Environment and livelihood of the Kouni community of the Kayes sub-prefecture (Bouenza, Congo)

Victor Kimpouni, Josérald Chaîph Mamboueni, Feldane Gladrich Mboussy Tsoungould and Elie Nsika Mikoko

Research

Abstract

Background: The rainforest is a source of particularly diversified natural goods and services, satisfying at least 80% of the population's needs. Notwithstanding the intimate link between population and biodiversity, anthropogenic pressure and its corollaries, such as global climate change, have led to a specific and genetic erosion of about 30% over the last three decades. The major causes of these are, in the case of the Congo, anarchic urbanization, construction of physical communication infrastructures without an environmental and social impact assessment; and unbridled collection of medicinal plants for commercial purposes. The loss of biodiversity is a clear sign of unsustainable use of natural resources, which the traditional societies depends on for their livelihoods.

Methods: Our study conducted at Mvouandzi, sub-prefecture of Kayes (Congo), is based on the ethnobotanical knowledge survey and floristic inventory. The informants, aged between 15 and 50 years or more comprised 25 men and 43 women who possess plant secrets. Prior to fieldwork, we reviewed existing literature that provided information on the status of inventoried species, their phytogeographic distribution, and known uses within their range. The ethnobotanical knowledge survey took place in two phases, namely: work with focus groups and conducting personalized interviews with the informants; and the collection of samples coupled, when possible, to the participatory approach.

Results: The floristic inventory lists 81 useful species, corresponding to 72 genera and 43 families. Some species are multi-purpose, and 26 of the 60 medicinal plants inventoried are specifically associated with the traditional pharmacopoeia. 36 species are multi-purpose and the others 15 intervene specially in food, 26 in phytotherapy, and 5 in handicrafts. The high values of the ethnobotanical indices (the ethnobotanical use value (VU), the informant consensus factor (CFI), and the level of fidelity (NF)) show a strong involvement of these taxa in the daily life of this traditional society. Sociological analysis reveals that the level of ethnobotanical knowledge is proportional to the subjects' age and in this matter, women excel in the exploitation of empirical knowledge.

Conclusions: The Kouni community possesses a sophisticated ethnobotanical knowledge, which is a fundamental part of socio-cultural base of the Kouni community and an important cultural asset of Congolese nation. However, the Kouni community is shrinking due to rural exodus. Therefore, documenting the existing traditional knowledge is the first priority to preserve the Kouni cultural diversity.

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Résumé

L'étude ethnobotanique et floristique conduite à Mvouandzi (4° 10' 00'' S, 13° 25' 00'' E), sous-préfecture de Kayes (Bouenza, Congo), se base sur l'inventaire floristique, les interviews personnalisées et les focus groupes. La population cible dont l'âge varie de 15 à 70 ans voire plus, se compose de 68 informateurs (25 hommes et 43 femmes) possesseurs des secrets de plantes. L'inventaire floristique recense 81 espèces utiles, correspondant à 72 genres et 43 familles. En dépit du fait que certaines espèces soient à multi-usages, 26 des 60 plantes médicinales inventoriées sont spécifiquement associées à la pharmacopée traditionnelle. Toutes les autres interviennent indifféremment dans l'alimentation et l'artisanat. La cohorte médicinale est associée à 108 recettes et 59 maladies et symptômes. Classées en sphère de maladies et symptômes, les maladies infectieuses et parasitaires sont prépondérantes (27,11%) et retiennent 33 recettes. Tous les organes (végétatifs et génératifs) interviennent à la satisfaction quotidienne des besoins des populations. L'analyse ethnosociologique révèle que le niveau de connaissances endogènes est proportionnel à l'âge des sujets et en la matière, les femmes de par leur rôle de gérant et gardienne des mœurs excellent dans l'exploitation des savoirs empiriques. Nonobstant le lien indissociable entre l'homme et son environnement, la valeur associée à cette biodiversité, socle socioculturel de la communauté ethnico-linguistique Kouni s'érode inéluctablement. Les raisons en sont: l'exode rural ; l'urbanisation anarchique et la construction des infrastructures physiques de communication, sans études d'impact environnemental et social ; la destruction des habitats ; le vieillissement de la population.

Background

The rainforest is a source of diversified natural goods and services, satisfying at least 80% of the population's needs (Chifundera 2001; Kimpouni *et al*. 2017, 2018; Sanogo 2006; Wezel 2002). It is estimated that the biodiversity, rich in quantity and quality, has been reduced by 30% in the last three decades (Bergonzini 2004; Bergonzini & Lanly 2000). The major causes of these are, in the case of the Congo, anarchic urbanization, construction of physical communication infrastructures without an environmental and social impact assessment; and unbridled collection of medicinal plants for commercial purposes (Bergonzini 2004; Profizi *et al*. 1993). This worrying trend has become a major problem for traditional societies whose daily lives are intimately associated with forest resources (Kimpouni *et al*. 2017, 2018). In reference to the various exchanges, at the national and international level, passing through the sub-region and or region, which have focused on the social and environmental functions of rainforest biodiversity, a sustainable and participatory community management model is needed to perpetuate the bioresource and guarantee the associated ethnobotanical knowledge (Bergonzini & Lanly 2000; WWF 2010).

The social and environmental functions offered by phytodiversity to rural and urban populations include direct and indirect benefits (Dounias 2000; Höft & Höft 1997; Kimpouni *et al*. 2017, 2018). Direct uses include the exploitation of food, medicinal, artisanal, cultural (creed and rituals), creation of source of income and employment. Indirectly, less perceptible, these plant resources help in the fight against climate change through the phenomena of carbon sequestration, climate regulation, erosion control, etc.

Because of the absence of sustainable management, traditional societies that daily depends on the exploitation of phytodiversity are the most vulnerable (Kimpouni & Motom 2012; Kimpouni *et al*. 2017, 2018). Severe impacts on biodiversity as a whole tend to weaken the sociocultural foundations of the various linguistic societies. The first element affected is the transmission of traditional knowledge from one generation to another. The culture of these societies is based on spoken (not written) knowledge and empirical observation. This knowledge can be irretrievably lost to the detriment of the community and indeed humanity. The other consequences are the rural exodus of the vital workforce and impoverishment of the various subjects, who can no longer afford quality primary health care due to the prohibitive costs of conventional medicine

This study has been undertaken to conserve the socio-cultural base of the linguistic group Kouni, by focusing on the links between the community and surrounding biodiversity. The study focused on the ethnobotanical knowledge associated with the phytodiversity with particular interest in its traditional knowledge importance.

Materials and Methods

Study area

The study area is located in the sub-prefecture of Kayes (Bouenza - Congo). The village Mvouandzi (4 ° 10 ' 00 ' ' S, 13 ° 25 ' 00 ' ' E) located on the right bank of the Niari River halfway between county seat

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of the district of Kayes and Madingou, particularly in the northeast of the district of Kayes (Figure 1). The climate of the study area is tropical humid, also called low Congolese climate, which prevails throughout the southern part of the country (Vennetier 1977). Its main features are: an average annual temperature of 25 °C for a low thermal amplitude; average annual rainfall of the order of 1200 mm; a seasonal alternation (Figure 2). There are two rainy, hot and humid seasons with peaks of precipitation; first in November, and again in March and April. The dry and cool season occurs from June to September. The vegetation consists of riparian forests and shrub savannas.

