International Journal of Plant & Soil Science
1(1): 16-29, 2012; Article no. IJPSS.2012.002

SCIENCEDOMAIN *international*
www.sciencedomain.org

Spontaneous Plants Used in the Traditional Soap Making in Cote D'Ivoire

Coulibaly Siendou[1], Ouattara Djakalia[1], Konkon N'dri Gilles[1], Kagoyire Kagohiré[1] and Kouakou Tanoh Hilaire[2*]

[1]Université Félix Houphouët Boigny, UFR Sciences Biosciences, Laboratoire de Botanique, 22 BP 1414 Abidjan 22, Côte d'Ivoire;
[2]Université Nangui Abrogoua, UFR Sciences de la Nature, Laboratoire de Biologie et Amélioration des Productions Végétales, 02 BP 801 Abidjan 02, Côte d'Ivoire.

Authors' contributions

This work was carried out in collaboration between all authors. Authors CS and OD led the study and wrote the first draft of the manuscript. Author KNG wrote the protocol managed the analyses of the study. Authors KK and KTH managed the literature searches and KTH finalized the manuscript. All authors read and approved the final manuscript.

Research Article

Received 13th August 2012
Accepted 24th November 2012
Published 12th December 2012

ABSTRACT

The study focused on the spontaneous plants used in the traditional soap making. The aim is to create a directory of the main plant species used in traditional soap making in the Sudan Savannah zone.
An ethnobotanical investigation based on direct structured or semi-structured individual interviews was carried out with 193 people. 33 plants were recorded, among which 7 plants are used for the extraction of the fat and 28 for potash manufacture. The frequency of plant use, level of abundance plant and origin of each plant species were estimated.
At the end of the study, 33 plants were recorded and 22 are abundant in study zone. *Carapa procera* was used much and on the other hand *Ceiba pentandra, Cussonia arborea, Elaeis guineensis* and *Vitellaria paradoxa* were moderately used. 28 plants are spontaneous and 84 % of respondents reported their involvement in the traditional soap making. 7 plants were used for fat extraction while 28 plants species were use to potash manufacture. Stems and fruit were most requested as organs of plants for soap making. The intensive use of the stem (trunk and branches) of these species is a real pressure on the resources itself and may lead to the extinction of the most vulnerable one. Plants

**Corresponding author: E-mail: tanohilaire@yahoo.fr;*

inventoried were ranked according to their importance for the soap makers. Several types of plants were identified, from the most known, commonly used and abundant in the study site (*Carapa procera*, *Ceiba pentandra* and *Cussonia arborea*) to the least known, little used and scarce. The valorization of these resources can be beneficial to concerned population, it is urgent to adopt a sustainable management approach for the preservation of the used species. So, 3 plants species *(C. procera, P. butyracea* and *C. arborea*) were proposed for possible revalorization.

Keywords: Côte d'Ivoire; plants; soap; Sudan savanna.

1. INTRODUCTION

Traditionally, the preparation of soap is made from crude palm oil and potash extracted from wood ashes [1]. In Europe, before the development of the soap factory, the Gauls and Romans were also making soap at home [2]. In Africa, despite progress in the soap industry, people are still using soap made traditionally, which remains cheap and have specific virtues. In Ivory Coast, the manufacture of traditional soaps is widespread, based on the use of plant species which are mostly spontaneous. It therefore contributes to the vulnerability, the scarcity or even extinction of the concerned species. This practice can impact the local ecosystems and may lead to the extinction of the species [3].

Presently, few are known about the involved species. The present study aims at creating a directory of the main species exploited in traditional soap making in the Center-North of Côte d'Ivoire (regions of Katiola and Dabakala) in order to insure an economical and ecological sustainable use of these materials.

2. MATERIALS AND METHODS

The study site (regions of Katiola and Dabakala) is located in Center-North of Côte d'Ivoire. The climate is Sudanian with 1053.10 mm of rain per annum.

2.1 Ethnobotanical Investigation

The study material is represented by an ethnobotanical investigation form developed after a pre-fieldwork. Fourteen localities were selected (Fig. 1) and the ethnobotanical investigation conducted among 193 people, was done through structured or semi-structured individual direct talks.

During the investigation, the informants were asked to answer questions from the survey form. Specimens of plants mentioned were collected with the help of informants for confirmation of the vernacular name and constitution of a reference collection. The determination of species (scientific name) was done at the National Center of Floristic (NCF) of the University of Cocody (Abidjan). The scientific names were also checked using the work of Lebrun and Stork [4-7].

The information collected on the survey forms were transferred into a database, processed and analyzed using Microsoft Office Excel 2003.

