



Baobab fruit production and factors affecting the productivity in North Kordofan, Sudan

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General Note



Article is recommended to print as color version in recycled paper. *Save Trees, Save Nature.*

ABSTRACT

The baobab tree (*Adansonia digitata* L.) is an essential multi-purpose tree species of dry land in Sudan however, its potentiality not yet fully discovered. It's isolated and neglected from many application and uses in Sudan. The baobab fresh leaves ranked among the most intriguing vegetable on Earth. Baobab products nowadays are well known nationally and at international level. It is much known to European market than Africans. This research estimated fruit production for baobab population in *Khor-Taggat* area under farm land practice. Data was collected from 500 baobab trees. Diameter at breast height was measured. Fruits on trees and on the ground were counted. R and SPSS statistics software used for data analysis. ArcGIS was used to create the distribution map. The results showed a significant variation in the diameters of trees, number of fruits produced. The average circumference, diameter at breast height and tree heights were 4.7 m, 1.5 m, and 19 m while the average number of fruits per tree was 20 fruits. However, the maximum number of fruits was 675. The study concluded that baobab trees in the area are productive and promised. However, some factors affected on the population of the trees and its fruit production. These factors affecting the productivity is mainly intensive-harvesting of leaves however, factors affecting the population are grazing, erosion and other anthropological factors. As a result of these factors, the fruit production has been negatively affected. Baobab trees in Kordofan need urgent intervention for both

conservation and sustainability of production. The research furnished some crucial solutions that could drive the force of interventions toward optimal utilization, proper management and developing the harvesting system.

Keywords: Baobab, tebeldi tree, productivity, leaves harvesting, Kordofan

1. INTRODUCTION

Baobab tree are important for their multipurpose uses. Their fruit used to be harvested continuously for subsistence and commercial use where harvesting has a relatively small impact on population stability, therefore mitigation of population decline should not only focus on reducing the impacts of fruit harvesting, but more importantly address the effect of predation, livestock numbers and climate change (Venter and Witkowski, 2013). Recently, the European Commission authorized the import of baobab fruit pulp as a novel food (Buchmann *et al.*, 2010) and it was approved in 2009 by the Food and Drug Administration as a food ingredient in the United States of America (Addy, 2009). Due to the high demand for commercial baobab products in EU and United States, this tree with its edible fruits needs to be conserved and treasured (Sanchez *et al.*, 2010). Baobab fruit pulp has been approved by statutory bodies for use in certain nutritional products. Although no recent turnover figures for baobab products could be located, it is certain that commercialization of baobab products (e.g. seed oil, fruit pulp) has increased especially after the FDA and EU have recognized the fruit pulp as a food supplement. The global demand for baobab has increased dramatically as more sectors, such as the cosmetic industry, developed an interest in this multipurpose plant. This in turn contributes significantly to the income of rural communities, positively affecting the livelihoods of many people (Kamatou *et al.*, 2011). Various plant parts (e.g. leaves, bark, and fruit pulp), have traditionally been used for immune stimulant, anti-inflammatory, analgesic, insect repellent and pesticidal properties, in the treatment of diarrhea and dysentery in many African countries, and have been evaluated as a substitute for imported western drugs (El-Rawy *et al.*, 1997). Baobab products are increasingly being commercialized and exported around the world leading to increased pressure on this resource (Sidibe and Williams, 2002). Baobab seed oil and baobab fruit pulp, have been exported to countries outside Africa, mainly Europe, Canada and USA. As baobab extracts become more popular, it is predicted that the demand for these resources will grow (Sidibe and Williams, 2002). According to Nour *et al.*, (1980) the fruit pulp has very high vitamin C content; almost ten times that of oranges. It contains sugars but no starch and is rich in pectin. The fruit pulp is used in preparing cool and hot drinks in rural areas and has recently, become the most popular drink during fasting months all over the country of Sudan. However the vitamin C content of the bulk fruit pulp varied from 1623 mgkg⁻¹ in one tree to 4991 mgkg⁻¹ in another (Sidibe *et al.*, 1998a). Baobab from Sudan contains naturally dehydrated fruit pulp with five times or more the vitamin C content present in oranges (53mg/100g of fruit pulp) (Eldoom *et al.*, 2014). According to Schumann *et al.*, (2010) population structure provided valuable information, given that it was combined with rates and patterns of harvesting and its impact on fruit production, on the population status, and its tolerance to harvesting. Individual baobabs bear fruits that are consistent in their shape and size; ecotypes from various regions of the Sudan were found to vary widely in fruit shape (Gebauer *et al.*, 2005), which in turn determined the number and weight of the seeds, globose fruits having more and heavier seeds than others. According to Ibiyemi *et al.*, (1988), a mature baobab should produce more than 250 fruit and provide at least 30 kg of food annually. On falling, the woody shell of the heavy fruit often fractures, enabling termites to enter and eat the sweet pulp and by so doing free the seeds, at the same time introducing a trail of soil into the fruit which, at the onset of the rains, becomes moist and provides a suitable medium for germination (Chevalier, 1906). The invasion of termites makes the fruit unpalatable to other animals and allows the seeds to germinate *in situ*. However, young baobabs are very rarely found beneath the canopy of the parent tree; the seedlings fail to survive. Wickens (2008) pointed that deforesting savanna woodland for cultivation and fuel, leaving traditional fruit-bearing trees, is anthropogenic parkland; species such as *Adansonia digitata* and *Faidherbia albida* bear silent witness to the economic value placed by the local people on the retention of such trees. In the Nuba Mountains, Sudan, Sweeney (1973) observed brown or Meyer's parrots (*Poicephalus meyeri*) on the ground feeding on broken baobab fruits. Although typically a ground feeder, the yellow-fronted canary (*Serinus mozambicus*), conspicuous because of its yellow rump, will feed on buds and flowers in the tree tops and is often associated with baobabs in the coastal districts of East Africa. The greater or black-throated honey-guide (*Indicator indicator*) has acquired the habit of guiding humans to the nests of wild bees, which are often found in baobabs (Wickens, 2008).

