Diversity and uses by farmers of cashew (*Anacardium occidentale* L.) orchards weeds in Côte d'Ivoire

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Notes on Ethnobotany

Abstract

Background: Weeds are always seen as pests and are continuously destroyed by farmers due to their impacts on crop production. But like many other plants, some have several virtues. This work aims to determine the uses of weed plants by cashew farmers in three 4 regions of Côte d'Ivoire.

Methods: In each region, an ethnobotanical survey using semi-direct interviews with 108 cashew producers let to identify the weeds of cashew orchards used by farmers and to highlight their uses.

Results: In total, 73 weeds were cited by farmers as useful for various uses, thus justifying their maintenance in their orchards. Five categories of uses of these weeds have been recorded, of which food weeds represent 42.39%. Weeds used in traditional medicine represent 34.78% while those used as fodder and in handicrafts represent 8.69% each; 5.34% of these weeds are used in other areas. The most used organs are fruits and leaves with a rate of 39% each.

Conclusion: These uses of weeds should induce a new consideration of these plants by farmers who could implement the cashew orchards in Côte d'Ivoire as an agroforestry systems.

Keywords: Cashew, Côte d'Ivoire, weeds, richness and uses

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Résumé

Contexte: Les adventices sont toujours considérées comme des pestes et continuellement détruites par les agriculteurs en raison de leurs impacts sur la production agricole. Mais comme beaucoup d'autres plantes, certaines adventices ont plusieurs vertus. Ce travail vise à déterminer les usages de ces adventices par les producteurs d'anacarde dans 4 régions de la Côte d'Ivoire.

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Méthods: Dans chaque région, une enquête ethnobotanique utilisant des entretiens semi-directs, auprès de 108 producteurs de cajou, a permis d'identifier les adventices des vergers de l'anacardier utilisées par les paysans et de mettre en exergue les utilisations de celles-ci.

Résultats: Au total, 73 adventices ont été citées par les agriculteurs comme utiles pour divers usages justifiant ainsi leur maintien dans leurs vergers. Cinq catégories d'utilisations de ces adventices ont été enregistrées parmi lesquelles les adventices alimentaires représentent 42,39%. Les adventices utilisées en médecine traditionnelle représentent 34,78% tandis que celles utilisées comme fourrage et en artisanat représentent chacune 8,69% ; 5,34% de ces adventices sont utilisées dans les autres domaines. Les organes les plus utilisés sont les fruits et les feuilles avec un taux de 39% chacun.

Conclusion: Ces utilisations des adventices devraient induire une nouvelle réflexion sur ces plantes par les agriculteurs qui pourraient mettre en œuvre les vergers de l'anacardier en Côte d'Ivoire comme un système agroforestier.

Mots clés: Cajou, Côte d'Ivoire, adventices, richesse et usages.

Context

The definition of the term weed has always been the subject of debate among specialists. It is considered by some authors as species that lives in a place where it should not be, causing serious problems for crops (Labrada 2005). The term weed is sometimes rejected by other authors because of the negative connotation for the plant thus designated (Ipou 2005). Weed can also be defined as a plant introduced voluntarily by humans or spontaneously into cultivated biotopes (Ipou 2005). Indeed, some weeds provide socio-economic services to farmers. In Mexico, farmers maintain certain species in association with the main crop, which they call "buen monte" (good plants) and only eliminate "mal monte" (bad plants) in traditional agroecosystems (Altieri 1987). Indeed, these species are maintained in the fields and used for various purposes: food, medicine, religious ceremonies, soil improvement (Ruthenberg 1976, Gliessman 1988).

