



Uses of Local Plant Species by Agropastoralists in South-western Niger

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Research

Abstract

Knowledge pertaining to local plant species in West African Sahel has been poorly documented despite the central role local vegetation plays in the everyday lives of the rural people. An ethnobotanical study was conducted between April and November 2005 to document knowledge and uses of local herbaceous and woody species by the agropastoralists in South-western Niger. One hundred and twenty three voucher reference samples were collected consisting of 87 and 36 herbaceous and woody species, respectively. The voucher specimens were used for individual interviews of the agropastoralists, guided by a semi-structured questionnaire. In each interview session, an interviewee was shown voucher reference samples and was asked to identify each of them. For each plant species identified, questions were asked about its utilization and the plant part(s) being used. Major uses of local plant species are for traditional medicine, human consumption, animal feed, household construction and firewood. Mean use value of woody species was significantly higher for all use categories ($p < 0.001$) than for the herbaceous species. These results confirm that "apparent" plants, perennial woody species, are used by the agropastoral communities more intensively than the "non-apparent" short life cycle herbaceous species.

Introduction

In West African Sahel, local vegetation has a central role in the everyday lives of rural people. Local vegetation provides people with food, fuel and medicine, as well as materials for construction and the manufacturing of crafts and many other products (Hamilton *et al.* 2003). Harvesting and processing of various plant products are undertaken by rural people in the region to fulfill their various daily needs (Nikiema 2005). Most rural populations in the Sahel will continue to be heavily reliant on local wild plants

in the foreseeable future. Apart from man's reliance on plant products, livestock also depend mainly on local vegetation for their feed. Given the long history of interactions between the local people and their environment, there undoubtedly exists an extensive local knowledge on plants and their uses.

In order to understand the contributions of the local plant species to the socio-economic and cultural conditions and overall livelihoods of the rural communities, and the appropriate strategies to sustainably manage these resources, the value of individual plant species overall and for specific uses need to be determined. Quantitative ethnobotanical techniques have been used to describe the importance of trees to local people and to compare the importance of different species (Phillips & Gentry 1993a,b, Theilade *et al.* 2007). In addition to its descriptive goals, quantitative ethnobotany makes use of numerical data that can be analyzed statistically. The use-value technique is a quantitative ethnobotanical approach proposed by Phillips and Gentry (1993a,b) as a measure of the relative importance of a plant. This technique is based

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on the number of uses attributed to a plant by the total number of informants. Plants that are infrequently mentioned will therefore be considered as less valued. The major weakness of this technique is that it does not distinguish between 'real use' and 'knowledge' or 'cognitive use' (Albuquerque & Lucena 2005). In addition, the use-value technique does not consider the cultural significance of a plant, its frequency of use or exploitation, nor the conduct of the local people in relation to the plant. In this study, we used the use-value technique to determine the relative importance of both woody and herbaceous plant species in the study location. The use-value technique was chosen as it is considered objective, reproducible and appropriate for statistical analyses (Hoffman & Gallaher 2007).

Several ethnobotanical studies in arid and semi-arid regions in Africa (Diop *et al.* 2005, Kiringe 2006, Lykke *et al.* 2004, Nikiema 2005, Theilade *et al.* 2007) and in similar regions in the rest of the world (Albuquerque *et al.* 2005, Ladio *et al.* 2007) have emphasized the relative importance of woody plant species in the livelihoods of local communities. These studies failed to consider the importance of herbaceous species which form a key component of arid and semi-arid vegetation and a major source of forage for animals. Hence, in this ethnobotanical study the herbaceous plants were included along with the woody plants.

This study documents knowledge of local uses of herbaceous and woody plant species by the agropastoral communities in South-western Niger. The effects of ethnicity, gender and age on indigenous knowledge of the local plant species in the study site have been considered in a separate paper (Ayantunde *et al.* 2008). By using use-value technique, we tested the "apparency" hypothesis postulated by Phillips and Gentry (1993a,b), that a plant's visibility tends to affect its local use. This implies that 'apparent' plants which are usually perennial woody plants or those that are normally dominant in the ecosystem will tend to have a higher relative importance in terms of use than 'non-apparent' plants, mostly herbaceous species with a short life cycle (Albuquerque & Lucena 2005). The objective of this study was to document local knowledge on utilization and relative importance of herbaceous and woody plant species in South-western Niger and to explore strategies used for community-based management of these resources. This study was carried out under the Desert Margins Program (DMP) project on arresting land degradation and the conservation of biodiversity in the desert margins of sub-Saharan Africa, partly funded by Global Environment Facility (GEF).

Materials and Methods

Study Site

The work presented here was conducted from April to November 2005 in three agropastoral territories namely

Banizoumbou, Tigo Tegui and Kodey in the Fakara region of South-western Niger (Kollo District). The study area is situated between the confluent valleys of the Niger River to the west and fossil valley of the Dallo Bosso to the east (13° 20' - 13° 35' N; 2° 35' - 2° 52' E). The area has been described in detail by Turner and Hiernaux (2002). The climate of Fakara is a typical inland semi-arid tropical climate with an average annual rainfall of 560 mm (1905 to 1989; Lebel *et al.* 1997). Fakara is part of the central Sahel bio-climatic zone. Rainfall is strictly monomodal, falling mostly between July and October. The study site covered 500 km² and is populated mainly by the Djerma and Fulani ethnic groups. In 1998, the population of the study site was 6000 inhabitants (Hiernaux & Ayantunde 2004). The three agropastoral territories where the survey was conducted are experiencing different land use pressures with Kodey having a high proportion of land cropped (65% in 1996) compared to 25% and 39% for Banizoumbou and Tigo Tegui, respectively (Turner & Hiernaux 2002). The vegetation of the study site is composed of two main components: an herbaceous layer dominated by long cycle annual grasses, and a scattered population of small trees and shrubs (Hiernaux & Ayantunde 2004). Unlike other arid ecosystems, perennial grasses and under-shrubs are not common. The severity and long duration of the dry season inhibits perennial grasses, while the seasonal regularity of the rains favors annual plants.

Ethnic groups in the study site

Djerma and Fulani are the two ethnic groups found in Fakara, our study site. The Djerma is the second largest ethnic group in Niger (about 21% of the total population), following the Hausa. The Djerma are historically land cultivators and their rural economy is largely dominated by subsistence agriculture. The main crops grown on their fields, usually controlled by a male household head, are millet (*Pennisetum glaucum* (L.) R.Br.), sorghum (*Sorghum bicolor* (L.) Moench) and cow pea (*Vigna unguiculata* (L.) Walp.). On individual fields the Djerma women grow groundnut (*Arachis hypogaea* L.), various kind of vegetables and, on the banks of the river Niger, wet rice (*Oryza sativa* L.). Though predominantly farmers, many Djerma own small herds of cattle, sheep and goats. During the growing season, the animals of the Djerma are generally given to Fulani herdsman who take care of them against payment in kind or in exchange of land. The Djerma form the majority of the population in Fakara and they largely control land ownership (Turner & Hiernaux 2002).

Fakara also harbors a significant number of Fulani people, who are pastoralists but are increasingly engaged in farming. The Fulani ethnic group accounts for about 10% of Niger's total population (Vennemann 2000). The Fulani are distributed all over the country. They are traditionally livestock keepers complemented by subsistence production of millet and sorghum. Keeping cattle is prestigious for the Fulani. In Fakara, the Fulani have settled in camps

in the vicinity of Djerma villages. They account for about 20% of the population in the study site (Turner & Hiernaux 2002). In addition to livestock rearing, many Fulani in Fakara grow crops (mainly millet and cow pea).

