Use of Ecosystem Services of *Sarcocephalus latifolius* (Sm.) E.A.Bruce and Induced Effect of Human Pressure on the Species in the Southwestern Region of Burkina Faso

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Research

Abstract

People depend heavily on natural resources for their daily living. In the Sudanian zone of Africa characterized by high population growth and poverty incidence, there is a growing pressure on high value species such as *Sarcocephalus latifolius* (Sm.) E.A.Bruce. The objectives of this study were to evaluate its diverse uses and to highlight some practices which could affect its survival. The work was conducted in the southwestern region of Burkina Faso with a sample of 360 respondents. Data were analyzed using three indexes. The results show that *S. latifolius* is used for 80 use-types belonging to seven use categories. The use of roots to treat stomachaches has a consensus value for use-types of 0.357 and is the most important use of the species in medicine. The fact that roots are the most often used plant part constitutes an aggravating factor for the survival of this species in the semi-arid context.

Introduction

Sarcocephalus latifolius (Sm.) E.A.Bruce is a shrub or a small tree living in humid areas across the tropical and austral regions of Africa (Arbonnier 2009). This species has medicinal uses that are much more known in sub-Saharan Africa in the traditional pharmacopoeia (Badiaga 2011). Many studies demonstrate that *S. latifolius* has some medicinal properties (Amos *et al*. 2005, Badiaga 2011, Iwueke & Nwodo 2008, Yesufu *et al*. 2010, Yinusa *et al*. 2012). Some studies have also documented the phytochemical screening of its organs (Badiaga 2011, Yinusa *et al*. 2012). It is used to treat certain major diseases such as diabetes (Karou *et al*. 2011), AIDS (Lamorde *et al*. 2010), and malaria (Benoit-Vical *et al*. 1998). Among the plant biodiversity of Burkina Faso, *S. latifolius* is one of the most known and used species by local populations in certain regions (Belem *et al*. 2007). However, no ethnobotanical study of this species has previously been done among local traditional communities of the southwestern region of Burkina Faso.

Plants provide a "green social security" to hundreds of millions of people throughout the world (Cunningham 2001). The choices of resources for certain purposes depend on cultural preferences, variety characteristics and abundance of the resource, the specific mechanisms of use, and the access to alternative resources and materials that could replace that resource (Campos & Ehringhaus 2003). In Burkina Faso, the rate of population growth is steadily increasing (1.8% in 1960 vs. 3.4% in 2006) (INSD 2009). Thus, the pressure on natural resources also becomes greater. A good understanding of usage patterns of wild species such as *S. latifolius* is crucial to help implement sustainable forest management policies. Ethnobotanical knowledge adds valuable information to ecological findings of a highly used tree species that could be used to

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design appropriate management policies and strategies (Schumann *et al*. 2012).

This paper considers the hypothesis that the diverse uses of this plant species may affect its long-term survival. The main objectives of the study are to (1) evaluate the uses of *S. latifolius* in the southwestern region of Burkina Faso and (2) identify some best practices leading to the sustainable uses of the species or dangerous practices that could jeopardize this resource.

Material and Methods

Study species

Sarcocephalus latifolius (syn. *Nauclea latifolia* Sm.) or African Negro peach belongs to the Rubiaceae. The plant has flexible and drooping branches. Its leaves (10–22 × 7–15 cm) are opposite, green, shiny, and greasy to the touch. Its ball-like inflorescence is composed of numerous flowers. The fruit is red or maroon with many alveoli and smells like strawberries (Arbonnier 2009). It is an irregularly globose berry, 3–8 cm in diameter, containing thousands of minute seeds immersed in a pinkish flesh (Stangeland *et al*. 2007).

Study area

This study was carried out in 12 villages belonging to the four provinces of the southwestern region of Burkina Faso (West Africa) which are Bougouriba, Ioba, Noumbièl, and Poni (Figure 1). The surveyed villages, mainly located around the Total and Partial Reserves of Fauna of Bontioli (TPRFB) and the Classified Forest of Koulbi (CFK), are Balingnar, Bontioli, Diourao, Djikologo, Sibteon, and Tovor for the TPRFB, and Bonfateon, Fadio, Gangalma, Mebar, Medicateon, and Titenateon for the CFK.

