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# Local Knowledge on Trees Utilization and Their Existing Threats in Rashad District of Nuba Mountains, Sudan

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## Abstract

Rural people of Sudan are endowed with a deep knowledge concerning the utilization of different tree species. However research on the local knowledge related to tree species utilization still lacks adequate attention. The study objectives were to identify the existing local knowledge related to the utilization of the tree species and the existing threats to the availability of the trees. A total of 300 respondents were selected randomly from Rashad district in Nuba Mountains in 2011. Semi-structured interview, direct observation, group discussion, preference ranking and direct matrix ranking were used to collect the data. The study results revealed that people of Nuba Mountains utilize different tree species for food, medicinal purposes, fodder, firewood, construction and cultural ceremonies. The study results also indicated that the availability of trees is negatively influenced by firewood collection, agricultural expansion, drought, overgrazing and charcoal production. The study concluded that local knowledge has crucial role in tree species utilization in Nuba Mountains. Further researches to document and substantiate the local knowledge on useful tree species are highly recommended.

**Key Words:** local knowledge, tree utilization, medicinal plants, Nuba Mountains, Sudan

## Introduction

The last few decades have seen a considerable growth in research on the direct-use values of wild natural resources for the livelihoods of rural people (Shackleton and Shackleton 2000; Kepe 2007; Madzwamuse et al. 2007; Davenport et al. 2012; Thondhlana et al. 2012). However, there is now recognition that the environment is often a site of competing local knowledge and interests among different people and these exert a strong influence on local resource-use preferences (Mandondo 1997; Cocks 2006). Local knowledge is the knowledge that people in a given community has developed over time, and continues to develop. It is based on experience, often tested over centuries of use, adapted to the local culture and environment and held by individuals or communities. It is not confined to tribal groups or to the original inhabitants of an area (Martin 1995).

Local knowledge on resource utilization (ranging from experiences, taboos, myths, belief systems, normative ways of utilizing specific plants, selective or limited utilization to sanctions against waste that offer protection to the environment), accumulated over thousands of years, often becomes encoded in everyday cultural practices (Colding and Folke 1997; Mandondo 1997; Berkes et al. 2000; Byers et al. 2001; Kanowski and Williams 2009; Kideghesho 2009).

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The knowledge of tree species utilization by human beings for a variety of purposes (medicinal, construction, food, fodder etc.) might have been established by trial and error, and this was being passed from generation to generation (Abebe 2000), and contributed to the accumulation of a complex wealth of knowledge and skills (Winter 1995; Cotton 1996; Balick and Cox 1996). For example, an indigenous fishing community (ribeirinhos) of the lower Brazilian Amazon survives and conserves fish resources in a hostile floodplain due to the community's possession of skilled knowledge (Harris 2005). Similarly, local knowledge of the Waorani people of the Ecuadorian Amazon allows for the recuperation of depleted fauna, soil nutrients and other natural resources in their territories (Lu 2001; Clark et al. 2008) though this knowledge is rapidly dwindling (Finer et al. 2009). In Bolivia, the Quechua farmers of semi-arid Apillapampa use their expert knowledge in the sustainable use of culturally significant medicinal plants (Thomas et al. 2008). Literature also shows that modernization and high resource demand may be weakening local knowledge systems and the control they assert over resource use – demonstrating that culture is not static but changes over time to conform to varying circumstances (Bremner and Lu 2006; Pretty 2006; Finer et al. 2009; Thondhlana et al. 2011). In most instances, belief systems are not uniform across groups either and may depend on their own personal values hence some people may be just out to get the most they can from natural resources (Thondhlana and Shackleton 2103).