2. STUDY AREA

North Kordofan state where the study site located roughly falls between latitude 10.5° and 15° north and longitude 27.5° and 32° east, it occupies a total area of about 185,302 km². The climate is hot and semi-arid with mean annual rainfall varying from 300 mm

in the north to over 900 mm in the south. Rainfall is concentrated in a single short season which increases in reliability and length from north (July–September) to south (May–October).

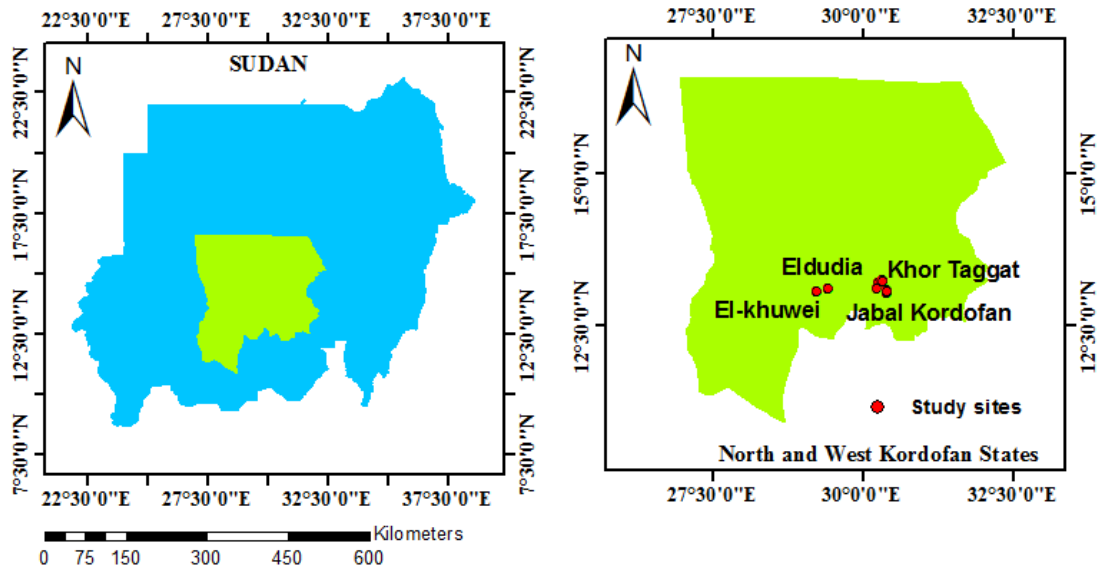


Figure 1 Study areas and study sites (developed by the author, 2017)