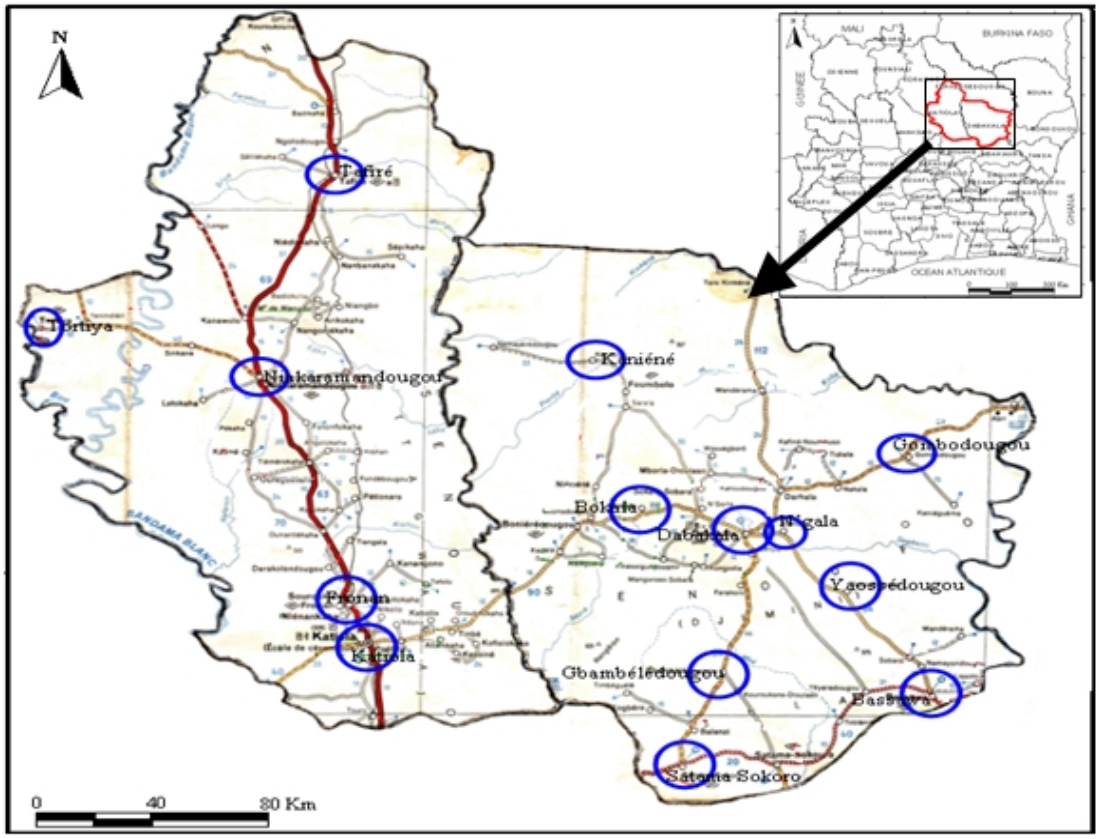

Fig. 1. Study site in regions of Katiola and Dabakala (Center-North of Côte d'Ivoire)

2.2 Estimated Frequency of Use and Level of Plants Abundance

The frequency of plant species allows us to assess their level of knowledge and exploitation by the people. It use was estimated by the method of the open list ("free-listing") of Cotton [8]. This approach, based on the spontaneous citations, rests on the principle that the most significant species are mentioned by several informants and therefore obtain a high ranking. Frequency of use of each species has been evaluated by its citation frequency spontaneous, according to the following formula:

$$\text{Frequency use of a plant} = \frac{\text{Number of people identifying the plant}}{\text{Number of questioned people}} \times 100$$

The abundance level was estimated for each plant species inventoried by the ratio between the number of people recognizing its abundance in the study site and the total number of people identifying the plant:

$$\text{Level of a plant abundance} = \frac{\text{Number of people recognizing the plant abundance in nature}}{\text{Number of people identifying the plant}} \times 100$$

2.3 Frequency of Plant Type

Following the same principle of Cotton [8], the frequency of the origin of each plant species (plant type) was calculated, according to whether the species of plant is cultivated, spontaneous or that it comes from a different region of our study site.

2.4 Statistical Analysis

Data were subjected to analysis of variance (ANOVA) using the Statistica 7.5 program. Significant differences among values were compared using Newman-Keuls test at 5 %. The means of phenolic compounds contents were determined.

3. RESULTS

3.1 Inventoried Plants

At the end of the ethnobotanical investigation, thirty-three plants were recorded. These species were left again in thirty-one genera and twenty-one families (Table 1). According to reports, the traditional soap making requires two essential plant raw materials: the fat content (oil, butter) and potash, each coming from specific plant species.

3.2 Plants and Bodies Used for Fat Extraction

Seven plants were used for the extraction of the fat content (oil or butter). They belong to five families and five genera (Table 2**)**. The Arecaceae and Euphorbiaceae are the most famillies, each represented with two plant species. The organ used on these plants is always part of the fruit. It is the seed, almond, endosperm or fruit pulp. Two types of organ are used at *Elaeis guineensis*: pulp and almond.

3.3 Plants and Organs Used for Potash Manufacture

Table 3 presents the twenty eight plants species for the manufacture of potash. They are divided into nineteen families and twenty six genera. Mimosaceae is the most exploited family with four species. Amaranthaceae, Caesalpiniaceae, Combretaceae, Euphorbiaceae, Moraceae and Rubiaceae families are each represented by two species plants. Among the organs harvested from these plants, the stems (trunk and branches) were largely requested. At the kapok (*Ceiba pentandra*), inside the trunk, the foothills and dried fruits are exploited by the population. Fruits and derivatives (pod, pod, pulp, skin) are also used. In *Amaranthus spinosus and Pupalia lappacea*, the entire aerial part of the plant (stems, leaves, fruit) is exploited.