That said, there has been little information on local knowledge concerning natural resources utilization in Sudan. Thus, it is difficult to fully account for the various ways in which different groups of people make use of and find value in wild natural resources, with the consequence that natural resource management and conservation interventions based on direct-use values alone may omit or glance over local knowledge dynamics and differences. Several authors argue that an understanding of the complex and often diverse local knowledge meanings of natural resources use can help ensure that resource management initiatives are compatible with local concerns and build respect and trust between local communities and conservation managers (Ntiamoa-Baidu et al. 2001; Kanowski and Williams 2009; Thondhlana and Shackleton 2103). Moreover, studying local knowledge is useful in documenting, analyzing and disseminating of the knowledge on the interaction between biodiversity and human society and how it is valued in different societies and how it is influenced by human activities (Martin 1995). A case in point here is the wild tree species from Mountain areas, where local people have developed knowledge on plants, for different household activities, which are vital for their survival during food shortages, when there are no other means of satisfying their basic needs. This should raise even greater concern when looking at the frequency of recent famine events in the country and the extent to which subsistence agriculture are still the norms. So this study covering the uses of the plants in natural vegetation formation to fill the existing gap of information about the local knowledge related to tree species utilization and further promotes resource management initiatives.

## Materials and Methods

### *Study area*

The study area is located in the north-western part of the central clay plain of the Nuba Mountains in the dry land savannah zone. It lies between latitudes $10^{o}$ and $13^{o}$ north and longitudes 29° and 33° east. The Rashad district occupies a total area of 7,872 $km^2$ with a population of around 241,046 (UNDP 2003). The main land uses in the study area are traditional agriculture, animal husbandry, and forestry (Suliman 2002; Jibear 2003). Agriculture is the main activity and is practiced by all the population. Nevertheless, its contribution to household food needs is declining (UNDP 2003). The farming system is based on shifting cultivation, which involves regular demand for new farmland (Hassan 2005).

The natural vegetation in the study area comprises of tree legumes dominated by the Acacia family as well as shrubs and annual grasses. However, the vegetation varies with soil type and rainfall pattern. The north and west of the locality, where the rainfall is less abundant (mean annual rainfall is 372 mm), have poor to moderate vegetation which includes scattered Acacia trees and short grasses and shrubs, while the south and east of the study area, where the mean annual rainfall is 712 mm, have denser vegetation comprising of Acacia and other trees and tall grasses (Pantuliano 2005).

### *Sampling and data collection*

A total of 300 households were selected randomly in Rashad district, Nuba Mountains in 2011. The households with ages between 15 and 90 were selected in study area. 15 years was used as the cut-off age because most acquisition of local knowledge of plant uses occurs after the age of 15 (Gadgil et al. 1993) and because at this age adolescents start forming their own households.

Ethnobotanical data were collected using open ended or semi-structured interview, direct observation, group discussion, preference ranking, direct matrix ranking, and paired comparison as given by Martin (1995). The criteria examined were the different benefits the society gets from the existing tree species as well as the existing threats to sustainable utilization and availability of the tree species in the study area. Interviews were conducted to gather baseline quantitative and qualitative information related to the different role of tree species. Portable cassette recorder was used to record (and later verify) verbal responses during interviews. The usefulness of semi-structured interview for collecting information on plant utilization was discussed by (Alexiades 1996). In most cases such interview is conducted with single informant and allows expressing personal viewpoint freely without being interrupted (Martin 1995). A transect walk was conducted along the farmland of the community in the study area together with the key informants and local people, to have a certain highlight on the existing situation of trees utilization.

To understand local peoples' perception on activities threatening the plants, pair wise ranking was conducted and the number of possible pairs was calculated using the relation N (N-1)/2, where N is the number of factors (activities). Information about historical events that happened in the past in the study area is gathered from the local elderly people. The method of gathering information was based on open discussions with widely recognized knowledgeable elders. As direct observation is a highly reliable technique for collecting data on plant use, the team had walked around, visiting sites where one may expect to see plants in use or on display such as in homes and take notes of anything found relevant to the subject being investigated. Interviewee guided field walks were also done throughout the areas where the plants of interest were expected to be found. As soon as the interviewee sees a particular plant he or she explains its local name, characteristics of the plant as well as its use. This method helped to note the problems related to the growing situation of the species and its habitat.