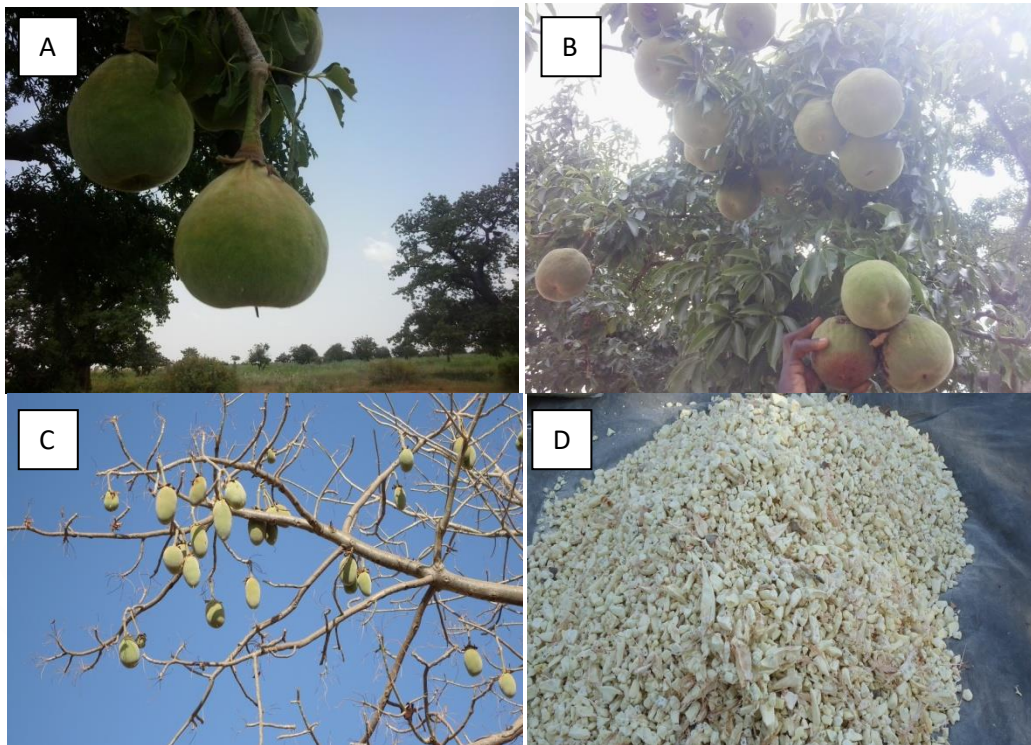


Figure 2 Bell shaped fruit (A), group of fruit on the branch (B), hanged fruits (C) and fruit pulp (D)

Generally, the rainy season normally extends from June/July to September/October. However, the period between the first and last useful rains is limited to 70 to 90 days only. Average maximum monthly temperatures range from 29.9°C in January to 39.6°C in May with average value of 34.5°C. The minimum average monthly temperatures vary from 13.3°C, in January, to 24.7°C in June with an average value of 20.3°C for the same period. Davies (1957) describes the baobab environment in Kordofan as follow "In Kordofan, the scenery became, by comparison, interesting. It was undulating country, with a surface of red sand carrying thick yellow grass and forests of the acacia which yield gum arabic. Rocky Mountains appeared to the south; and every now and then, in some