The CFK and the TPRFB were erected in 1955 and 1957, respectively. These protected areas are dominated by savannas. *Sarcocephalus latifolius* is found in the protected areas and outside especially along rivers. At Gaoua, in the center of the southwestern region, the rainfall between 1997 and 2007 fluctuated between 900 mm and 1300 mm with an average of 1000 mm. The annual mean minimum and maximum temperatures are 20°C and 34°C (INSD 2009). There are two seasons: one rainy season from June to September and one dry season from October to May. The major ethnic groups in the southwestern region are Dagara, Lobi, and Birifor. They are mostly farmers. The social organization is characterized by the absence of chiefs in the villages. Land priests are the guarantors of the traditional religion.

Data collection and analysis

Semi-structured questions were used in this study. The selected persons (30 informants per village) were interviewed individually. The work was conducted in May 2012 with a sample of 360 respondents. The respondents were selected randomly among the consenting persons. The questions were obtained after a preliminary survey and were organized around seven items: food, medicine, craft, construction, firewood, fodder, and rite/tradition/magic. Voucher specimens were collected and deposited at the herbarium of the Centre National de la Recherche Scientifique et Technologique (CNRST) in Ouagadougou, Burkina Faso. Data were processed using Excel 2007 and XLSTAT Pro 7.5.2 software. The following indexes were calculated: the informant diversity value (ID) giving the number of informants that use the species and the distribution of use among them; the informant equitability value (IE) measuring the degree of homogeneity of informants' knowledge; and the consensus value of use-types (CTU) assessing the level of agreement among the informants (Table 1).

Table 1. Measures of the uses of *Sarcocephalus latifolius* (Sm.) E.A.Bruce among the local population of the southwestern region of Burkina Faso.

Index	Calculation	Description	Sources
Informant diversity value (ID)	$ID = U_x/U_t$ Number of reports of use of species by informant (Ux) divided by the total number of reports of use of species (U_t)	Measures how many informants use a species and how its use is distributed among them. Values range between 0 and the number of informants using it.	Byg & Baslev (2001)
Informant equitability value (IE)	$IE = ID/ID_{max}$ Informant diversity value (ID) divided by the highest value diversity index found (ID_{max})	Measures how the use of a species is distributed among informants independently of the number of informants using it.	Byg & Baslev (2001)
Consensus value of use-types (CTU)	$CTU = (TU/U_t)/S$ Number of times in which a given use is reported (TU) divided by the total number of uses (U_t). This value is then divided by the types of use separated within each category (food, medicine…) (S).	Measures the degree of concordance among the interviewees in regards to the uses of a given species.	Monteiro *et al.* (2006)