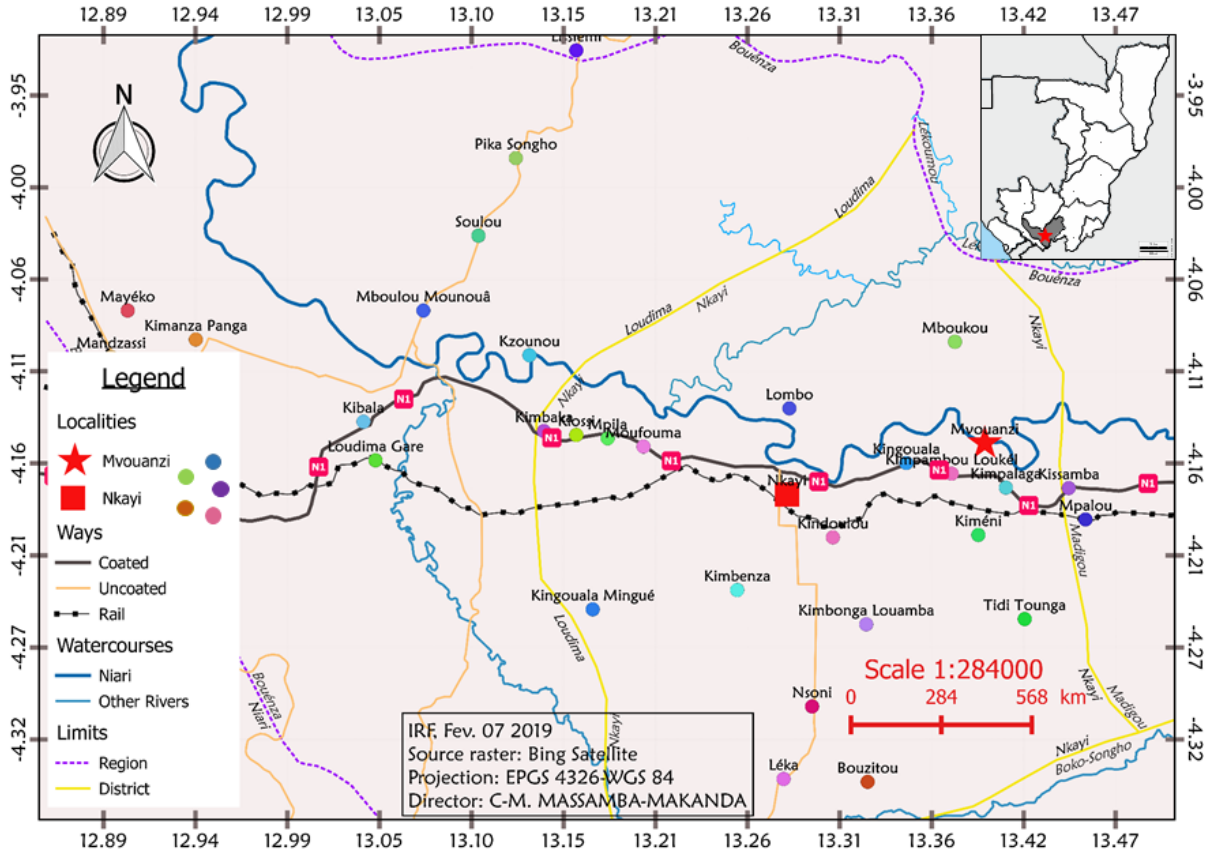

Figure 1. Location of the study site in the Kayes sub-prefecture

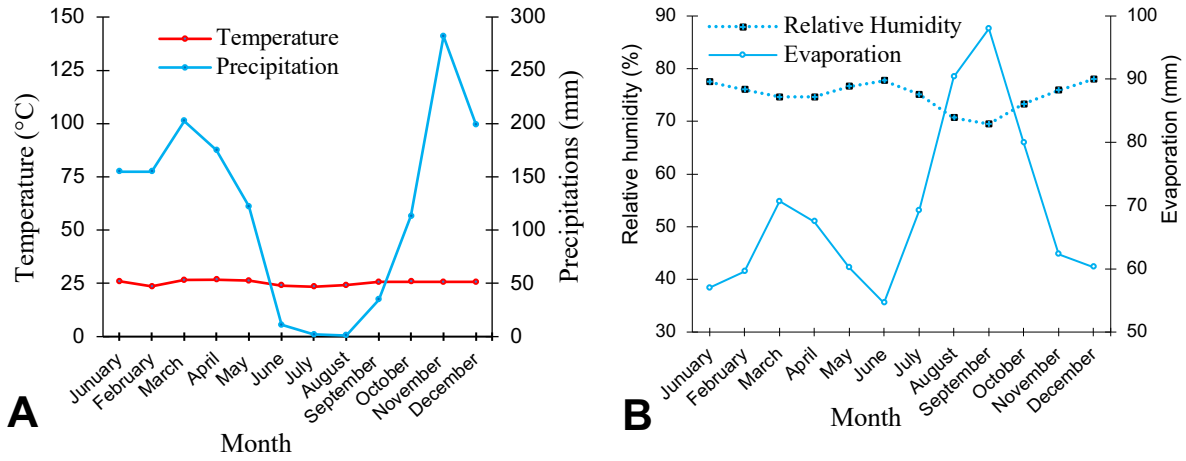

Figure 2. Climatic parameters of Brazzaville (period of 2000-2016, source ANAC)
Legend: Ombrothermic curve (A); Curves of relative humidity and evaporation (B)

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The plant material that is the basis of the study was harvested at Mvouandzi in September 2016. It is quoted by a group of 68 people holding knowledge about the virtues of plants. For each species, the following information is reported: Status (spontaneous, sub-spontaneous, cultivated, indigenous or allochthonous); Habitat; Morphological and phytogeographic types; and the part used. The most common specimens were identified in situ and confirmed at the National Herbarium (IEC) in Brazzaville where the collected specimens were deposited. The ordination followed is APG IV (Angiosperm phylogeny group 2016) and the nomenclature adopted is that of Lebrun and Stork (1991-2015).

Group of informants

The group of informants whose age ranges from 15 to 50 years and older, consists of 68 persons possessing the secrets of plants. The group is based on gender diversity and consists mainly of adolescents and adults, with knowledge of traditional know-how (Table 1).

Table 1. Overview of the characteristics of the informant panel.

Informants	Gender Contribution					
	Men		Women		Total	
Age groups (years)	Number	%	Number	%	Number	%
15 to 25	4	5.88	7	10.29	11	16.18
25 to 50	11	16.18	21	30.88	32	47.06
50 and over	10	14.70	15	22.06	25	36.76
Total	25	36.76	43	63.34	68	100

Study method

The method of data collection is based on the primary and secondary methods of data collection. Secondary data was collected through literature review, while primary data was collected through (ethnobotany survey and floristic inventory). These methods are explained as follows:

Literature review

The data of the literature allowed making the state of ethnobotanical knowledge studies in general and particularly in the study area. They provided information on the status of inventoried species, their phytogeographic distribution, and known uses within their range.