In Côte d'Ivoire, previous studies on the identification of the weed flora were conducted on several cultivated species areas. Aman et al. (2004) and Ipou (2005) investigated on the weeds of cotton (*Gossypium herbaceum* L.*)* farms, while Traoré et al. (2010) focused on the weeds of palm (*Elaeis guineensis* Jacq.*)* plantations. Mangara et al. (2010) studied the weeds in pineapple (*Ananas comosus* (L.) Merr.) farms when Tano et al. (2016) assessed the weeds of banana (*Musa paradisiaca* L.*)* farms and Traoré et al. (2019) on those of the sugarcane (*Saccharum officinarum* L.) farms. The weed flora of rice was inventoried by Kouamé et al. (2011), Konan et al. (2014) and Touré (2014). Indeed, many species were harvested from these biotopes by communities for several purposes. Touré *et al*. (2018) have shown that the riparian communities of the Sanaimbo forest reserve, in the south Côte d'Ivoire, knew and maintained the weed species used as traditional medicine, food, house construction and basketry material in their fields. For the cashew (*A. occidentale* L.) few is known about both on the diversity and the use of the associated weed species by farmers. In savannah zones, this crop occupies increasingly large areas (Dugué et al. 2003) and its relations with other species in the farms and the importance of these plants for farmers should be understood. Furthermore, it is necessary to know the useful weed species preserved during the maintenance operations in the cashew orchards. In order to gather these data, this study was conducted the regions of Gontougo, Bounkani, Marahoué and Kabadougou were cashew is most cultivated. The objective of this manuscript was to show the richness and diversity of the useful weeds in the cashew orchards and their uses by farmers in the savannah area of Côte d'Ivoire.

Materials and Methods

Study area

The study was carried out in the regions of Bounkani and Gontougo (Northern-east), of Kabadougou (Northern-west) and Marahoué (Center-west) in Côte d'Ivoire (Figure 1) from July to October 2020 when all the weeds especially herbaceous species were alive and could be easily named botanically. The regions of Kabadougou and Bounkani are characterized by a Sudanese climate with an average temperature of 30 °C with a Sudanian savannah vegetation (Monnier 1983). The annual rainfall of these regions ranged from 800 to 1 200 mm (Krogba et al. 2016). The regions of Gontougo and Marahoué are in a forest-savannah mosaic vegetation (Monnier 1983) where the climatic regime was similar to the Guinean zone with an average annual rainfall varying between 1.200 and 1.500 mm. The annual average temperature is 28.4 ° C (FAO 2005).

Data collection

This study was conducted in 108 cashew farms (Figure 2, Table 1) encompassing three villages in each region of Bounkani and Gontougo, and six villages in each region of Kabadougou and Marahoué. In each village, six cashew orchards were visited, and a semi-direct questionnaire (Appendix) proposed by Touré et al. (2018) was used to interview the owner of each visited farm.