Table 1. Inventory of plants harvested in the regions of Katiola and Dabakala (Center-North of Côte d'Ivoire)

Scientific names	Vernacular names			
	Tagbana	**Djimini**	**Malinké (Djamala)**	**Baoulé**
Acacia polyacantha	Gronhon			
Albizia ferruginea			Samandêrê	
Albizia zygia	Dimakanhan			
Amaranthus spinosus	Noumrinhin			
Anogeissus leiocarpus	Nglaha, Guindihi	Nglaga	Krêkêtê, Tchêgbêlêyiri	
Berlinia grandiflora		Yaurfougo	Wôngbê	
Carapa procera	Kakpaha	Krougbêguê	Gbohi, Gbohou, Kobi, Gbogo, Gbowi	Kohndou
Ceiba pentandra	Sédihi, Kplaba	Séligué, Cheligué	Banda, Bada	Nyin
Cocos nucifera	Kpaco	Kpaco	Kpaco	
Coffea spp.	Café	Café	Café	
Cussonia arborea	Fitio, Foutchouhou, Gbotoho	Yémbetché, Dédégué	Borokourou	
Elaeis guineensis	Hèhètihi	Sindigué	Téhi	Mmé
Ficus capensis		Ndassaga	Toro, tro	
Ficus exasperata	Waha			
Gardenia ternifolia			Blé	
Jatropha curcas L.	Kapaha, Kahadja	Kapara	Pôrôpôrô Mangandawa-gbê	
Khaya senegalensis		Wêdigué	Djala	
Manihot esculenta		Gbéndé	Gbéndé	
Musa spp.		Blahnda	Barada	
Parkia biglobosa	Nindihi	Nindigué	Nèrè	
Pentadesma butyracea	Djréhé	Ndjéligué	Gbêlèn	
Piliostigma thonningii	Yoganhan, Yéganhan	Yéwangan	Niaman	
Pterocarpus erinaceus	Nagnranhan	Gbatèlguê	Gbin	
Pupalia lappacea		Sibagniguiré		
Ricinus communis L.		Tombotigui	Tombotigui	
Securidaca longepedunculata		Félibé	Djoro, Djohi	
Spondias mombin	Tônanhan	Monlimon		
Sorghum spp.	Gbodioho			
Terminalia glaucescens	Kohotihi, Kohoun	Koman		
Theobroma cacao	Cacao	Cacao	Cacao	
Vitellaria paradoxa	Lodihi, Lohodjal, Lokatchlé	Létigué	Kôrô, Kwèi, Sihé	
Vitex doniana	Hangonhon	Sandjo wôô	Koto	
Zanthoxylum zanthoxyloides		Nganhan	Ngôndô	

Tagbana, djimini, malinké and baoulé are local languages

Table 2. Plants used for fat extraction in regions of Katiola and Dabakala (Center-North of Côte d'Ivoire)

Family	Species	Organ of the plant
Arecaceae	*Cocos nucifera* Linn.	Coconut endosperm)
	Elaeis guineensis Jacq.	Pulp, almond
Clusiaceae	*Pentadesma butyracea* Sab.	Seeds
Euphorbiaceae	*Jatropha curcas* Linn.	Almond
	Ricinus communis Linn.	Almond
Meliaceae	*Carapa procera* CD.	Seeds
Sapotaceae	*Vitellaria paradoxa* Gaertn.	Almond

3.4 Types of Species Used

Among the thirty five plants species inventoried, twenty eight plants are spontaneous (79 %), four plants come from other parts of Côted'Ivoire (12 %) and only three plants are cultivated in the region (9 %), Table 3.

Table 3. Plants used for the potash manufacture in the regions of Katiola and Dabakala (Center-North of Côte d'Ivoire)

