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Ethnobotanical survey of plants used by the riparian population of Banco National Park (Abidjan, Ivory Coast)

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[2]Researcher at National Center for Agricultural Research, Forest Program and Environment, Station of Cocody, 08 PO. Box 33, Abidjan 08, Republic of Ivory Coast
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Abstract. *Gnahore E, Kouadio KR, Amba AJG, Kone M, Bakayoko A. 2022. Ethnobotanical survey of plants used by the riparian population of Banco National Park (Abidjan, Ivory Coast). Asian J Ethnobiol 5: 121-129.* Situated at the "heart" of Abidjan, Banco National Park (BNP), Ivory Coast, is the rare relics of moist, dense rainforests coveted everywhere. This work was undertaken with an aim of identifying the plants most usually used by the riparian population of BNP in human food, animal food, and pharmacopeia. An ethnobotanical survey was carried out of the riparian population of the BNP. The method consists of an ethnobotanical survey realized among the inhabitants of the park and those of the surrounding urban districts. The method used was semi-structured interviews. This study targeted 294 people, including 20% men and 80% women, aged between 30 and 60. A total of 36 plant species from 34 genera and 28 families were recorded. Thirteen species were used in food, three fodder species, and thirty others used to treat several ailments in the area. Two of these plants have strong ratio utilization in human food: *Myrianthus arboreus* P.Beauv. (15.25%) and *M. libericus* Rendle (14%). Thus, in the area study, five species are respectively considered threatened and three species rare. Leaves (32.55%) and bark (20.93%) are the most used organ. Decoction (98%) was the most common traditional medicine preparation method. Indigenous knowledge distribution in the community showed significant differences ($p<0.05$) in the study groups for factors of age, sex, gender, and educational level. The number of resources used can seriously impact the forest negatively. It is urgent to adopt a lasting management plan for sustainable harvest for the safeguard and preservation of the plant cash of the BNP.

Keywords: Banco National Park, ethnobotanical surveys, riparian population

INTRODUCTION

Tropical forest ecosystems are biodiversity reservoirs that play a fundamental role in meeting the basic needs of local communities (Agbo et al. 2017). Indeed, food, medicine and energy supply are the most important ecosystem services terrestrial ecosystems provide to local people (Ouédraogo et al. 2020). People in rural and urban areas, particularly indigenous peoples, have long used traditional health care approaches based on medicinal plants (Dogara et al. 2021). Therefore, wild food species are heavily exploited by local people to improve food security and their livelihoods causing high human pressure on savanna species (Ouédraogo et al. 2017). Ethnobotany is an interdisciplinary specialty concerned with understanding and applying plants and their ecosystems in connection with their cultural, social, and economic significance (Gaoue et al. 2017). It studies human-plant interactions at various spatial, chronological, historical, and cross-cultural scales, focusing on the cultural value of plants, how humans have used and modified plants, and how they represent plants in their knowledge systems (Mahmoud et al. 2020). Focusing on the present-day situation of ever-increasing exploitation of plants and natural resources, the main reason for showing interest in ethnobotany is its vast outcome that benefits every living being (Guissou et al. 2015). About 80% of the human population and 90% of livestock is believed to be dependent on traditional medicine and most of this comes from plants (Aragaw et al. 2020). Indeed, the anthropogenic pressures on these forest resources due to population growth are becoming increasingly important. Socio-economic characteristics of people (ethnicity, gender, age, occupation, etc.) are important factors affecting the management and use of forest resources, including preferences and valorization (Agúndez et al. 2020). Deforestation increased mainly in tropical forests due to the strong link between people's economic activities and land needs (De Sy et al. 2019). Moreover, in tropical countries where poor people's livelihoods depend strongly on forest resources, the exploitation is still done without respect to management plans. Ivory Coast is one of those countries.

In West Africa, the vegetal species are of very great importance to the rural and urban populations, a reason of their use for the satisfaction of the food needs (humans and animals), therapeutic, energizing and of service so much profit-making that on other aspects of the man's well-being (Dro et al. 2013). Urban communities in the Abidjan

region, especially those near the Banco National Park (BNP) areas, have a higher dependency on forest resource consumption. Forest resources are the source of revenue, employment, shelter, housing materials, cloth, ornament, fuel, fodder, grazing, timber, food, vegetables, medicines, fertilizer, fiber, floss, oilseed, cottage industries and handicrafts, and other non-timber forest products in the rural areas of BNP. Supply many products and non-timber forest products (leaves, flowers, fruits, seeds, barks, saps, fibers, rootstocks, etc.) by the woody multi-purpose is a perfect illustration.