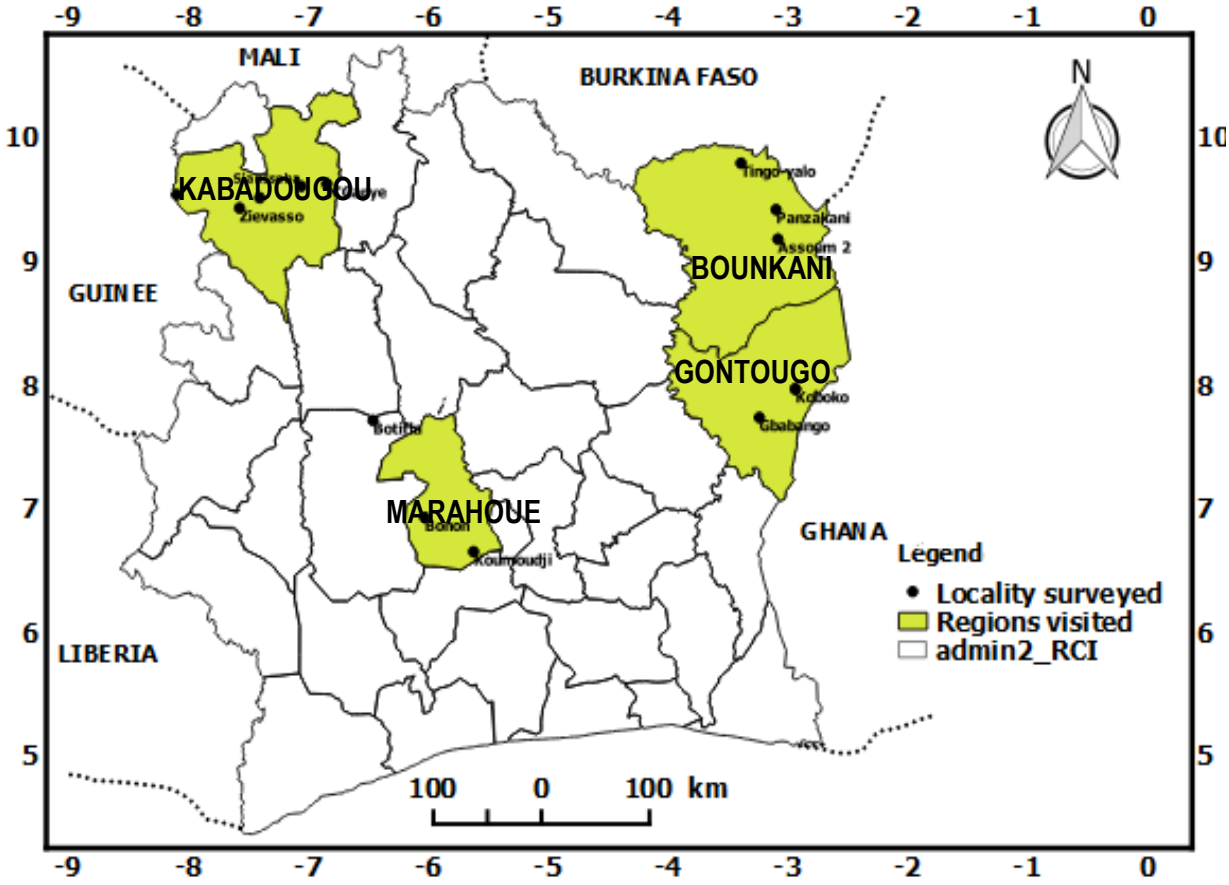

Figure 1. Localization of the studied regions on the map of Côte d'Ivoire.

Figure 2: A picture of a cashew orchard in the Northern Côte d'Ivoire

Specimen identification

The collected weeds were identified in the field using the West African weed guide of Akobundu and Agyakwa (1989), the Adventrop, weeds from Sudano-Sahelian Africa of Bourgeois and Merlier (1995), and the trees, shrubs and lianas of the drylands of West Africa of Arbonnier (2009) or at the herbarium of the Centre Suisse de Recherches Scientifiques en Côte d'Ivoire. The nomenclature of

Cronquist (1981, 1983) updated by APG (2016) was followed in this work.

Table 1. Sociodemographic characteristics of the cashew farmers interviewed.

Variables	Modalities	Number of farmers	Percentage (%)
Sex	Men	91	84.26
	Women	17	15.74
Age (years)	0-30	7	6.48
	31-50	59	54.63
	> 50	42	38.89
Study level	Analphabetic	71	65.74
	Primary	21	19.44
	Secondary	13	12.04
	University	3	2.78

Data analysis

The diversity index of the useful weeds in the farms was calculated using the ratio of the species number on the genera number (Aké Assi 1984, Aman *et al.* 2004). The relative importance of the categories of the weeds uses and of the organs used were analyzed by a simple descriptive statistical method as the percentage.

Results

Profiles of the interviewed farmers

The 108 farmers surveyed were between 15.74% of women and 84.26% of men; this population was at 54.63% between 31 and 50 years old and at 38.89% older than 50 years (Table 1). The illiteracy rate of farmers was about 65.74% while the farmers with a university level was set only at 2.78% (Table 1).

Useful weed flora richness and diversity in the cashew farms

A total of 73 useful weeds for the farmers were assessed in the cashew farms of the four visited regions. These useful weeds species belong to 64 genera and 33 families (Table 2) of which the most represented were Malvaceae (25%), Fabaceae (17%) and Dioscoreaceae (11%). The generic diversity index was set between 1.08 in Kabadougou region and 1.29 Marahoué region (Table 3).

The Gontougo region, with only 18 questioned farmers, showed the highest number of useful species while the lowest number of useful weeds was recorded in the Kabadougou region, with 36 questioned farmers (Table 4). Six commonest species were cited by the farmers in all regions (Table 2). *Azadirachta indica*, *Hibiscus asper* and *Saba senegalensis* were cited only in Bounkani Region while *Dioscorea bulbifera, Adenia cissampeloides, Alchornea cordifolia, Anthocleista djalonensis* and *Cnestis ferruginea* were cited only in Gontougo Region. *Annona senegalensis, Arachis hypogaea, Daniellia oliveri* and *Sarcocephalus latifolius* were cited only in Kabadougou region. The species cited only in Marahoué region were *Borassus aethiopum, Carica papaya, Cocos nucifera, Coffea canephora, Griffonia simplicifolia, Hevea brasiliensis, Newbouldia laevis* and *Theobroma cacao*.

The Gontougo region showed the highest percentage of cultivated weeds and lowest percentage of spontaneous weeds (Table 4) while the lowest percentage of cultivated weeds was found in the Kabadougou Region.