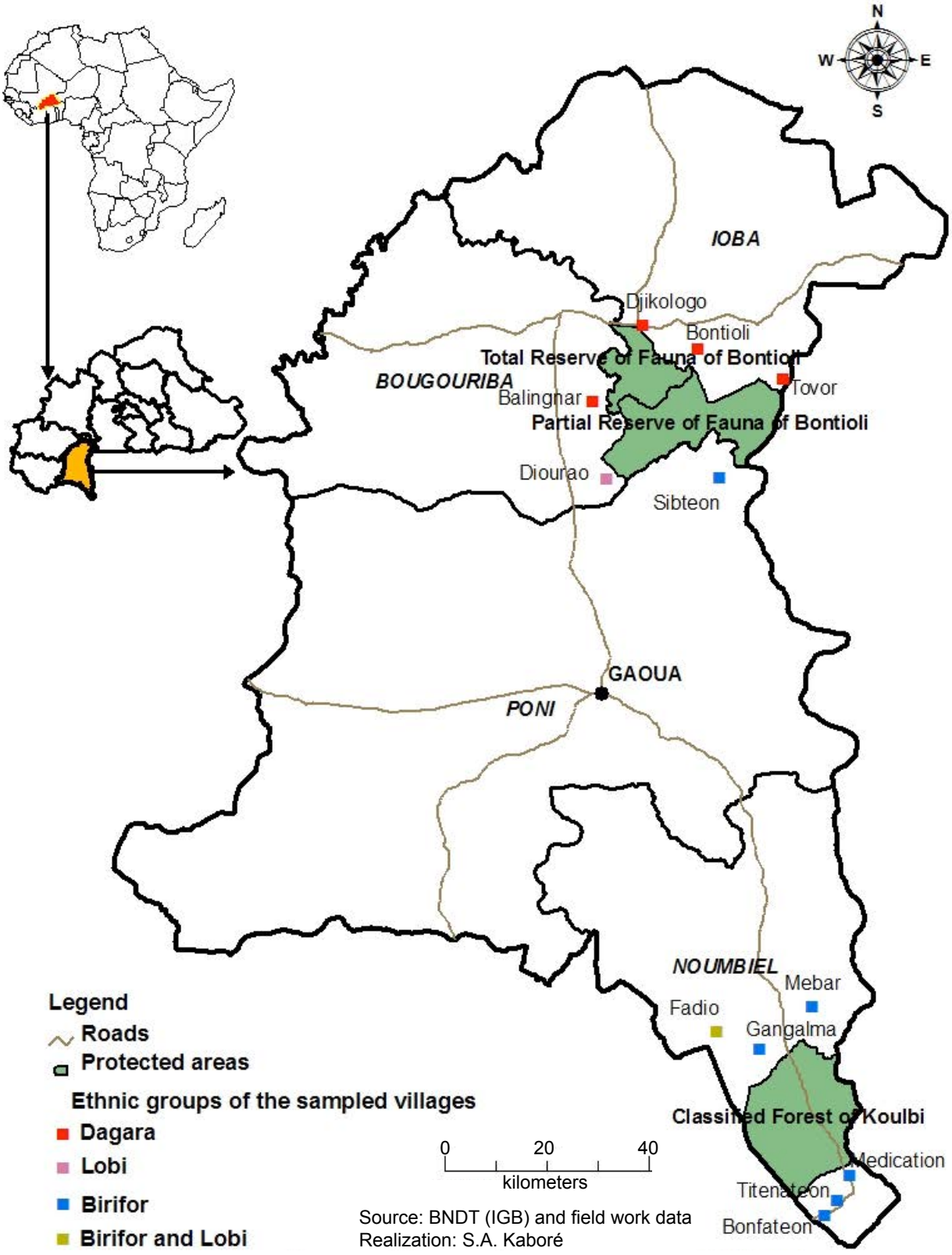

Figure 1. Location of the study area and ethnic group distributions in the southwestern region of Burkina Faso.

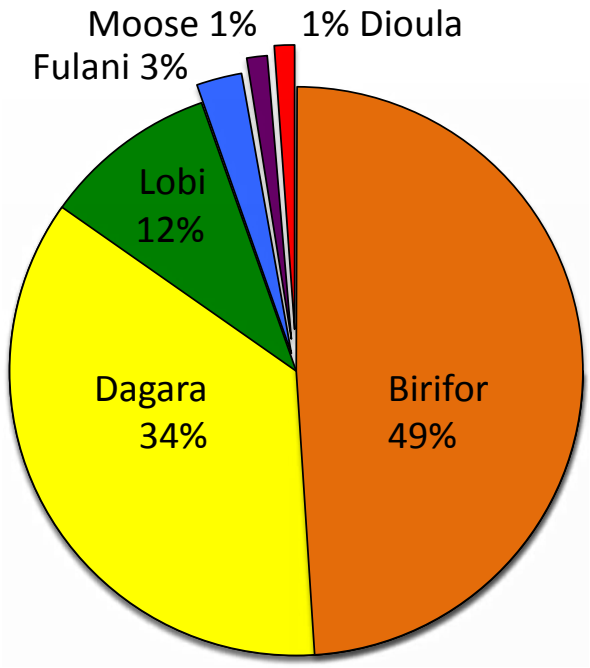

Figure 2. Number of informants (%) per ethnic group from local population of the southwestern region of Burkina Faso.

Results

Informants' affiliation to ethnic groups

Informants belong mainly to three ethnic groups: Birifor (49%), Dagara (34%), and Lobi (12%). The three other ethnic groups are Fulani, Moose, and Dioula (Figure 2). The average age of respondents was 44±14 years old. Concerning their profession, they are largely farmers (57%) and housewives (37%). Men were more numerous than women in the sample (61% vs. 39%) (Table 2).