Preference ranking and paired comparison exercises were conducted during fieldwork. Ten key informants were volunteered to conduct the preference ranking and the paired comparison exercises. For the preference ranking, the informants were given important tree species mentioned and asked to arrange these trees according to their importance for food, fodder, construction, medicinal purpose, cultural and fuel wood. They were told to arrange each species giving high value (5) to the tree they thought most effective and lowest value (1) to least effective trees. Hence rank was determined for each one of the five utilizations for the trees based on total score of each species. This exercise helped to identify or indicate relatively the more effective tree species preferred by the community for the above mentioned purposes.

For the paired comparison, the trees were compared two times to determine its utilization preference. Each of the ten respondents assigned 5 to the best, 4 to the very good one, 3 to the good one, 2 to the one considered fair and 1 to the least effective. Finally the values of each species were added and given ranks. Then the overall scores given to each attribute by all informants were obtained by adding the values given to each attribute. The list of the attributes includes: trees used for food, medicinal purpose, fodder, fuelwood, construction purpose and cultural ceremonies.

## Results and Discussion

### *Trees utilized for food*

Using tree species as a source of food is a common tradition in Nuba Mountains. The people use many tree species as a source of food. Among the frequently mentioned species in the study area, *Adansonia digitata* was mentioned by almost 90% of the respondents as the best food tree species in the study area. In the Rashad district, *Adansonia digitata* is very widely grown for its edible leaves and fruits. The leaves are an ingredient in a daily dish. The study results reveal that for the same purpose about 80% of the respondents appreciated *Balanites aegyptiaca* for its food value, preceded by *Grewia tenax* (75%), *Borassus aethiopum* (70%),

*Ziziphus spina-christi* (66%), *Hyphaene thebaica* (60%), *Sclerocarya birrea* (55%) and *Cordia Africana* (50%), as a very good food tree species (Fig. 1). These findings are similar to those obtained by (El Tahir and Gebaurer 2004) in Sudan, Campbell (1987) and Maroyi (2011) in Zimbabwe, Rashid et al. (2008) in India and Balemie and Kebebew (2006) in Ethiopia. This may be to the fact that people in the study area utilized these trees for different purposes. In these categories the fruits, leaves and flowers are the best parts of the trees which are being used by respondents in study area. The food composition of the people in Nuba Mountains from tree species constitutes different parts of a tree of which leaves take a larger proportion. These findings are agreed with those of Abdelmutti (1999) who studied the biochemical and nutritional aspects of famine food in Kordofan and Darfur regions. The same findings were obtained in Ethiopia by (Abebe and Ayehu 1993) who reported that local people know the importance and the contribution that trees make to their daily diet. The study findings revealed that local people consume leaves more than fruits, seeds, flowers, bark and root. 60% of the respondents mentioned leaves as a main preferred part for food in the study area. This is done to enable young plants to reach maturity for the benefit of all community members and users.

