Asian Journal of Agricultural Sciences 3(4): 286-290, 2011
ISSN: 2041-3890

Received: April 10, 2011 Accepted: May 13, 2011 Published: July 20, 2011

Uses and Conservation Status of *Balanites aegyptiaca* (L.) Del. (Hegleig Tree) in Sudan: Local People Perspective

[1]A.A. Elfeel and [2]E.I. Warrag
[1]Department of Arid land Agriculture, King Abdulaziz University, KSA
[2]Faculty of Forestry, University of Khartoum, Sudan

Abstract: The aim of this study was to evaluate the current and potential values and identify main threatening factors of *Balanites aegyptiaca* in Sudan. Three areas were selected for data collection (Umm Abdalla, Boat and Id Elfrissan). Group discussion was carried out to tap local community knowledge about the species uses, potentials and threatening factors. Then structured interview was used to verify and check the information generated in group discussion. A total of 120 respondents from the three areas were interviewed. Results showed that Hegleig tree is very important multi-purpose tree for livelihood of local communities in many areas of the Sudan. The gene pool of the species was severely affected by many deteriorating factors like lopping of branches, grazing, mechanized farming and gap in transfer of indigenous knowledge. These factors were combined with removal of associated trees and retaining Balanites which made it vulnerable. Protection, in situ conservation stands and conservation in use is the most suitable measures for this species in Sudan.

Key words: Conservation measures, Endangered, local knowledge, non-wood, utilization pattern

INTRODUCTION

Balanites aegyptiaca (hegleig) is widely distributed in Africa, Arabian peninsula and as far as Pakistan (Arbonnier, 2004; Hall and Walker, 1991; Hall, 1992), with large patterns of variation including intraspecific taxa (Sands, 2001). It is an indigenous species in Sudan with a wide range of natural occurrence over diverse climatic and edaphic conditions (Suliman and Jackson, 1959). Its traditional roles and values were well known for thousands of years as fruits were found in tombs of the 12th Egyptian dynasty (Von Maydell, 1986). The tree is used for food and fodder (Elseed *et al*., 2002; Billore, 1988), as agroforestry tree (ICRAF, 1998) and has a wide range of medicinal uses. The seed kernel contains high amount of oil and protein that varies among different sources (Elfeel, 2010). The oil is very similar to sesame and groundnuts oils in quality and quantity (Abu Al-Futuh, 1983) and has no any serious safety concern (Obidah *et al*., 2009). Also, it can be used for biodiesel production (Chapagain *et al*., 2009) and has anticancer activities (Hanan *et al*., 2009). The most important parts are fruit pulp and kernel that contain saponin, which have wide industrial and medicinal values (Beit-Yanai, 2010; Farid *et al*., 2002; FAO, 1985).

B. aegyptiaca has good natural regeneration, sprout well and coppice freely in Sudan (El-Nour, 1994). It has been protected in Sudan by native customs and retained on farms for non-timber product values and benefits that were essential for rural livelihood. However, substantial impacts were exerted on the tree that led to loss of large number of trees and populations. It was believed that the gene pool was reduced and genetic erosion was occurring within and between natural populations (HCENR, 2001). Accordingly, it was declared as an endangered priority species and its cutting was banned (Warrag *et al*. 2002). The species was identified as over exploited in Africa, that needs prompt action in germplasm collection, provenance and progeny testing and establishment of *ex situ* and *in situ* conservation measures (FAO, 2001).

Actual and potential values for Sudan were emphasized by Abu-Al-Futuh (1983). Commercial products can be extracted from fruits that can generate annually more than US$ 80 million. Such economic returns will provide direct income to many rural areas and to country and that will lead to protection of trees and eventually its genetic conservation (conservation by use of non-timber products).

Little attention was given to this species and valuable information was disappearing such as indigenous knowledge. The current conservation status is not known. Conservation status refers to the present state of the tree and risk of depletion in the future (Graudal *et al*., 1997; Kjaer and Graudal, 2000). To develop and implement effective genetic conservation strategies it is necessary to integrate information drawn from several areas, including local people's knowledge (Isager, 2003). Many techniques and tools are used for generating community knowledge about trees and their uses and values. These include semi-structured and key informant interviews,

Corresponding Author: Abdalla A. Elfeel, Department of Arid land Agriculture, King Abdulaziz University, KSA

institutional analysis, transects walks, matrix scoring and ranking, participatory mapping and diagramming (Vabi, 1996).