Ethno-nomenclature of S. latifolius

Seven different names are used to refer to *S. latifolius*. Both Birifor and Lobi call the species **gongan** whereas the Dagara name it **habara** (Table 3). Sometimes, Dagara add "-**tae**" after the name to underline that it is a tree, thereby dinstinguishing between the name of the tree and the name of the fruit (without "-**tae**"). Thus, **habara** and **habaratae** are the similar terms to name the same species.

Informant diversity and equitability values

The calculation of the different parameters gives a better understanding of the distribution of knowledge on *S. latifolius* among people from different villages, ethnicities, ages, and gender issues. The species is used for 80 use-types. The minimum informant diversity value (ID) found was 0.01 and the maximum was 0.10. This result means that the least knowledgeable of respondents possesses only 1% of the knowledge on the use of *S. latifolius*. The respondent with the most knowledge cited 10% of uses. The average ID and IE for all the informants is 0.042±0.016 and 0.417±0.155, respectively. Informants of Gangalma possessed more knowledge (ID = 0.052±0.017; IE = 0.519±0.166) whereas those of Bontioli (ID = 0.033± 0.006; IE = 0.333±0.058) and Mebar (ID = 0.033±0.012; IE = 0.333±0.120) exhibited less knowledge. Among the major ethnic groups, Lobi (ID = 0.050±0.013; IE = 0.504±0.131) possessed more information than Birifor and Dagara. The two age classes had approximately the same ID and IE. Data indicate that men possess a greater knowledge of the species than women (Table 4).

Table 2. Number of informants per profession and per gender from local population of the southwestern region of Burkina Faso.

	N	%
Profession		
Farmers	204	56.67
Housewives	134	37.22
Breeders	9	2.50
Local beer sellers	6	1.67
Traditional healers	4	1.11
Smiths	3	0.83
Total	360	100
Gender		
Men	221	61.38
Women	139	38.62
Total	360	100

Table 3. Different names of *Sarcocephalus latifolius* (Sm.) E.A.Bruce according to the ethnic groups of the southwestern region of Burkina Faso.

Ethnic group	Language	Name
Birifor	Birifor	**Gongan, Ogangour**
Dagara	Dagara	**Habara**
Lobi	Lobiri	**Gongan**
Fulani	Fulfuldé	**Barkourlaye**
Moose	Moore	**Gwinga, Gadré**
Dioula	Dioula	**Baati**

Consensus value for use-types

Medicine (CTU = 0.638) is the most important category of use with 47 use-types (Table 5). Root (CTU = 0.695) is the most used plant part (Table 6). The uses of the species for rituals and to treat testicle aches and hernias were responses given by men while women reported uses concerning aches during delivery and infant care.

Table 4. Informant diversity (ID) and equitability (IE) values of the use of *Sarcocephalus latifolius* (Sm.) E.A.Bruce in the southwestern region of Burkina Faso. Total number of informants = 360. Number of use-types = 80.

	Informant values (Average ± Standard Error)	
	Diversity (ID)	**Equibility (IE)**
Villages		
Bontioli	0.033±0.006	0.333±0.058
Mebar	0.033±0.012	0.333±0.120
Tovor	0.037±0.016	0.370±0.161
Djikologo	0.038±0.012	0.378±0.119
Balingnar	0.038±0.015	0.381±0.151
Sibteon	0.043±0.014	0.426±0.143
Titenateon	0.043±0.018	0.433±0.176
Medicateon	0.043±0.019	0.426±0.187
Bonfateon	0.044±0.020	0.441±0.203
Fadio	0.046±0.007	0.463±0.066
Diourao	0.050±0.014	0.500±0.136
Gangalma	0.052±0.017	0.519±0.166
All the villages	0.042±0.016	0.417±0.155

	Informant values (Average ± Standard Error)	
	Diversity (ID)	**Equibility (IE)**
Ethnic groups		
Dioula	0.030±0.006	0.296±0.064
Dagara	0.037±0.013	0.370±0.130
Mosse	0.040±0.024	0.400±0.243
Birifor	0.043±0.016	0.429±0.161
Fulani	0.044±0.021	0.444±0.210
Lobi	0.050±0.013	0.504±0.131
Ages		
Informants with age > 45	0.042±0.015	0.423±0.152
Informants with age ≤ 45	0.041±0.016	0.409±0.159
Genders		
Women	0.039±0.014	0.390±0.143
Men	0.043±0.016	0.434±0.161

Table 5. Consensus value for use-types (CTU) of *Sarcocephalus latifolius* (Sm.) E.A.Bruce among the local population of the southwestern region of Burkina Faso.