clayey depression or on the edge of dried-up watercourse, there was one of the immense baobab trees which provide rope from their bark and medicine from their fruit and, in well-less areas of western Kordofan, were hollowed out as cisterns". The differences in historical development between traditional farming systems in North and west Kordofan has been recognized, (UNDEP, 2003) specifically, that gum arabic collection from the *Hashab* trees (*Acacia senegal*) is an important source of income besides its role in integrating traditional agricultural and livestock production in the area. *Hashab* (gum arabic) trees provide people with a traditional cash crop. According to the prevalent kind of tenure in North Kordofan, smallholder tenure predominates, with a limited number of families in a few places owning large *Hashab* areas (100-300 Feddan equivalents to 42-126 ha). A shifting cultivation system is widely used in the state, especially in the Enuhud locality, where the *Hashab* stands are established along with the shifting cultivation system; hence, *Hashab* stands are found intermingled with cultivation, and when they reach a non-productive age they are removed for cultivation. In most villages a household owns 2-3 plots, compared to clayey property rights are more fixed in the sandy areas due to prolonged settlement and the succession of cultivation and *Hashab* on the same plot (IIED and IES, 1990) (fig. 1 & 2).

Sampling and measurements

Data collection took place in September and October as season for fruit production and flowering was over. Five hundred (500) baobab trees grown in *Khor-Taggat* area were enumerated. GPS coordinates were recorded. Diameter at breast height (DBH) was measured, hanged and fallen fruits were counted. Key informant interview was also done. Observation and necessary remarks were recorded too.

Data analysis

The R statistics software and Statistical packages for Social Sciences (SPSS) were applied for data analysis. Descriptive statistics was done. The results were shown in the table, histograms and box plots.

3. RESULTS AND DISCUSSION

Spatial distribution of Baobab trees

The spatial distribution of Baobab trees in *Khor Taggat* area was showed in Figure (3). The Baobab trees were distributed around the resident area and farmland. The Baobab populations in this site were found in groups forming V-shape toward the Northern eastern part of the area. They concentrated in area of latitudes $13^{\circ} 12' 0''$ N and $30^{\circ} 16' 30''$ E.

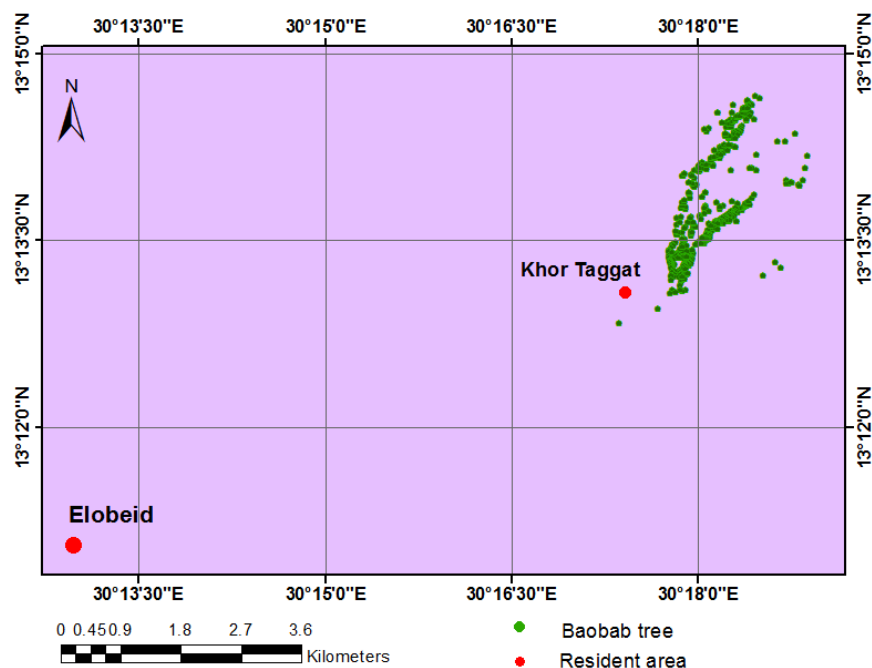


Figure 3 Spatial distribution of Baobab trees in Northern part of Khor-Taggat area, North Kordofan

Tree attributes density and dbh size class distribution

Table 3 Tree attributes and number of fruits/tree in Khor-Taggat area, North Kordofan, Sudan