However, these vegetal species and their habitats undergo some disturbances bound to this anthropogenic action and the climatic changes that threaten their survival even if their ecological, morphological, genetic characterizations and the inventory of their utility have been deepened (Adou et al. 2018). Such is the case of the BNP and her outskirts undergoing anthropogenic actions (Adou et al. 2018). This protected area was created in 1953 for biodiversity it has been conservation and been part of this network of protected areas from the Ivory Coast. Unfortunately, this protected area is infiltrated largely by the riparian population for harvesting medicinal plants, human food, and animal food plants (Adou et al. 2018). Delimited by four townships, this park undergoes the urbanization consequences of Abidjan city. This situation compromises its conservation, like many works realized on the knowledge of the utility plants collected in the forestry or savannah training by the local populations in Ivory Coast (Adou et al. 2018). This study is part of implementing a conservation strategy in the context of the degradation of the natural resources that this park is experiencing. A better knowledge of the vegetal species in place, their typology of uses as well as their state in conservation prove to be necessary. The present study's general objective conducted in the Abidjan commune was to document the medicinal, human and animal food plants mostly used by the riparian population of the BNP, their local names, and their mode of use and their various pharmacological and therapeutic uses. It is specifically about leading an ethnobotanical investigation of the riparian population, to collect, identify and characterize the vegetal species while raising their uses.

MATERIALS AND METHODS

Study area

The present research was carried out in the BNP and its outskirts are situated in Abidjan, Ivory Coast. It is between 5°21' and 5°25 North latitude and between 4°01' and 4°05' West longitude (Figure 1). It covers an area of about 3438.34 hectares and is delimited by the community of Abobo in the North, Adjamé in the East, the rural community of Attécoube in the South and the community of Yopougon in the West.

The climate in this area is sub-equatorial type, it is humid and cool in winter and mild in summer. Precipitation is characterized by non-regularity from one year to the next. The annual average precipitation is 1550 mm, while the monthly temperatures oscillate between 21°C and 31°C with an average of 26°C (Tiébre et al. 2014). Despite its relatively limited surface, the park of Banco maintains a forest microclimate. The temperature decreases superior to the bass stratum, the gap sometimes of more than 4°C. August is the hottest month of the year (Tiébre et al. 2014).

