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Socio-cultural importance of the species *Blighia sapida* koenig (Sapindaceae) in Benin

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Abstract

Objective: *Blighia sapida* is a species whose nutritional potential has been demonstrated by certain authors. Nevertheless, its valuation knows real constraints due to the lack of knowledge of the species by the community. The general objective of this study is to contribute to improving the levels of knowledge about *B. sapida* for its better use.

Methodology and Results: Eight hundred and sixty-three (863) households were surveyed across 24 villages distributed in 8 communes chosen from the three phytogeographical regions of the country (south, center and north). Ethnobotanical data were collected using a semi-structured questionnaire. Five uses of the species have been identified: food (81%), cosmetic (10%), medicinal (7%), commercial (0.31%) and fertilizer (0.21%) uses. The organs used are the fruit (arils, seed and fruit capsule), seed, bark, leaves and root. The use value obtained in the localities surveyed (VUt = 2.2) reflects the level of use of the species by the population. The diversity and equitability index values (ID = 1.43 and IE = 0.57) show a heterogeneous distribution of knowledge about the species within the population groups. The low value of the vulnerability index (IV=2.50) justifies that the species is not yet under threat of extinction in Benin.

Conclusion and application of the results: At the end of this study, it is observed that *B. sapida* is of high socio-cultural importance for the rural population of Benin. This level of importance assessed through ethnobotanical indices (IC, ID, VU and IV) justifies the perception that indigenous populations have given to the plant, which nevertheless provides an important source of income, food supply and pharmacopoeia.

Keywords: Valuation; Vulnerability; Aril; Ethnobotany; Ackee

1. Introduction

Human dependence on cereal resources for food in a world marked by a demographic boom is an obstacle to food security. Consequently, reflections are increasingly focused on the use of alternative resources to improve food security [1]. Thus the food forest resources designated under the term NTFPs (Non-Timber Forest Products) have revealed their usefulness; these native wild resources could contribute to reducing hunger as well as improving nutrition and health [1]. In addition, these resources play a decisive role in the lives of populations by contributing strongly to the local economy; they therefore constitute an indispensable component in the subsistence strategies of rural populations [2].

In Africa, the populations of the rural world are active in the exploitation of Non-Timber Forest Products (NTFPs) which provide a good part of their food, medicinal and financial needs. Moreover, the research of (Ekué and *al.,* 2004),

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(Assogbadjo, 2006), (Poissonnet and *al*., 2006), (Djosa, 2007), (Rouxel, 2010), (Loubelo, 2012) has demonstrated the economic potential of NWFPs in supporting the sustainable development and resilience of indigenous populations [3, 4, 5, 6, 7, 8]. These NWFPs contribute significantly to the national economy. In monetary value, 10 billion dollars were obtained thanks to NWFPs with an increase of 100% during the period from 1999 to 2002 [9].

Knowledge of the local potential of these NWFPs is essential for better development [3]. Nevertheless, this valuation knows real constraints which could be due to the lack of knowledge and accessibility of the species by the community. It is within this framework that this study focuses on a species whose nutritional and cultural potentialities have been demonstrated by certain authors [10, 1]: it is *Blighia sapida*.

However, based on the available documentation, little scientific information exists on the level of use of the species in rural areas. These research gaps which we will try to provide answers to are related to the nature and the mode of use of the species as well as the place of the species in the life of the populations:

- What are the nature and mode of use of the organs of the species ?
- Does the level of use constitute a threat in relation to the vulnerability of the species ?

In view of the shortcomings noted in the scientific work listed above, the general objective of this study is to contribute to the improvement of the levels of knowledge on *B. sapida* for its better valorization.

objectives

1. Determine the nature and mode of use of *B. sapida*.
2. Assess the level of vulnerability of the species in Benin.
3. Characterize the value chain of *B. sapida*.