Characteristics	Circumference (m)	DBH (m)	H (m)	No. of fruits	No. of fallen fruits
Mean	4.70±3.1	1.50±0.9	19.45±9.3	20±64	1±5.6
Mode	4.00	1.27	20.00	0	0
Minimum	0.40	0.13	0.17	0	0
Maximum	30.0	9.55	38.00	675	75

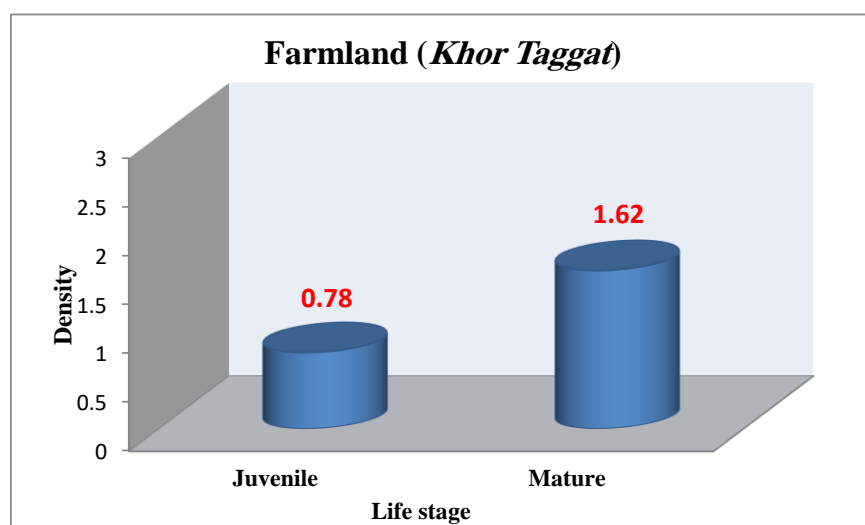


Figure 4 Density of juvenile and mature Baobab trees in farmland

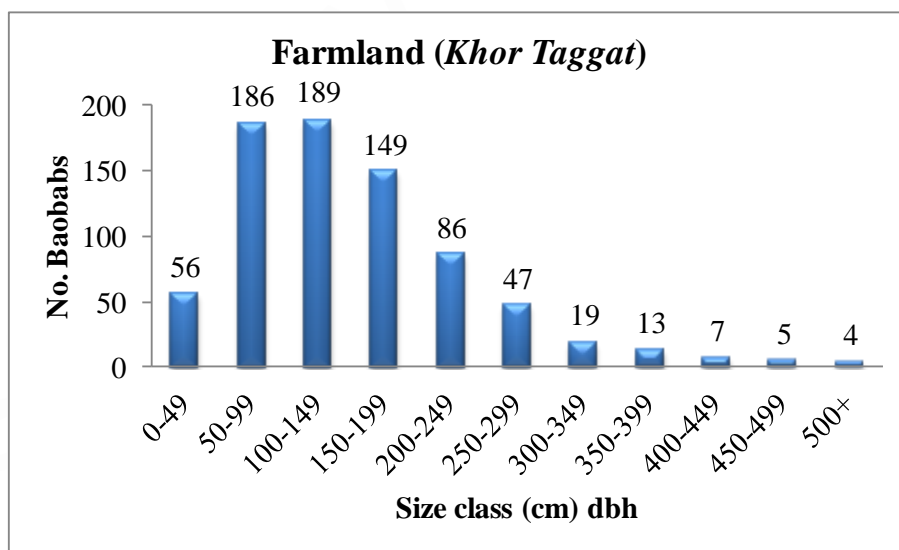


Figure 5 Size class distributions of Baobab trees in the study area

The results table 3 showed a significant variation in the diameters of trees, number of fruits produced. The average circumference, dbh, and height of the tree were 4.7 m, 1.5 m, and 19 m while the average number of fruits per tree was 20 fruits. However, the maximum number of fruits per tree was 675 fruits. The results showed that baobab trees in the area are productive and promised. However, many factors affect the trees and fruit production such as intensive harvesting of leaves and other anthropological factors. In September, almost trees bear flower buds followed by fruit buds. The leaves sending continuing that is why it attracts the harvester throughout. Most of the harvester do not consider important and the significant of this stage. The intention of the people is to get the leaves whatever they are. At this moment and usually there is occurrence of leaves on small associated with flower buds