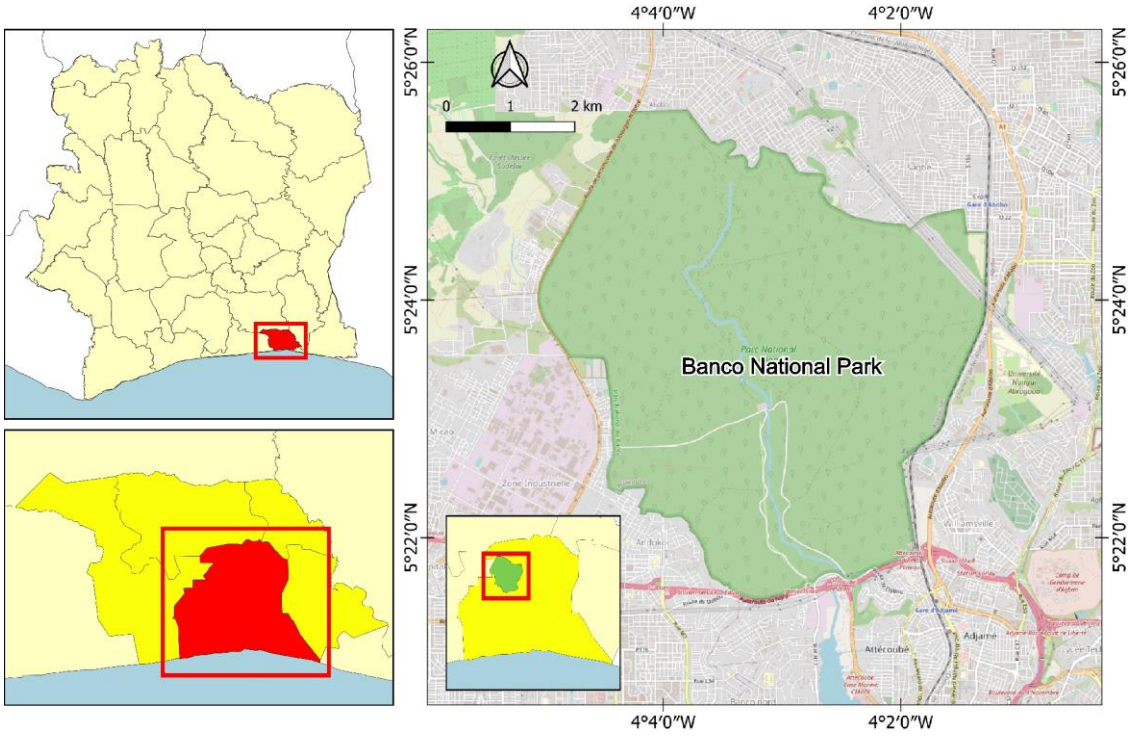

Figure 1. Geographical location of the study framework in Banco National Park, Abidjan, Ivory Coast

The relative humidity is close to the saturation, the gradient higher to soil than to the summit, with a minimum of 27% in January, the driest month (Tiébre et al. 2014). January the coldest month of the year according to the classification of (Tiébre et al. 2014), the BNP belongs to the ombrophily sector characterized by a predominance of sempervirante dense humid forest bound to abundant precipitations. The vegetation of the park of Banco is marked by a mosaic of vegetal formations, which are the most important basis of plant groups formation on the land.

The edaphic groups are situated under the dependence of water in funds of the talwegs. The anthropogenic groups or forest plantations were realized between 1925 and 1950 in the setting of the enrichment of the natural populations, or the reconstruction of the forest stand in the zones of culture or fallow.

Ethnobotany survey and data analysis

The information was obtained through ethnobotanical approaches with the people born in that area/or those who have lived in the area for a long time in the different townships near the Banco National Park (Kouakou et al. 2020).

Data collection

The ethnobotanical survey was conducted from September to December 2018. Ethnobotanical data were obtained using a semi-structured questionnaire method. The target groups for this study were herbalists, traditional medical practitioners, traditional midwives, homemakers, and other people of old age who have practiced and used medicinal and food (Human and animals) plants. The questionnaires used were divided into two parts, namely part A and B.

In part A, the socio-demographic information of the respondents was recorded, and information on plants used for traditional medicinal and food (humans and animals) was recorded in part B. Then, the local population was invited to gather the plants' samples and inform them of their mode of use and indications. Finally, the medicinal vegetal species' samples were received to validate and/or verify their local names with several investigations.

For the second part (part B), an inquiry was made to know "the extent to which food usage (mode of use) was associated with plant species" rather than asking "which plants were used for which food usages." For each mode of use cited, the name of the plants and the plant parts used were recorded. Our questionnaire data covered the respondent's backgrounds: name, age, sex, occupation, education level, habitat and distribution, major use categories, part(s) used, mode of collection, and local status. The survey was carried out with a sample size of 294 people from the population of different towns and their surroundings for four months. The women made up 80% of the total investigated population. During each interview, introverted information was obtained from the participants, the data obtained included the plants the participants used. The interviews were conducted in French, they lasted 20 to 30 minutes, during which we tried to obtain as much information on the socio-demographic profile of the people surveyed (age, sex, academic level, etc.) and the vegetal species used by them (local name, different uses, partly used, a different mode of use and diseases treated by these plants). Interviews were actualized in diversified places (farms, houses, and parks).

Collection and identification of plants specimens

Preliminary identification was done in the park. The voucher specimens which could not be identified in the park were taken to the Swiss Center for Scientific Research in Ivory Coast Herbarium and were identified using taxonomic keys and the flora of West Africa. The scientific names of the plant species were updated using relevant databases (http://www.ipni.org) and the family names were confirmed using databases (http://www.theplantlist.org) accessed on 13/05/2022.

Data analysis

Obtained informant data were analyzed by quantitative index: use value (T). The use value is a quantitative method used to demonstrate the relative importance of a species known locally. The result was processed using XLSTAT-Pro (version 7.1) software and the Excel spreadsheet. In this study, only the use value (T) was used. This measure was calculated to determine the relative importance of a particular species. The use value was calculated using the formula (Shaheen et al. 2017):

$$T\ (\%) = (Np / N) \times 100$$

Where; T denotes the use value of a species, Np is several citations per species; and N refers to the number of respondents. The range of T is 0 to 100%. The use value is high when several use reports exist for a plant, which means the plant is imperative. The use value drops to 0 when only a few use-related plant reports are found. However, T does not differentiate if a plant is used for one or more purposes (Ndiaye et al. 2017). Higher T is an indicative ratio utilization of a particular plant species for the treatment of a disease or ailment of a specific category by the informants of the studied area (Ndiaye et al. 2017).