Ethnobotanical knowledge survey

The ethnobotany inventory took place in two phases, namely: selection of focal groups and personalized interviews with informants; and the collection of samples coupled, when possible, to the participatory approach.

- The first phase is based on personalized or grouped interviews involving both genders. This work is carried out in accordance with an open-ended interview guide, with a view of collecting as much information as possible and occasionally closed questions for accurate information. The interviews are semi-directional (Martin 1995). The final part of this phase is the classification of goods and services (direct and indirect) into types of ecosystem services.
- The second phase consisted of checking the data collected during the interviews and discussions. It focuses on the collection of plant samples, including the parts used, and the tangible signs of their use. Finally, the participatory approach has made it possible to follow the process of preparation and use.

Expressions of results

Ecosystem services are categorized into three categories, following the Millennium Ecosystem Assessment (2003, 2005): Supply services are appropriate assets acquired through the exploitation of ecosystems; regulation services that are of an indirect nature and cultural services. Since the informants do not control the cultural service, only the supply and regulation services are considered in this study. The data are analyzed on the basis of ethnobotanical knowledge indicators related to traditional pharmacopoeia, food anthropology and handicrafts. The parameters monitored are the ethnobotanical use value (VU), the informant consensus factor (CFI), and the level of fidelity (NF). In the category of ecosystem goods and services, the formula of calculation for the different indicators are: the ethnobotanical use value (VU)

$$VU = \frac{\sum_i^n Ui}{\mathrm{n}} \text{ either } \mathrm{VUt} = \sum_1^p \mathrm{VU} \ (1)$$

Ui = number of quotes per ecosystem service and N = total number of respondents.

The informant Consensus factor (CFI) adapted from Heinrich *et al*. (1998) and the level of fidelity (NF) are used to determine the relative importance of the ecosystem services underpinning the community's sociocultural base. The CFI generally supports ethno-therapeutic efforts to identify species that are

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community-based, agree on their uses, and possibly deserve deeper studies (Andrade-Cetto & Heinrich 2011; Heinrich *et al*. 1998; Uddin & Hassan 2014). The CFI's value varies from 0 to 1 and indicates a high consensus when it tends towards 1.

$$FCI = (Nur - N1) / (Nur - 1) \quad (2)$$

Nur = number of quotations in each category of ecosystem services and N1 = number of ecosystem services that comprise it.
The level of fidelity (NF) is calculated within this category of ecosystem services, based on the adapted formula of Friedman *et al*. (1986).

$$NF = (Np / N) \times 100 \quad (3)$$

With Np = number of people who have cited a type of ecosystem service or use and N = total number of people who derive an ecosystem service from any of them.

Results

Floristic Inventory

The inventory highlights 81 species divided into 72 genera grouped into 44 families (Table 2). The specific diversity varies from 1.23 to 11.11% per family and a dominance of Fabaceae and Malvaceae is found with 11.11 and 7.41% respectively of inventoried species (Figure 3). Spontaneous plants are predominant with 54.32% of species inventoried (Table 3).

Table 2. Taxonomic summary and status of the taxa identified.

Taxa	Levels taxonomic hierarchical status						Status					
	Families		Genera		Species		Cultivated species		Spontaneous species		Spont/cult species.	
	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%
Dicotyledonae	31	72.1	57	79.16	65	80.24	20	24.69	39	48.14	6	7.40
Monocotyledonae	12	27.9	15	20.84	16	19.76	8	9.87	5	6.57	3	3.70
Total	43	100	72	100	81	100	28	34.56	44	54.32	9	11.10

Table 3. Summary of patterns of use of species identified in Mvouandzi

Plant uses		Species	
		Number	%
Mono	Medicinal	26	32.10
	Alimentation	15	18.52
	Handicraft	5	6.17
Multiple	Medicinal-alimentation (alicamentary)	24	29.63
	Medicinal-handicraft	7	8.64
	Alimentation-handicraft	3	3.70
	Medicinal-alimentation-handicraft	2	2.47

Species Characterization

Distribution of habitat taxa

Depending on the type of habitat, a preponderance of cultivated species (48%) is noted in comparison with those found in Savannah (40%) and forest (12%).

Morphological Type

The inventoried taxa are divided into six morphological types (Figure 3). A clear dominance of shrubs (32%) was noted in comparison with other morphological types with a contribution of 4 to 28%.

Phytogeographical types

Six phytogeographic types can be distinguished, mostly the elements of large distribution. The endemic Guineo-Congolese element is poorly represented (21.51%) in front of the large-distribution element, which encompasses more than ¾ of the inventory (Figure 4).

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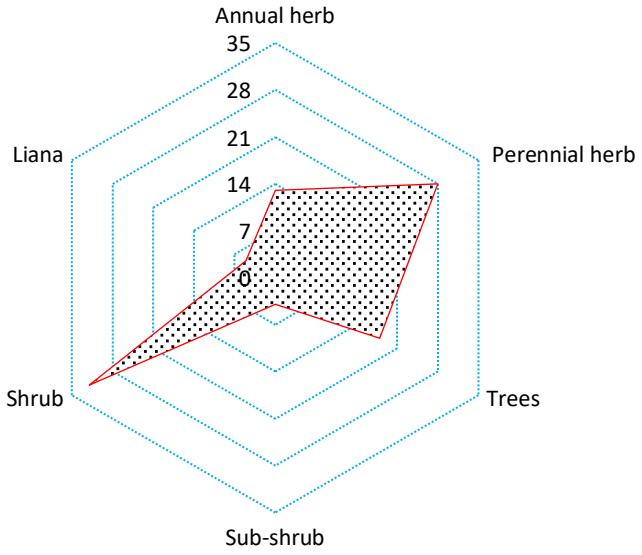

Figure 3. Contribution of taxa by morphological types (%).

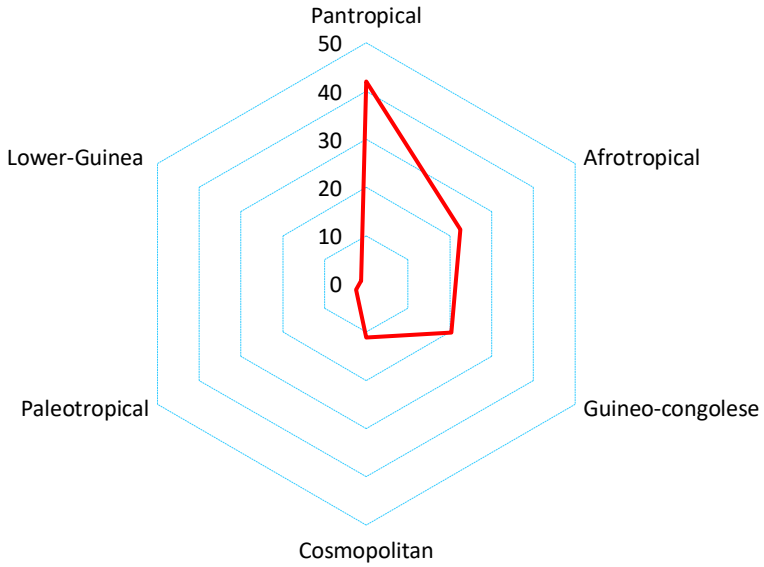

Figure 4. Phytogeographic spectrum of the taxa identified (%)

Empirical knowledge and socio-cultural base

The exploitation of the phytodiversity varies according to criteria associated with the gender and the age group. The rate of use by women and men is almost 1/3 *versus* 2/3, respectively. The use of suitable plants is most commonly expressed by the 25 to 50 year age group with a rate of 47.05%. For the 15-25 year age group, the use rate is 16.17%, and 36.76% for persons ≥ 50 years of age.