Categories of uses	**CTU**
Uses in category	
Food (3)	0.573
Fruit consumption	0.490
Roots used as condiment	0.070
Roots used to prepare sauce for women after delivery	0.013
Medicine (47)	0.638
Roots used to treat stomachache	0.357
Roots used to treat a sore navel	0.035
Roots used to treat parasitic worms	0.029
Roots used to treat hernia	0.022
Roots used for puppies' appetite fortification	0.019
Roots used to treat malaria	0.017
Roots used for healing the navel of infants	0.016
Roots used during delivery	0.016
Bark of stem used to treat stomachache	0.013
Roots used to treat earache	0.010
Roots used to bathe infant	0.010
Roots used to treat diarrhea	0.008
Roots used to treat jaundice	0.008
Roots used to treat wounds and injuries	0.006

Categories of uses	**CTU**
Uses in category	
Leaves used to treat earache	0.006
Leaves used to treat malaria	0.006
Roots used to treat hemorrhoid	0.005
Roots used to treat sore breasts	0.003
Roots used to treat snake bite	0.003
Roots used to treat stomach ulcer	0.003
Roots used to treat sore eyes	0.003
Roots used to treat yellow fever	0.003
Roots used to treat boils	0.003
Roots used for puppies' stomachache	0.002
Roots used to treat chronic stomachache	0.002
Roots used during pregnancy	0.002
Bark of stem used to treat hernia	0.002
Bark of stem used to treat itching	0.002
Leaves used to treat sore eyes	0.002
Leaves used to treat stomachache	0.002
Fruit used to treat diarrhea	0.002
Fruit used to treat jaundice	0.002
Fruit used to treat bilharzia	0.002
Fruit used to treat stomachache	0.002

Categories of uses	CTU
Uses in category	
Roots used to treat abscess	0.002
Roots used to treat sore testicles	0.002
Roots used to treat bilharzia	0.002
Roots used to treat itching	0.002
Roots used to treat general pain	0.002
Roots used to treat muscle pain	0.002
Roots used to treat swelling	0.002
Roots used to treat epilepsy	0.002
Roots used to treat general tiredness	0.002
Roots used to treat fever	0.002
Roots used to wash infant before first nursing	0.002
Roots used to treat headache	0.002
Roots used to treat cough	0.002
Crafts	0.214
Wood used to make baskets	0.127
Wood used to make chairs	0.033
Wood used to make footstools	0.021
Wood used to make hatcheries	0.013
Wood used to make xylophones	0.006
Wood used to make pestles	0.003
Wood used to make checkerboards	0.002
Wood used to make mangers for puppies	0.002
Wood used to make pickaxe handles	0.002
Wood used to make spatulas	0.002
Wood used to make statuettes	0.002
Wood used to make walking sticks	0.002
Leaves used to conserve shea butter	0.002

Categories of uses	CTU
Uses in category	
Construction	0.160
Wood used to make house roofs	0.135
Wood used to make attics	0.013
Wood used to make sheds	0.011
Wood used to make coops	0.002
Firewood	0.289
Fuel wood	0.289
Fodder	0.232
Leaves eaten by pets (sheep, cattle)	0.108
Fruit eaten by pets (pigs, goat, sheep, cattle)	0.108
Fruit eaten by wildlife (snakes, birds, monkeys)	0.022
Seedlings eaten by agouties	0.002
Rites/Traditions/Magic	0.027
Totem: forbidden to cut, to use, or to bring any part of the species at home	0.010
Roots used in mysticism	0.008
Wood placed in the fields as fetishes	0.002
Roots buried at the beginning of some rites	0.002
Roots used during the **bouro** festivity	0.002
Use of the root that crosses a road in cases of early weaning due to a new pregnancy	0.002
Species used to protect somebody against enemies	0.002
It is forbidden for a woman whose maternal uncles are all living to use the species as firewood.	0.002

Table 6. Consensus value for use-types (CTU) of the different plant parts and the first ten use-types of *Sarcocephalus latifolius* (Sm.) E.A.Bruce in the southwestern region of Burkina Faso.