Descriptive statistical methods (percentage and frequency) were used to summarize plant parts, mode of use, and mode of administration (Teka et al. 2020). Word 2013 software was used for data entry, and Excel 2013 for producing tables and figures. Univariate statistics were conducted to evaluate net effects. Mean differences between the paired study sites surrounding the BNP were compared with non-parametric Kruskal-Wallis matched pairs test statistics when discrete count data were analyzed. One-way ANOVAs and student t test are used to compare normally distributed data. Post-hoc comparisons were performed using the Tukey HSD tests. Non-parametric Mann-Whitney analysis was used to examine traditional knowledge differences across age class, gender and educational level. These variables determined traditional knowledge of a community (Teka et al. 2020). All statistical analyses were performed using XLSTAT-Pro (version 7.1) software.

RESULTS AND DISCUSSION

Results

Socio-participants characteristics of respondents

The informants (59 men and 235 women) were either native-born or had been living in the zone for more than 20 years. The ages of the interviewees ranged from 30 to 60 years. Most of the respondents (43.53%) were above 50 years of age. Participants reported different numbers of medicinal plants in the demographic characters considered. The statistical details showing variation in medicinal plants reported in different demographic characters are presented below.

In the region of Abidjan, both men and women use the plant species of BNP. However, women use plant species more than men (Table 1). Women listed a greater number of plant species (80%) than men with 20% (Figure 2). Mann-Whitney Test statistical analysis showed a significant knowledge difference between the two (2) gender groups on the traditional use of plant species for different purposes ($P<0.0001$).

The use of vegetal species in the study area is widespread among all the age groups, with a predominance of people in age categories 50 to 60 years (43.53%), according to Table 1. The age group of 40 to 50 years and 30 to 40 years come next with 25.85% and 30.61%, respectively (Figure 3). The average age was around forty years (40 years), the youngest was 32 years old, and the oldest was 58 years. People of at least fifty years (50 years) represent more than a third of the investigated population. However, people under 30 years did not use a lot of vegetal species. The ANOVA test showed a very significant difference in all age classes ($F=5.1$; $P<0.009$, observed in the age groups between 30 and 40 years, $F=185.486$; $P<0.0001$ for age 40 to 50 and $F=70.55$; $P<0.0001$ for age 50 to 60). In addition, a significant difference in the number of medicinal plants mentioned was found between the age groups, with a greater number of medicinal plants mentioned by older adults (above 50 years) than young ones (30-50 years) (ANOVA test Test, $p<0.05$).

In our study area, a large proportion of vegetal species users were illiterate, 52.63% (Table 1). Nevertheless, people with primary school education had an average percentage of medicinal plant use of 47.37% (Figure 4). However, statistical analysis of the educated showed that this percentage varied significantly ($F=4.93$; $P=0.009$). Similarly, the proportion was significantly different among those illiterate ($F=4.31$; $P=0.015$). Educational levels also showed significant differences in the illiterates cited more plants than educated informants. On average, more medicinal plants were cited by men, but the statistical analysis showed a significant difference ($p<0.05$). However, the presence of gender-specific knowledge was reported.

According to Table 1, the family's situation was very important in using plants: 56.76% of single people used plants against 43.24% of married people. In addition, 42.20% of people were cited as housewives, 110 (37.60%) as traders, and 59 (20.20%) people from mechanics.

Plant used by the riparian population of BNP

Human foods plant used

The present study shows that 13 vegetal species (35.13%) were used in human food (Table 2). These picking products constitute an important source, less expensive and easily accessible to the population. Table 2 lists species used in human food and their usage rates throughout the survey. Two (2) of these plants have strong ratio utilization: *Myrianthus arboreus* P.Beauv. (15.25%) and *M. libericus* Rendle (14%). The dominant harvest type was picking (63.51%) followed by stripping (23.07%) and uprooting with 15.38% (Figure 5). The plant name, the plant family, the used part, the type of harvest, and the use rates are shown in Table 2 and medicinal plant species and their uses are shown in Table 3.