The analysis of the rates of use of medicinal plants showed dominance in the age range ≥ 50 with 49.45%, compared to 36.26% for the age group 25 to 50 and finally 14.28% for the 15-25 years. As regards gender, women are the group with the highest number of quotations with 68.13% of the 81 species inventoried, compared to 31.87% for men.

Ethnobotanical knowledge Analysis

The ethnobotanical aspects cover 81 species useful for this population, of which 59 species (or 72.83%) have traditional herbal properties, 43 species (or 53.08%) have a food trait and 15 (or 14.81%) are sought for aspects related to crafts. The distribution of the sectors of activity and the exploitation of the various plants also take into account the multiple uses of certain plants (Table 3). It is notable that 26 species occur only in traditional herbal medicine, 15 are known specifically as foodstuffs, and 5 are associated only with crafts (Table 3).

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Phytodiversity Operating Data

Traditional herbal Medicine

Analysis of the data from the ethnobotanical survey reveals 59 plants used to remedy the various ailments of their community (Table 4). For the preparation of the products, several kinds of organs are used. The leaves (51.16%) are the most used organs compared to fruits and roots (Figure 5). The least used are rhizomes and flowers with a contribution of 0.88%. These species occur in 109 recipes for 57 different diseases and symptoms.

Food Anthropology

Most of the species, representing 65% of the taxa, are consumed raw, compared to 35% of those that undergo cooking. The different products are consumed at more than 90% in the fresh state and about 0.1% in the dry state. The rest is indiscriminately consumed under all states. The demand for these consumed organs varies with the age group and gender. Notwithstanding the gender, some species are more appreciated by adolescents, while others are of interest to adults and the elderly. These species are central to the food intake of the Kouni population.

Handicrafts

These are connected with sculpture, tool handles, construction and furnishing materials, fishing (canoe and paddle), hunting (skin), packing, kitchen utensils (kneading, mortar, pestle), bed, furniture, brooms and baskets, funeral and religious objects, cultural (xylophone, tam-tam, maracas).

Ethnobotanical knowledge Use value

The use value (VU) is calculated for medicinal, food and artisanal aspects (Table 4). This range varies from 0.04 to 0.9 for an average of 0.35 ± 0.02 in herbal medicine, 0.07 – 0.94 for an average of 0.55 ± 0.03 for food and finally, 0.09-0.72 for an average of 0.42 ± 0.05 in handicrafts. The total use value (Vt) of the species varies from 0.07 to 1.62 or an average of 0.64 ± 0.03.

The informant consensus factor (CFI) is between 0.5 and 0.98 for an average of 0.93 ± 0.01 in herbal medicine; in food supply, it ranges from 0.75 to 0.98 and an average of 0.96 ± 0.003; in handicrafts, it oscillates from 0.8 to 0.98 or an average of 0.94 ± 0.01.

The fidelity level oscillates between 4.41 and 89.71 for an average of 35.37 ± 1.96 in medicine; in food supply, it ranges from 7.35 to 94.12 and an average of 54.79 ± 2.66; finally, in handicrafts the fidelity level is between 8.82 and 72.06 for an average of 42.45 ± 5.32.

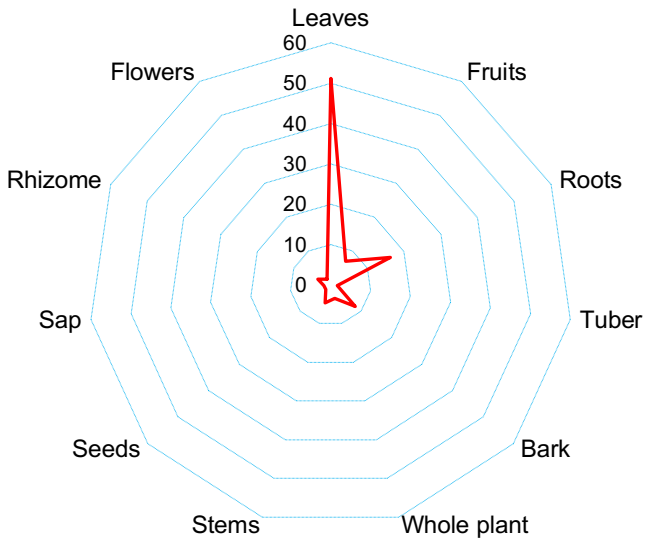

Figure 5. Contribution of the different parts of the medicinal plants used (%).

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Table 4. Number of citations and ethnobotanical use value of Mvouandzi's useful plants

Family	Taxa	Citations of plant uses and ethnobotanical use value															VUt
		Medicinal					Alimentation					Handicraft					
		Nb	%	VU	FCI	NF	Nb	%	VU	FCI	NF	Nb	%	VU	FCI	NF	
Acanthaceae	*Brillantaisia patula* T. Anderson	19	27.94	0.28	0.94	27.94	0	0	0	0	0	0	0	0	0	0	0.28
Anacardiaceae	*Mangifera indica* L.	39	57.35	0.57	0.97	57.35	57	83.82	0.84	0.98	83.82	14	21	0.21	0.92	20.59	1.62
Anacardiaceae	*Spondias cytherea* Sonner	5	7.35	0.07	0.75	7.353	0	0	0	0	0	0	0	0	0	0.00	0.07
Anacardiaceae	*Spondias mombin* L.	26	38.24	0.38	0.96	38.24	43	63.24	0.63	0.98	63.24	0	0	0	0	0.00	1.01
Annonaceae	*Annona muricata* L.	28	41.18	0.41	0.96	41.18	52	76.47	0.76	0.98	76.47	0	0	0	0	0.00	1.18
Annonaceae	*Annona senegalensis* Pers.	34	5	0.50	0.97	50	27	39.71	0.4	0.96	39.71	0	0	0	0	0.00	0.90
Apocynaceae	*Landolphia owariensis* P. Beauv.	3	4.41	0.04	0.50	4.412	56	82.35	0.82	0.98	82.35	0	0	0	0	0.00	0.87
Araceae	*Colocasia esculenta* (L.) Schott	0	0	0	0	0	34	5	0.5	0.97	50	0	0	0	0	0.00	0.50
Arecaceae	*Elaeis guineensis* Jacq.	25	36.76	0.37	0.96	36.76	50	73.53	0.73	0.98	73.53	20	29	0.29	0.95	29.41	1.40
Asteraceae	*Chromolaena odorata* (L.) R. King & H. Robinson	61	89.71	0.90	0.98	89.71	0	0	0	0	0	0	0	0	0	0.00	0.90
Asteraceae	*Gymnanthemum amygdalimun* (Del.) Walp.	20	29.41	0.29	0.95	29.41	0	0	0	0	0	0	0	0	0	0.00	0.29
Bignoniaceae	*Newbouldia laevis* (P.Beauv.) Seem.ex Bureau	16	23.53	0.24	0.93	23.53	0	0	0	0	0	0	0	0	0	0.00	0.24
Boraginaceae	*Heliotropium ovalifolium* L.	0	0	0.00	0	0	21	30.88	0.31	0.95	30.88	0	0	0	0	0.00	0.31
Bromeliaceae	*Ananas comosus* (L.) Merr.	0	0	0	0	0	36	52.94	0.53	0.97	52.94	0	0	0	0	0.00	0.53
Burseraceae	*Dacryodes edulis* (G. Don) H.J. Lam.	7	10.29	0.10	0.83	10.29	38	55.88	0.56	0.97	55.88	0	0	0	0	0.00	0.66
Caricaceae	*Carica papaya* L.	29	42.65	0.43	0.96	42.65	45	66.18	0.66	0.98	66.18	0	0	0	0	0.00	1.09
Chenopodiaceae	*Chenopodium ambrosioides* L.	42	61.76	0.62	0.98	61.76	0	0	0	0	0	0	0	0	0	0.00	0.62
Combretaceae	*Terminalia superba* Engl. & Diels	6	8.82	0.09	0.80	8.824	0	0	0	0	0	42	62	0.62	0.98	61.76	0.71