The aim of this study was to evaluate the current and potential values of the species, identify main threats and analyze the risks through local people's perspectives.

Specifically,

- To tap information from local community knowledge about known uses and values.
- To assess the present state of the tree, the deteriorating factors and trend of change and measures needed for conservation of the species.

MATERIALS AND METHODS

Study areas: Data was collected from three areas in Sudan during the season 2008/2009. These areas represent the natural distribution of *B. aegyptiaca* with different tree association and land use patterns. The areas are: Id Elfrissan, which is located within the Baggara catena (Baggara belt) in Darfur. The major soil is sandy clay loam. However, within this zone stabilized sand dunes (Al-atamur) alternate with slightly lower flats of non cracking clay (Naga'a). The later is impervious and is flooded during the rainy season. Balanites in this zone is found in areas with more lighter soils and at the bank of the wadis, but it can even be found in Nga'a soil. Umm Abdallah, lies west of Rashad in Tageli area, Eastern Nuba Mountains. In this zone Acacia species are prominent, but the introduction of Combretaceae and other broad leaved trees gave a unique landscape outlook for this area. *B. aegyptica* is associated with both acacias and combretums. Boat, located west of Ed Damazin in the one of main mechanized crop production schemes, where most of the trees were removed for mechanized cropping. The main soil is clay soil. Balanites is associated with Acacia seyal, Acacia Senegal and other species.

Data collection: Data were collected based on group discussion as well as structured interview.

The group discussion took place in two villages in Umm Abdalla area and two villages in Boat area. Walking around discussions were carried with communities, where they identified known uses, trends in utilization pattern, land use pattern and its effect on species. Extend of new and young regeneration, past and present distribution, main threats and action required restoring the situation and whether there are any community forestry programs and is the species is targeted in these programs.

A questionnaire was then designed according to information obtained in group discussion. The structured interview was used to verify and check the information generated in group discussion. A stratified random sampling design was used in which two villages were selected in each of the three areas. A total of 120 households who are native to the area were interviewed. Each respondent was asked to indicate main uses, threats and present status, distribution and extend of regeneration and their perception in the establishment and maintenance of the species.

Data analysis: The collected data from the questionnaire were statistically analyzed using frequency distribution according to El-Nakhlawy (2008).

RESULTS

Group discussion: In group discussion local people identified many uses of the tree, most of it is non-wood uses. These include medicine for treatment of stomach pains, diabetics, healing of wounds, jaundice, human and animal food, oil, nuts (kornaka). Also the tree used for shade during dry season, praying beads (seibha), Quran tablets (looh), hand tools, saddles, and native mortars. Peoples also belief that the tree has a high religious value, where others cited that the tree brings thunder and demon. The traditional methods of nuts preparation are by boiling and changing of the water for four consecutive times, to remove the bitter taste of the kernel. Debittered kernel is then used as snacks or mixed with honey and used to increase the male sexual drive. While the oil is extracted by crushing the hard woody shells by stones, grounding by native mortars and stirred slowly in boiling water, then the oil is separated from the water and boiled again to remove the remaining water.

Despite all these uses the tree was endangered in many places. The identified causes of tree deterioration cited by local people were mechanized cropping, selective cutting for furniture industry, over grazing and lopping of branches for browsing and gap in transfer of local knowledge between generations. The new emerging factors are die-back in Umm Abdalla and Boat and tree locust. People debated that most of these factors emerged as the results of the removal of hegleig associates and retaining hegleig as only available tree in these areas.