Ethnobotany Survey

Voucher specimens of herbaceous and woody species in Fakara were collected between September and October 2004 by a research technician who has been conducting vegetation surveys in the study site since 1994. To ensure collection of as many plant species as could be found in the study site, the research assistant was accompanied by a local guide who is highly knowledgeable of the local vegetation. One hundred and twenty three plant species were collected consisting of 87 herbaceous and 36 woody plant species. In view of inter-annual fluctuations in floristic composition that normally characterize annual dominated Sahelian vegetation (Hiernaux & Ayantunde 2004), a few annual herbaceous species may have been left out in our collection. However, we believe that the number left out was small, and would not have altered our data significantly. The year we collected the voucher specimens (2004) actually had quite a high number of annual herbaceous species (87) compared to the average of 72 species recorded from vegetation surveys of the study site between 1994 and 2003 (Hiernaux & Ayantunde 2004). The resulting herbarium was used for the interviews which were conducted individually. The interviews were guided by a semi-structured questionnaire. In each interview session, an interviewee was shown plant species collected and was asked to identify each of them. Mentioning of the correct local name(s), either in Zarma (Djerma's language) or Fulfulde (Fulani's language) of a plant species by the interviewee was considered as a correct identification of the plant. We followed the dictionary of local names of plants in Niger by Peyre de Fabregues (1977). This dictionary contains the vernacular names of most herbaceous and woody plant species in Niger for all the major languages (Hausa, Zarma, Fulfulde and Tamacheq). In our study site, the two major languages are Zarma and Fulfulde and the dictionary of local plants in Niger by Peyre de Fabregues provides vernacular names for all the plant species we used for the interviews. In all the interviews we did not come across new vernacular names for any of the species. For each plant species that was identified by the interviewee, questions were asked about use and the plant parts being used, habitat and perception on the present population status (species abundance) of the plant species. For plant uses, six use categories were included namely medicine, food, forage, construction, firewood and others. Uses of plants for household utensils, farm tools, magic, ornaments and decorations, and burial were included in the category "other". A question on the habitat focused on where the plant species are normally found. On the perception of present population status of the plant species, we asked if the species is abundant, moderately available, rare or has disappeared. The sci-

entific names of plants species follow Hutchinson and Dalziel (1954-1972) Flora of West Tropical Africa unless revised since that time.

Two hundred and five respondents were interviewed from 2 dominant ethnic groups (Djerma and Fulani) representing about 5% of the population. The informants included 116 male (age 16-65 years) and 89 female (14-71 years) Three male enumerators who were fluent in the languages of the interviewees (Fulfulde and Zarma) administered the questionnaire.

Data Analysis

A use-value (UV) was calculated for each species, and use-category employing the following equations (Lucena *et al.* 2008):

$$UV = \sum U_i/n, \text{ and } UV_c = \sum UV/nc$$

Where: U_i = number of uses mentioned by each informant; n = total number of informants; UV_c = use value of each species in the use category; nc = number of species in the use category.

Data analysis was performed with SAS (1987) using a frequency procedure for the description of the data. ANOVA procedure in SAS was used to analyze use-value data for different use categories per plant types (herbaceous and woody plant species). Differences among the use categories were compared using Tukey's Studentized Range Test (HSD) in the ANOVA statement. Differences between the two plant types (herbaceous versus woody plant species) were compared using T-Test. Unless otherwise specified, the level of significance was declared at $p < 0.05$.

Results

Relative importance of plant species based on use-value

Of the 87 herbaceous plant species included in the survey, 81 were considered useful, whereas all 36 woody plant species were considered useful by the respondents. The species were placed in six use categories. Figure 1 indicates the species richness reported for herbaceous and woody plant species. For the woody plants, nearly all the species were reported to be useful for medicine, forage, construction and firewood. The number of uses per species ranged from 1 to 5 (Figure 2). Nearly 60% of the herbaceous species had one use, mainly as forage whereas about 80% of the woody plants in the study site had at least 3 uses (Figure 2). The use-values for all the use categories within each plant type (herbaceous and woody species) were significantly different (Table 1). For all use categories woody plants had significantly higher use-values than the herbaceous plants (Table 1). Nine

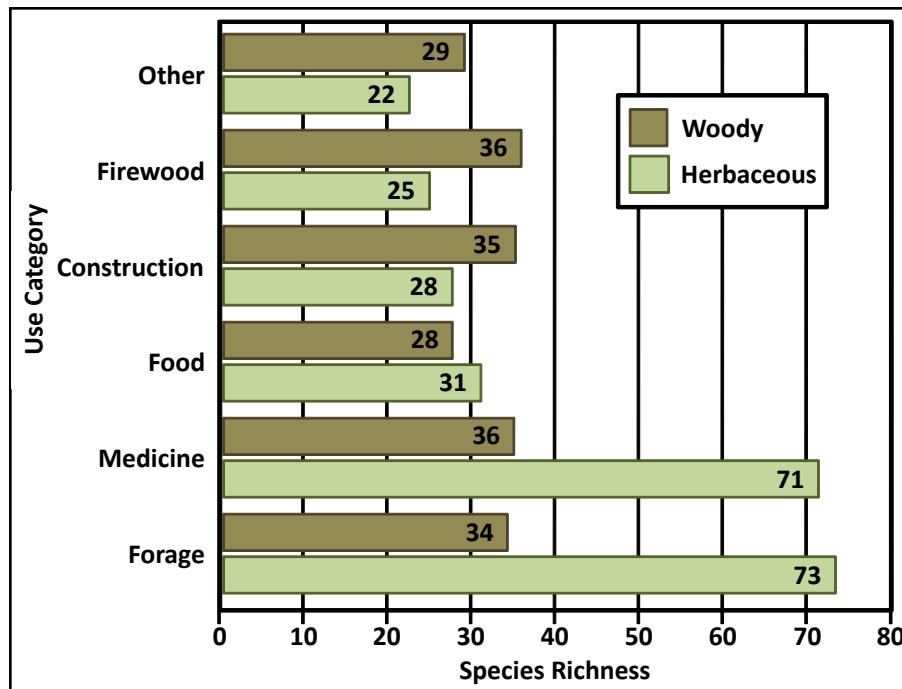


Figure 1. Distribution of species richness by plant type in the different use categories reported by agropastoralists in South-western Niger.

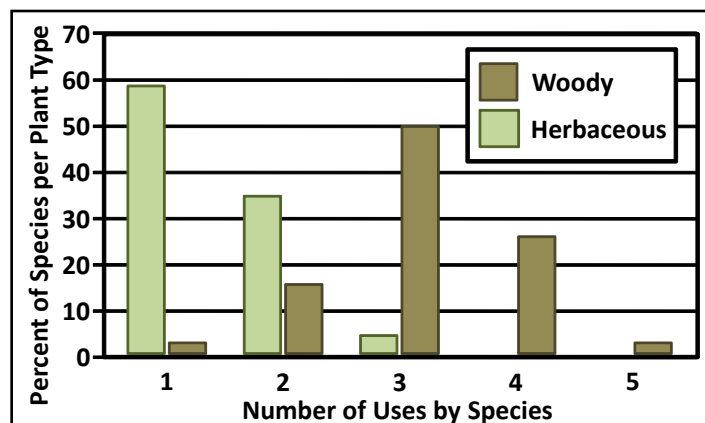


Figure 2. Number of uses attributed to each species by plant type as reported by agropastoralists in South-western Niger.

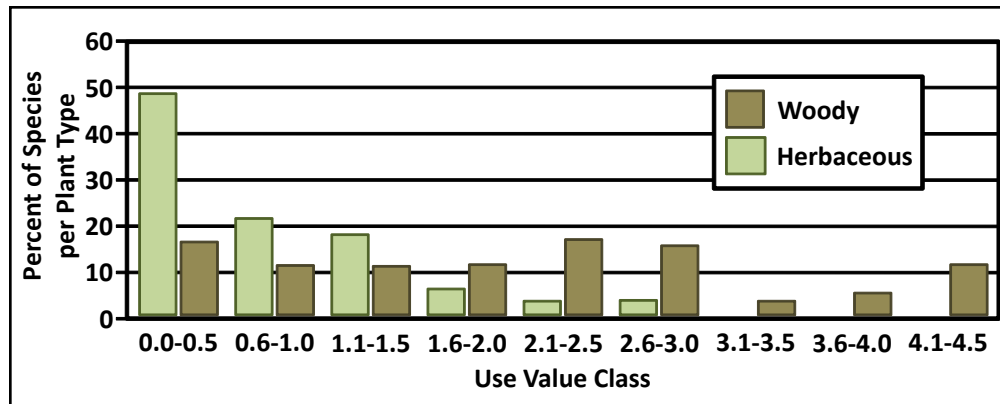


Figure 3. Percentage of species in each of the use value class for herbaceous and woody plant species reported by agropastoralists in South-western Niger.

use-value classes were established with intervals of 0.5 (Figure 3) ranging from use values of 0.0 to 4.5.

