



Tropentag 2014, Prague, Czech Republic
September 17-19, 2014

Conference on International Research on Food Security, Natural Resource
Management and Rural Development
organised by the Czech University of Life Sciences Prague

Promoting the Use of Baobab (*Adansonia digitata* L.) in Rural Communities in Eastern Africa

Rabea North^a, Dietrich Darr^{a*}, Jens Gebauer^a, Dagmar Mithöfer^a, Willis Omondi Owino^b, Fredah Karambu Rimberia^b, Katja Kehlenbeck^c, Muneer Elyas Siddig^d, Tarig Elsheikh Mahmoud^d, Mohamed El Nour Taha^d, Andreas Triebel^e, Henry Johnson^f, Anthony Maina^g, Mahmoud Fadl El Mula Ahmed^h, Yahia Omar Adam^h, Munthali Chimulekeⁱ, Elwasila Mukhtar Mohamed Elwasila^h, Tsige-Yohannes Habte^j, Michael B. Krawinkel^j, Nyori Jeremiah Mbugua^b, Kavoi Mutuku Muendo^b, El Amin Sanjak^h, Martin Schüring^k

^a Rhine-Waal University of Applied Sciences, Marie-Curie-Str. 1, 47533 Kleve, Germany, ^b Jomo Kenyatta University of Agriculture and Technology, Kenya, ^c ICRAF, United Nations Avenue, Gigiri, PO Box 30677, Nairobi, 00100, Kenya, ^d University of Kordofan, 157 Elobeid 51111, Gama'a Street, Sudan, ^e Baola Social Business GmbH, Tizianstraße 3, 80637 München, Germany, ^f PhytoTrade Africa, 5 Calvert Avenue, London, E2 7JP, UK, ^g Wild Living Resources, P.O Box 974, Kilifi, 80108, Kenya, ^h University of Khartoum, Gamma Ave, Khartoum 11111, Sudan, ⁱ Mzuzu University, Luwingu, Mzuzu 2, Malawi, ^j Justus-Liebig University, Institute of Nutritional Sciences, Justus-Liebig-University Giessen, Wilhelmstr. 20, 35392 Giessen, Germany, ^k ttz Bremerhaven, Fischkai 1, 27572 Bremerhaven, Germany

*Corresponding author: dietrich.darr@hochschule-rhein-waal.de

Key words: Fruit tree, Food security, Underutilized species, Nutrition, Value chain, Kenya, Sudan, Workshop

Abstract

Baobab (*Adansonia digitata* L.) is a tree widely grown throughout sub-Saharan Africa. Its exceptionally nutritious fruit has the potential to play an important role in family nutrition and food security in marginalized rural communities. In addition, baobab products have a growing market in Europe and the US, which offers income opportunities for baobab producers in Africa. Little is known about baobab trees, baobab products and markets in East Africa, particularly in Kenya and Sudan which gave reason to form the project BAOFRUIT. During stakeholder workshops and field visits in Germany and Kenya the available information was exchanged and knowledge gaps were identified. The project consortium includes research institutions and private companies from Kenya, Sudan, Malawi, UK and Germany.

The results of the workshops include the urgent need to investigate the current contribution of baobab products to local diets, food security, income generation and the active promotion of baobab fruit as a beneficial foodstuff. Furthermore, the ecology, distribution and abundance of baobab and possible future changes need to be assessed.

Introduction

Baobab (*Adansonia digitata* L.) is a majestic tree that occurs naturally throughout the drier parts of sub-Saharan Africa, which are hot spots of food and nutritional insecurity and socio-economic marginalization (IFAD 2011). The species, of which many parts can be used for food (see e.g. Gebauer et al. 2002; Sidibe and William 2002), has an important role in addressing such issues

(Jamnadass et al. 2011; Adam et al. 2012), particularly for marginalized rural communities. The fruit pulp is of high nutritional value, especially regarding calcium and vitamin C (Stadlmayr et al. 2013), has pre-biotic and antioxidant functions and high dietary fiber content (Gebauer et al. 2002). Other edible parts of the baobab such as the leaves, young roots and oil from the seeds also provide valuable nutrients and are eaten either regularly or in times of food scarcity. In addition, baobab parts are being processed by local communities into diverse products such as juice, sweets and snacks (Gebauer et al. 2014). Baobab also provides a variety of medicines, bark for making ropes and baskets, and material for tools and handicrafts (Wickens and Lowe 2008).