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Convolvulaceae	*Ipomoea batatas* (L.) Lam.	0	0	0.00	0	0	41	60.29	0.60	0.98	60.29	0	0	0	0	0.00	0.60
Costaceae	*Costus phyllocephalus* K. Schum.	28	41.18	0.41	0.96	41.18	0	0	0	0	0	21	31	0.31	0.95	30.88	0.72
Crassulaceae	*Kalanchoe crenata* (Anders.) Harv.	36	52.94	0.53	0.97	52.94	0	0	0	0	0	0	0	0	0	0.00	0.53
Cucurbitaceae	*Luffa cylindrica* (L.) Roam.	12	17.65	0.18	0.91	17.65	9	13.24	0.13	0.88	13.24	0	0	0	0	0.00	0.31
Cucurbitaceae	*Momordica charantia* L.	48	70.59	0.71	0.98	70.59	0	0	0	0	0	0	0	0	0	0.00	0.71
Cyperaceae	*Cyperus articulatus* L.	12	17.65	0.18	0.91	17.65	0	0	0	0	0	0	0	0	0	0.00	0.18
Dioscoreaceae	*Dioscorea alata* L.	0	0	0	0	0	43	63.24	0.63	0.98	63.24	0	0	0	0	0.00	0.63
Dioscoreaceae	*Dioscorea liebrechtsiana* De Will.	4	5.88	0.06	0.67	5.882	38	55.88	0.56	0.97	55.88	0	0	0	0	0.00	0.62
Euphorbiaceae	*Alchornea cordifolia* (Schum. & Thonn.) Muell. Arg.	55	80.88	0.81	0.98	80.88	0	0	0	0	0	0	0	0	0	0.00	0.81
Euphorbiaceae	*Manihot esculenta* Crantz	23	33.82	0.34	0.95	33.82	64	94.12	0.94	0.98	94.12	0	0	0	0	0.00	1.28
Fabaceae	*Arachis hypogaea* L.	0	0	0.00	0	0	63	92.65	0.93	0.98	92.65	0	0	0	0	0.00	0.93
Fabaceae	*Cajanus cajan* L. Millspaugh	15	22.06	0.22	0.93	22.06	58	85.29	0.85	0.98	85.29	0	0	0	0	0.00	1.07
Fabaceae	*Desmodium velutinum* (Willd.) DC.	26	38.24	0.38	0.96	38.24	0	0	0	0	0	0	0	0	0	0.00	0.38
Fabaceae	*Dichrostachys cinerea* (L.) W.Wight & Arn.	17	25	0.25	0.94	25	0	0	0	0	0	0	0	0	0	0.00	0.25
Fabaceae	*Millettia versicolor* Baker	21	30.88	0.31	0.95	30.88	0	0	0	0	0	13	19	0.19	0.92	19.12	0.50
Fabaceae	*Senna alata* (L.) Roxb.	35	51.47	0.51	0.97	51.47	0	0	0	0	0	0	0	0	0	0.00	0.51
Fabaceae	*Senna occidentalis* (L.) Link	42	61.76	0.62	0.98	61.76	0	0	0	0	0	0	0	0	0	0.00	0.62
Fabaceae	*Senna siamea* (Lam.) Irwin & Barneby	37	54.41	0.54	0.97	54.41	0	0	0	0	0	0	0	0	0	0.00	0.54
Fabaceae	*Tephrosia vogelii* Hook.f.	0	0	0.00	0	0	0	0	0	0	0	46	68	0.68	0.98	67.65	0.68
Fabaceae	*Urera repens* (Wedd.) Rendle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Gnetaceae	*Gnetum africanum* Welw.	8	11.76	0.12	0.86	11.76	56	82.35	0.82	0.98	82.35	0	0	0	0	0.00	0.94
Hypoxidaceae	*Curculigo pilosa* (Schum. & Thomn.) Engl.	22	32.35	0.32	0.95	32.35	0	0	0	0	0	0	0	0	0	0.00	0.32