Family	Species	Organ of the plant
Amaranthaceae	*Amaranthus spinosus* Linn.	Aerial part
	Pupalia lappacea (L.) A.Juss.	Aerial part
Anacardiaceae	*Spondias mombin* Linn.	Stems
Araliaceae	*Cussonia arborea* Hochst.ex A. Rich.	Stems
Arecaceae	*Cocos nucifera* Linn.	Fleshy fruit pulp
Bombacaceae	*Ceiba pentandra* (L.) Gaertn.	Trunk (buttress), cockles
Caesalpiniaceae	*Berlinia grandiflora* (Vahl) Hutch. et Dalz.	Pods (cockles)
	Piliostigma thonningii Milne Red.	Stem, fruits
Combretaceae	*Anogeissus leiocarpus* (DC.) Guill. et Perr.	Stems
	Terminalia glaucescens Planch. ex Benth.	Stems
Euphorbiaceae	*Jatropha curcas* Linn.	Stems
	Manihot esculenta Crantz.	Tuber peel
Fabaceae	*Pterocarpus erinaceus* Poir.	Stems
Meliaceae	*Khaya senegalensis* (Desr.) A.Juss.	Stems
Mimosaceae	*Acacia polyacantha* var. *campylacantha* (Hochst.) Roberty	Stems
	Albizia ferruginea (Guill. et Perr.) Benth.	Stems
	Albizia zygia (CD.) J.F.Macbr.	Stems
	Parkia biglobosa (Jacq.) R.Br. ex G.Don	Stems
Moraceae	*Ficus capensis* Thunb.	Stems
	Ficus exasperata Vahl	Stems
Musaceae	*Musa spp.*	Tuber peel
Poaceae	*Sorghum spp.*	Stems
Polygalaceae	*Securidaca longepedunculata* Fres.	Stems
Rubiaceae	*Coffea spp.*	Fruit pulp
	Gardenia ternifolia Schum. et Thonn.	Stems
Rutaceae	*Zanthoxylum zanthoxyloides* (Lam.) Zep. et Tim.	Stems
Sterculiaceae	*Theobroma cacao* Linn.	Cockles (+ rachis)
Verbenaceae	*Vitex doniana* Sweet.	Stems

Values followed by a different letter are significantly different (test of Newman Keuls at 5%)

The spontaneous plants were cited by 84 % of respondents while 15 % cited only plants from other regions of Côte d'Ivoire. Finally, a very small number of respondents (1 %) know the involvement of crops in the region in the traditional soap making (Fig. 2).

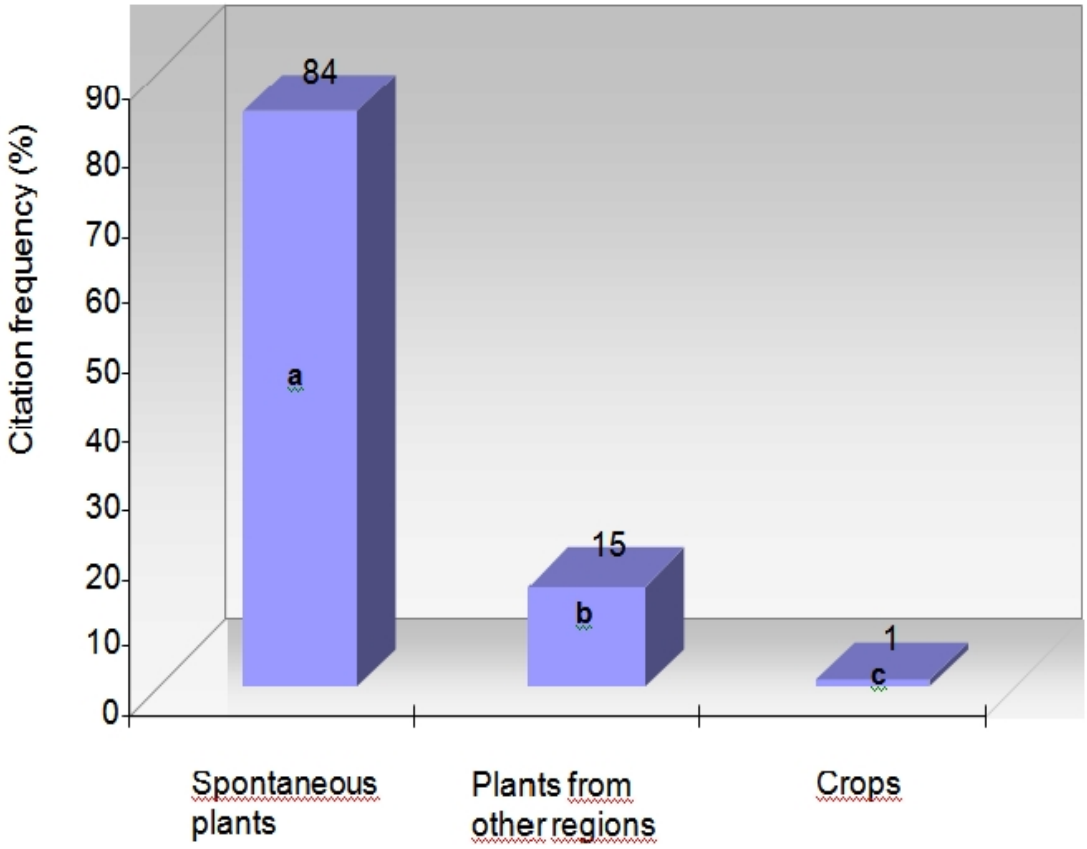

Fig. 2. Distribution of frequency citation of plant species according on the plant type in regions of Katiola and Dabakala (Center-North of Côte d'Ivoire)

3.5 Frequency of Use and Abundance Level of Plants Used for Fat Extraction

Fig. 3 shows the frequency of use of oilseeds and their abundance level in the place. It appears that plants *Carapa procera* is the most used plant, with 79.48 % of the citations. The shea tree (*Vitellaria paradoxa*) and palm oil (*Elaeis guineensis*), with quotations respective 36.92 and 33.33 %, ranked second and third. Other plants species are very poorly known, with less than 4 % of the citations. Regarding the level of abundance, almost all oilseed species are very well represented in the site, according to informants. However, three trends emerged. First, plants that are very abundant with over 90 % level of abundance were *Jatropha curcas* (100 %), *Ricinus communis* (100 %) and *Vitellaria paradoxa* (90.27 %), with statistically identical level of abundance. Then, the fairly abundant plants (60-90 %) which are *E. guineensis* (73.84 %), *Carapa procera* (68.38 %) and *Cocos nucifera* (66.66 %). Only *Pentadesma butyracea* is not very abundant in the area with 33.33 % level of abundance.