In terms of morphological types, all regions showed 23 weedy trees, 28 weedy shrubs, 14 weedy lianas and 8 herbaceous weeds (Figure 3). The Gontougo region showed the highest number of both useful weed trees and lianas species while the Marahoué region experienced the poorest useful weeds trees species (Table 5). The highest number of useful weeds shrubs was found in the Marahoué region and the lowest number of both useful weeds lianas and shrubs was recorded in the Kabadougou region of (Table 5). The herbaceous useful weeds were higher in Kabadougou region and poorer in Marahoué region (Table 5).

Uses categories

The uses of weed species could be encompassed into the categories of food, of medicine, of crafts, of fodders and of other (Figure 4). The farmers used more the weeds for food and health care in the study area. The Marahoué region showed the highest number of weeds used in the farmers' diets while the lowest number was obtained in the Kabadougou region (Table 6). Similar number of weeds were recognized in both Marahoué and Gontougo regions as medicinal plants while fewer species were experienced in Kabadougou region (Table 6). In all regions, few weeds were used as fodders, handicrafts and others (Table 6).

Parts of weeds used

All the organs of weedy species were used, except for the flowers (Figure 4). The fruits and the leaves were the most used organs with a proportion of 39% each while the stems and the roots were the least used with respectively 14% and 8% of uses (Figure 5).

Table 2. List of useful weeds in the cashew farms of the studied regions.

Family	Scientific names of species	Origins		Uses categories					Organs				Regions			
		Cul	Spo	Foo	Med	Cra	Fod	Oth	Fru	Roo	Lea	Rod	Bou	Gon	Kab	Mar
Malvaceae	*Adansonia digitata* L.		x	x	x				x		x		x		X	
Passifloraceae	*Adenia cissampeloides* Harms		x	x					x					X		
Zingiberaceae	*Aframomum alboviolaceum* K. Schum.		x	x	x				x	x			X		X	
Fabaceae	*Albizia adianthifolia* W.F. Wight		x				x				x		X	X		
Fabaceae	*Albyzia zygia* (DC.) J.F. Macbr.		x		x						x			X		X
Euphorbiaceae	*Alchornea cordifolia* Müll.-Arg.		x		x						x			X		
Sapindaceae	*Allophylus africanus* P. Beauv.		x		x						x		X	X		
Bromeliaceae	*Ananas comosus* (L.) Merr.		x	x					x				x	X	X	X
Araceae	*Anchomanes difformis* (Blume) Engl.		x		x						x			X		
Annonaceae	*Annona senegalensis* Pers.		x	x					x						X	
Combretaceae	*Anogeissus leiocarpa* Guill. & Perr.		x		x			X		x		x	x			X
Gentianaceae	*Anthocleista djalonensis* A. Chev.		x		x	x				x		x		X		
Moraceae	*Antiaris toxicaria* Loes.		x				x				x		X			X
Fabaceae	*Arachis hypogaea* L.	x		x					x						X	
Meliaceae	*Azadirachta indica* A. Juss.	x			x						x		X			
Sapindaceae	*Blighia sapida* K.D. Koenig		x		x						x			X		
Malvaceae	*Bombax costatum* Pellegr.		x	x						x				X	X	X
Arecaceae	*Borassus aethiopum* Mart.		x	x	x	x			x		x	x				X
Caricaceae	*Carica papaya* L.	x		x	x				x		x					X
Malvaceae	*Ceiba pentendra* (L.) Gaertn.		x	x		x					x		X	X		
Asteraceae	*Chromoleana odorata* R. King & H. Rob.		x					X			x		X		X	
Rutaceae	*Citrus limon* (L.) Osbeck	x		x	x				x	x	x		X	X	X	X
Rutaceae	*Citrus maxima* (Burm.) Merr.	x		x	x				x	x	x		X	X	X	X
Rutaceae	*Citrus reticulata* Blanco	x		x	x				x		x				X	X
Connaraceae	*Cnestis ferruginea* Vahl ex DC.		x		x				x		x			X		
Arecaceae	*Cocos nucifera* L.	x		x	x				x							X