Use of local plant species as traditional medicine

The vast majority of herbaceous species (71 of 81) and all 36 woody species were identified as having medicinal value by the respondents (Figure 1). Details of the common medicinal herbaceous and woody species in the study site are presented in Table 2. Three woody species were known by nearly all the respondents namely *Azadirachta indica* A. Juss., *Bauhinia rufescens* Lam., and *Prosopis africana* (Guill. & Perr.) Taub.. Most (85% of the herbaceous and 67% of the woody) medicinal species in the study site are

used to treat human ailments whereas only 11% of herbaceous and 19% the woody species had ethno-veterinary use according to the respondents. Four percent and 14% of the species are used to treat both human and animal ailments, according to the respondents. Leaves are the most frequently used plant part for treatment of human and or animal ailments (Figure 4) followed by a mixture of leaf and stem. The most common ailment that medicinal plants are used for was stomach problems (Figure 5). Both herbaceous (50% of the medicinal) and woody species (90%), are used to treat stomach problem. It needs to be emphasized that stomach problem referred to by the respondents included many ailments such as stomach ache, abdominal

pains, ulcer, digestive system disorders, and even female reproductive system disorders. Other major ailments reported by the respondents in our study that were treated by using local plant species included diarrhea, malaria, fresh wounds, skin diseases, rheumatism and sickle cell anaemia (Figure 5). The medicinal plants

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Table 1. Use-value (means \pm standard error) by use categories for herbaceous and woody plant species as determined by agropastoral communities in South-western Niger.

Use Category*	Use Value			
	Herbaceous		Woody	
	Mean	Species	Mean	Species
Medicine	0.75 \pm 0.08 ^a	71	2.01 \pm 0.21 ^a	36
Food	0.95 \pm 0.11 ^{ab}	31	2.30 \pm 0.24 ^a	28
Forage	0.73 \pm 0.07 ^a	73	2.11 \pm 0.21 ^a	34
Construction	1.03 \pm 0.13 ^b	28	2.06 \pm 0.20 ^a	35
Firewood	1.17 \pm 0.14 ^b	25	2.01 \pm 0.20 ^a	36
Other	1.14 \pm 0.14 ^b	22	2.19 \pm 0.24 ^a	29

*Mean values with no common superscript for each use category within each plant type (herbaceous and woody plants) differ significantly ($P < 0.05$). There were significant differences between plant types (herbaceous versus woody plants) for all use categories ($P < 0.05$).

Table 2. Common medicinal species in the study site according to agropastoralist respondents (n = 205) in South-western Niger. Ordered from most to least commonly reported.

Name	No Re ¹	Use Value	Part Used	Man/Vet ²	Ailments Treated	Plant Habitat	Species Abundance
Herbaceous species							
<i>Waltheria indica</i> L.	132	1.32	Root, Bark	Man	Diarrhea, Wound, Stomach ache	Sand dunes, sandy depression	Moderately available
<i>Momordica balsamina</i> L.	125	1.75	Leaf, Stem	Man	Stomach ache	Sand dunes	Rare
<i>Alysicarpus ovalifolius</i> (Schumach. & Thonn.) J. Léonard	125	1.40	Leaf, Stem	Man	Malaria, Stomach ache	Sand dunes	Moderately available
<i>Striga hermonthica</i> (Delile) Benth.	112	1.32	Leaf, Stem	Man, Vet	Wound, Stomach ache	Sand dunes	Moderately available
<i>Tephrosia lupinifolia</i> DC.	100	1.02	Leaf, Stem	Man	Stomach ache	Sand dunes	Rare
Woody species							
<i>Azadirachta indica</i> A. Juss.	189	4.26	Leaf, Bark, Root	Man	Stomach ache, Malaria	Sand dunes, clay depression	Moderately available
<i>Bauhinia rufesens</i> Lam.	162	2.62	Leaf, Root	Man	Stomach ache	Sand dunes, clay depression	Rare
<i>Prosopis africana</i> (Guill. & Perr.) Taub.	157	3.94	Bark, Leaf, Root	Man	Stomach ache	Sand dunes	Moderately available
<i>Acacia albida</i> Delile	139	2.91	Bark, Leaf	Man	Whitlow	Clay depression, sand dunes	Abundant (common)
<i>Acacia nilotica</i> (L.) Willd. ex Delile	121	3.10	Fruit, Leaf	Man	Rheumatism, Sore throat	sandy depression, clay depression	Moderately available
<i>Guiera senegalensis</i> J.F. Gmel.	117	2.82	Leaf	Man	Fresh wound	Sand dunes	Abundant
<i>Gardenia sokotensis</i> Hutch.	105	1.14	Leaf, Stem	Man	Stomach ache	Plateau	Moderately available
<i>Ziziphus mauritania</i> Lam.	101	2.83	Root, Leaf	Man	Whitlow, Stomach ache	Plateau, sand dunes, loamy soil	Moderately available

¹No Re = Number of respondents that recognized the medicinal value of the species.

²Man / Vet = Used for treating human and/or animal ailments.

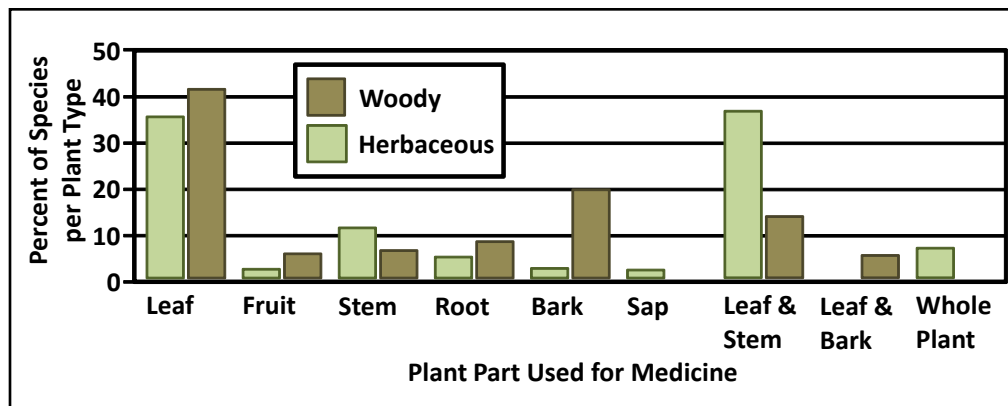


Figure 4. Parts of herbaceous (n=71) and woody (n=36) species used for medicine consumed by different animal species according to agropastoralists in South-western Niger.