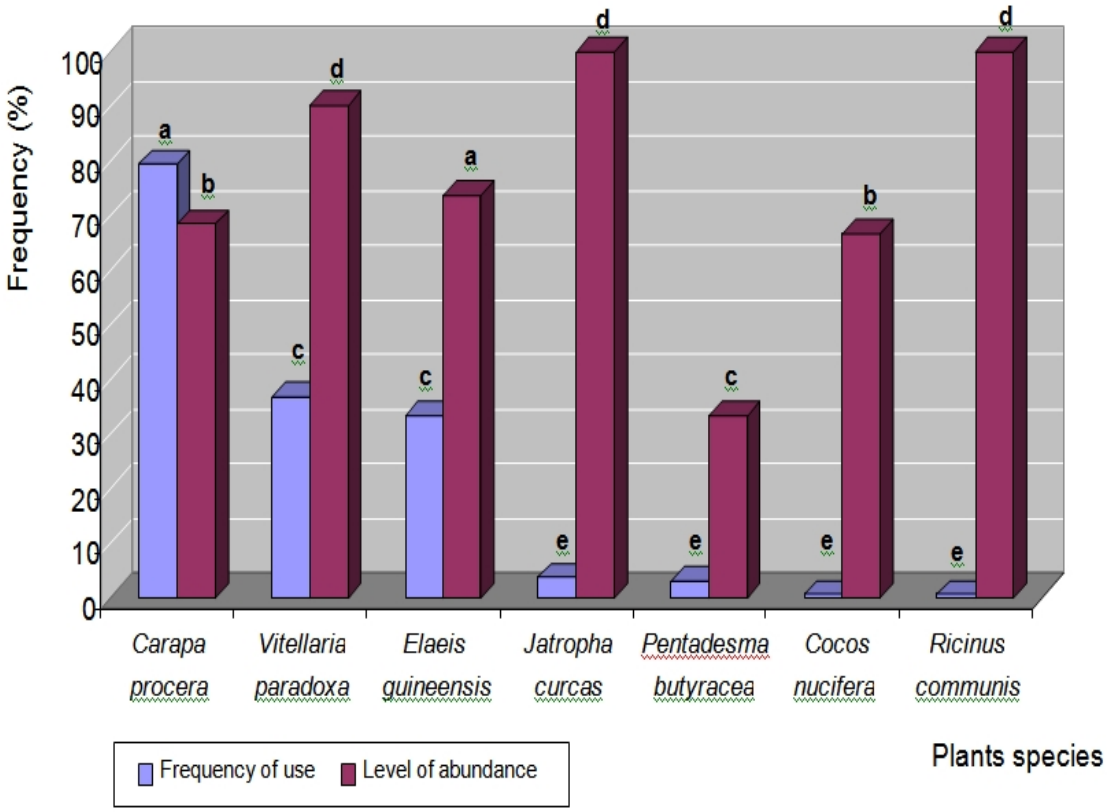

Fig. 3. Frequency of use and level of abundance of the oleaginous plants used for the soap making in the regions of Katiola and Dabakala (Center-North of Côte d'Ivoire)
Values followed by a different letter are significantly different (test of Newman Keuls at 5%)

3.6 Frequency of Use and Abundance Level of Plants Species Used For Potash Manufacture

Among the twenty eight plants identified for the manufacture of potash (Table 4), only two plants are distinguished (Fig. 4). These are *Ceiba pentandra* and *Cussonia arborea* with 51.28 % of all citations. The others twenty six plant species are very slightly mentioned (frequency <9%). Their abundance level, meanwhile, is very high (> 90 %) or high (50-90 %) for almost all inventoried plants.

Table 4. Inventoried plants according to their origin in the regions of Katiola and Dabakala (Center-North of Côte d'Ivoire)

Spontaneous plants	Cultivated plants	Plants from other regions
Albizia ferruginea	*Musa spp.*	*Coffea spp.*
Albizia zygia	*Sorghum spp.*	*Elaeis guineensis*
Amaranthus spinosus		*Theobroma cacao*
Anogeissus leiocarpus		
Berlinia grandiflora		
Carapa procera		
Ceiba pentandra		
Cussonia arborea		
Ficus capensis		
Ficus exasperata		
Gardenia ternifolia		
Jatropha curcas		
Khaya senegalensis		
Parkia biglobosa		
Pentadesma butyracea		
Piliostigma thonningii		
Pterocarpus erinaceus		
Pupalia lappacea		
Ricinus communis		
Securidaca longepedunculata		
Spondias mombin		
Terminalia glaucescens		
Vitellaria paradoxa		
Vitex doniana		
Zanthoxylum zanthoxyloides		

However, *Theobroma* cacao with 13.3 % of abundance level is statically characterized by very low presence and the total absence of Coffea spp. (0 %) in the study region.