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Iridaceae	*Gladiolus gregarius* Welw. ex Baker	0	0	0	0	0	0	0	0	0	0	0	0	0.72	0.98	72.06	0.72
Lamiaceae	*Ocimum gratissimum* L.	40	58.82	0.59	0.97	58.82	0	0	0	0	0	0	0	0	0	0.00	0.59
Lauraceae	*Persea americana* Mill.	24	35.29	0.35	0.96	35.29	48	70.59	0.71	0.98	70.59	0	0	0	0	0.00	1.06
Malvaceae	*Adansonia digitata* L.	0	0	0.00	0	0	47	69.12	0.69	0.98	69.12	0	0	0	0	0.00	0.69
Malvaceae	*Ceiba pentandra* (L.) Gaertn.	0	0	0.00	0	0	0	0	0	0	0	46	68	0.68	0.98	67.65	0.68
Malvaceae	*Gossypium hirsutum* L.	26	38.24	0.38	0.96	38.24	0	0	0	0	0	0	0	0	0	0.00	0.38
Malvaceae	*Hibiscus sabdariffa* L.	0	0	0.00	0	0	33	48.53	0.48	0.97	48.53	0	0	0	0	0.00	0.49
Malvaceae	*Sida acuta* L.	23	33.82	0.34	0.95	33.82	0	0	0	0	0	0	0	0	0	0.00	0.34
Malvaceae	*Waltheria indica* L.	11	16.18	0.16	0.90	16.18	0	0	0	0	0	0	0	0	0	0.00	0.16
Marantaceae	*Trachyphrynium braunianum* (K. Schum.) Bak.	0	0	0	0	0	0	0	0	0	0	45	66	0.66	0.98	66.18	0.66
Moraceae	*Milicia excelsa* (Welw.) C.C. Berg.	16	23.53	0.24	0.93	23.53	0	0	0	0	0	16	24	0.24	0.93	23.53	0.47
Moraceae	*Trilepisium madagascariense* DC.	29	42.65	0.43	0.96	42.65	36	52.94	0.53	0.97	52.94	0	0	0	0	0.00	0.96
Musaceae	*Musa x sapientum* L.	0	0	0	0	0	42	61.76	0.62	0.98	61.76	32	47	0.47	0.97	47.06	1.09
Myrtaceae	*Eugenia uniflora* L.	13	19.12	0.19	0.92	19.12	20	29.41	0.29	0.95	29.41	0	0	0	0	0.00	0.49
Myrtaceae	*Psidium guajava* L.	24	35.29	0.35	0.96	35.29	35	51.47	0.51	0.97	51.47	0	0	0	0	0.00	0.87
Passifloraceae	*Adenia lobata* (Jacq.) Engl.	0	0	0.00	0	0	10	14.71	0.15	0.89	14.71	0	0	0	0	0.00	0.15
Passifloraceae	*Passiflora foetida* L.	38	55.88	0.56	0.97	55.88	31	45.59	0.46	0.97	45.59	0	0	0	0	0.00	1.01
Periplocaceae	*Mondia whitei* (Hook.f.) Skells	0	0	0.00	0	0	11	16.18	0.16	0.90	16.18	0	0	0	0	0.00	0.16
Phyllanthaceae	*Bridelia ferruginea* Benth.	45	66.18	0.66	0.98	66.18	0	0	0	0	0	35	51	0.51	0.97	51.47	1.18
Poaceae	*Cymbopogon citratus* L.	13	19.12	0.19	0.92	19.12	0	0	0	0	0	0	0	0	0	0.00	0.19
Poaceae	*Imperata cylindrica* P. Beauv.	0	0	0.00	0	0	0	0	0	0	0	7	10	0.1	0.83	10.29	0.10
Poaceae	*Saccharum officinarum* L.	11	16.18	0.16	0.90	16.18	48	70.59	0.71	0.98	70.59	0	0	0	0	0.00	0.87
Poaceae	*Zea mays* L.	0	0	0	0	0	45	66.18	0.66	0.98	66.18	0	0	0	0	0.00	0.66

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Rubiaceae	*Gardenia ternifolia* Schumach & Thonn.	21	30.88	0.31	0.95	30.88	0	0	0	0	0	0	0	0	0	0.00	0.31
Rubiaceae	*Morinda lucida* Benth.	12	17.65	0.18	0.91	17.65	0	0	0	0	0	6	8.8	0.09	0.80	8.82	0.26
Rubiaceae	*Sarcocephalus latifolius* (Smith) Bruce	25	36.76	0.37	0.96	36.76	0	0	0	0	0	41	60	0.6	0.98	60.29	0.97
Rutaceae	*Citrus aurantifolia* (Christm.) Swingle	35	51.47	0.51	0.97	51.47	32	47.06	0.47	0.97	47.06	0	0	0	0	0.00	0.99
Rutaceae	*Citrus grandis* (L.) Osbeck	0	0	0	0	0	56	82.35	0.82	0.98	82.35	0	0	0	0	0.00	0.82
Rutaceae	*Citrus limon* (L.) Burm. f.	36	52.94	0.53	0.97	52.94	34	5	0.5	0.97	50	0	0	0	0	0.00	1.03
Rutaceae	*Citrus reticulata* Blanco	0	0	0	0	0	23	33.82	0.34	0.95	33.82	0	0	0	0	0.00	0.34
Rutaceae	*Citrus sisensis* (L.) Osbeck	23	33.82	0.34	0.95	33.82	42	61.76	0.62	0.98	61.76	0	0	0	0	0.00	0.96
Sapindaceae	*Paullinia pinnata* L.	0	0	0	0	0	5	7.35	0.07	0.75	7.353	0	0	0	0	0.00	0.07
Solanaceae	*Lycopersicum esculentum* P. Mill.	10	14.71	0.15	0.89	14.71	31	45.59	0.46	0.97	45.59	0	0	0	0	0.00	0.60
Solanaceae	*Nicotiana tabacum* L.	15	22.06	0.22	0.93	22.06	0	0	0	0	0	0	0	0	0	0.00	0.22
Solanaceae	*Solanum melongena* L.	22	32.35	0.32	0.95	32.35	34	5	0.5	0.97	50	0	0	0	0	0.00	0.82
Ulmaceae	*Celtis mildbraedii* Engl.	0	0	0	0	0	13	19.12	0.19	0.92	19.12	0	0	0	0	0.00	0.19
Verbenaceae	*Lantana camara* L.	37	54.41	0.54	0.97	54.41	0	0	0	0	0	0	0	0	0	0.00	0.54
Verbenaceae	*Lippia multiflora* L.	12	17.65	0.18	0.91	17.65	43	63.24	0.63	0.98	63.24	0	0	0	0	0.00	0.81
Verbenaceae	*Vitex madiensis* Oliv.	19	27.94	0.28	0.94	27.94	32	47.06	0.47	0.97	47.06	0	0	0	0	0.00	0.75
Vitaceae	*Cissus rubiginosa* Baker	13	19.12	0.19	0.92	19.12	0	0	0	0	0	0	0	0	0	0.00	0.19
Zingiberaceae	*Zingiber officinale* Rosc	25	36.76	0.37	0.96	36.76	20	29.41	0.29	0.95	29.41	0	0	0	0	0.00	0.66

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Discussion

Ecological and floristic Analysis

The floristic diversity in use reveals that the socio-cultural foundation of the Kouni linguistic community has been significantly influenced by contact with neighbouring or even distant societies (Grenand & Prevost 1994; Kimpouni & Motom 2012; Lavergne & Véra 1989). The consequences of these contacts are materialized by an almost similar level of use of native and alien species in their local knowledge. Thus, for more than one requests, several exotic taxa are cultivated around the huts. This provides an indisputable proof of a meeting of civilization and an appropriation of extrinsic values to the socio-cultural foundation (Grenand & Prevost 1994; Kimpouni & Motom 2012; Lavergne & Véra 1989). The ecological data of the species inventoried show that the populations of the ethnic-linguistic group Kouni effectively exploit all the surrounding ecosystems, for the daily satisfaction of their needs. Thus, although most of ethnobotanical knowledge data are associated with the forest flora, the other wild ecosystems, in particular the savannah, are full of floristic potential (Kimpouni *et al*. 2017, 2018). The level of exploitation of the different ecosystems reveals specificities associated with gender and species, not to mention the related uses.

With regard to phytogeographic data, most of the taxa surveyed have a wide distribution, within which their virtues are recognized and exploited by several traditional communities (Betti *et al*. 2013a, 2013b; Lavergne & Véra 1989; Raponda-Walker & Sillans 1961; Wezel 2002). This broad recognition of the virtues associated with these plants by societies with different backgrounds and practices inevitably underpins their ethno-anthropological potential.