The actions required to restore the conditions identified in group discussion are:

- Protection of natural regeneration and that was preferred over planting.
- Development of better techniques for processing of fruits as removal of the kernel from the hard woody shell is a major problem hindering utilization of fruits.
- Improvement of marketing channels.
- Extension on the current and potential values of the species

Table 1: Relative frequency distribution about known uses of Heglig in Umm Abdalla, Boat and Id Elfrissan Areas

Use	Umm Abdalla (%)	Boat (%)	Id Elfrissan (%)
Furniture	25	63.2	47.1
Hand tools	80	60.5	58.8
Human food	95	97.4	100
Animal food	100	86.8	94.1
Nuts (kernal)	95	18.4	52.9
Oil	90	36.8	70.6
Browsing/grazing	100	76.3	88.2
Shade	100	89.5	88.2
Praying beads (seibha)	95	63.2	76.5
Quran tablets	100	92.1	88.2
Medicinal	100	63.2	76.5
leaves as vegetables	90	15.8	76.5
Saddles	20	-	-
Fuel	10	-	-
Soap	5	-	-

Table 2: Relative frequency distribution about extend of distribution and regeneration of Heglig in Umm Abdalla, Boat and Id Elfrissan Areas

State	Umm Abdalla %	Boat %	Id Elfrissan %
Occur in pure stands	0	5.3	5.9
Occur in mixed trees	100	84.2	70.6
Presence of big trees	100	100	100
Presence of small tress	70	47.4	82.4
Presence of young regeneration	80	31.6	70.6
Found on Clay soil	100	94.7	94.1
Found on Sand soil	5	5.3	17.6
Found on Silt	5	18.4	47.1
Found on Gardud and Naga'a (compact)	90	42.1	52.9

Local people revealed that commercialization of the fruit were developed in recent years, due to its high fruit value. However, they believe that they received the least benefits than the middlemen. A medium scale production and trade of kornaka for export and local use was observed. Also small factory for large scale production of oil and soap was established in Abu Jubeiha. However, this was stopped due to the difficulty in extracting the kernel from the hard woody shell. In Singa Town the closed steamed bend wood factory (closed when cutting banned by the law) and presence of many private saw mills led to a very large scale selective felling of Hegleig in these areas.

Structured interview: The structured interview confirmed the group discussion data, that most of known uses of the tree are non-wood (Table 1). About 70-100% respondents indicated that the tree is found in association with many trees, Majority of them (more than 70%) cited good natural regeneration, except Boat where mechanized farming affected natural regeneration (Table 2).

Table 3: Relative frequency distribution about Present Status of Heglig in Umm Abdalla, Boat and Id Elfrissan Areas

State	Umm Abdalla	Bule Nile	Id Elfrissan
	%	%	%
Is it endangered:	70	94.7	88.2
By: Grazing	65	28.9	76.5
Lopping	65	44.7	70.6
cutting	60	92.1	58.8
Agriculture	25	94.7	64.7
Tree locust	35	18.4	47.1
Change of status	65	92.1	94.1
Decline in trees	60	52.3	82.4
Spreading north	05	2.6	0
Spreading south	25	57.9	76.5
Know cutting is banned	95	94.7	82.4
Reason: Endangered	00	50.0	47.1
Non-wood value	95	26.3	70.6
Environment	55	81.6	52.9

Majority of the respondents (70-94%) in the studied area belief that the tree was endangered. However, the underlining causes varies from area to area (Table 3). Also most of the respondents knew cutting of the tree was banned by the law, but differed in the reason behind it. In Umm Abdalla and Id Elfrissan the majority attributed it to the non-wood value of the tree, where in Boat that was attributed to environmental reasons (table 3).

Most respondents revealed that they retain Balanites while clearing their lands for farming and disagree with the cutting of the tree for wood purposes (Table 4). About 65 to 88% of respondents are willing to incorporate Balanites in community forests preferring reserving natural forest to planting new stands (Table 4). Few of them think that there is no need for establishing Balanites forests. Most of them relate this to the wide occurrence of natural reserves that only requires protection.

DISCUSSION

The study revealed that *B. aegyptiaca* is a tree of wide occurrence in Sudan. It has diverse uses and benefits and wide future potentials. This is why it was preserved by native customs in the past. The traditional techniques for extraction and processing of different products were not well developed. That led to poor links between

Table 4: Relative frequency distribution about the perception of the community in the establishment and maintenance of Hegleig tree

	Umm Abdalla (%)	Boat (%)	Id Elfrissan (%)
Retain Balanites in agric. lands	85	84.2	52.9
Against cutting of the tree	90	73.7	47.0
Is the tree targeted in extension services	20	42.1	58.8
Willingness to incorporate Balanites. in Community Forestry.	75	73.7	88.2
It is priority tree to me	90	92.1	100
Prefer protect existing trees	65	52.6	72.2
Prefer Plant more trees	50	50.0	58.8

generations. The negligence of the non-wood use of this tree combined with other factors like mechanized cropping, over grazing and lopping of branches led to threatening of this species in many areas. The people cited that the tree was never being occurred in pure stands, but the presences of the pure stands is mainly due to the removal of the tree associates. Hall and Walker (1991) and Hall (1992), reported that this tree is found in association with many tree species. Although retaining of balanites accompanied with its good natural regeneration assisted in its distribution, it has a negative effect. The tree was left stand vulnerable to many deteriorating factors like looping of branches for browsing especially in the dry season and cutting of the tree for different purposes.