Rare and threatened species at the survey level

It is clear that the vegetal species contribute to improving the conditions of life of the populations, but uses are not without consequence on the sustainability of these resources. This is how it was cited as threatened species because of the high frequency of use but recognized by the riparian population for these virtues. According to this study, threatened species are *Panicum maximum* Jacq., *Ficus exasperata* Vahl, *Microdesmis keayana* J.Léonard, *Strombosia pustulata* Oliv. and *Bambusa vulgaris* Schrad. ex J.C.Wendl.. The species cited by the population but rarely listed in the inventory is *Annickia polycarpa* (DC.) Setten & Maas ex I.M.Turner, *Newbouldia leavis* (P.Beauv.) Seem and *Buchholzia coriacea* Engl. In this way, the main causes are illegal cuts (14.4%), skinning (55.6%), uprooting (12.9%), and stripping (17.1%).

Figure 2. Distribution of plant users by sex

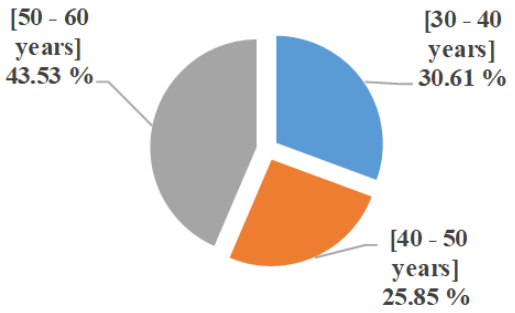

Figure 3. Distribution of plant users by age

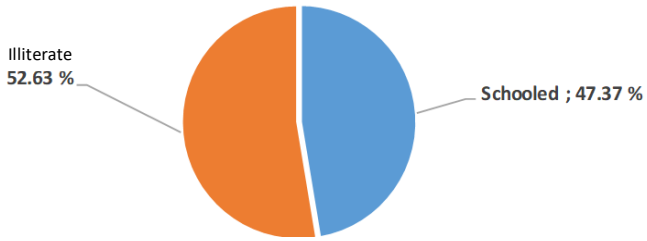

Figure 4. Distribution of plant users by grade level

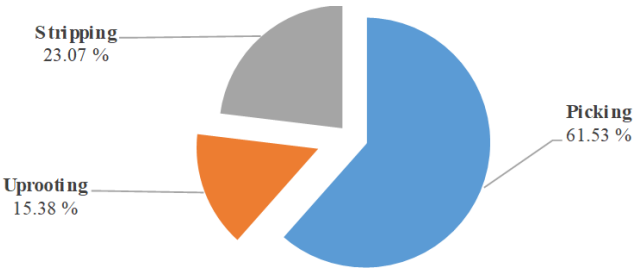

Figure 5. Distribution of the most used state of the plant

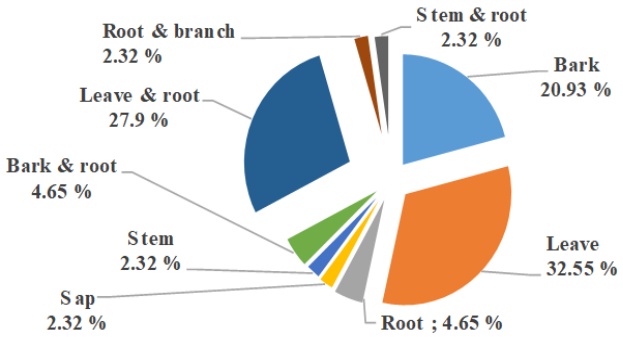

Figure 7. Percentage of plant parts used for medicinal purpose

Table 1. Socio-participants characteristics of the respondents in the study area

Socio-economic variables	Characteristics	Freq.	Percent. (%)
Age classes (years)	30 to 40	90	30.55
	40 to 50	76	25.82
	50 to 60	128	43.63
Total			**100**
Gender	Male	59	20
	Female	235	80
Total			**100**
Residence	Abobo	175	59.52
	Adjamé	46	15.64
	Yopougon	73	24.84
Total			**100**
Socio-cultural group	Indigenous people	38	12.92
	Immigrant people	256	87.08
Total			**100**
Educational level	Illiterate	155	52.63
	Schooled	139	47.37
Total			**100**
Socio-professional activities	Mechanics	59	20.2
	Traders	110	37.6
	Housewives	125	42.2
Total			**100**
Family status	Single	167	56.76
	Married	127	43.24
Total			**100**

Note: *Total exceeded the number sampled due to multiple socio-economic activities calculation is however based on number sampled

Comparison of important species of plants in the study area used by the local people

The majority of the community in the study area relied on wild plants for various purposes such as pharmacopeia, Human and animal food. The Abobo municipality had a high mean specific richness in all three areas of use. Then comes the community of Yopougon and finally that of Adjamé with low average specific richness. The study of the average specific richness of the species used in the different fields indicated a significant difference in the number of species for medicinal and food use (human and animal) in the different municipalities (Table 4). Furthermore, a significant difference in the mean of all category uses mentioned was found between the age groups, with a greater number of medicinal plants mentioned by elderly peoples (above 50 years) than young ones (30-50 years) (Kruskal-Wallis Test; $p<0.05$).