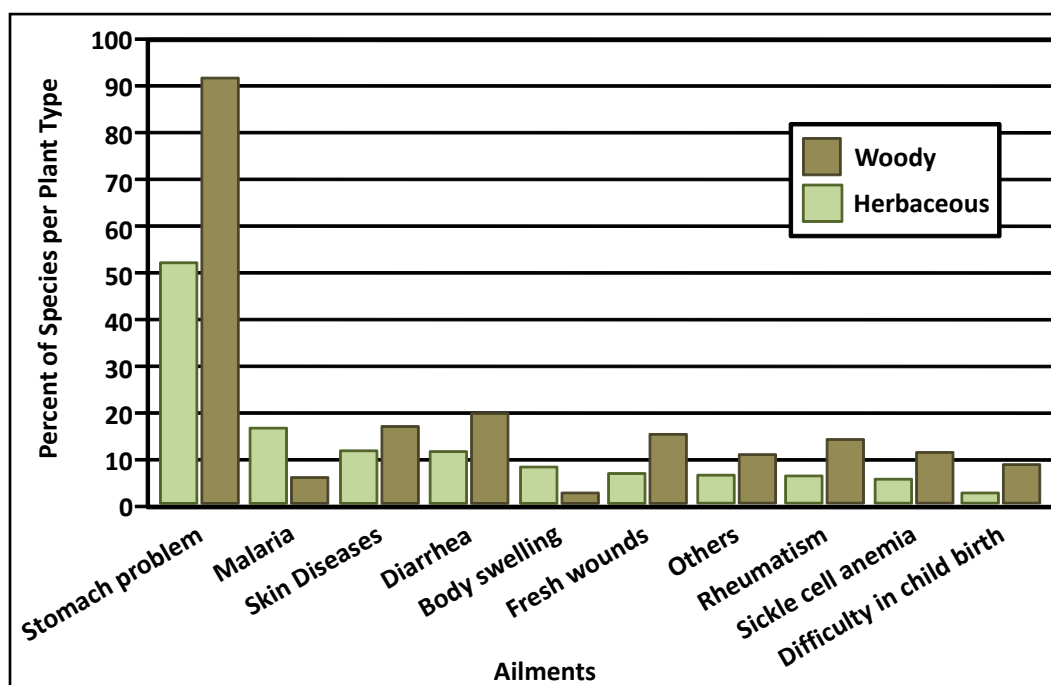


Figure 5. Major ailments that local herbaceous (n=71) and woody (n=36) species are used to treat according to agropastoralists in South-western Niger.

are usually prepared by elderly men and women by boiling, soaking in water, burning, roasting, sun drying and chewing, and often administered by them according to the respondents. In our study site, women are particularly charged with the responsibility for the well being of the children and other members of their households.

Use of local plant species as food for human consumption

Thirty-one of the useful 81 herbaceous species and 28 of the 36 woody species were reported as food for human consumption by the respondents (Figure 1). Four of the herbaceous food species were known by nearly all the respondents namely *Ceratotheca sesamoides* Endl., *Cor-*

chorus tridens L., *Citrullus colocynthis* (L.) Schrad. and *Leptadenia hastata* Vatke. The leaves of the first two species serve in a common sauce for eating solid millet food, which is the most common daily meal in the region. The fruit of *C. colocynthis* is also widely used to prepare sauce while leaves of *L. hastata* are normally boiled and eaten as a vegetable with millet couscous and **garri** (a popular cassava food in West Africa). *Leptadenia hastata* is commonly eaten as a vegetable in the West African Sahel. The most common woody species consumed in the study site were *Balanites aegyptiacus* (L.) Delile, *Piliostigma reticulatum* (DC.) Hochst. and *Annona senegalensis* (Table 3). Leaves of *B. egypticum* serve as sauce while its fruits are also commonly consumed. Both the leaves and fruits are sold in the local market. Other common food species

are listed in Table 3. Fruit is the common part of woody plants consumed in our study location whereas for herbaceous food species, leaves are the part being consumed (Figure 6). Most fruits of woody species are eaten raw while leaves are often boiled.

Use of local plant species as forage

Seventy-three of the useful 81 herbaceous species and 34 of the 36 woody species were reported as forage for animals by the respondents (Figure 1). There was quite a significant number of herbaceous and woody species that nearly all the respondents recognized for their nutritional value for the animals. The common herbaceous and woody forage species in the study location are presented in Table 4. According to the respondents, leaves and stems were the parts of herbaceous plants preferred by the animals, while leaves and fruits were the woody plant parts most frequently eaten (Figure 7). The respondents reported that all above ground parts (leaf, stem, fruits) of 17 of the

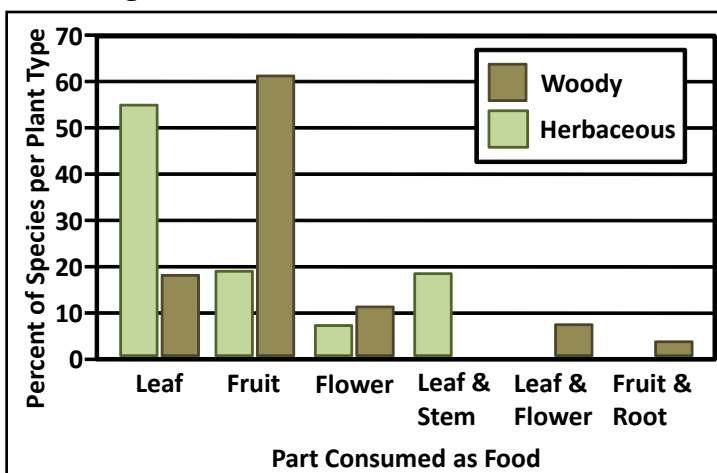


Figure 6. Herbaceous (n=31) and woody (n=28) plant parts consumed as food by agropastoralists in South-western Niger.

73 herbaceous forage species are consumed by animals. These species were mainly annual grasses such as *Eragrostis tremula* Hochst. ex Steud., *Ctenium elegans* Kunth and *Aristida sieberiana* Trin. ex Spreng. Of the few dicot-

Table 3. Common food plant species in the study site according to the agropastoralist respondents (n = 205) in South-western Niger. Ordered from most to least commonly reported.

Name	No Re ¹	Use Value	Part Used	Plant Habitat	Species Abundance
Herbaceous species					
<i>Ceratotheca sesamoides</i> Endl.	195	2.32	Leaf	Sandy depression, Sand dunes	Abundant
<i>Leptodenia hastata</i> Vatke	168	2.00	Leaf	Sand dunes	Rare
<i>Corchorus tridens</i> L.	161	1.61	Leaf	Sand dunes	Moderately available
<i>Citrullus colocynthis</i> (L.) Schrad.	154	1.69	Fruit	Sand dunes, Clay depression	Moderately available
<i>Momordica balsamina</i> L.	117	1.75	Fruit	Sand dunes	Rare
Woody species					
<i>Balanites aegyptiacus</i> (L.) Delile	202	4.03	Leaf, Fruit	Plateau, Sand dunes	Moderately available
<i>Piliostigma reticulatum</i> (DC.) Hochst.	199	4.40	Fruit	Clay depression, Sandy loamy soil	Abundant
<i>Annona senegalensis</i> Pers.	188	2.98	Fruit	Sandy depression, Sand dunes	Moderately available
<i>Hyphaene thebaica</i> (L.) Mart.	182	4.29	Root, Fruit	Clay depression, Sand dunes	Rare
<i>Sclerocarya birrea</i> (A. Rich.) Hochst.	174	3.63	Leaf, Fruit	Sand dunes, Sandy depression	Moderately available
<i>Ziziphus mauritania</i> Lam.	163	2.83	Fruit	Plateau, Sand dunes	Moderately available
<i>Parinari macrophylla</i> Sabine	147	2.23	Fruit	Clay depression, Sand dunes	Moderately available
<i>Lannea microcarpa</i> Engl.	143	1.88	Leaf	Plateau	Rare
<i>Detarium microcarpum</i> Guill. & Perr.	134	2.41	Fruit	Sand dunes, Sandy depression	Moderately available
<i>Adansonia digitata</i> L.	126	1.68	Leaf, Fruit	Clay depression	Rare

¹No Re = number of respondents that recognized the value of the species as food for human consumption.