Rubiaceae	*Coffea canephora* Pierre	x		x					x							X
Rubiaceae	*Coffea arabica* L.	x		x					x					X		X
Malvaceae	*Cola nitida* (Vent.) Schott & Endl.	x		x				X	x					X		X
Malvaceae	*Corchorus tridens* L.		x	x					x		x		X	X		
Fabaceae	*Daniellia oliveri* (Rolfe) Hutch. & Dalz.		x					X				x			X	
Sapindaceae	*Deinbollia pinnata* Schum. & Thonn.		x		x						x		X	X		
Fabaceae	*Dialium guineense* Willd.		x	x					x					X	X	
Dioscoreaceae	*Dioscorea alata* L.	x		x					x				X	X		X
Dioscoreaceae	*Dioscorea bulbifera* L.		x	x					x					X		X
Dioscoreaceae	*Dioscorea cayennensis* Lam.	x		x					x				X	X		X
Dioscoreaceae	*Dioscorea odoratissima* Pax		x	x					x				X	X		X
Ebenaceae	*Diospyros mespiliformis* Hochst.		x	x	x	x			x	x	x	x	X	X		X
Arecaceae	*Elaeis guineensis* L.	x		x	x				x				X	X	X	X
Moraceae	*Ficus exasperata* Vahl		x				x				x	x	X			X
Moraceae	*Ficus sur* Forssk.		x			x					x		X			X
Malvaceae	*Griffonia simplicifolia* (Vahl) Baill.		x		x	x					x	x				X
Euphorbiaceae	*Hevea brasiliensis* (Willd.) Müll.-Arg.	x				x	x					x				X
Malvaceae	*Hibiscus asper* Hook. f.		x	x					x		x		X			
Malvaceae	*Hibiscus esculentus* (L.) Moench.	x		x					x				X	X	X	X
Meliaceae	*Khaya senegalensis* (Desv.) A. Juss.		x					X				x			X	
Verbenaceae	*Lippia multiflora* Moldenke		x	x	x					x	x		X		X	
Euphorbiaceae	*Mallotus oppositifolius* Müll.-Arg.		x		x						x					X
Anacardiaceae	*Mangifera indica* L.	x		x	x			X	x	x	x		X	X	X	X
Euphorbiaceae	*Manihot esculenta* Crantz	x		x					x		x		X	X	X	
Moraceae	*Milicia excelsa* (Welw.) Berg		x			x						x		X		X
Apocynaceae	*Motandra guineensis* (Thonn.) A. DC.		x		x						x		X	X		
Musaceae	*Musa paradisiaca* L.	x		x					x					X		X
Musaceae	*Musa sapientum* L.	x		x					x					X		X
Bignoniaceae	*Newbouldia laevis* (P. Beauv.) Seem.		x				x				x	x				X
Fabaceae	*Parkia biglobosa* (Jacq.) R. Br.		x	x				X	x				X		X	

Poaceae	*Paullinia pinnata* L.		x		x					x		X	X			
Phyllanthaceae	*Phyllanthus amarus* Schum. & Thonn.		x		x					x	x	X	X			
Fabaceae	*Piliostigma thonningii* Milne-Redh.		x		x					x		X	X	X	X	
Myrtaceae	*Psidium guajava* L.	x		x				x					X			
Apocynaceae	*Rauvolfia vomitoria* Afzel.		x		x					x		X			X	
Apocynaceae	*Saba senegalensis* (A. DC.) Pichon		x	x				x				X				
Celastraceae	*Salacia baumannii* Loes.		x		x					x			X		X	
Rubiaceae	*Sarcocephalus esculentus* (Sm.) Afzel.		x		x					x						
Anacardiaceae	*Spondias mombin* L.		x	x				x					X			
Malvaceae	*Theobroma cacao* L.	x		x			X	x							X	
Balanophoraceae	*Thonningia sanguinea* Vahl		x		x					x	x		X	X	X	
Annonaceae	*Uvaria chamae* P. Beauv.		x	x				x					X			
Asteraceae	*Vernonia amygdalina* Delile		x		x					x			X		X	
Sapotaceae	*Vitellaria paradoxa* C.F. Gaertn.		x	x	x			x		x		X		X		
Lamiaceae	*Vitex doniana* Sweet		x	x				x					X	X	X	
Poaceae	*Zea mays* L.	x		x				x				X		X	X	
Zingiberaceae	*Zingiber officinale* Roscoe.	x		x	x			x	x			x		X		

Cul : cultivated , Spo : spontaneous, Foo : food , Med : medicinal , Cra : crafts , Fol : Fodder , Oth : other , Fru : fruits , Lea : leaves , Roo : roots , Rod : rods, Bou: Bounkani, Gon: Gontougo, Kab: Kabadougou, Mar: Marahoué