Rank	Plant part	CTU	Rank	Use-types	CTU
1	Root	0.695	1	Fruit consumption	0.490
2	Fruit	0.619	2	Root used to treat stomachache	0.357
3	Wood	0.375	3	Fuel wood	0.289
4	Leaf	0.125	4	House roofs	0.135
5	Bark	0.016	5	Baskets	0.127
			6	Leaves eaten by pets (sheep, cattle)	0.108
			7	Fruit eaten by pets (pigs, goats, sheep, cattle)	0.100
			8	Root used as condiment	0.070
			9	Root used to treat sore navel	0.035
			10	Chairs	0.033

Medicinal use of S. latifolius

People use *S. latifolius* to treat many illnesses and for infant care. As shown in Table 7, 34 different ailments and infant care uses were reported. Stomachaches, hernia, navel aches, testicle aches, malaria, and snake bite are some of the cited ailments. The species is used to wash a baby just after birth, to heal his navel, and for his daily bath. All those treatments purportedly serve to prevent certain illnesses. The decoction, the maceration, and the sap are used either by oral route or applied on the diseased organ. Roots are the most used plant parts in medicine. They are involved in 89% of all the cited medicinal and care-related uses.

Table 7. Preparation of *Sarcocephalus latifolius* (Sm.) E.A.Bruce organs and mode of administration to treat some ailments or cares practiced by the population of the southwestern region of Burkina Faso.

Ailment/Care	Preparation/Administration
Abscess	Wash the infected organ with root decoction
Aches during delivery	Mix decoction or powder based on the second envelope of root with sauce and eat
	Eat sauce based on the second envelope of roots
Bilharzia	Drink root decoction
	Eat raw and ripe fruit
Boils	Apply root decoction
Breast aches	Drink root decoction
Chronic stomachache	Drink root decoction
Cough	Drink root decoction
Diarrhea	Drink root decoction
Earache	Press a leaf then put the sap in the ear
Epilepsy	Burn roots and add to some secret components
Eye ache	Press a leaf to apply the sap in the eyes
Fever	Drink root decoction
General pain	Drink root decoction
General tiredness	Drink root decoction
Headache	Drink root decoction
Healing infant navel	Apply root decoction on navel
Hemorrhoid	Crush dry root and add to porridge
Hernia	Put a root or bark in water bottle and drink the maceration
	Root second envelope powder added to sauce and eat
Itching	Take a bath of bark decoction
Infant bath	Wash infant with root decoction
Infant care before first nursing, just after birth	Wash infant with root decoction
Jaundice	Drink root decoction
Malaria	Drink root or leaf decoction
	Take bath based on decoction of root or leaf
Muscle pains	Drink root decoction
Navel ache	Drink root decoction
Parasitic worms	Drink root decoction
Puppy appetite fortification and stomachache	Root decoction added to food
Snake bite	Drink root decoction
Stomachache	Add the decoction of the second envelope of a root to a sauce and eat
	Eat sauce based on the second envelope of roots
	Put a root in water bottle and drink the maceration
	Add the powder of the second envelope of a root to sauce and eat
	Purge with root decoction
	Drink root decoction. NB: only 1 or 2 teaspoon for children if not a high dose make them sleep deeply
Stomach ulcer	Add the powder of the second envelope of root to any food and eat
	Eat sauce based on the second envelope of roots
Swelling	Pound the roots with a small quantity of water and apply on the swollen part
Testicle aches	Drink root decoction
Treat wounds and injuries	Use root decoction as a germicide on the concerned part
Yellow fever	Drink root decoction