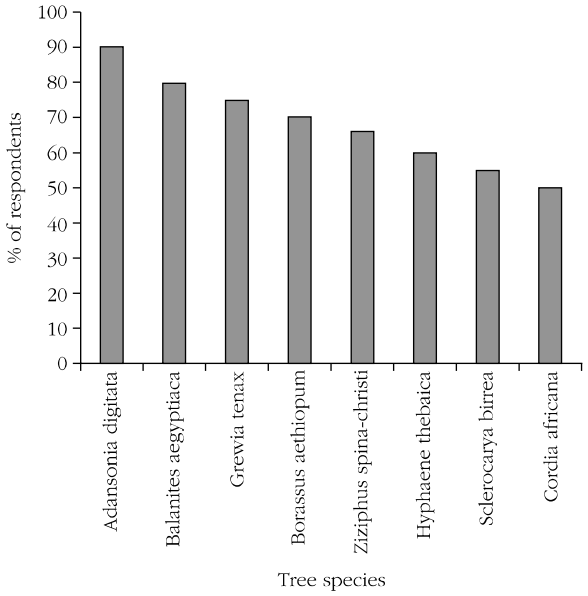


**Fig. 1.** Trees utilized as source of food in study area.

In addition, the key informants reported that many people harvest wild plants after the rains because the plants will be green and easy to identify, making it easier to distinguish between the poisonous and non-poisonous, and bitter and edible plants. During this period, it is also possible for some plants (stems) to be planted back into the ground (the ground will be wet in summer) if the roots are used. This practice was not confirmed and practiced by many community members though. A few respondents with better ecological knowledge mentioned harvesting plants all year round since the roots and stems normally remain fresh while the upper part is dry. For certain plants, such as *Borassus aethiopum*, only smaller new shoots are harvested given that bigger and older parts are bitter when consumed (Fig. 1).

### *Trees utilized for medicinal purposes*

The rural inhabitants of the study area in the plains use tree parts for curing different ailments. A total of 17 tree species belonging to 15 families and 16 genera were reported to be used as medicine (Table 1). Among the medicinal plants, trees were most frequent used. This finding is in line with Halim et al. (2007) who stated that trees were used more than shrubs and herbs in Bangladesh. Most of

**Table 1.** Scientific, local and family names of trees utilized for medicinal purposes in the study area

| Scientific name | Local name | Family |
|---|---|---|
| *Annona senegalensis* | Gishta | Annonaceae |
| *Sclerocarya birrea* | Humeid | Anacardiaceae |
| *Hyphaene thebaica* | Dom | Arecaceae |
| *Borassus aethiopum* | Deleib | Arecaceae |
| *Balanites aegyptiaca* | Higlig | Balanitaceae |
| *Adansonia digitata* | Tebeldi | Bombacaceae |
| *Cordia africana* | Gimbil | Boraginaceae |
| *Diospyros mespiliformis* | Goghan | Ebenaceae |
| *Tamarindus indica* | Aradeib | Fabaceae |
| *Azanza garckeana* | Nakhgar | Malvaceae |
| *Ficus sycomorous* | Gomeiz | Moraceae |
| *Ziziphus spina-christi* | Sidir | Rhamnaceae |
| *Sarcocephalus latifolius* | Karmadoda | Rubiaceae |
| *Vangueria madagascariensis* | Kirkir | Rubiaceae |
| *Grewia tenax* | Guddeim | Tiliaceae |
| *Vitex doniana* | Um tugulgul | Verbenaceae |
| *Azadirachta indica* | Neem | Meliaceae |

the respondents mentioned that they preferred wild trees for medicinal uses. The similarity in wild species preference could be attributed to the similarity in traditional knowledge and culture between the respondents. This finding is similar to Yineger and Yewhalaw (2007) in Ethiopia and Lee et al. (2008) in China who reported that their study respondents prefer wild harvested medicinal plants for herbal medication.

Though indigenous knowledge systems are often closely linked to local myths, beliefs and norms around the use of plants and animals, less than half (40%) of respondents had knowledge of these myths, beliefs and norms. Only a few respondents, mostly elderly people, could meaningfully explain what these myths and norms were and what they meant for conservation of natural resources and culture. One such myth is that if soil is not sprinkled over a plant that has been cut, the plant will not grow again, which will bring misfortune to the harvester. In fact, this is to prevent the sun from directly heating the fresh cut. In addition, there is a belief among the Nuba people that if a plant is within the home vicinity, it cannot be harvested because human shadows would have been cast on the plants. The common myth is that the healing properties of that plant will become dysfunctional. One respondent interviewed explained that this is only to make sure that such culturally important plants are protected for future generations. With regard to the use of wild plants, the key informants (the elderly and certified herbalists) also mentioned certain norms, rules and practices that were (or are supposed to be) followed. For example, the size of the plant determines the quantity that is harvested. The bigger the plant, the more material harvested (leaves, stem, flowers and roots). This is done to enable young plants to reach maturity for benefit of all community members and users (Table 1).