The National Forest Inventory (FNC, 1998), estimated more than 93 million *B. aegyptiaca* trees in northern, central, eastern and western Sudan. Taking into account the very high fruit production per tree (Hall and Walker, 1991), it further highlights the potential of this tree in Sudan. Our observations in the field which was clarified by the study showed that there is very high and prolific regeneration, but the young regrowth were suppressed by grazing. The local people believe that the species is largely endangered or vulnerable in these areas, but differing in the threatening factors. Where in Boat area most respondents cited that agriculture is among the most deteriorating factors, in Umm Abdalla area agriculture is not serious deteriorating factor. This because in Boat mechanized farming is predominant and in Umm Abdalla still most of people use traditional farming in which they retain the tree upon clearing the land for farming. This is further confirmed with main land use pattern in Sudan (FNC, 1998). The area under mechanized cultivation in some of these area reached 55.9% and grazing is higher than land under forest. The study revealed a new phenomenon of die-back in Umm Abdalla and Boat areas. This was confirmed by Faris (2006), who showed that many trees in Sennar State were attacked by beetles that cause death of branches from top downwards. An urgent survey is strongly needed to determine the magnitude and extend of the infestation in different Areas.

A common dialogue was shown in many areas, especially in Umm Abdalla area. Some people things that because the tree now is common property, there is a conflict in multiple users interests. Some users want to lop the tree to feed their animals, where other against this because it is seriously affects fruit production. Also, while other villagers prefer preserve some trees as their own properties, in contrast others believes that this will lead to a conflict in property rights. Therefore, different interest group analysis and their impacts on the tree may be pre-requisite for designing proper conservation measures

The results of this study had shown that the species has non-timber values that can contribute to the conservation of the genetic base of *B. aegyptiaca*. The value of the fruit is now recognized by many authors (Elfeel, 2010; Beit-Yanai, 2010; Chapagain *et al*., 2009; Hanan *et al*., 2009). Extension about the potential value of this species is highly required. Also, value addition by the development of the processing of various non wood products is important. Planning different measures for conservation is urgently needed. Protection, in situ conservation stands and conservation in use is the most suitable measures for this species in Sudan.

CONCLUSION

The study revealed that the species was recognized by local people as important multi-purpose tree. However, the tree was threatened by many deteriorating factors. In situ conservation is suitable measure for this species in Sudan.

ACKNOWLEDGMENT

We are grateful to Forest National Corporation staff in Umm Abdalla, Boat and Id Elfrissan Areas for their invaluable help. Also we are thankful to AFORNET at the African Academy of Science and Sudan University of Science and.

REFERENCES

Abu-Al-Futuh, I.M., 1983. Balanites aegyptiaca: An Unutilized raw material potential ready for agro-industrial exploitation. UNIDO Document no. 12419 project TF/INT/77/021. UNIDO of the United Nations.

Arbonnier, M., 2004. Trees , Shrubs and Lianas of West African Dry Zones. CIRAD, MARGRAF Publishers GMBH.

Beit-Yannai, E., S. Ben-Shabat, N. Gold, B.P. Chapagain and R.Z. Wiesman, 2010. Antiproliferative activityof steroidal saponins from Balanites aegyptiaca-An *in vitro* study. Phytochemistry Letters.

Billore, S.K.V., 1988. Balanites Aegyptiaca: A Browse Plant of High Protein Value in Degraded Lands. In: Singh, P. and P.S. Pathak (Eds.), Rangelands Resources and Management, pp: 350-355.

Chapagain, B.P., Y. Hariv and W. Zeev, 2009. Desert date (*Balanites aegyptiaca*) as an arid lands sustainable bioresource for biodiesel. Bioresour. Technol., 100: 1221-1226.

