planning and design.* Pearson, Upper Saddle River.

Legwaila, G.M., Mojeremane, W., Madisa, M.F., Mmolotsi, R.M. & Rampart, M., 2011, 'Potential of traditional food plants in rural household in Botswana', *Journal of Horticulture and Forestry*, 3(6), 145–174.

Lisao, K., Geldenhuys, C.J. & Chirwa, P.W., 2017, 'Traditional uses and local perspectives on baobab (*Adansonia digitata*) population structure by selected ethnic groups in northern Namibia', *South African Journal of Botany*, 113, 449–456.

Maree, K., 2013, '*First steps in research',* Van Schaik, Pretoria.

Meinhold, K, Adam, Y.O., Munthali, C.R.Y., Evang, E., Gebauer, J., Habt, Y., Hommels,, M., Kewenberk, K., Kranwinkel, M.B., Kugler, F., Mahmoud, T.E., Mbugua, W.J., Mithofer, D., Muendo, K.M., Njiru, A.M., Owino, W.O., Rimberia, F.K., Sanjak, E.A., Schiiring, M., Siddig, M.E., Stevens, A., Taha, M.E.N., Triebel, A. & Darr, D., 2016, 'The BAOFOOD project: Enhancing local food security and nutrition in eastern Africa with the baobab tree', paper presented at the Conference on International Research on Food Security, Natural Resource Management and Rural Development, Boku Austria, Vienna, 18 -21 September.

Mugangavari, B., 2019, 'Exploring the potential of sustainable utilization of the baobab tree (*Adansonia digitata*) to improve food security. A case study of the south-east Lowveld of Zimbabwe', MSc dissertation, Department of Agriculture and Animal Health, University of South Africa, South Africa.

Mutambara, J., 2014, 'Multiple vulnerabilities locking rural communities of south-eastern Lowveld of Zimbabwe', *Journal of Economics and Sustainable Development*, 5 (19), 1–11.

Patrut, A., Woodborne, S., Partrut, R.T., Rakosy, L., Lowy, D.A., Hall, G. & Von Reden, K.F., 2018, 'The demise of the largest and oldest African baobabs', *Nature Plants,* 9 (4), 968–980.

Rahul, J., Jain, M.K., Singh, S.P., Kamal, R.K., Naz, A., Gupta, A.K. & Mrityunjay, M., 2015, '*Adansonia digitata L.* (baobab): A review of traditional information and taxonomic description', *Asian Pacific Journal of Tropical Medicine,* 5 (1): 79–84.

Ramadhani, T., 2002, '*Marketing indigenous fruits in Zimbabwe: Socio-economic studies on rural development',* Wissenchaflsverlag Vauk Kiel, Germany.

Sanchez, A.C., 2011, 'The baobab tree in Malawi', *Fruit Journal*, 66 (6), 405–416.

Sanchez, A.C., 2012, 'The status of baobab tree populations in Southern Malawi: Implications for further exploitation', *Forests, Trees and Livelihoods*, 20 (23), 157–173.

Sanchez, A.C., Osborne, P.E. & Haq, N., 2011, 'Climate change and the African baobab (*Adansonia digitata L.*): The need for better conservation strategies', *African Journal of Ecology,* 49, 234–245.

Saunders, M., Lewis, P. & Thornhill, A., 2016, '*Research methods for business students',* 7th edn, Pearson, Harlow.

Simbo, D.J., De Smeldt, S., Von de Bilcke, N., De Meulenaer, B., Van Camp, J., Uytterhoeven, V. & Samson, R., 2013, 'Opportunities for domesticating the African baobab (*Adansonia digitata L*): Multi-trait fruit selection', *Agroforestry Systems*, 87 (3), 493–505.

Van Wyk, B. & Van Wyk, P., 2013, '*Field guide to trees of Southern Africa',* Struik Nature, Cape Town.

Venter, S.M., 2012, 'The ecology of baobabs (*Adansonia digitata L.)* in relation to sustainable utilization in northern Venda', PhD thesis, Department of Geography, University of the Witwatersrand, South Africa.

Venter, S.M. & Witkowski, E.T.F., 2011, 'Baobab (*Adansonia digitata L.*) fruit production in communal and conservation land-use types in Southern Africa', *Forest Ecology and Management,* 261, 630–639.

Venter, S.M. & Witkowski, E.T.F., 2013, 'Where are the young baobabs? Factors affecting regeneration of *Adansonia digitata L.* in a communally managed region of Southern Africa', *Journal of Arid Environments,* 92, 1–13.

Vermaak, I., Kamatou, G.P.P., Komane-Mofokeng, B., Viljoen, A.M. & Beckett, K., 2011, 'Africa seed oils of commercial importance – Cosmetic applications', *South African Journal of Botany,* 77 (4), 920–933.

Wickens, G.E. & Lowe, P., 2008, 'The *baobab: Pachycauls of Africa, Madagascar and Australia',* Springer, London.

Wynberg, R., Van Niekerk, J., Kozanayi, W. & Laird, S., 2012, '*Formalisation and the non-timber forest product sector: Experiences from Southern Africa',* Report, Bogor, CIFOR, Indonesia.