2. Material and methods

2.1. Presentation of the study area

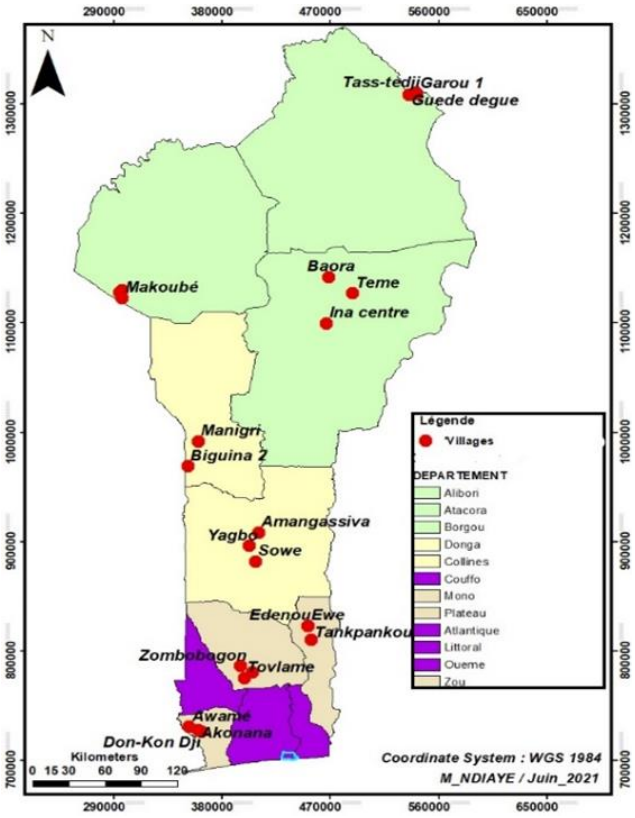

Figure 1 Geographical location and location of the sampled villages (Source: Ndiaye, 2021)

With a view to national coverage, the study was conducted across 24 villages (Edenou, Ewe, Tankpankou, Dovogon, Zombobogon, Tovlamé, Don-Kon Dji, Awamé, Akonana, Biguina 2, Manigri, Pennessoulou, Sowé, Amangassiva, Yagbo, Koumagou B, Kounakogou, Makoubé, Ina centre, Témé, Baora, Garou 1, Guede degue and Tass-tédji) divided into 8 communes in the three agro-ecological zones of Benin. These villages were chosen taking into account the reputation of the community and its attachment to using the plant, in particular the arils; the proximity of the collection sites as well as the availability of the resource. A country in West Africa, Benin covers an area of 114,763 km^2 between the parallels 6°30' and 12°30' north latitude and the meridians 1° and 30°40' east longitude. It is bordered to the south by the Atlantic Ocean, to the north by the Republic of Niger, to the east by the Federal Republic of Nigeria and to the west by the Republic of Togo and the Republic of Burkina Faso [11].

2.2. Data collection methods

For the ethnobotanical study, a survey by stratified and reasoned sampling was carried out with our targets. The size of the sample was determined in two successive phases: an exploratory phase to determine the proportion of positive responses and a final sampling phase using the formula of [12]. A total of 863 households were surveyed across the 24 villages. Ethnobotanical data were collected using a questionnaire previously established and tested according to the objectives. The interview was of a direct type and mainly targeted the head of household and the women (especially for questions related to the use of fruit). For more completeness, resource persons (village chiefs, herbalists, processing structures, producers, traders and others) were systematically targeted for additional information. Local markets were visited and interviews conducted to gain insight into the arils marketing circuit.

2.3. Data processing and analysis

The data collected during the ethnobotanical survey were entered into an Excel spreadsheet and descriptive statistics were calculated. The diversity of uses and the categories of uses relating to each organ of *B. sapida* have been determined. In order to evaluate the socio-cultural importance of the plant as well as the level of use of the different organs, the frequency of use (FU), the cultural indices (IC), of diversity (ID) and of equitability (IE) as well as the value in use (VU) were calculated. The evaluation of the impact of the use of organs on *B. sapida* was made from the calculation of the vulnerability index (IV) as proposed by [13] and adapted by [14] as well as [15]. Thus, in the context of this study, the frequency of use (FU), the number of categories of use (NU), the types of plant organs used and the mode of organ collection were the main parameters used to measure the vulnerability of *B. sapida*. To facilitate the interpretation of the results, some of the data were represented in the form of histograms and circular diagrams through an Excel spreadsheet and the Minitab 20.3.0 software.