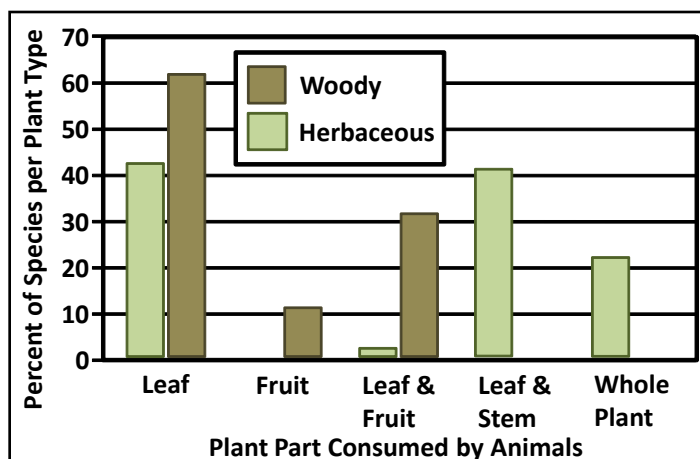


Figure 7. Parts of herbaceous (n=73) and woody (n=34) forage species consumed by the animals based on observations reported by agropastoralists in South-western Niger.

yledonous species whose all the above ground parts are consumed by the animals, especially ruminants, are *C. sesamoides*, *Zornia glochidiata*, Rchb. ex DC. and *A. ovalifolius*.

The most common herbaceous forage species are reported in Table 4. The first three of these species are annual grasses that are preferred by cattle, sheep and goats. *Cenchrus biflorus* has prickly spikelets and is widespread in West African Sahel, especially on sandy soils (Maliki 1981). Ruminants like grazing it especially when it has just begun to sprout but it is normally avoided once the prickly spikelets mature. The animals return to graze it in the dry season after the spikelets have fallen. In several regions in the West African Sahel, *C. biflorus* hay constitutes the main available herbaceous fodder during the dry season. *Cera-*

Table 4. Common forage plant species in the study site according to the agropastoralist respondents (n = 205) in South-western Niger. Ordered from most to least commonly reported.

Name	No Re ¹	Use Value	Part Used	Pal ²	Animal Species	Species Habitat	Species Abundance
Herbaceous species							
<i>Eragrostis tremula</i> Hochst. ex Steud.	201	2.58	All ³	4	Cattle, Sheep, Goat, Donkey	Sand dunes	Moderately available
<i>Cenchrus biflorus</i> Roxb.	195	1.14	All ³ except fruit	3	Cattle, Sheep, Goat, Horse, Donkey	Sand dunes	Moderately available
<i>Ceratothera sesamoides</i> Endl.	192	2.32	All ³	3	Cattle, Sheep, Goat	Sand depression, sand dunes	Moderately available
<i>Ctenium elegans</i> Kunth	190	2.57	All ³	3	Cattle, Sheep, Goat, Horse, Donkey	Sand dunes, plateau	Moderately available
<i>Citrullus colocynthis</i> (L.) Schrad.	174	1.69	Leaf, Fruit	3	Cattle, Sheep, Goat, Horse, Donkey, Camel	Sand depression, sand dunes	Moderately available
<i>Aristida sieberiana</i> Trin. ex Spreng.	173	2.19	All ³	2	Cattle, Sheep, Goat, Donkey	Sand dunes, sandy depression	Moderately available
<i>Mitracarpus hirtus</i> (L.) DC.	172	1.21	All ³	2	Cattle, Sheep, Goat	Sand dunes	Moderately available
<i>Leptadenia hastata</i> Vatke	167	2.00	Leaf, Stem	2	Cattle, Sheep, Goat, Donkey	Sand dunes	Rare
<i>Corchorus tridens</i> L.	162	1.61	Leaf, Stem	3	Cattle, Sheep, Goat	Sand dunes, clay depression	Rare
Woody species							
<i>Piliostigma reticulatum</i> (DC.) Hochst.	204	4.40	Leaf, Fruit	2	Cattle, Sheep, Goat, Camel	Clay depression	Common
<i>Balanites aegyptiacus</i> (L.) Delile	204	4.03	Leaf, Flower, Fruit	3	Camel, Sheep, Goat	Plateau, sand dunes	Rare
<i>Acacia albida</i> Delile	196	2.91	Leaf, Fruit	3	Cattle, Sheep, Goat, Camel	Clay depression, sand dunes	Common

Table 4(cont). Common forage plant species in the study site according to the agropastoralist respondents (n = 205) in South-western Niger.

Name	No Re ¹	Use Value	Part Used	Pal ²	Animal Species	Species Habitat	Species Abundance
<i>Hyphaene thebaica</i> (L.) Mart.	195	4.29	Leaf	2	Cattle, Sheep, Goat	Sand dunes, clay depression	Rare
<i>Sclerocarya birrea</i> (A. Rich.) Hochst.	182	3.63	Leaf, Fruit	2	Cattle, Sheep, Goat, Camel	Sand dunes, sandy depression	Moderately available
<i>Prosopis africana</i> (Guill. & Perr.) Taub.	179	3.94	Leaf	2	Cattle, Sheep, Goat, Donkey, Camel, Horse	Sand dunes	Moderately available
<i>Azadirachta indica</i> A. Juss.	175	4.29	Leaf	2	Camel, Goat, Sheep	Sand dunes	Moderately available

¹No Re = number of respondents that recognized the value of the species as forage for animals.

²Pal = Palatability of the species: 1 = Refused by animal; 2 = Only eaten if there is nothing else to eat; 3 = Generally eaten; 4 = Highly preferred.

³All = All above ground parts used.

totheca sesamoides is an annual dicotyledonous plant that is highly sought by man and animal.

Of the 87 herbaceous species used for the interview, only 6% was highly preferred (very palatable) by ruminants (Figure 8). These species were *E. tremula*, *C. sesamoides*, *Z. glochidiata*, *A. ovalifolius* and *Pandiaka involu-crata* (Moq.) Hook.f. None of the 36 woody species were highly preferred by the ruminants. Nine herbaceous species and two woody species found in the study location are completely rejected by ruminants. Herbaceous species rejected by the animals included *Acanthospermum hispidum* DC., *Rogeria adenophylla* J. Gay ex Delile, *Sporobolus microprotus* Stapf and *Pergularia tomentosa* while the two woody species rejected by the ruminants were *Cassia sieberiana* and *Vitellaria paradoxa* C.F. Gaertn. *Rogeria adenophylla* and *P. tomentosa* are rejected because of their toxicity. *Acanthospermum hispidum* is rejected due to its offensive odor. It is not clear why *S. micropro-*

pus, *V. paradoxa* and *C. sieberiana* are rejected by the ruminants. In the latter case, a possible reason could be the rarity of the tree in the study location. The few plants (less than 10 in number) found in the study area are very tall and inaccessible to ruminants. *Cassia sieberiana* DC. is rejected by ruminants due to its offensive odor. Most of the herbaceous species rejected by ruminants are dicotyledonous plants.

Common woody plants used as fodder in South-western Niger are listed in Table 4. Leaves and young fruits of *P. reticulatum* are consumed by cattle, sheep, goats and camels. *Balanites aegyptiacus* is one of the most commonly found trees in the Sahel. It is quite resistant to lack of humidity and drought. Its leaves and fruits are very much sought after by camels and small ruminants (Maliki 1981). The leaves and fruits of *A. albida* are also particularly sought after by small ruminants and camels. Nearly 95% of the herbaceous (n=73) and woody (n=34) for-