3.7 Classification of Plant Species Recorded

To present the results, all taxa inventoried were grouped according to the combination with the frequency criteria of use - abundance level (Table 5). Abundant species are numerous (22), but only *Carapa procera* was requested much. *Ceiba pentandra, Cussonia arborea, Elaeis guineensis* and *Vitellaria paradoxa* were moderately used.

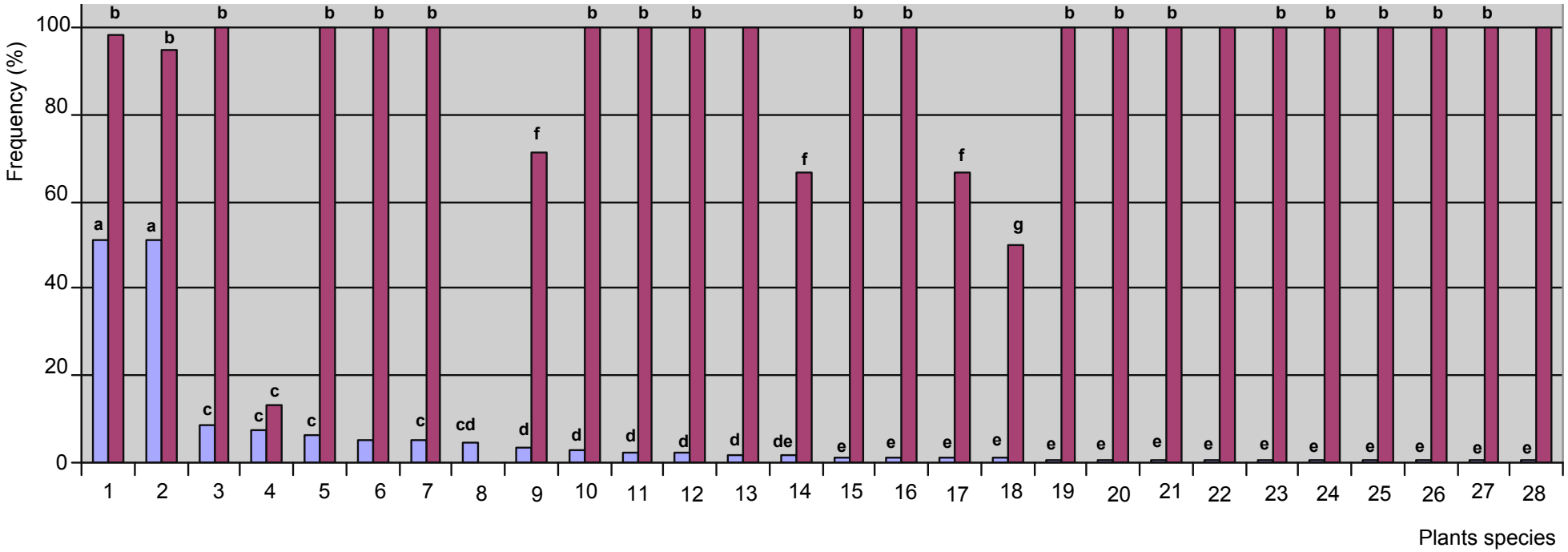

Fig. 4. Frequency of use and abundance level of used plants for potash manufacture in soap making in the regions of Katiola and Dabakala (Center-North of Côte d'Ivoire)

Values followed by a different letter are significantly different (test of Newman Keuls at 5%)

Table 5. Inventoried plants for the potash manufacture in the regions of Katiola and Dabakala (Center-North of Côte d'Ivoire)

Plants used in potash manufacture		
1- *Ceiba pentandra*	11- *Terminalia glaucescens*	21- *Gardenia ternifolia*
2- *Cussonia arborea*	12- *Acacia polyacantha* var.	22- *Pupalia lappacea*
3- *Anogeissus leiocarpus*	13- *Parkia biglobosa*	23- *Securidaca L.*
4- *Theobroma cacao*	14- *Pterocarpus erinaceus*	24- *Ficus capensis*
5- *Jatropha curcas*	15- *Albizia zygia*	25- *Ficus exasperata*
6- *Piliostigma thonningii*	16- *Amaranthus spinosus*	26- *Khaya senegalensis*
7- *Vitex doniana*	17- *Cocos nucifera* (potasse)	27- *Manihot esculenta*
8- *Coffea spp.*	18- *Zanthoxylum zanthoxyloides*	28- *Sorghum spp*.
9- *Musa spp*.	19- *Berlinia grandiflora*	
10- *Spondias mombin*	20- *Albizia ferruginea*	

4. DISCUSSION

Evaluation of plants devoted to traditional soap making in Sudanese region (Katiola and Dabakala) of Côte d'Ivoire showed a limited number of plants involved. Ethnobotanical studies conducted with methods similar to ours have an inventory of 75 wild edible fruit in the region of Seguela [3], and 42 medicinal plants used by people in rural Morocco [9]. The low number of plants species in this study (33) could be explained either by the restriction of our study area (traditional soap making), the tendency of people (mostly young) to shift away from traditional practice in benefits of modernity, and the reduction of plant resources in the study zone.