3. Results

3.1. Respondent Demographics

Analysis of the demographic profile of our respondents found that there are 13 ethnic groups in the surveyed areas. They are dominated by the Fon community (46.45%), followed by the Peulh (19.35%), the Bariba (12.98%) and the Ditamari (10.43%). On the other hand, the Goun, Nago and Lokpa communities seem to be the minorities with rates lower than 3%. All these communities are mainly composed of young men and women (73.23%) aged 25 to 50, are married (98.03%) and are most often active in agriculture and livestock. Among these respondents, 54% are educated at different levels: primary (31.98%), secondary (10.78%) and higher (1.85%). However, some respondents, particularly women who have not had the chance to benefit from French education, have taken literacy courses (1.39%), not to mention those who are unaware of their level of schooling (8% of respondents).

3.2. Knowledge, availability and use of the species

Table 2 below presents the local names of *B. sapida* recorded in households and their meanings according to ethnicity. Through the latter, we can see that the Atchan (Adja and Cotafon) and Lissé (Fon and Goun) appellations are common to several ethnic groups. According to resource persons, the current knowledge about *B. sapida* held by the population has been transmitted from generation to generation (parents, grandparents, phytotherapists, etc.). According to the majority of households surveyed (52.17%), it is very common to find *B. sapida* plants within a radius of 1 km around concessions. Nevertheless, a few plants of the species can be spotted in agricultural (28.83%) and forest (0.46%) environments within a radius of 5 km and more from concessions (figure 2).

Table 1 Respondent Demographics

Parameters		Rate (%)	Parameters	Rate (%)	Parameters	Rate (%)
Age groupe and sex			**Marital status**		**Ethnic groups**	
	M	4.06	Married	98.03*	Adja	6.60
[18-25[	F	2.09	Widow	0.35	Bariba	12.98*
	M	45.54*	Single	1.62	Cotafon	4.17
[25-50[	F	27.69*	**Level of education**		Dassa	4.78
	M	11.94	Unschooled	45.77*	Ditamari	10.43
[50-75[	F	7.18	Primary	31.98*	Fon	46.45*
	M	1.39	Secondary	10.78%	Goun	0.35
[75 and +]	F	0.12	Level unknown	8.23%	Lokpo	2.55
Activity area			Superior	1.85%	Mahi	14.72
Agricultur		85.631518*			Nango	2.43
Breeding		35.921205			Otamari	6.6
					Peulh	19.35*
Other		8.5747393	Literate	1.39%	Yoruba	0.58

The data followed by an (*) are the majority rates (%) of the demographic characteristics of the respondents.

Table 2 Local names and meanings of *B. sapida* according to ethnicities

Ethnicity	Local name	Meanings
Adja	Atchan	Brain tree (due to the toxicity of the fruit which inhibits the brain and kills the human)
Bariba	Direm	
Cotafon	Atchan	Leak from the brain
Dassa	Iquin	
Ditamari	Ofolom	
Fon	Lissé	False cashew
Goun	Lissé	False cashew fruit
Lokpa	kpossou	
Mahi	Aisseti, Sissi	red pear tree
Nago	Issin	
Otamari	Moussoudouamou	Egg fruit (refers to the white arils contained in the fruit and resembling eggs)
Peulh	Bissaré	devil fruit plant
Yoruba	Ichin	red apple tree