However, in Eastern Africa, the species is regarded as underutilized as its potential for improving local diets and livelihoods is not yet fully recognized. Also, value chains and marketing pathways are poorly developed and the species is largely neglected by research, development and extension institutions. Consequently, little information is available regarding the abundance and productivity of baobab trees in Eastern Africa including the present contribution of baobab to local food security and livelihoods.

Since 2008, dried baobab fruit pulp has been accepted as a novel food ingredient in the European Union and for the US market (CEC 2008; FDA 2009). This poses a signal for an expansion of demand and a vital condition for market access thus increasing efficiency of its marketing channels. It may provide a vital incentive to realize more of baobab's potential economic value and hence present incentives for conservation through the use or even domestication of this resource. Constraints to full use of baobab's economic potential have been identified in terms of limited availability of planting material (fruits are mainly harvested from natural stands), lack of knowledge on sustainable resource management techniques, poor fruit processing technologies and the lack of well-organized market chains (Wickens and Lowe 2008).

Literature Review

The vast majority of recent research activities on baobab have mainly focused on Southern and Western Africa. Only a small number of scientists have concentrated their research on East African countries like Kenya and Sudan.

Both genetics and the environment play a role in baobab morphology (Cuni Sanchez 2010). For example, in Mali and Malawi fruits from baobab trees in hotter and drier areas were roundish, had smaller seeds and lower pulp percentage than those from wetter areas (Cuni Sanchez 2010).

A study in South Africa on baobab productivity across five land-use types showed that fruit production was only slightly better in villages and fields as compared to nature reserves, plains and rocky outcrops. Also, there only seems to be a weak relationship between tree size and fruit production. The age of the tree, however, seems to be a significant factor. Adult trees with a stem diameter of more than 100 cm produce more fruits than smaller and thus younger trees (Venter & Witkowski, 2010). In Mali, baobab fruits demonstrate a high phenotypic variation in numerous characteristics, which may present opportunities for selection and cultivar development (De Smedt et al. 2010). An ethnobotanical survey in Benin, Burkina Faso, Ghana and Senegal emphasizes the importance of involving indigenous people when it comes to baobab improvement. Particularly older women provide rich knowledge of baobab trees which allows them to distinguish the ones with many desirable traits (the 'female' trees) to the ones with undesirable traits (the 'male' trees). The term 'male' and 'female' trees are used by local people to define nonproductive and productive trees respectively (Assogbadjo et al. 2008).

For Kenya and Sudan, only little information on baobab is available. In Kenya for example, baobabs were found on 50% of the 104 farms surveyed in a semi-arid area of Eastern Kenya (Kehlenbeck et al. 2013). In Sudan, Gebauer and Luedeling (2013) mapped wild baobab trees and recorded a high morphological diversity in various fruit traits. Furthermore, Wiehle et al. (2014) observed high genetic diversity of baobabs in homesteads in the Nuba Mountains in Sudan.

A thorough market chain analysis of baobab and tamarind took place in Mali and Benin (De Caluwé, 2011). Amongst others, De Caluwé described the many different uses of baobab in terms of food and medicine. However, desirable fruit traits such as the maturity of the fruit or the size of the capsule seem to vary from one ethnic group to another. In Benin, the Ditamari ethnic group prefers

precociousness and small size capsules whereas the Gourmantché and Mossi ethnic groups from Burkina Faso appreciate big capsules with fatty, delicious kernels (Assogbadjo et al. 2008). Local preferences therefore need to be taken into account if a domestication program is planned. This would also imply that domestication strategies would need to be specific to each country (Assogbadjo et al. 2008).

Many authors agree with Bennett (2006) that natural products from Africa such as baobab present an income opportunity for vulnerable and poor local communities. This could be enhanced by the acceptance of baobab fruit pulp as a novel food ingredient in the European Commission (EC). However, Buchmann et al. (2010) stress the importance of baobab for the local population in Benin, Mali and Senegal, while the latter is already a major exporter of baobab produce. They regard the recent decision of the EC as a potential threat to family nutrition and food security for rural people, but there is a lack of data on this important issue so far.