Sociological analysis

The empirical knowledge of the properties and uses of plants is usually acquired as a result of long experience. Thus, this sum of values associated with the exploitation of biodiversity remains an immutable family or clan asset (Betti *et al*. 2013a, 2013b; Lavergne & Véra 1989; Raponda-Walker & Sillans 1961; Wezel 2002). A classification of use of the virtues of the phytodiversity shows, irrespective of society, the popular local knowledge (known throughout the community) restricted to a caste or to certain individuals (Kimpouni & Motom 2012; Kimpouni *et al*. 2018, 2017). Since African societies in general and Congolese in particular are of oral tradition, these values are being forgotten for various reasons. The main ones are the rural exodus, which targets more young boys than girls, and the aging of the population. The study site is located close to the town of Nkayi, which has a strong attraction to rural communities. Its economic power, based on the secondary, tertiary and quaternary sectors, are levers that would offer success and social well-being to anyone who settles in. The combined effects of these causes pose the cultural knowledge to be at risk, as the transmission chain becomes broken. The preponderance of women in all age groups and their better mastery of plants' virtues are elements that highlight the role and function of the female agent in this society (El Hafian *et al*. 2014; Kimpouni *et al*. 2012). In addition to this aspect, the analysis of the various uses shows a certain specificity closely linked to gender and even activities.

Ethnobotany knowledge Analysis

Useful plant surveys have enabled the identification of ethnobotanical knowledge associated with food, herbal medicine, and handicrafts. This empirical knowledge of plant uses is transmitted following clan or familial rituals (Betti 2001). This practice in the transmission of ethnobotanical knowledge alone would explain the observed differences in the use of plants, on the one hand, the differences in valuation within the population of the same clan (Grenand & Prévost 1994). The divergences of practice observed between the traditional communities in the area of the various species correspond to the intrinsic values of the socio-cultural base of each ethnic-linguistic group (Kimpouni & Motom 2012; Kimpouni *et al*. 2017, 2018; Raponda-Walker & Sillans, 1961). In relation to age groups, the observations highlight the group of informants with ages of 25-50 years, including women. The plausible explanation is based on the physical dynamism of this age group. Indeed, by traversing all the ecosystems, even the furthest ones, in the quest for the values of biodiversity, they relay between the youngest and the elderly. The value of empirical findings on the therapeutic and nutritional properties of the plants surveyed is supported by phytochemistry and pharmacognosy studies, which has isolated more than one active substance and revealed the biochemical composition of the useful organs (Baker *et al*. 1995; Farsworth *et al*. 1986; Kerharo 1974; Kimpouni *et al*. 2018; Raponda-Walker & Sillans 1961; Sanogo 2006; Sofowara 1996; Verpoorte 1999). In addition to phytotherapy and food, the use of which is undoubtedly the subject of taxa, the plants looked for and used in handicrafts by the Kouni group community appeared to be the same as documented in their neighbours for the same purposes (Kimpouni & Nguembo 2018; Raponda-Walker & Sillans 1961).

The analysis of data on the value of ethnobotanical uses, the level of fidelity and the informant consensus factor underlie a mastery of

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ethnobotanical knowledge correlated with floristic diversity (Grenand & Prévost 1994; Kimpouni 2001). These ethnobotanical parameters are tangible indicators of the place of these species in the primary health care sphere of the community, on the one hand, and on the other hand, a guarantee that their daily needs will be met (El Hafian *et al*. 2014; Kimpouni *et al*. 2012). This dependence of man on phytodiversity for daily satisfaction of elementary needs, means that there must be sustainable management of ecosystems. Special attention should be given to multiple-use taxa, which are more vulnerable, or those colonizing fragile habitats, or even pauciflores taxa (Bergonzini 2004).

Conclusion

Like all traditional societies, the Kouni ethnic-linguistic community is intimately dependent on phytodiversity. Exploiting all sources, women represent the most active group in the conservation and enhancement of the sociocultural base. In relation to the transmission of knowledge, there is a gradual transfer of learning from one generation to another. The age range of 25 to 50 years is the one that feeds the system. Despite the fact that the maintenance of empirical knowledge is effective within this traditional society, several constraints affect it; mainly the erosion of taxa as a result of habitat modification and rural exodus. Finally, the analysis of the uses highlights specificities associated with the gender and the age group. As the traditional Kouni society does not live in self-sufficiency, it has integrated extrinsic values, resulting from the encounters and mixing of populations with different customs, into its socio-cultural base.

Declarations

List of abbreviations: Not applicable.

Ethics approval and consent to participate: The purpose of the study was explained to the community members interviewed, and they were asked to sign an informed consent form, as required the Research Ethics Committee, in accordance with the Nagoya agreements.

Consent for publication: Not applicable.

Availability of data and materials: The data was not deposited in public repositories.

Competing interests: The authors do not have any competing interests.

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Authors' contributions: FGMT and JCM carried out fieldwork, data analysis and drafted the manuscript. VK and ENM configured the research project, supervised the work and improved the manuscript. All authors read, reviewed and approved the final version of the manuscript.

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Literature cited

Adjanohoun EJ, Ahyi AMR, Ake-Asi L, Baniakina J, Chibon P, Cusset G, Doulou V, Enzanza A, Eyme J, Goudote E, Keita E, Mbemba C, Mollet J, Moutsamboté J-M, Mpati J, Sita P. 1988. Contribution aux études ethnobotaniques et floristiques en République populaire du Congo:médecine traditionnelle et pharmacopée. ACCT, Paris, France.

Andrade-Cetto A, Heinrich M. 2011. From the field into the lab: useful approaches to selecting species based on local knowledge. Frontiers in Pharmacology 2(20):1-5. doi:10.3389/fphar.2011.00020

APG. 2016. An update of the Angiosperm phylogeny group classification for the orders and families of flowering plants: APG IV. Botanical Journal of the Linnean Society 181: 1-20, doi:10.1111/boj.12385

Baker JT, Borris RP, Carte B, Cordell GA, Soejarto DD, Cragg GM, Gupta MP, Iwu MW, Maduud DR., Tyler VE. 1995. Natural product drug discovery and development: new perspectives on international collaboration. Journal of Natural Products 58:1325-1357.

Bergonzini J-C. 2004. Changements climatiques, désertification, diversité biologique et forets. Silva-RIAT, Paris, France.

Bergonzini J-C, Lanly J-P. 2000. Les forêts tropicales. Karthala-CIRAD, Paris, France.

Betti JL. 2001. Vulnérabilité des plantes utilisées comme antipaludiques dans l'arrondissement de Mintom au Sud de la réserve de biosphère du Dja (Cameroun). Systematics and Geography of Plants 71(2):122-127.

Betti JL, Midoko Iponga D, Yongo OD, Obiang Mbomio D, Mikolo Yobo C, Ngoye A. 2013. Ethnobotanical study of medicinal plants of the Ipassa-Makokou Biosphere Reserve, Gabon: Plants used for treating malaria. Journal of Medicinal Plants

Published:31 December 2019

http://dx.doi.org/10.32859/era.18.44.1-15

Research 7, 31:2300-2318. doi:10.5897/JMPR11.1754

Betti JL, Yongo OD, Obiang Mbomio D, Midoko Iponga D, Ngoye A. 2013. Ethnobotanical and floristical study of Alstonia boonei De Wild. (Apocynaceae) in the Makokou region, Oogoué-Ivindo province, Gabon. International Journal of Agricultural Sciences 3(3):459-469.