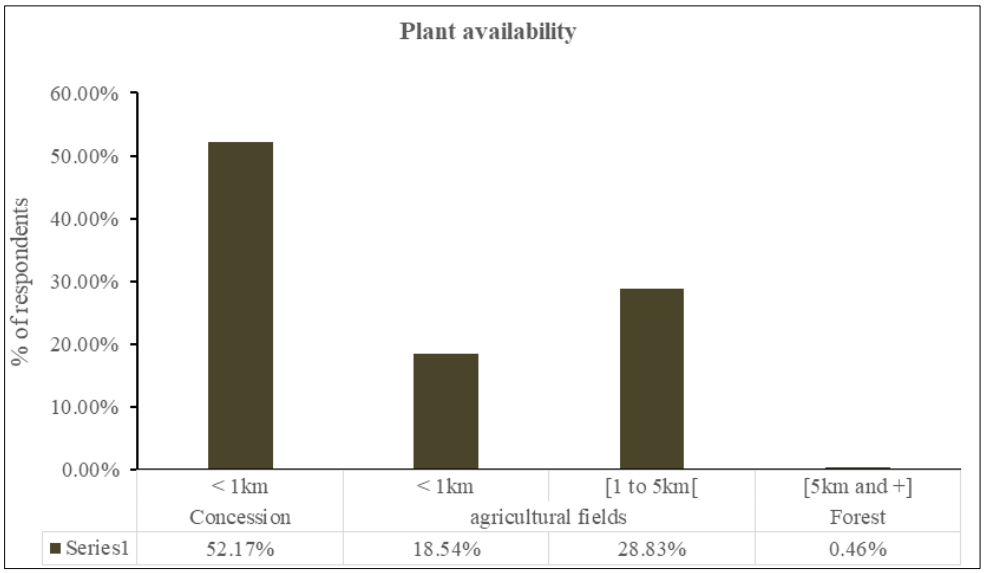

Figure 2 Availability of the species in relation to fields and dwellings

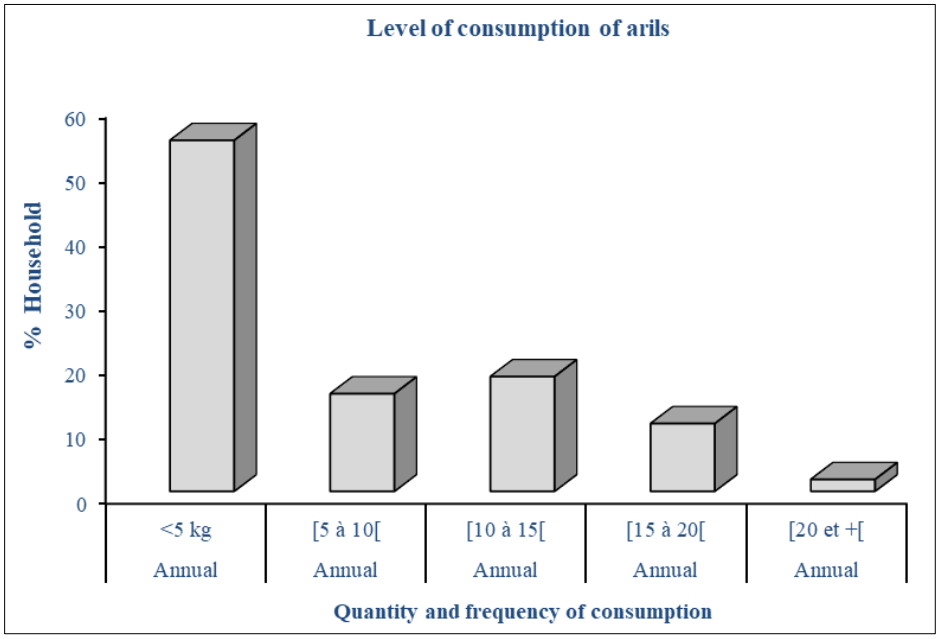

Figure 3 Consumption level of *B. sapida* arils in Benin

3.3. Use of *B. sapida* in Benin

Through Figure 4, the food use of *B. sapida* is more representative (81.52%) in the study areas; it is followed by cosmetic (10.44%) and medicinal (7.52%) uses. On the other hand, the categories of commercial use and fertilizer are under-represented with less than 5% of the households surveyed. Compared to the level of organ use presented in Figure 5, the fruit, bark, leaf and root are the main organs used by the population of Benin. However, the fruit is the most edible organ of the plant (82.71%); and its use is divided among other aril (55.33%), seed (20.73%) and shell (6.79%). The use of other organs, in particular the bark, leaf and root, is relatively low with respective percentages of around 10.22%, 6.79% and 0.28%.