and fruit buds. Usually, harvesters are not the tree owners of the trees; consequently no much care is paid to such conditions. Sometimes when owners are away from their farmland or busy with agricultural activities harvest mis-use the tree in term of harvesting and its sustainability. As a result of this practice the fruit production being negatively affected. Baobab trees in Kordofan need urgent intervention for both conservation and sustainability. The research furnished some crucial solutions that could drive the force of interventions toward optimal utilization, proper management and developing harvesting system. Beside that some natural factors are also contribute indirectly in reducing the production of the trees such as wind storms, heavy rain-fall during the flowering period and budding period. The bird hunters hit small fruits, flowers, buds and immature fruit while shooting the birds. Insects attach young and wet fruits and lead to easy microbial infestation. Some people target fruits and harvest whatever is on hand, they do not distinguish between ripen and unripen fruit. Moreover, harvesting new wet branches for robe making is widely common and reduces the production. Extraction of pulp and seeds outside baobab areas resulted in low regeneration.

In farmland (Figures 4 - 7), fruits were presented in all categorized size classes. However, in other land use type, there were no fruits counted in some size classes. This figure also indicated that majority of the trees produce more than 400 fruits per season however, few trees produced more than that.

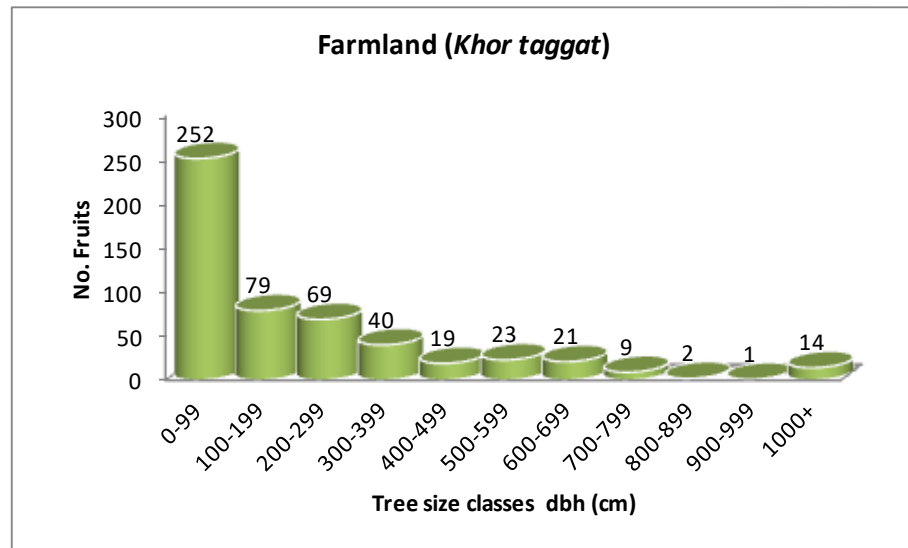


Figure 6 Number and size class distribution of Baobab fruits in farmland

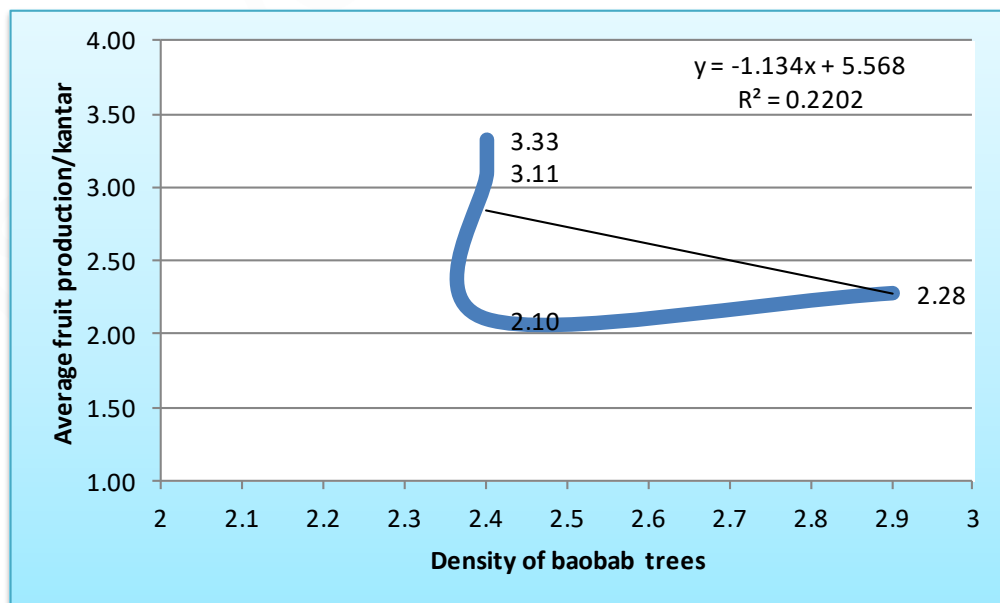


Figure 7 Number and size class distribution of Baobab fruits in farmland

Productive and non-productive baobab trees

With regards to the fruit production, there was 95% of respondents mentioned that the majority Baobab trees in the area produce fruits with variation. Some trees produce fruits annually while others produce fruits year after another. In the same line, 5% of respondents stated that some trees do not produce fruit at all (sterile trees), they stated that they have never seen fruits on those trees. They also considered these trees as male trees. To sum up 96% of respondents stated that there was variation in production of the fruits from year to another.

Baobab tree calendar

Months of Baobab fruits collection according to respondents knowledge. Fruit collection is carried out from October to December, November to December and November to February respectively. The flowering of Baobab was detected at the mid of rainy season. However, some trees send flowers even before rainfall. In case of early rainfall and according to respondents' knowledge very few fruits or nothing will be expected in that year. Respondents think that early rainfall drops flower buds which are the base of fruiting. This case reduces consequently