Elfeel, AA., 2010 . Variability in Balanites aegyptiaca var. aegyptiaca seed kernel oil, protein and minerals contents between and within locations. Agric. Biol. J. North Am., (ABJNA), 1(2): 170-174.

El-Nakhlawy, F.S., 2008. Principles of statistical design and analysis of the bioexperiements. Sc. Pub. Centre, King Abdulaziz University, Saudi Arabia, pp: 364.

El-Nour, M., 1994. Natural regeneration of hegleig *Balanites aegyptiaca* (L) Dell on clay soil of central Sudan. J. Agric. Sci., 2(2).

Elseed, A.M.A.F., A.E. Amin, Khadiga, A.A. Ali, J. Sekene, M. Hishinum and K. Hamana, 2002. Nutritive evaluation of some fodder tree species during the dry season in Central Sudan. Asian-Aust. J. Anim. Sci., 15(6): 844-850.

FAO, 1985. An all purpose tree for Africa offers food and income. Ceres, 18: 6-7.

FAO, 2001. Priority species of Africa: Species identified as high global, regional and/or national priority. FAO panel of experts on forest gene resources, Electronic document, FAO, Rome, Italy.

Farid, H., E. Haslinger, O. Kunert, C. Wegner and M. Hamburger, 2002. New steroidal glycosides from Balanites aegyptiaca. Helv. Chim. Acta, 88(4): 1019-1026.

Faris, S.M., 2006. Investigation on decline of Acacia nilotica, Acacia senegal and Balanites aegyptica associated with two cerambycid beetles. Ph.D. Thesis, University of Khartoum.

Forest National Corporation (FNC), 1998. National Forest Inventory. FAO Funded by FAO under Project (GCP/SUD/047/NET).

Graudal, L., E. Kjaer, A. Thomsen and A.B. Larsen, 1997. Planning National Programmes for Conservation of Forest Genetic Resources, Technical Note No. 48, December 1997. Danida Forest Seed Centre.

Hall, J.B. and D.H. Walker, 1991. *Balanites aegyptiaca*; a Monograph. School of Agricultural and Forest Sciences Publication, University of Wales, No. 3.

Hall, J.B., 1992. Ecology of key African multipurpose tree species, Balanites aegyptiaca (Balanitaceae): The state of knowledge. Forest Ecol. Manage., 50(1-2): 1-30.

Hanan, A., Al-Ashaal, A.F. Ayman, M.M. Abd El-Aziz and M.A. Ali, 2009. Phytochemical investigation and medicinal evaluation of fixed oil of *Balanites aegyptiaca* fruits (Balantiaceae). J. Ethnopharmacol., 2(3): 495-501.

HCENR, 2001. Sudan Country Study on Bio-Diversity. NBSAP Project No. Sud/97/Q31.

ICRAF, 1998. *Balanites aegyptiaca*. Agroforestree Data Base.

Isager, L., I. Theilade and L. Thomsen, 2003. People's participation in forest conservation: Considerations and case stories. Danida Forest Centre, Denmark.

Kjaer, E.D. and L. Graudal, 2000. How can forest resources be conserved for future use, some considerations regarding techniques. Paper presented at SAFORGEN regional training workshop, Nairobi, Kenya.

Obidah, W., M.S. Nadro, G.O. Tiyafo and A.U. Wurochekke, 2009. Toxicity of crude *Balanites aegyptiaca* seed oil in rats. J. Am. Sci., 5(6): 13-165.

Sands, M.J., 2001. The desert date and its relatives: A revision of the genus Balanites. Kew Bull., 56: 1-128.

Suliman, A.M. and J.K. Jackson, 1959. The Hegleig Tree. Sudan Silva, 9(1): 1-4.

Vabi, M., 1996. Eliciting community knowledge about uses of trees through participatory rural appraisal methods: Examples from Cameroon and the Central African Republic. Rural Development Forestry Network Paper 19e, Regent's College, London, UK.

Von Maydell, H.J., 1986. Trees and Shrubs of the Sahel: Their Characteristics and Uses. Eschborn.

Warrag, E.I., A. Elshiekh and A.A. Elfeel, 2002. Forest genetic resource conservation in Sudan. Forest Gen. Resour., No. 30, FAO.