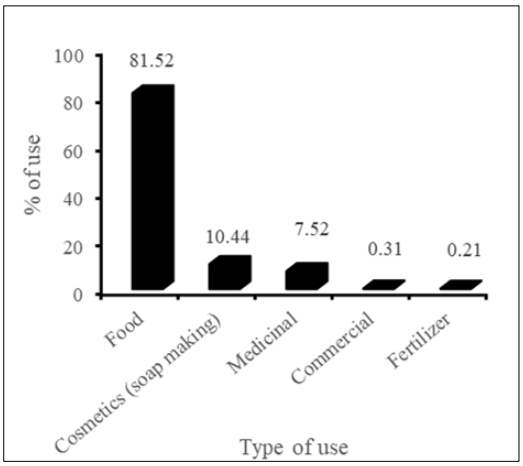

Figure 4 Categories of use of *B. sapida* organs

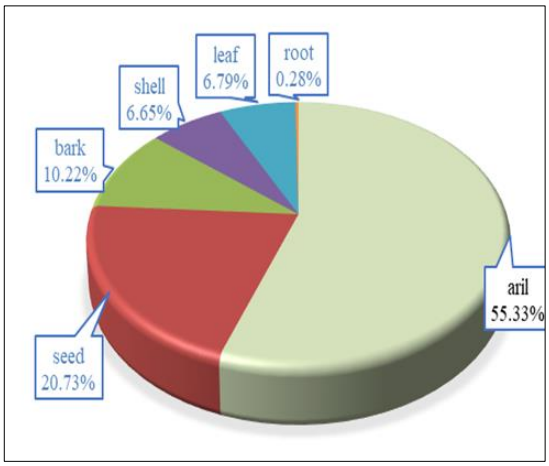

Figure 5 Categories of organs used by populations

Table 3 Forms of use of *B. sapida* organs according to use categories in Benin

Organs	Forms of use	Use categories	Uses	FU (%)
Root	Decoction	Medicinal	Treatment of diseases such as malaria, yellow fever, etc.	0.28
Bark	Decoction/Powder	Medicinal	Treatment of skin diseases in particular wound healing	10.22
Leaf	Powder/Decoction	Medicinal	Fight against hemorrhoids, hyperthermia, jaundice, migraines and sprains	6.79
Fruit shell	Powder	Medicinal/Cosmetic(Soap)/ Fishery	- Soap making - Poisoning to stun and capture fish	6.65
Seed	Powder	Cosmetic(Soap)/Fishing	- Soap making - Poisoning to stun and capture fish - Organic fertilizer	20.73
Arille	Believed	Food	- Direct consumption - Preparation of dishes from the raw or processed product	55.32
	Soft			
	Plain flour			
	French fries			
	Toast			

According to the cultural index, the food use of *B. sapida* arils is the most representative with an IC of 0.88. The low values of the knowledge diversity and equity indices of the respondents (Table 4) show that there is a heterogeneous distribution of knowledge about the plant. This would mean that a small group of the population holds most of the knowledge about *B. sapida*. In other words, a small group of people especially the elderly (old men and ladies) hold most of the knowledge about the plant. Indeed, this unequal distribution of knowledge on *B. sapida* particularly concerns cosmetic (soap making), medicinal, fertilizer and fishery uses. In Benin, the ethnobotanical use value of *B. sapida*, which is 2.2, testifies to the level of importance attributed to the use of other organs (leaf, bark, and root); unlike the arils.