BAOFRUIT project

BAOFRUIT is a joint project which was funded by the German Federal Ministry of Education and Research (BMBF, 01DG13015) between September 2013 and July 2014. The aim of BAOFRUIT is the exploration of sustainable use and commercialisation of products based on baobab to improve food and nutrition security and to combat rural poverty in East Africa. To assist this goal, a consortium of baobab experts has been established, workshops performed and a joint research proposal developed and submitted to fund-raise for future research activities. The members of BAOFRUIT consist of partners from research institutions, NGOs and the private sector in Kenya, Sudan, Malawi, UK and Germany.

In the context of this project a number of activities were performed: First, a kick-off workshop with key partners was conducted in Kleve (Germany) for defining research priorities. After an extensive study of secondary literature a pilot study regarding the distribution of baobab trees in Kenya and Sudan took place. Finally, a field trip was performed in Kenya and results were discussed and composed during a second stakeholder workshop in Nairobi. The outcome of BAOFRUIT was presented at various conferences and in a conference paper (Darr & North 2014).

Results of the BAOFRUIT activities

Research has shown that the current contribution of baobab products to local diets, food security and income generation needs to be investigated further, particularly in countries such as Kenya and Sudan. Knowledge and capacity of communities on sustainable baobab utilization seems to be low. At this point in time extension services do not promote technologies for sustainable baobab management, processing and utilization.

A map that would show the distribution, densities and age structures of baobab trees should be developed for Kenya and Sudan which would greatly assist in estimating present and future production potential for different regions. Domestication, which includes selection of superior mother trees, their vegetative propagation and cultivation on farms (Buchmann et al. 2010) could be a viable strategy to sustain the requested supply of baobab raw materials and to reduce any possible competition between subsistence and commercial use of this resource. To select superior mother trees, further characterization of morphological fruit traits, individual tree productivity and nutrient contents of the fruit pulp needs to be performed. In addition, protocols for vegetative propagation of baobab should be developed.

Traditional processing technologies may have the potential to be improved, however, the impact of processing on nutritional value of the end product needs to be investigated.

Future research should therefore address the possible contribution of baobab production, processing, marketing and consumption to sustainably improve livelihoods, food security and nutrition security in the local rural communities of Kenya and Sudan. Ways need to be identified that actively promote baobab as an excellent natural source of nutrient-dense food and for income generation.

Acknowledgment

This project was supported by the Federal Ministry of Education and Research (BMBF, 01DG13015).