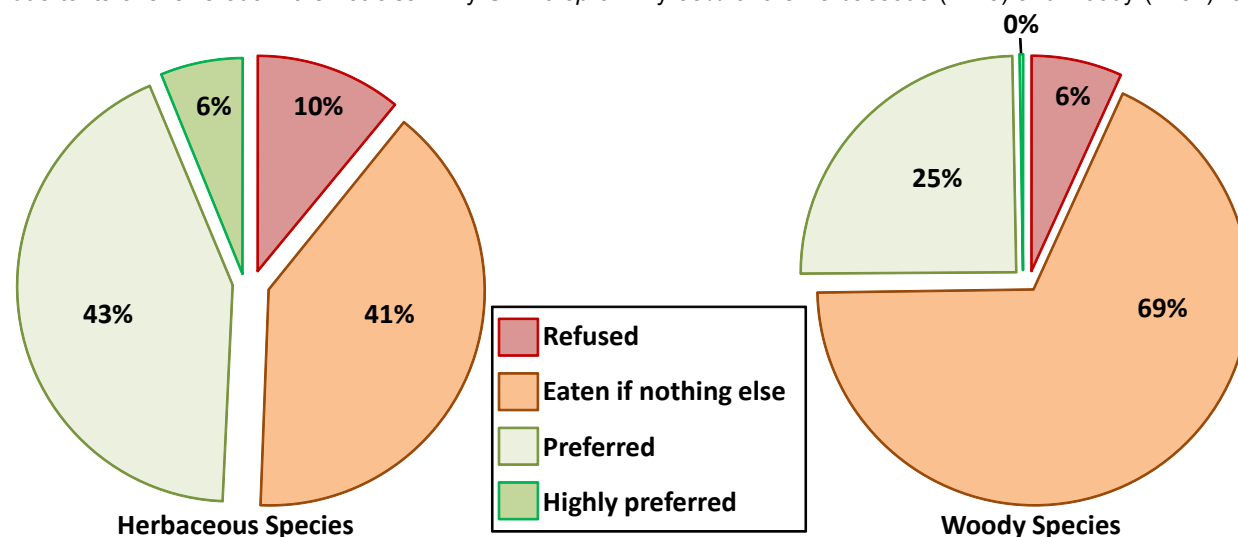


Figure 8. Palatability of herbaceous (n=87) and woody (n=36) species by ruminants according to observations reported by agropastoralists in South-western Niger.

age species were consumed by the ruminants (cattle, sheep and goats) according to the respondents (Figure 9). Camels were said to prefer tree leaves and fruits. According to the respondents, donkeys and horses consumed relatively few herbaceous (donkey: 19; horse: 15) and woody (donkey: 4; horse: 3) species compared to the ruminants.

Use of local plant species for household construction and firewood

Household construction implies building of a household hut or settlement, roofing and fencing. Only 28 of the 81 useful herbaceous species are used for construction whereas all the 36 woody species used for the interview were reported to be useful for construction (Figure 1). Common herbaceous and woody species used for household construction are listed in Table 5. All of the common herbaceous species are grasses and are used mainly for building huts. The woody species are used as poles for the huts, and as roofing materials for mud houses. They are also used to make doors for the hut or mud house and for fencing. Building of a new hut or mud house and repair is mainly the task of young men and adults in the study site. However, it is women's role to prepare food for the men who are

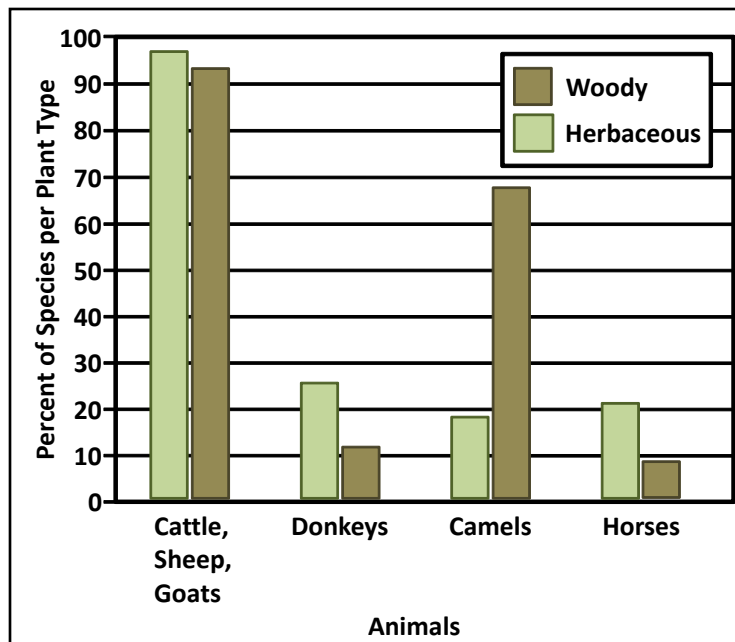


Figure 9. Herbaceous (n=73) and woody (n=34) forage species consumed by different animals according to agropastoralists in South-western Niger.

Table 5. Common plant species used for household construction in the study sites according to the agropastoralist respondents (n = 205) in South-western Niger.

Name	No Re ¹	Use Value	Part Used	Species Habitat	Species Abundance
Herbaceous species					
<i>Ctenium elegans</i> Kunth	186	2.57	Stem	Sand dunes, Plateau	Moderately available
<i>Eragrostis tremula</i> Hochst. ex Steud.	144	2.58	Stem	Sand dunes	Moderately available
<i>Aristida sieberiana</i> Trin. ex Spreng.	142	2.19	Stem	Sand dunes, Sandy depression	Moderately available
<i>Andropogon gayanus</i> Kunth	135	1.95	Stem	Sand dunes, Sandy depression	Moderately available
Woody species					
<i>Azadirachta indica</i> A. Juss.	194	4.26	Stem	Sand dunes	Moderately available
<i>Piliostigma reticulatum</i> (DC.) Hochst.	192	4.40	Bark, Stem	Clay depression	Very common
<i>Hyphaene thebaica</i> (L.) Mart.	191	4.29	Leaf	Sand dunes, Clay depression	Rare
<i>Prosopis africana</i> (Guill. & Perr.) Taub.	177	3.94	Stem	Sand dunes	Moderately available
<i>Guiera senegalensis</i> J.F. Gmel.	153	2.82	Stem	Sand dunes	Very common
<i>Combretum micranthum</i> G. Don	130	2.07	Stem	Plateau	Moderately available
<i>Acacia nilotica</i> (L.) Willd. ex Delile	107	3.10	Stem	Sand dunes, Sandy depression	Moderately available
<i>Combretum glutinosum</i> Perr.	105	2.28	Stem	Sand dunes	Moderately available

¹No Re = number of respondents that recognized the usefulness of the species for household construction.

ceous plants used for construction are the aboveground parts (leaves and stems) while stem (trunk) of the woody species is the main part being used for household settlements. Expectedly, few herbaceous species are used as firewood whereas all the woody species are used for household cooking (Figure 1). Herbaceous species used for cooking are mainly used to start or revive the fire for cooking. Common woody species used as firewood are listed in Table 6. Quite often the woody plants near to the village are the most exploited as firewood. In the study location, women normally collect deadwood for cooking but may also prune live branches or cut shrubs if deadwood is not available. Not only the rural populations rely on woody species as firewood, many urban households in West African Sahel also rely on purchased firewood.

Other uses of local plant species

Other uses of herbaceous and woody plant species in the study location included fabrication of farm tools, traditional furniture and musical instruments, making of household utensils, ornaments and decorations, ritual uses and burial (Figure 10). Only woody species are used for fabrication of farm tools such as handles for hoe, digger and cutlass. According to the respondents, common woody species used for farm tools were *S. birrea*, *C. glutinosum*, *D. microcarpum* and *C. nigricans*. For household utensils such as wooden spoons, mortar and pestles, the common woody species used were *S. birrea*, *P. africana*, and *Calotropis procera* (Aiton) W.T. Aiton while herbaceous species were used to make brooms, namely *E. tremula*, *C. elegans* and *A. sieberiana*. Common woody species used for traditional furniture such as beds, chairs and tables were *C. micranthum*, *C. procera* and *B. rufesens*. Common herbaceous species used for traditional furniture such as mats included *Chrozophora senegalensis* (Lam.) A. Juss. ex Spreng. and *C. elegans*. For dyeing

and decoration, the bark of *P. reticulatum* is commonly used according to the respondents. The bark is normally soaked in water and the extract is used for dyeing and as cosmetics. The bark of *B. aegyptiacus* is used as soap for washing clothes and household utensils. For human burial, the small branches of *C. glutinosum* are used for making coffins in the study site. For ritual uses, 8 herbaceous species were mentioned which included *E. tremula*, *Polycarpha eriantha* Hochst. ex A. Rich., *M. hirtus*, and *C. sesamoides*. Information on ritual uses of these species was not given by the respondents. This is expected given the reluctance of traditional healers and herbalists to release information on their activities and many taboos that are associated with spiritism and exorcism.