The vulnerability index of *B. sapida* evaluated during this study in Benin is IV = 2.50. This value included in the interval $1 \leq IV < 3$ shows that the species is weakly vulnerable in the study areas. Table 5 summarizes the vulnerability scales according to the parameters assessed. This low vulnerability of *B. sapida* is largely due to its low frequency of use (FU =

16.665%) despite the large number of use categories (NU = 5) as well as the plant organs used (fruit, leaves, bark, roots) and the method of collecting organs (cutting and picking) of the species in the localities surveyed

Table 4 Ethnobotanical indices of *B. sapida* in Benin

Use categories	**IC**	**ID**	**IE**	**VU**
Food	0.88	0.5	1	
Cosmetic	0.057	0.16	0.33	
Commercial	0.052	0.33	0.66	
Medicinal	0.037	0.28	0.56	
Fertilizer	0.010	0.16	0.33	
Total	1.038	1.43	2.88	2.2
Average	0.207	0.286	0.576	

The values in bold represent those used in the analysis and interpretation of the indices

Table 5 Evaluation of the vulnerability of *B. sapida* according to the frequency of use, categories of use, organs used and mode of organ collection

Parameter evaluated	**Results**	**Vulnerability level**
Average frequency of use	16.665	1
Number of use categories	5	3
Organs used	4 (fruit, leaf, bark, root)	3
Mode de collection	Cut and pick	3
Iv		2.5*

The value followed by an (*) represents the total value of the vulnerability index (IV) of *Blighia sapida*

3.4. Arils marketing chain

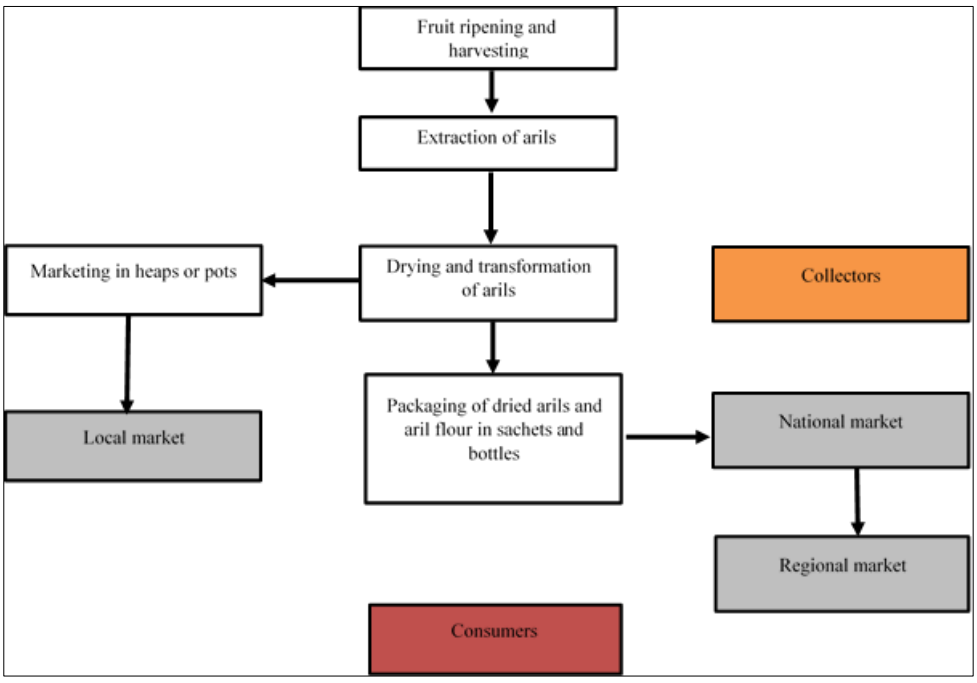

Figure 6 *B. sapida* marketing circuit in Benin (source: Ndiaye, 2021)

From collection of ripe fruits to use, arils (processed or not) and other organs of *B. sapida* can be marketed in three stages. First, they can be marketed directly in heaps and jars in local markets. Secondly, the arils dried and then transformed into flour can be packaged and then marketed in sachets and bottles in local and national markets. Nationally and regionally, arils are first collected in large quantities in village markets before being transported to national markets or exported to other countries (Figure 6).