Regarding plant organs, the seeds and almonds used for the fat extraction seems to be satisfactory, because these organs are renewable following a regular physiological cycle. Their harvest does not affect the physical integrity of the plants. On the other hand, the almost exclusive use of stem (trunk and branches) for potash manufacture is particularly worrying. Indeed, many plants are often completely slaughtered and incinerated to obtain a good amount of ash, thus potash. This method of harvest puts in danger the survival of exploited plants species. According to Sælemyr [10], there is a clear relationship between the traveled portion of the used plant and the effects of harvesting on its existence. The use of buttresses of *Ceiba pentandra* in potash manufacture was also reported by Tra Bi [11] in populations living to the neighbourhoods of the classified forests of Haut-Sassandra and Scio (West of Côte d'Ivoire). It was noted that the exploited species are primarily spontaneous, from the savannah. Several authors have explained that the extensive use of local species is due to the proximity of these plants [9, 12]. The limited number of plants used as source of fat (7 of 33 species) might suggest a limitation of oleaginous species in the environment, their ignorance by the people. The difficulties of extracting vegetable oil could also justify the neglect of women with respect to the oleiferous species. This would explain the fact that many oleiferous species quoted in the literature and in the region have not been reported by informants. It is obvious that the valuation of these unused resources can contribute to reduce the present pressure on species already exploited, but also to help traditional soap makers to preserve this ancestral practice. Among the oil crops in the region, *Carapa procera* is the most preferred and used in soap making. The best quality of soaps made from oil of this plant and it's the non-use of this oil for food (because of its bitterness) as well as its therapeutic uses seem to support this preference.

Although moderately represented in the region, *C. procera* is known as an ecological restriction. The plant is essentially restricted to gallery forests. The exploitation of lowland rivers and rice is a serious threat to the survival of these species. It is the same for *Pentadesma butyracea* which remains very poorly represented in the study zone because of its limitation limited to only a few shallows. The unavailability of the last species of plant and its oil very appreciated in the food, seem to justify its weak use in the traditional soap manufacture. These two species plants (*C. procera* and *P. butyracea*) therefore deserve special attention, and can allow their backup or upgrading their local populations. According to Ambe [3], particular attention should be given to relatively few products consumed today, the latter being for a loss with more or less rapid destruction of their habitat. In addition, Ottoson [13] reported the high content of oleic acid seeds of *Carapa procera*, which could justify its valuation. Thus, the domestication of these plants or their retention in agriculture could be considered as alternatives. Some plants that are well known and used, termed sub-spontaneous, such as *Vitellaria paradoxa*, *Parkia biglobosa* and *Elaeis guineensis* are already protected by the local population [3]. The threat on *Carapa procera* and *Pentadesma butyracea* is exclusively linked to their habitat (threatened and restricted) and not their exploitation. This explains the mention of *C. procera*, in addition to *P. biglobosa* and *Spondias mombin* among the underutilized plant species from Côte d'Ivoire and other parts of Africa [14-16].

Ceiba pentandra and *Cussonia arborea* were the most representative plants for potash manufacture. If the first specie is very abundant in West Africa [17] as well as in the study site and does not run of risk of imminent extinction, it is the opposite for the second species plant. Indeed, *C. arborea* is dominant in the landscape, i.e. the open savanna vegetation. However, savannahs ecosystems are the most destroyed by agricultural clearing. At this threat, should be add the systematic demolition of the plant for potash manufacture used in traditional soaps making. On the field investigation, we noticed that the plants species is present in the savannah far away from settlements. It is also used for medicinal purposes against conjunctivitis, leprosy, diarrhea and dysentery [14, 18, 19]. The preferential use of *Ceiba pentandra* and *Cussonia arborea* for making potash could be related to the quality and efficiency of potash compared to other plants. This is even true that many plants are abundant in the site or are very little used for potash manufacture. Therefore, face to the threats on plant species in the region, it is urgent to adopt a sustainable management approach for the safeguarding and preservation of the most exploited plants species. Thus, in addition to the domestication suggested for some plants, the identification of gallery forests portion as biological and ecological interest sites, may be an interesting approach. We note that none of the plants surveyed were among the endemic, rare or endangered in Côte d'Ivoire and West Africa [14, 20, 21].