Bouquet A. 1969. Féticheurs et médecines traditionnelles du Congo, Brazzaville. ORSTOM, Paris, France.

Chifundera K. 2001. Contribution to the inventory of medicinal plants from the Bushi area, South Kivu Province, Democratic Republic of Congo. Fitoterapia 72:351-368.

Dounias E. 2000. Review of ethnobotanical literature of central and West Africa. Bulletin of the African Ethnobotany Network 2:5-117.

El Hafian M, Benlamdini N, Elyacoubi H, Zidane L, Rochdi A. 2014. Etude floristique et ethnobotanique des plantes médicinales utilisées au niveau de la préfecture d'Agadir-Ida-Outanane, Maroc. Journal of Applied Biosciences 81:7198-7213.

Farsworth NR, Akerele O, Bingel AS, Soejarto DD, Guo Z. 1986. Place des plantes médicinales dans la thérapeutique. Bulletin de l'OMS 64(2):159-175.

Friedman J, Yaniv Z, Palevitch D. 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev desert, Israel. Journal of Ethnopharmacology 16:275-287. doi:10.1016/0378-8741(86)90094-2

Grenand P, Prévost M-F. 1994. Les plantes colorantes utilisées en Guyane française. Journal d'Agriculture traditionnelle et de Botanique appliquée (nouvelle série) 36(1):139-172.

Hecketsweiler P, Mokoko Ikonga J. 1991. La réserve de Conkouati:Congo, le secteur Sud-Est. UICN, Gland, Suisse.

Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. 1998. Medicinal plants in Mexico: healers' consensus and cultural importance. Social Science & Medicine 47: 1859-1871. DOI:10.1016/S0277-9536(98)00181-6

Höft R, Höft M. 1997. A profile of ethnobotany in Afric: Results of an Africa wide survey. Bulletin of the African Ethnobotany Network 1:5-22.

Kerharo J. 1974. La pharmacopée sénégalaise traditionnelle. Plantes médicinales et toxique. Vigot, Paris, France.

Kimpouni V. 2001. Contribution aux études ethnobotaniques et floristiques de la forêt de Lossi (R. P. Congo): les plantes de cueillette à usage alimentaire. Systematics and Geography of Plants 71:679-686.

Kimpouni V. 1999. Preliminary market survey of Non-Wood Forest Products traded in the Pointe-Noire markets (Congo-Brazzaville), In: T.C.H. Sunderland, L.E. Clark and P. Vantomme (Eds) Non Wood Forest Products of Central Africa: Current Research issues and prospects for conservation and development: CARPE-FAO (Rome: FAO), pp. 221-226.

Kimpouni V, Motom M. 2012. Empirisme et exploitation traditionnelle de la flore par la population riveraine du lac Cayo (Congo-Brazzaville), Annales de l'Université Marien Ngouabi 12-13(4):83-100.

Kimpouni V, Nguembo J. 2018. Diversité floristique et identité culturelle des populations à la périphérie du sanctuaire de Lossi, Congo (Brazzaville). Annales de l'Université Marien NGOUABI, Sciences et Techniques 18(1):17-34. www.annalesumng.org

Kimpouni V, Koubouana F, Apani A, Motom M, Makita-Madzou J-P. 2012. Contribution à l'inventaire et à l'utilisation des plantes à effet psychotropes et toxiques au Congo (Brazzaville). Phytothérapie 10:19-24. doi:10.1007/s10298-012-0684-8

Kimpouni V, Lenga-Sacadura M-Y, Mamboueni JC, Nsika Mikoko E. 2018. Phytodiversité et pharmacopée traditionnelle de la communauté Kaamba de Madingou (Bouenza - Congo). European Scientific Journal 14(3):191-220. doi:10.19044/esj.2018.v14n3p191 URL:http://dx.doi.org/10.19044/esj.2018.v14n3p191

Kimpouni V, Makita-Madzou J-P, Apani E, Motom M. 2014. L'ixeutique, un exemple de gestion empirique de la biodiversité végétale par la communauté traditionnelle Tsaaya du massif du Chaillu, Congo. Revue d'ethnoécologie [En ligne], 5 | 2014, mis en ligne le 04 juillet 2014, consulté le 18 juillet 2014. URL:http:// ethnoecologie.revues.org/1670 ; doi:10.4000/ethnoecologie.1670

Kimpouni V, Mamboueni JC, Lenga-Sacadura M-Y, Nsika Mikoko E. 2017. Recipes and Treatments in Traditional Herbal Medicine to the Kaamba Community of Madingou, Congo. European Journal of Medicinal Plants 20:1-13, doi10.9734/EJMP/2017/35096

Lavergne R, Véra R. 1989. Médecine traditionnelle et pharmacopée:étude ethnobotanique des plantes utilisées dans la pharmacopée traditionnelle à la Réunion. ACCT, Paris, France

Lebrun J-P, Stork AL. 1991-2015. Énumération des plantes à fleurs d'Afrique tropicale et Tropical African Flowering Plants: Ecology and Distribution, vol. 1-10. Éditions du Conservatoire et Jardin botanique de la

ville de Genève, Genève. Disponible sur: http://www.villege.ch/musinfo/bd/cjb/africa/recherche.php?langue=fr

Martin GJ. 1995. Ethnobotany: A methods manual. Chapman & Hall, London, UK.

Millenium Ecosystem Assessment (MEA). 2003. Ecosystems and human well-being: a framework for assessment. Island Press, Washington DC, USA.

Millenium Ecosystem Assessment (MEA). 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington DC, USA.

Profizi J-P, Makita-Madzou J-P, Milandou J-C, Karanda CN, Motom M, Bitsindou I. 1993. Ressources végétales non ligneuses des forêts du Congo. Plan d'Action Forestier Tropical du Congo (PAFT-Congo). Université Marien Ngouabi, Brazzaville, Congo.

Raponda-Walker RA, Sillans R. 1961. Les plantes utiles du Gabon. P. Lechevalier, Paris, France

Sanogo R. 2006. Le rôle des plantes en médecine traditionnelle, in Développement, environnement et santé. 10e Ecole d'Eté de l'IEPF et du SIFEE, Bamako, du 6 au 10 juin.

Sofowora A. 1996. Plantes médicinales et médecine traditionnelle d'Afrique. Karthala, Paris, France.

Uddin MZ, Hassan MA. 2014. Determination of informant consensus factor of ethnomedicinal plants used in Kalenga forest, Bangladesh. Bangladesh Journal of Plant Taxonomy 21:83-91. doi:10.3329/bjpt.v21i1.19272

Vennetier P. 1977. Atlas de la République Populaire du Congo. Éditions Jeune Afrique, Paris, France.

Verpoorte R. 1999. Pharmacognosy in new millennium leadfinding and biotechnology. Journal of Pharmacy and Pharmacology 52:253-262. doi:10.1211/0022357001773931

Wezel A. 2002. Plantes médicinales et leur utilisation traditionnelle chez les paysans au Niger. Etudes sur la Flore et la Végétation du Burkina Faso 6:9-18.

WWF. 2010. Living planet: biodiversity, biocapacity and development. Report 2010. Pp. 1-3.

Published:31 December 2019

http://dx.doi.org/10.32859/era.18.44.1-15