4. Discussion

The values of the diversity and evenness indices show an unequal distribution of knowledge about the uses of *B. sapida*. This result confirms those of (Lougbegnon and *al.*, 2015) as well as (Akouehou and *al.*, 2014) respectively for *Chrysophyllum albidum* and *Artocarpus altilis* indicating that knowledge about these two species is not evenly distributed among the rural populations of Benin [16, 17]. This heterogeneity could be justified by the fact that the endogenous knowledge on *B. sapida* accumulated over millennia and considered as cultural wealth is held by a minority who inherited it from their ancestors. Moreover, (Morton, 1987) Had mentioned the possession of this endogenous knowledge of *B. sapida* by a minority in other countries such as Côte d'Ivoire, Cuba and Colombia [18]. However, during our study, many respondents claimed not to know the medicinal and cultural uses of the plant. For these uses of the species, the transmission of supposedly important knowledge is from father to son (medicinal, mystical, etc.). While among traditional healers, there is a total refusal to reveal certain secrets of the plant because of the financial benefits resulting from their activities (treatment of diseases, sale of drugs, etc.). This same phenomenon is noted in women where the process of making soap from *B. sapida* is classified as secret. This proves that old men and women as well as traditional healers hold most of the local knowledge about *B. sapida*. Even if the variation in knowledge according to demographic factors (age, sex or ethnicity, etc.) was not taken into account in this study, it was confirmed by the authors [19, 16] on *Artocarpus altilis* and *Chrysophyllum albidum*.

In total, five categories of uses have been identified for *B. sapida* (food, medicinal, soap, commercial and fertilizer). These results on the types of use are lower than those obtained on *B. sapida* with eight categories of use [1] and on other agroforestry species such as *Canarium schweinfurthi, Vitex dononia*, with seven categories of use. Uses in Cameroon [6, 20]. This difference is justified by the fact that certain uses, including wood for furniture, are no longer available because *B. sapida* has almost disappeared from the natural environment. Indeed, the density of *B. sapida* in the middle of the forest in 2011 was around 6 ind /ha [1]. However, under these conditions, taking into account the evolution of anthropogenic pressure and in addition to individuals located In agricultural fields and concessions, the production of *B. sapida* wood no longer seems to be relevant. The use value of *B. sapida* in the context of this study (Vu=2.2) is lower than those obtained by the authors [14, 21] on several species including *Dialium guineense* (8.98); *Spondianthus preussi* (8.16); *Blighia sapida* (7.34); *Vitallaria paradoxa* (2.95) and *Parkia biglobosa* (2.36). The low value obtained could be due to the number of uses made of the species. Indeed, the number of use categories and the type of organ that involved in the daily lives of consumers bear witness to the importance they attach to this resource.

The vulnerability index of *B. sapida* in the study area is low (2.50). This result corroborates those of [22] and [23] which each classified *B. sapida* in the category of non-threatened species. With a stable demographic trend. On the other hand, previous studies on other plant species have reached different conclusions: very high vulnerability for *Detarium microcarpum*, *Chrysophyllum albidum* [24]. This difference could be due to the fact that the organs with difficult regeneration (root, bark) are less used by the population for the species *B. sapida*. Because according to (Ayena and *al.*, 2016) intensive debarking leads to a slowdown in woody growth while frequent cutting of the roots ends up killing the tree [15]. Nevertheless, the removal of *B. sapida* organs (bark, leaves and roots) by the population constitutes a significant anthropogenic pressure to be taken into account in the conservation policy for the species. Moreover, even if the level of vulnerability of *B. sapida* is low, it remains threatened with extinction because no regeneration activity has been undertaken to date by local communities

5. Conclusion

At the end of this study, all the specific objectives set at the start have been achieved. The answers to the research questions are for the following: on the socio-cultural level, it is observed that *B. sapida* is of high socio-cultural importance for the rural population of Benin. This level of importance of *B. sapida* evaluated through ethnobotanical indices (IC, ID, VU and IV) justifies the perception that the indigenous populations have granted to the plant which nevertheless provides an important source of income, food supply and of pharmacopoeia.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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