Table 2. List of human foods plant used, part used, types of harvest and their use rates

Human foods plant used	Plant family	Part used	Type of harvest	Use rates (%)
Blighia sapida K.D.Koenig	Sapindaceae	Fruit	Picking	9.25
Calamus deeratus G.Mann & H.Wendl.	Arecaceae	Terminal bud	Stripping	5.36
Chrysophyllum subnudum Baker	Sapotaceae	Fruit	Picking	6.25
Ceiba pentandra Ceiba pentandra	Malvaceae	Young leave	Stripping	11.23
Cola nitida (Vent.) Schott & Endl.	Malvaceae	Seed	Picking	4.12
Elaeis guineensis Jacq.	Arecaceae	Seeds, Terminal bud	Uprooting	5.63
Laccosperma secundiflorum (P.Beauv.) Kuntze	Arecaceae	Terminal bud	Stripping	6.33
Myrianthus arboreus P.Beauv.	Urticaceae	Bud	Picking	15.25
Myrianthus libericus Rendle	Urticaceae	Bud	Picking	14
Napoleonaea vogelii Hook. & Planch.	Lecythidaceae	Fruit	Picking	6.23
Raphia hookeri G.Mann & H.Wendl.	Arecaceae	Terminal bud	Uprooting	3.55
Spondias mombin Jacq.	Anacardiaceae	Fruit	Picking	3
Strombosia pustulata Oliv.	Olacaceae	Fruit	Picking	9.8

Table 3. Medicinal plant species and their uses

Plant name	Mode of use	Medical uses and part used
Albizia adianthifolia (Schumach.) W.Wight	Decoction	Dizziness (bark & leaves)
Albizia zygia (DC.) J.F.Macbr.	Decoction	Dysentery, diarrhea (bark)
Alchornea cordifolia (Schumach. & Thonn.) Müll.Arg.	Decoction	Varicella, malaria (leave, bark), haemostatic (leave & bark), fortifying (leave & bark), dysentery (young leave), fortifying (dry leave)
Alstonia boonei de Wild.	Decoction	Ictery, malaria (bark & leaves)
Annickia polycarpa (DC.) Setten & Maas	Decoction	Malaria (bark & root)
Anchomanes difformis (Blume) Engl.	maceration	Cough, rheumatism (young leave)
Antiaris toxicaria (Pers.) Lesch.	Decoction	Healing (bark)
Baphia nitida G.Lodd.	Decoction	Headache (leave, bark)
Bambusa vulgaris Schrad. ex J.C.Wendl.	Decoction	Typhoid fever (young leave)
Blighia sapida K.D.Koenig	Decoction	Aphrodisiac, curvature (leave, bark), ictery, (leave & bark)
Blighia welwitschii (Hiern) Radlk.	Decoction	Ictery, lepsy (bark)
Buchholzia coriacea Engl.	maceration	Breastfeeding (leave & bark)
Ceiba pentandra (L.) Gaertn.	Decoction	Cough, heartache (leave & bark)
Chromolaena odorata (L.) R.King & H.Rob.	Decoction	Healing, belly pain (leave)
Cola nitida (Vent.) Schott & Endl.	Decoction	Fountain (bark)
Costus afer Ker Gawl.	Decoction	Belly wound (leave)
Elaeis guineensis Jacq.	Decoction	Asthma, rheumatism (root), dental crest, lack appetite (root & branch)
Ficus exasperata Vahl	Decoction	Bone tuberculosis (leave)
Harungana madagascariensis Poir.	Decoction	Malaria (leave), hemorroid (bark)
Microdesmis keayana J.Léonard	Decoction	Gall, aphrodisiac (bark & root), snake bite (leave & roots) migraine (leave)
Myrianthus arboreus P.Beauv.	Decoction	Kidney pain (leave), angina (bark)
Napoleonaea vogelii Hook. & Planch.	Decoction	Rheumatism, curvature, healing (bark)
Newbouldia laevis (P.Beauv.) Seem.	Decoction	Dysentery (bark & leaves)
Palisota hirsuta (Thunb.) K.Schum.	Decoction	Rheumatism (leave)
Paullinia pinnata L.	Decoction	Malaria, vomiting, vertigo (leave), fortifying, cholera, high blood pressure (stem & root)
Phyllanthus muellerianus (Kuntze) Exell	Decoction	Dysentery (leave)
Pycnanthus angolensis (Welw.) Exell	Decoction	Toothache (sap), angina (bark)
Spondias mombin Jacq.	Decoction	Belly pain (leave)
Sterculia tragacantha Lindl.	Decoction	Nerve attack (bark & leaves)
Strombosia pustulata Oliv.	Decoction	Curvature (bark)