Fig. 2 shows that both above- and below-ground tree parts are utilized in herbal medication in the study area. Above-ground tree parts are utilized more often (70.5%) than below-ground plant parts (20.5%), and whole trees are rarely utilized (9%). In some cases, different parts of an individual tree are utilized for treating different ailments; in other cases, different parts of more than one tree are mixed together and applied against a single ailment. With regard to above-ground tree parts, only leaves were utilized from most trees (37.0%); for 6.5% of trees, leaves and other parts

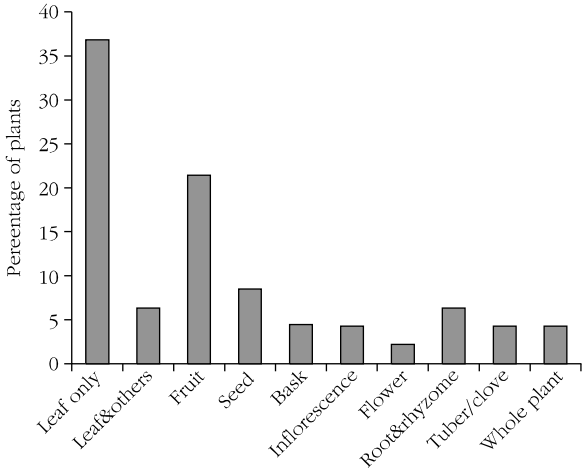


**Fig. 2.** Different parts of trees utilized for medicinal purposes.

are utilized. Fruits are also utilized from 21.7% of trees; species providing flowers for healing purposes accounted for only 2.2%. The predominant use of leaves has also been reported by scholars in different countries (e.g., Gazzaneo et al. 2005; Bussmann and Sharon 2006; Sajem and Gosai 2006; Halim et al. 2007; Mukul et al. 2007). However, Lulekal et al. (2008), in southeastern Ethiopia, found that local people most frequently use roots of medicinal plants for healing purposes. Halim et al. (2007) opined that plentiful use of leaves ensures sustainable harvesting of medicinal plants; and Schippmann et al. (2002) suggest that this also provides an incentive to protect and maintain wild populations and their habitats and the genetic diversity of medicinal trees (Fig. 2).

The study showed that local people use different tree parts to treat 20 different ailments. Seven species are used against diabetes. Both colds/coughs and cuts/wounds are treated with six species, and indigestion and dysentery with five species each. Three species - *Annona senegalensis, Azadirachta indica,* and *Ziziphus spina-christi* - are each utilized as a therapeutic agent against up to five ailments. Mukul et al. (2007) reported the use of *Azadirachta indica* alone against six diseases by the people residing in and around a conservation area of northern Bangladesh. This plant has been used in treating so many ailments that it has been called "the village pharmacy" in India (Anonymous 2008).

The diverse patterns of use of different parts of medici-

nal trees in the study area show that rural people have a high level of indigenous knowledge. Most of the tree parts are consumed orally after processing, such as macerating or squeezing into extracts, grinding into powder, blending together, soaking in water, boiling in water or milk or mustard oil, rubbing, or burning. Some are taken raw, and some after cooking as vegetables. Some tree parts are applied externally to different body parts for curing cuts, wounds, scabies, muscle congestion and joint ache, and skin problems.