5. CONCLUSION

The study has established a list of wild species used in the traditional soap making in Sudanese zone of Côte d'Ivoire, and evaluated the relative importance of these plants. 33 plant species have been recorded and 22 are abundant in study zone but only *Carapa procera* was used much. *Ceiba pentandra*, *Cussonia arborea*, *Elaeis guineensis* and *Vitellaria paradoxa* were moderately used. 28 plants are spontaneous (79 %) and 84 % of respondents reported their involvement in the traditional soap making. *Jatropha curcas* (100 %), *Ricinus communis* (100 %) and *Vitellaria paradoxa* (90.27 %) are very abundant for fat extraction while *Ceiba pentandra* and *Cussonia arborea* with 51.28 % of all citations are the most abundance level for potash. Harvesting the trees by stamping out is the most

practiced method of collecting. Maintaining all these resources being illusory, identification of the products is more or less easy to value their useful approach. Thus, taking into account their frequency of use by people, their abundance level and 3 wild species were proposed for possible revalorization. These are *C. procera*, *P. butyracea* and *C. arborea*.

COMPETING INTERESTS

Authors declare that no competing interests exist.

REFERENCES

1. Caubergs L. Soap making: Technical, economic and social aspects. ATOL, Leuven, Belgium; 2006.
2. Bella OM. How to manufacture the soap at home? Accessed 14 June 2012; 2005. Available: http://saponification.afrikblog.com/.
3. Ambé GA. Edible wild fruits in Guinean savannas of Côte d'Ivoire: state of knowledge by local population, the Malinke. Biotechnol Agron Soc Environ. 2001;5:43-58.
4. Lebrun JP, Stork AL. Enumeration of flowering plants of Tropical Africa: Annonaceae to Pandaceae. CJB, Geneva, Switzerland; 1991.
5. Lebrun JP, Stork AL. Enumeration of flowering plants of Tropical Africa: Chrysobalanaceae to Apiaceae. CJB, Geneva, Switzerland; 1992.
6. Lebrun JP, Stork AL. Enumeration of flowering plants of Tropical Africa, Monocots: Limnocharitaceae to Poaceae. CJB, Geneva, Switzerland; 1995.
7. Lebrun JP, Stork AL. Enumeration of flowering plants of Tropical Africa, gamopetalous: Ericaceae to Lamiaceae. CJB, Geneva, Switzerland; 1997.
8. Cotton CM. Ethnobotany: Principles and Applications. Chichester, UK: Wiley; 1996.
9. Mehdioui R, Kahouadji A. Ethnobotanical study among the population riparian Amsittene forest: case of the Municipality of Imi n'Tlit (Province of Essaouira). Bull Sci Vie. 1996;29:11-20.
10. Sælemyr S. People, park and plant use: Perception and use of Andean 'nature' in the southern Ecuadorian Andes. Norw J Geog. 2004;58(4):194-203.
11. Tra Bi FH. Uses of plants by man in the forests of Upper Sassandra and Scio, Côte d'Ivoire. PhD UFR Biosciences, University of Cocody-Abidjan, Côte d'Ivoire; 1997.
12. Dahare DK, Jain A. Ethnobotanical Studies on Plant Resources of Tahsil Multai, District Betul, Madhya Pradesh, India. Ethnobot Leaf. 2010;14:694-705.
13. Ottoson N. Soap Making From the Garden: Using Herbs and Plant Materials For Texture and Visual Appeal. 2008; 02:44. Accessed 17 April 2012. http://davesgarden.com/guides/articles/view/1346.
14. Ahoussou N, Koffi G, Sangaré A. Côte d'Ivoire: Country Report for the International Technical Conference on Plant Genetic Resources FAO. Leipzig, Germany 17-23 June; 1995.
15. Upadhyaya HD, Ortiz R, Bramel PJ, Singh Sube. Development of a groundnut core collection using taxonomical, geographical, and morphological descriptors. Genet Resour Crop Evol. 2003;50:139–148.
16. Tuberosa R, Graner A, Varshney RK. Plant Genetic Resources: Characterization and Utilization. 2nd International Symposium on "Genomics of Plant Genetic Resources", 24–27 April, Bologna, Italy; 2010.
17. Siepel A, Poorter L, Hawthorne WD. Ecological profiles of large timber species, in: Poorter L, Bongers F, Kouamé FN, Hawthorne WD (Eds), Biodiversity of West African Forests. An Ecological Atlas of Woody Plant Species, CABI Publishing; 2004.

18. Verna AK, Kumar M, Bussmann RW. Medicinal plant in an environment: the medicinal flora of Banares Hindu University, Varqnasi, Uttar Pradesh. J Ethnobiol. Ethnomed. 2007;3:35-43.
19. Varnika S, Ashish S, Imran A. A review on ethnomedical and traditional uses of Mimosa pudia (Chui-Mui). Int Res J Pharm. 2012;3(2):41-44.
20. Poorter L, Bongers F, Kouamé FN, Hawthorne WD. Biodiversity of West African Forests. An Ecological Atlas of Woody Plant Species. CABI Publishing; 2004.
21. Nacoulma BMI, Schumann K, Traoré S, Bernhardt-Römermann M, Hahn K, Wittig R, Thiombiano A. Impacts of land-use on West African savanna vegetation: a comparison between protected and communal area in Burkina Faso. Biodiv Conserv. 2011;20(14):3341-3362.

© 2012 Siendou et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/3.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=169&id=24&aid=783