Table 4. Comparison of the means effects by category of use (mean ± standard error)

Category of use	Local name			Statistical parameters	
	Adjamé	Abobo	Yopougon	F	P
Pharmacopeia	5.8 ± 1.2^{b}	22.4 ± 2.11^{a}	10 ± 2.28^{b}	k=3.815	P=0.04*****
Human food	2.4 ± 0.5^{b}	7.8 ± 1.15^{a}	2.6 ± 0.92^{b}	k=1.031	P=0.03*****
Animal food	1 ± 0.31^{b}	4.8 ± 0.58^{a}	2 ± 0.44^{b}	k=4.126	P=0.02*****

Note: *Significant overall means effects, *p<0.05*. For category of use, means with different letters are significantly different based on Tukey's HSD test

Discussion

A total of 36 plant species belonging to 34 genera distributed among 28 families are used by the riparian population of BNP. This value of 36 species remains lower than that of Adomou et al. (2017), which identified 94 plant species belonging to 89 genera distributed among 47 families in the Bahazoun forest in South Benin. The difference in the number of species could be explained by sampling effort. However, again, those results are explained by the retention of information by the resource persons on the virtues of species and knowledge (Adomou et al. 2012). This situation may cause a reduction in the number of species.

According to the socio-demographic information, most of the respondents were female. These results can be explained by the fact that women have in-depth knowledge of medicinal species and their different therapeutic uses compared to men and that women were responsible for the first aid of their grandchildren. This result agrees with the findings reported by Borokini et al. (2013), who reported that 58.1% of the respondents in an ethnobiological study of traditional medicines used for women's health in Oyo state, Nigeria were female. These results were in line with the results obtained elsewhere by other ethnobotanical studies conducted in the different regions of Morocco by Benlamdini et al. (2014). Women, in general, have great know-how in the field of traditional herbal medicine and also have a great responsibility as mothers and homemakers. They give first aid to care, especially within their families. Also, women are aware of the responsibility they own in their families (Chohra and Ferchichi 2019).

The result also revealed that most of the respondents were between 40 to 50 years of age, which showed that people of old age were the main custodians of traditional

knowledge compared to other age groups. The oldest people did the most reliable information for medicinal plants in traditional medicine because they have good ancestral knowledge that is part of their oral tradition. It was noticeable that there was an information lack regarding young people that tend not to believe in this traditional medicine (Chohra and Ferchichi 2019). These results were due, on the one hand, to the fact that older people are familiar with traditional medicine compared to other age groups, and on the other hand, to the mistrust of young people under 20 years old who did not believe much in this traditional medicine (Jaadan et al. 2020).

In our study area, a large proportion of plant users were illiterate. Furthermore, most of the respondents had no formal education, and these findings were attributed to the fact that women, who were the majority of the respondents, were not enrolled in women's schools relatively high percentage correlated with the educational level of the local population of BNP. Nevertheless, people with primary school education had an average percentage of medicinal plant use, while secondary and university education used medicinal plants sparingly in their therapeutic treatment. These results were in line with other studies by Kpodar et al. (2015).

According to family situations of all traditional medicines; human and animal food users by the riparian population of BNP, the single proportion was more than married. These results could be explained by the fact that single people try to reduce their financial burdens and the very high costs of pharmaceutical products as much as possible. Moreover, the park is delimited by precarious neighborhoods where low-income populations live. This explains the high proportion of single people living near the park.

The socio-professional activities noted around the park are mechanics, traders and homemakers. These people have the habit of entering the park for samples of natural resources for their daily needs.