### Trees utilized for fodder

Acacia senegal is considered as the most palatable tree species to livestock as indicated by 80.4% of the respondents. Other tree species mentioned were *Ziziphus spina-christi* and *Balanities aegyptiaca* by 70.8% and 46%, respondents, respectively. The majority of the respondents (88%) mentioned that some other trees have a value to animal feeding such as *Grewia tenax, Adansonia digitata, Sclerocarya birrea, Leptadenia pyrotechnica, Anogeissus leiocarpus,* and *Combretum hartmannianum*. This disparity of identifying the most palatable tree species could be attributed to the presence of different ecological zones across the animal routes in the stud area. This finding clearly shows that trees, irrespective of the species, provide fodder to livestock particularly during summer time where natural rangelands are deprived off grasses, weeds and herbs. This agrees with Akkasaeng et al. (1989) who described that the woody species are an important component of the potential fodder resources for both livestock and wildlife.

The leaves of tree species are believed to be very much nutritious for their protein content. And mostly the goats are the beneficiaries of such advantage. The Pods of *Acacia mellifer* and *Acacia senegal*, tree species are mentioned by the respondents as a good source of fodder for the animals. In contrast with pasture grasses and herbaceous legumes, the respondents (76%) indicated that fodder from trees and shrubs is has many advantages for animal production, amongst which are high feeding quality in terms of protein and contents of some minerals; and the capacity to produce fodder when other species have become dormant in order to avoid harsh climatic conditions. This result agree with Paterson et al. (1998) who stated that some trees fodder has high levels of organic matter digestibility (up to 85.5%) and CP contents (up to 34.6%), indicating the high potential of tree species for use as animal fodder.

### Trees utilized for fuelwood

Trees are main source of fuel wood in the study area. The local people cut trees and use them as a fuelwood. Mostly women are engaged in searching for twigs and some branches from the surrounding forests. Most of the people walk long distances in search for fuel wood. And some of them use their own trees for their fuel wood purpose. According to the study results people use many tree species for fuel wood. Some species are more preferred than others. The most preferred species of trees for their fuel wood value are *Acacia seyal, Balanites aegyptiaca, Acacia mellifera, Cordia Africana, Combretum molle,* and *Acacia senegal*. The most common parts of a tree species used for fuelwood in Nuba Mountains are the branches and twigs. The people get the branches and twigs from the nearby forests mostly from the natural forests.

### Trees utilized for construction purposes

Constructing a house from a wood is common in Nuba Mountains. The local people use the wood from different species for constructing house, to prepare some household utensils, farm equipment and construct fences. The study results reveal that the people are dependent on wood tree species for all the above mentioned activities. The use of trees as a source of construction wood is an old activity in Nuba Mountains. Accordingly the most valuable tree species used for construction purpose by the people are *Acacia mellifera, Acacia sayel, Acacia senegal, Cordia africana, Balanites aegyptiaca* followed by *Terminalia brownii* and *Acacia nilotica*. Most of the respondents assured that they use the woods from Acacias trees for constructing their houses as well as to construct chairs and tables in the household. According to 20% of the respondents the woods from *Acacia mellifera* are mostly used for constructing houses and roofs. The wood of *Cordia africana* is used for making tables and chairs in Nuba Mountains. According to the respondents the tables and chairs made from this species is very much durable and strong to break. *Balanites aegyptiaca* is used for the purpose of making sticks, and other household equipment.

**Table 2.** Preference ranking for threats against the availability of tree species

| Threats | A | B | C | D | E | F | G | H | I | J | Total | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Firewood collection | 3 | 2 | 4 | 4 | 3 | 5 | 4 | 3 | 2 | 1 | 31 | 3rd |
| Agricultural expansion | 4 | 4 | 3 | 3 | 5 | 5 | 4 | 3 | 4 | 5 | 40 | 2nd |
| Drought | 5 | 4 | 4 | 2 | 5 | 5 | 4 | 5 | 4 | 4 | 42 | 1st |
| Overgrazing | 5 | 4 | 3 | 5 | 2 | 1 | 4 | 3 | 2 | 1 | 30 | 4th |
| Charcoal production | 4 | 3 | 3 | 4 | 2 | 2 | 1 | 4 | 1 | 1 | 25 | 5th |

Letters (A-J) refer to the key informants.