Table 3. Richness and generic diversity index of useful weeds in cashew orchards of the investigated regions

Regions	Families	Genera	Species	Generic diversity index
Bounkani	24	31	36	1.16
Gontougo	26	36	42	1.16
Kabadougou	18	24	26	1.08
Marahoué	23	31	40	1.29

Table 4. Origins of the useful weeds recorded in the cashew farms in each region

Region	Cultivated weeds		Spontaneous weeds	
	Number	%	Number	%
Bounkani	13	36.12	23	63.88
Gontougo	18	42.85	24	57.15
Kabadougou	10	38.46	16	61.54
Marahoué	15	37.50	25	62.50

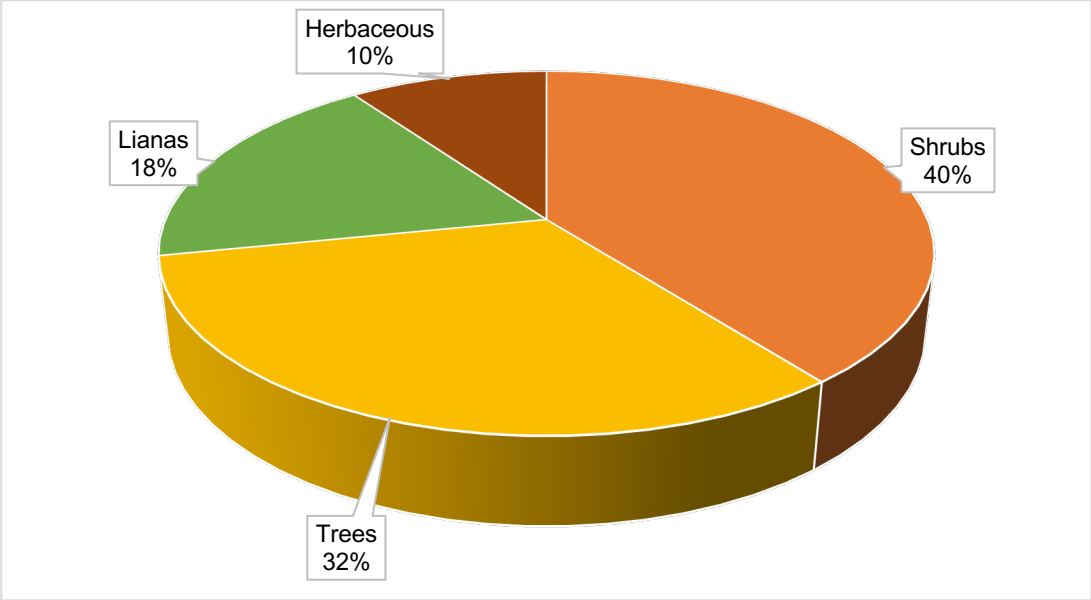

Figure 3. Proportions of the morphological types of the useful weeds in the study area.

Table 5. Morphological types of useful weeds recorded in each region

Life forms	Trees		Shrubs		Lianas		Herbaceous	
Regions	Number	%	Number	%	Number	%	Number	%
Bounkani	9	24	15	24	7	33	6	26
Gontougo	11	26	15	24	9	43	6	26
Kabadougou	8	33	9	14	0	0	7	31
Marahoué	7	17	23	37	5	24	4	17