Analysis of the collected information showed that the most consumed species were *M. arboreus* and *M. libericus*. It also showed that the consumption of a species depends on its availability, which explains the frequency of low or high citations observed in some species. However, the species of *M. arboreus* and *M. libericus* had the highest citation frequencies. This finding was already mentioned by Dossou et al. (2012) during the ethnobotanical study of woody forest resources in the Agonvè marshy forest and related land in Benin. Indeed, the importance attached to a species does not depend on its availability but on its ability to meet the needs of populations in the different categories of uses (Allabi et al. 2011). Also, this low rate could be explained by the fact that this survey occurred in urban areas where people use different food supply sites.

The inventory of feed species and their percentage citation frequencies were: *P. maximum*, *F. exasperata* and *Elaeis guineensis* Jacq. whose mode of use is grazing. The low utilization of plant species may explain this low level of herbal species richness because the present survey was conducted in urban settings where several health centers use disease populations for appropriate care.

In our results (Table 7), the use rate of its different parts shows that the leaves are the most used and bark occupies second place. The obtained results are in good accordance with the literature, Az-Zahra et al. (2021) affirmed that leaves are the most used in the recipes of traditional medicine. Also, leaves are plants' main photosynthetic organs, and photosynthates are translocated to other parts, such as the root, stem, fruit, and seed. These can act as toxins to protect from predators; some are of medicinal value to humans (Amsalu et al. 2018).

The population has a greater knowledge of medicinal plant species, reflected in the common use in the traditional pharmacopeia of *M. keayana*, *S. pustulata*, *A. cordifolia* and *B. vulgaris*. The most commonly used organs are barking, leaves and roots. Treated diseases are most often hemorrhoid and other supernatural diseases. For most of these species, roots that are highly sensitive organs were used in the traditional pharmacopeia, particularly to treat hemorrhoid seizures. These diseases are very common in rural areas, which justifies the excessive removal of the roots of these species.

There are 30 plant species used in the traditional pharmacopeia for a wide spectrum of therapeutic action. However, this number remains lower than Ilyass et al. (2021), with 283 species in Morocco. This inferiority in the number of species could be due to several pathologies identified by these authors since the vast majority of plant species are specific to different diseases.

Of the diseases frequently treated in the study area, most of the spectrum was provided by malaria. In line with Black et al. (2010), diseases such as diarrhea and malaria are the major causes of child mortality in Africa. The abundance of a chemical compound in the leaves that are the synthesis seat of the secondary metabolites of the plant gives them broad therapeutic possibilities for many diseases, thus justifying the frequent use of the leaves (Kumar and Lalramnghinglova 2011). These results can be explained by the ease of harvesting the leaves and the fact that the leaves are the site of photosynthesis and storage of secondary metabolites responsible for the biological properties of the plant (Boughrara and Belgacem 2016).

In terms of the mode of use, the decoction was the most used mode. These results showed that the population adopts the decoction method and finds it adequate to warm the body and disinfect the plant (Boughrara and Legseir 2016). Corroborating the work of Barkaoui et al. (2014), the decoction allows for a collection of the most active ingredients and attains or cancels the toxic effect of certain recipes. Other studies that obtained the same results were done by Salhi et al. (2010). Similarly, several studies have shown that, among many forest plant species used by riparian forest populations, only medicinal use is most important. The results obtained in this study corroborate those of Kouakou et al. (2017) in the Haut-Sassandra Classified Forest. In general, plant species remain one of the main sources of food, medicines for rural and urban populations in tropical Africa (Hama et al. 2019).

However, patterns of use in the study area pose a threat to most species. For example, some three species are already considered rare in the study area due to harvest and

mismanagement of stands. These species include *A. polycarpa*, *N. leavis* and *B. coriacea*. The result is a gradual degradation of the environment that results in a depletion of woody species. Similarly, Traoré et al. (2011) point out that species affected by excessive organ harvesting can no longer perform their physiological functions to the best of their potential, which necessarily influences the production of fruits and seeds, which ensure the survival of the species.

High medicinal plant usage is putting significant pressure on these plant resources and their habitat. These different anthropogenic pressures on stands have a significant negative impact, inducing structural change and increasing their degradation. According to the population surveyed, barking, illegal cutting, uprooting, grinding and gathering remain the main factors that threaten several plant species. The different practices of the species revealed are grouped into; animal food, human food, and pharmacopeia.

However, the survey demonstrates that most of these present natural resources are at risk of disappearance. Therefore, the plant species should be given particular attention to rationalizing their uses.

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