Discussion

Sarcocephalus latifolius is a multipurpose species in the southwestern region of Burkina Faso. It is used as food, as medicine, for utilitarian objects manufacturing, as timber, as an energy source, and in ritual practices. It provides primary products (fruit) for wildlife such as snakes, birds, and monkeys. The total number (80) of the different use-types of *S. latifolius* in the present study is high in comparison to previous studies (Asase & Oteng-Yeboah 2012, Badiaga 2011). This result could be explained by the relatively great number of villages and informants and by the specificities of the involved ethnic groups. Unfortunately, the multiple uses of *S. latifolius* increases the ecologic pressure on these plants. If nothing is done, this can contribute with the other factors such as plant community composition, land use practices, and drought to jeopardize its survival. Indeed, as Ticktin (2004) noted, the most direct ecological consequence of non-timber forest products (NTFP) extraction is alteration of the rates of survival, growth, and reproduction of harvested individuals. The low informant diversity and equitability values found here show that knowledge of the species is unevenly distributed among the informants. These values are low in comparison to similar studies among other communities on *Adansonia digitata* L. (Schumann *et al*. 2012) in Burkina Faso and *Spondias tuberosa* Arruda (Lins Neto *et al*. 2010) in Brazil.

The particularity of uses of *S. latifolius* is that some information is known by everybody while other information is secret and is kept by few persons. Indeed, the uses of the plant in fetish, mysticism, against enemies, and during the **bouro** festivities were not disclosed so that no detail on these uses was given. The **bouro** is a ritual in which Birifor, Lobi, and Dagara are introduced to how to live in society. It is forbidden to talk about what was learned during this initiation. Almost all informants know that its roots treat stomachaches. This information is transmitted from generation to generation probably because stomachache is one of the major diseases in the community. In addition some uses given by men differ from those given by women. This difference may partially explain the fact that men possess more knowledge than women.

The species plays an important role for people's health because of the large number of diseases treated. Despite the low number of traditional healers, the study shows that many individuals have knowledge about the medicinal use of the species. The reported medicinal uses (47) are more diverse than those reported for the same species by Duke (2013) (22 uses), Badiaga (2011) (13 uses), and Tabuti *et al*. (2003) (10 uses). Due to weak purchasing power and the unavailability of pharmaceuticals in each village, people are obliged to continue to use plants. In addition, many people from the southwestern region of Burkina Faso remain committed to the traditional culture and spirituality. Thereby, *S. latifolius* will remain one of the important species for their well-being for a long time.

All plant parts are used except flowers. However, there are hives in certain plants. *Sarcocephalus latifolius* is a melliferous plant exploited by the local people, corroborating results found by Nombré *et al*. (2009). The use of the root as condiment has never been reported. Root decoction used during pregnancy can be dangerous according to Legba *et al*. (2012) because it causes abortion. The study reveals that root is the most used plant part (highest CTU), corroborating the results of a study carried out by Tabuti *et al*. (2003) in Uganda. The harvesting of roots is practiced either by cutting one part of the lateral root while sparing the trunk of the plant or by uprooting the entire root system. Since roots are very sensitive parts of the plant, their harvesting must be moderated. Despite its importance, no form of protection of the species is adopted by the local population except in the case of its use as a totem, whose CTU is unfortunately too low. The roots are sold in cities like Gaoua. It is therefore necessary to conduct a monetary valuation of raw or derivative products from *S. latifolius*. Such a study would reinforce the knowledge that we already have of this plant. Thus, monetary valuations of the importance of ecosystem services to society can serve as a powerful communication tool for the management of lands and resources (De Groot *et al*. 2012).

Conclusion

This study has permitted us to evaluate the diversified uses of *S. latifolius* in the southwestern region of Burkina Faso. The ethnobotanical indices highlighted the most used plant parts and the distribution of knowledge among villages and ethnic groups. People use the species mainly in medicine, construction, craft, and as fire wood. Some results of this study such as the use of the plant to treat hernia, navel aches, testicle aches, and stomachaches could serve as a basis for clinical studies. It is essential to document the uses of native species in order to better safeguard the knowledge accumulated over many generations. In the context of land regression, people must integrate sustainable management in their daily relation with plants by avoiding overuse especially when sensitive plant parts such as roots and bark are harvested.

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