Discussion

The agropastoralists interviewed in this study were highly aware of the usefulness of nearly all the woody plant species. Awareness of the actual and/or potential use of the herbaceous species varied markedly among the six use categories with a strong bias towards the utilization as animal fodder and for traditional medicine. The significantly higher use-values for the woody plant species compared to the herbaceous species support the ‘apparency’ hypothesis that plants that are visible and dominant in the ecosystems are more likely to be used than those that are non-apparent which are mainly herbaceous species with short life cycles. These results agree with the past ethnobotanical studies in the West African Sahel (Diop *et al.* 2005, Lykke *et al.* 2004, Nikiema 2005) which reported the multipurpose uses of woody plant species. High-use value for a plant species may be an indication of high use-pressure and this may call for specific conservation measures to prevent over-exploitation of the species. Given the widespread report of the multipurpose uses of tree

Table 6. Common plant species used for firewood in the study sites according to the agropastoralist respondents (n = 205) in South-western Niger.

Name	No Re ¹	Use Value	Part Used	Species Habitat	Species abundance
Woody species					
<i>Piliostigma reticulatum</i> (DC.) Hochst.	200	4.40	Stem	Clay depression	Very common
<i>Azadirachta indica</i> A. Juss.	197	4.26	Stem	Sand dunes	Moderately available
<i>Acacia albida</i> Delile	187	2.91	Stem	Valley, Sand dunes	Very common
<i>Balanites aegyptiacus</i> (L.) Delile	186	4.03	Stem	Plateau, Sand dunes	Moderately available
<i>Prosopis africana</i> (Guill. & Perr.) Taub.	175	3.94	Stem	Sand dunes	Moderately available
<i>Sclerocarya birrea</i> (A. Rich.) Hochst.	161	3.63	Stem	Sand dunes, Valley	Moderately available
<i>Acacia nilotica</i> (L.) Willd. ex Delile	157	3.10	Stem	Sand dunes, Valley	Moderately available
<i>Guiera senegalensis</i> J.F. Gmel.	153	2.82	Stem	Sand dunes	Very common
<i>Hyphaene thebaica</i> (L.) Mart.	140	4.29	Stem	Sand dunes, Valley	Rare
<i>Combretum glutinosum</i> Perr.	139	2.28	Stem	Sand dunes	Moderately available

¹No Re = number of respondents that recognized the usefulness of the species as firewood.

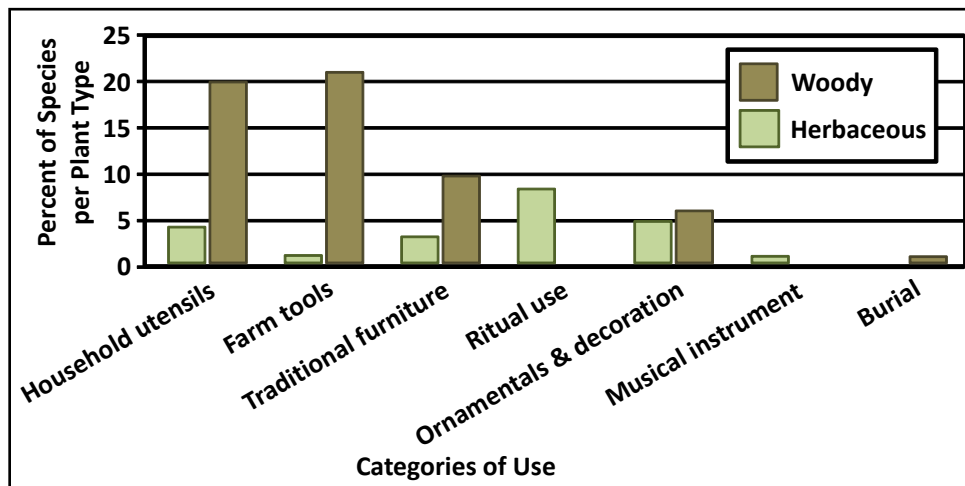


Figure 10. Other uses of herbaceous and woody species in the study site as reported by agropastoralists in South-western Niger.

species in the study site, conservation measures addressing woody plants may stand a better chance of succeeding than measures that only seek to protect species that are not commonly used by the communities. However, caution should be exercised in interpreting the use-values results as there was no clear distinction between the actual use and potential use by the informants (Albuquerque & Lucena 2005).

The widespread use of leaves for traditional medicine in our study is in accordance with the findings of Ricker (2002) in northern Nigeria, where leaves are the most widely plant part used for traditional medicine. The widespread use of local plants to treat stomach related problems in our study agrees with the observation made by Maundu *et al.* (2001) in their study on ethnobotany of Loita Massai in Kenya that gastro-intestinal problems is the leading ailment for which local plants are used. The uses of local plants for traditional medicine are often site specific and influenced by cultural and religious beliefs of the people. In our study site, it is common to find people, especially Muslim traditional healers called **marabouts** using traditional medicine together with quotations from the Koran due to the dominance of Islam in the region. Sometimes, the **marabouts** use divination to ascertain the root cause of the sickness. The large number of plants used for traditional medicine in our study site illustrates the important role played by local plant species in the health of the rural communities. The majority of rural communities will continue to rely on traditional medicine in the future for much of their primary health care due to poverty and the high cost of western-style medical care (Lykke *et al.* 2004). The majority of the population in our study site relies on traditional medical practitioners and only consults western medical practitioners as a last resort.

The low number of herbaceous species reported as useful for human consumption could be partly attributed to the

seasonal availability of most herbaceous species in the study site. Another factor may be that many herbaceous species are consumed mainly when there is crop failure and famine, e.g., grains of *C. biflorus* and leaves of *Senna obtusifolia* (L.) H.S. Irwin & Barneby and *Cassia occidentalis* L. Relatively few plant species are used for human consumption in the study site confirming the widely held view that man consumes only few species of the available plant resources (Kiambi & Attah-Krah 2003).

The high percentage of herbaceous plants recognized as useful forage in the study area is a consequence of low species diversity which often characterizes most Sahelian rangelands. However, the relative importance of herbaceous species as forage in the study area is a reflection of the importance of livestock in the economy of the agropastoral communities. The common practice of harvesting dry herbaceous plants (bush hay) in the study site to fatten sheep or to sell provides opportunity to learn about forage species and this might have enhanced the local knowledge. Tree fodder is particularly important as animal feed in the late dry season (April – June) in the West African Sahel when there are virtually no herbaceous species left for grazing and crop residues are scarce. However, tree fodder is a good nitrogen supplement to poor quality residues (Thorne *et al.* 1999). The major limitation to their utilization by ruminants is high tannin content (Morrison *et al.* 1996).

The response of the interviewees as regards the dominance of tree leaves and fruits in camel's diets agrees with the report of Kaufmann (1998) on pastoral camel husbandry in northern Kenya. It is quite interesting that the response of the interviewees showed a similar number of herbaceous and woody species consumed by donkeys and horses in view of their similar digestive system. Both are monogastric herbivores, thus they eat roughages and utilize cellulose and hemicellulose efficiently. They graze

on bushes, scrub vegetation and bark, as well as on grass (Aganga & Tsopito 1998). In spite of their similar digestive systems, donkeys need more fiber and less protein in their diets than horses. Another major difference in feeding behavior of donkeys compared to horses is coprophagy (eating of their own feces). This is common among young donkeys, which often eat the feces of their dams within a few months of birth (Aganga & Tsopito 1998). This is viewed as a way for the young donkeys to obtain cellulose digesting bacteria and other microbes, which are abundant in the feces. Adult, well-fed donkeys on a balanced diet do not normally practice coprophagy.

Ethnobotanical study provides a means to create awareness of the conservation needs of the local species. Through our survey, we observed that the informants admitted the serious threat some of the valuable woody species face if they continue to exploit them without putting in place regeneration practices. Given the site-specificity of traditional uses of plant species, every ethnobotanical study is therefore a contribution to understanding and documentation of the indigenous ecological knowledge. To go beyond documentation of local knowledge of plant species and facilitate community-based conservation measures, it is important to share the main results from the ethnobotany survey with the community and encourage the people to identify community actions that can address main issues from the survey and the possible contributions by the development agencies. Since the local communities are dependent on the resources for their livelihood, they are in better positions to assess the true costs and benefits of any conservation measures coming from outside. Cultural diversity is closely linked to biodiversity; conserving biodiversity can therefore help to strengthen cultural integrity and values of rural communities.