### *Trees utilized for cultural ceremonies*

Ceremonies are an important part of the people's life in the study area and take place for significant life cycle events such as naming and circumcision, as well as being used to fight disease, to combat infertility, for blessings and to settle disputes. The ceremonies can be short or long, sometimes lasting several weeks. According to the study results, trees are keys to public as well as shared places of the study area. Every village has for example a courtyard; which is a place where meetings are held by the society. It is also a place where recreation takes place. The respondents mentioned that *Azadirachta indica* and *Adansonia digitata* are the most trees utilized for this purpose. Many tree species are being used by people in Nuba Mountains for various cultural or ritual purposes such as protection from transmittable disease, cultural ceremonies, tomb or grave marking, warding of sprits believed to inflict death, generation poles, funeral ceremonies, and other similar purposes that contribute spiritual functions. According to the respondents, *Cupressus Lusitanicais* used to protect magicians. Trees of *Azadirachta indica* are used as a shade when the local leaders have an assembly. *Terminalia laxiflora* tree is used for calling spirits. Dugmore and van Wyk (2008) argue that tales of how these plants fulfilled certain cultural needs in history contain encoded cultural significances.

### *Existing threats to availability of trees*

Trees are facing threats in their natural habitats from various human activities. The level of impacts for these activities varies from place to place. The people of the study area are well aware of the environmental treats affecting the biodiversity. The study area is relatively harsher than the surrounding areas particularly due to the rugged terrain coupled with moisture deficiency. This situation by itself is a threat for the tree species availability in the area. In addition to this, the study results indicated that there are more threats to the availability of tree species. The key Informants were asked to rank five constraints to tree species availability as reported by most informants, field observation. The threats were listed by the key informants as firewood collection; agricultural expansion; drought; overgrazing, and charcoal production.

The results of preference ranking for five selected threats against the availability of trees in the study area shows that drought is the first ranking threat (most detrimental), followed by agricultural expansion, firewood collection, overgrazing and charcoal production as shown in Table 2 below. The study findings are similar to those obtained by (El Tahir and Gebaurer 2004) who stated that tree clearance for agricultural production, overgrazing and charcoal production were the main constraints for trees deterioration in Nuba Mountains. The effects of land clearance for mechanized farming in the clay plains of the Nuba Mountains were unanimously considered as the main cause of degradation of vegetation cover. For example, a survey of the tree cover on un-cleared sites in mechanized farms in Nuba Mountains clay plains showed an average of 200 trees and shrubs per 0.42 ha (Table 2) (Prance 1991).

In addition to the above mentioned threats the respondents mentioned that limited government support for species conservation and the gradual waning of the existing traditional systems and coping mechanisms due to external intervention are among the main reasons behind the neglecting of local knowledge and tree management and conservation systems. The breakout of the war and conflict in the area was also mentioned by the people for changing their attitude towards their own culture and contributed to-

wards the erosion of cultural norms and taboos. The people have mentioned that several trees are becoming endangered and rare owing to deforestation. According to them many species among the endangered species were abundant in the area during the past decades and by now they are rare to find.

## Conclusion and Recommendations

The local people of Nuba Mountains are knowledgeable about the trees that provide food, fodder, medicines to humans and livestock health problems, cultural and ritual trees etc. This is a substantial input to the livelihood of the people. However, the area is losing its natural vegetation cover together with the edible and medicinally valuable species. Most of the tree species are getting very rare as confirmed by elders and observation during the field work too.Tree species are facing threats in their natural habitats from various human activities. The level of impacts of these activities varies from place to place. The people of the study area are well aware of the environmental treats affecting the biodiversity. Therefore, the recording and preserving of this knowledge is pressing and fundamental. Such knowledge can be disseminated to future generations through working in integration with local people and institutions, schools, mosques, churches and universities.

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