References

- Adam YO, Eisa MA, Ahmed DM (2012) Role of *Adansonia digitata* L. fruits in development and forest conservation in Rashad locality, Nuba Mountains, Sudan. *U of K J Agric Sci* 20:314–328
- Assogbadjo AE, Glèlè Kakaï R, Chadare FJ, Thomson L, Kyndt T, Sinsin B, van Damme P (2008) Folk classification, perception and preferences of baobab products in West Africa: consequences for species conservation and improvement. *Econ Bot* 62:74–84
- Bennett B (2006) Natural products: the new engine for African trade growth. Technical report. Regional trade facilitation programme/Natural Resources Institute, UK
- Buchmann C, Prehler S, Hartl A, Vogl CR (2010) The importance of baobab (*Adansonia digitata* L.) in rural West African subsistence—suggestion of a cautionary approach to international market export of baobab fruits. *Ecol Food Nutr* 49:145–172
- Europäische Kommission (2008) Commission decision: authorising the placing on the market of Baobab dried fruit pulp as a novel food ingredient under Regulation (EC) No 258/97 of the European Parliament and of the Council. *Official J EU*, L 183(38):1–2
- Cuni Sanchez A, De Smedt S, Haq N, Samson R (2011) Comparative study on baobab fruit morphological variation between western and south-eastern Africa: opportunities for domestication. *Genet Resour Crop Evol* 58:1143–1156
- Darr D, North R (2014) Challenges and opportunities for developing the use of baobab (*Adansonia digitata* L.) in the African and European food industry value chains. In: Domke, Maxi; Tarig Elsheikh Mahmoud (Eds.) (in press): Welcome to Africa: Scientific Cooperation Network on Climate Change Adaptation. Proceedings of the Welcome to Africa Summer-School Workshop 2014. Wondo Genet College of Forestry, Ethiopia, 12-13 March 2014. Technische Universität Dresden. Tharandt, Germany: Scientific Cooperation Network
- De Caluwé E (2011) Market chain analysis of baobab (*Adansonia digitata* L.) and tamarind (*Tamarindus indica* L.) products in Mali and Benin. Ph.D. thesis, Faculty of Bioscience Engineering, Ghent University, Ghent, Belgium
- De Smedt S, Alaerts K, Kouyaté AM, Van Damme P, Potters G, Samson R (2010) Phenotypic variation of baobab (*Adansonia digitata* L.) fruit traits in Mali. *Agroforestry Systems* 82:87–97
- FDA (2009) Agency response letter GRAS notice no. GRN000273, 25/July/2009. US Food and Drug Administration. <http://www.fda.gov/Food/IngredientsPackagingLabeling/GRAS/NoticeInventory/ucm174945.htm> [last accessed on 06/10/2014]
- Gebauer J, Assem A, Busch E, Hardtmann S, Möckel D, Krebs F, Ziegler T, Wichern F, Wiehle M, Kehlenbeck K (2014) Der Baobab (*Adansonia digitata* L.): Wildobst aus Afrika für Deutschland und Europa?! *Erwerbs-Obstbau* 56:9–24
- Gebauer J, El-Siddig K, Ebert G (2002) Baobab (*Adansonia digitata* L.): a review on a multipurpose tree with promising future in the Sudan. *Eur J Hort Sci* 67:155–160
- Gebauer J, Luedeling E (2013) A note on baobab (*Adansonia digitata* L.) in Kordofan, Sudan. *Genet Resour Crop Evol* 60:1587–1596.
- Gruenwald J, Galizia M (2005) Market brief in the European Union for selected natural ingredients derived from native species. *Adansonia digitata* L., Baobab. United Nations Conference on Trade and Development, UN, Schweiz
- IFAD (2011). Enabling poor rural people to overcome poverty in Kenya. International Fund for Agricultural Development, Rome, Italy
- Jamnadass RH, Dawson IK, Franzel Z, Leakey RRB, Mithöfer D, Akinnifesi FK, Tchoundjeu Z (2011) Improving livelihoods and nutrition in sub-Saharan Africa through the promotion of indigenous and exotic fruit production in smallholders' agroforestry systems. A review. *Int For Rev* 13:1–17
- Kehlenbeck K, Asaah E, Jamnadass R (2013) Diversity of indigenous fruit trees and their contribution to nutrition and livelihoods in sub-Saharan Africa: examples from Kenya and Cameroon. In: Fanzo J, Hunter D, Borelli T, Mattei F (eds.) *Diversifying Food and Diets: Using Agricultural Biodiversity to Improve Nutrition and Health*. Earthscan Routledge, New York, USA, pp. 257-269
- Sidibé M, Williams JT (2002) Baobab *Adansonia digitata*. International Centre for Under-utilised Crops, UK
- Stadlmayr B, Charrondière UR, Eisenwagen S, Jamnadass R, Kehlenbeck K (2013) Nutrient composition of selected indigenous fruits from sub-Saharan Africa. *J Sci Food Agric* 93:2627–2636
- Venter S and Witkowski E, (2010) Baobab (*Adansonia digitata* L.) fruit production in communal and conservation land-use types in Southern Africa. *For Ecol Manage* 261:630–639
- Wickens GE, Lowe P (2008) *The baobabs: pachycauls of Africa, Madagascar and Australia*. Springer, UK.
- Wiehle M, Prinz K, Kehlenbeck K, Goenster S, Mohamed S A, Finkeldey R, Buerkert A, Gebauer J (2014) The African baobab (*Adansonia digitata* L.) – genetic resources in neglected populations of the Nuba Mountains, Sudan. *Am J Bot* 101:1498–1507