the number of fruit which is supposed to be produced. The fruiting of Baobab trees in Kordofan varied between North Kordofan to West Kordofan, it also varies from tree to another and from year to another sometimes starts in June, July or even in September; the ripening of fruit then follows and continues to reach maturity in November in West Kordofan or up to December in North Kordofan. The fruit collection started in November and continues up to February as the case in North Kordofan. These results match with Wicknes (1982) who reported that flowering starts at the rainy season which is August at that time and continue up to October while he reported that fruiting starts from October up to December. These variations could be attributed to the site and site condition and to the climatic factors as well. In general, the stated months of flowering, fruiting and collection were five months; October, November, December, January and February. In detailed, the fruiting of Baobab trees in North Kordofan begins late September; the fruit ripening followed and continues to reach maturity in November up to December. The fruit collection starts from November and continues up to February. There were variations in fruiting calendar between sites and between trees even in the same site (Figure 8).

	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March
Flowering												
Fruit budding												
Fruiting												
Fruit maturity												
Fruit collection												
Leaf shedding												
Leafing												

Figure 8 Baobab tree calendar

4. CONCLUSION

Mature Baobab trees are the dominant ones and their proportions were higher than the proportions of juveniles. The lower height size classes (≤ 5 and $5.1 - 10$) encompassed scanty proportion of Baobab trees in farmland area. There were variations in fruit productivity. Some trees produce more than thousand fruits while others produce only one fruit per season. Bird-hunting, rope-making, brick-making, intensive leaf-Harvesting, mal-harvesting, termites, pests and diseases and wind storms are the most factors affecting fruit productivity and production.

Recommendations

It is recommended that FNC should establish Baobab reserves across baobab Belt, impeding grazing and browsing around Baobab populations and introducing Model Harvesting Technique (MHTs) for both fruits and leaves. Moreover, raising people awareness with regards to opportunities, ecology, and product promotion of Baobab products is important issue. Prohibiting soil excavation and brick making nearby Baobab trees enable growing of natural regeneration of baobab trees.

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Conflict of Interest:

The authors declare that there are no conflicts of interests.

Peer-review:

External peer-review was done through double-blind method.

Data and materials availability:

All data associated with this study are present in the paper.

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