Conclusion

In conclusion, this study has shown the relative importance of herbaceous and woody plant species in South-western Niger and the tendency to exploit more visible and dominant species, especially woody plants by the agropastoral communities. Major uses of local plant species are for traditional medicine, human consumption, animal feed, household construction and firewood. The results of this study demonstrate the necessity of proper documentation of indigenous ecological knowledge in order to preserve the wisdom and practices of past generations for present benefit and for future local and global use. Results from this study confirm that availability of a plant largely determines its utilization. Given the low diversity of the Sahelian flora in comparison to other arid or semi-arid zones such as Karoo-Namib in Southern Africa and the horn of Africa (Hiernaux & Ayantunde 2004) caution should be exercised in extrapolating the results of our study. The question of whether the availability of plant species is a reflection of the strength of anthropogenic factors which

favor them is not considered in this study. Results from this study also show the necessity for targeted community-based conservation measures to protect species with high use-pressure as suggested by use-value technique.

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Literature Cited

- Aganga, A.A. & C.M. Tsopito. 1998. A note on the feeding behaviour of domestic donkeys: a Botswana case study. *Applied Animal Behaviour Science* 60: 235-239.
- Albuquerque, U.P. & R.F.P. Lucena. 2005. Can apparency affect the use of plants by local people in tropical forests? *Interciencia* 30:506-511.
- Albuquerque, U.P., L.H.C. Andrade & A.C.O. Silva. 2005. Use of plant resources in a seasonal dry forest (North-eastern Brazil). *Acta Botanica Brasilica* 19: 27-38.
- Ayantunde, A.A., M. Briejer, P. Hiernaux, H.M.J. Udo & R. Tabo. 2008. Botanical knowledge and its differentiation by age, gender and ethnicity in South-western Niger. *Human Ecology* 36:881-889.
- Diop, M., B. Kaya, A. Niang & A. Olivier. 2005. *Les Espèces Ligneuses et Leurs Usages: Les preferences des paysans dans le Cercle de Ségou, au Mali*. ICRAF working paper no. 9. World Agroforestry Centre Nairobi, Kenya.
- Hamilton, A.C., P. Shengji, J. Kessy, A.A. Khan, S. Lagos-Witte & Z.K. Shinwari. 2003. *The Purposes and Teaching of Applied Ethnobotany*. People and Plants working paper no. 11. Surrey, U.K.
- Hiernaux, P. & A.A. Ayantunde. 2004. *The Fakara: A semi-arid agro-ecosystems under stress. Report of research activities of International Livestock Research Institute (ILRI) in Fakara, South-western Niger, between 1994 and 2002*. Submitted to Desert Margins Program, ICRISAT Niamey, Niger.
- Hoffman, B. & T. Gallaher. 2007. Important indices in ethnobotany. *Ethnobotany Research & Applications* 5:201-218.

- Hutchinson, J. & J.M. Dalziel. 1954-1972. *Flora of West Tropical Africa*. 2nd edition, Volume 1-3. Edited by R.W.J. Keay & F.N. Hepper. Crown Agents for Overseas Government and Administration, London, UK.
- Kaufmann, B. 1998. *Analysis of Pastoral Camel Husbandry in Northern Kenya*. Hohenheim Tropical Agricultural series 5. Margraf, Weikersheim, Germany.
- Kiambi, D. & K. Atta-Krah. 2003. Plant genetic resources in the global and African setting. Pp. 33-52 in *Plant Resources in Tropical Africa*. Proceedings of the first PROTA International workshop, 23-25 September 2002, Nairobi, Kenya. Edited by G.H. Schmelzer & E.A. Omino. PROTA Foundation, Wageningen, the Netherlands.
- Kiringe, J.W. 2006. A survey of traditional health remedies used by the Maasai of southern Kaijiado district, Kenya. *Ethnobotany Research & Applications* 4:61-73.
- Ladio, A., M. Lozada & M. Weigandt. 2007. Comparison of traditional wild plant knowledge between aboriginal communities inhabiting arid and forest environments in Patagonia, Argentina. *Journal of Arid Environments* 69:695-715.
- Lebel, T., J.D. Taupin & N. D'Amato. 1997. Rainfall monitoring during Hapex-Sahel. 1. General rainfall conditions and climatology. *Journal of Hydrology* 188:74-96.
- Lucena, R.F.P., V.T. Nascimento, E.M. Araujo & U.P. Albuquerque. 2008. Local uses of native plants in an area of Caatinga vegetation (Pernambuco, NE Brazil). *Ethnobotany Research & Applications* 6:3-13.
- Lykke, A.M., M.K. Kristensen & Ganaba S. 2004. Valuation of local use and dynamics of 56 woody species in the Sahel. *Biodiversity and Conservation* 13:1961-1990.
- Maliki, A.B. 1981. *Ngaynaaka: l'Élevage selon les WoDaaBe du Niger*. Rapport préliminaire: Project gestion des pâturages, Ministère du Développement Rural, Tahua, Niger.
- Maundu, P., D.J. Berger, C. ole Saitabau, J. Nasieku, M. Kipelian, S.G. Mathenge, Y. Morimoto & R. Höft. 2001. *Ethnobotany of the Loita Maasai: Towards community management of the forest of the lost child – experiences from the Loita ethnobotany project*. People and Plants working paper 8. UNESCO, Paris, France.
- Morrison, B.J., M.A. Gold, & D.O. Lantagne. 1996. Incorporating indigenous knowledge of fodder trees into small-scale silvopastoral systems in Jamaica. *Agroforestry Systems* 34:101-117.
- Nikiema, A. 2005. *Agroforestry Parkland Species Diversity: Uses and management in semi-arid West Africa (Burkina Faso)*. PhD Thesis, University of Wageningen, Wageningen, The Netherlands.
- Peyre de Fabregues, B. 1977. *Lexique de Noms Vernaculaires de Plantes du Niger*. Institut d'Élevage et de Médecine Veterinaire des Pays Tropicaux. Alfort, France.
- Phillips, O. & A.H. Gentry. 1993a. The useful plants of Tambopata, Peru: I. Statistical hypothesis tests with a new quantitative technique. *Economic Botany* 47:15-32.
- Phillips, O. & A.H. Gentry. 1993b. The useful plants of Tambopata, Peru: II. Additional hypothesis testing in quantitative ethnobotany. *Economic Botany* 47:33-43.
- Ricker, I. 2002. *Legume Diversity and Ethnobotanical Surveys in the Northern Guinea Savannah of Nigeria*. M.S. Thesis, University of Hohenheim, Stuttgart, Germany.
- SAS. 1987. *Statistical Analysis System*. SAS Institute, Cary, North Carolina.
- Theilade, I., H.H. Hansen, M. Krog & C.K. Ruffo. 2007. Use-values and relative importance of trees to the Kaguru people in semi-arid Tanzania: Part II. Woodland species. *Forests, Trees and Livelihoods* 17:1-15.
- Thorne, P.J., D.B. Subba, D.H. Walker, B. Thapa, C.D. Wood & F.L. Sinclair. 1999. The basis of indigenous knowledge of tree fodder quality and its implications for improving the use of tree fodder in developing countries. *Animal Feed Science and Technology* 81:119-131.
- Turner, M.D. & P. Hiernaux P. 2002. The use of herders' accounts to map livestock activities across agropastoral landscapes in Semi-Arid Africa. *Landscape Ecology* 17:367-385.
- Vennemann, K. 2000. The population of Niger – distribution and development. Pp. 83-88 in *Adapted Farming in West Africa: Issues, potentials and perspectives*. Edited by F. Graef., P. Lawrence & M. von Oppen. Verlag Ulrich, Stuttgart, Germany.