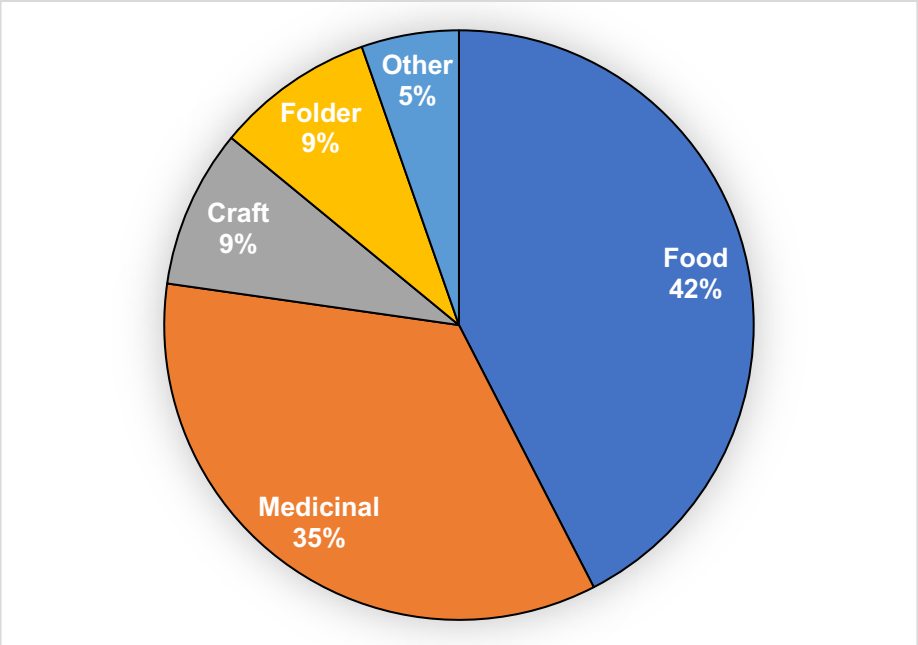

Figure 4. Representativeness of the weeds uses categories.

Table 6. Number of weeds species per use-categories in the different regions

Regions	Food	Medicine	Crafts	Fodders	Others
Bounkani	22	18	3	2	4
Gontougo	25	21	6	3	4
Kabadougou	13	16	3	2	2
Marahoué	26	21	3	3	4

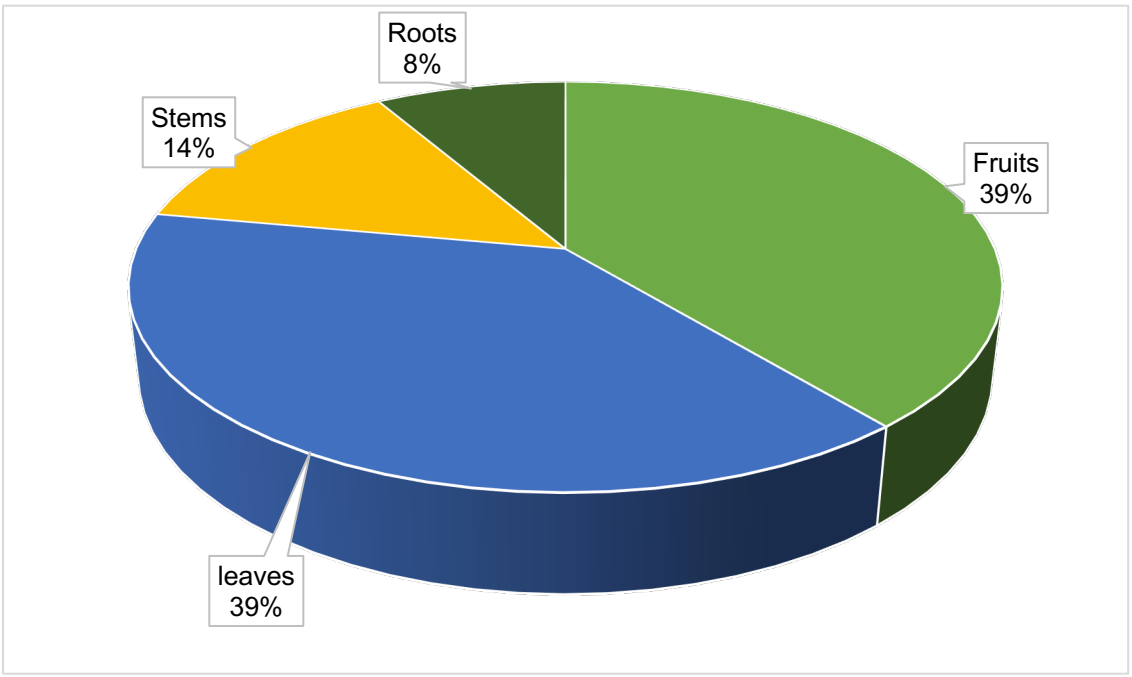

Figure 5. Distribution spectrum of weed organs used by cashew farmers.

Weeds as food

Forty-four (44) edible species were encountered (Table 2). The organs generally consumed were the fruits, the tubers and the leaves. In all regions, the fruits of *Mangifera indica*, *Citrus limon* and *Citrus maxima* were directly consumed in the field and sometimes at home. The tubers of *Dioscorea alata, Dioscorea cayennensis* and *Dioscorea odoratissima* were cooked in water and eaten boiled or crushed. The fruits of *Parkia biglobosa* and *Vitellaria paradoxa*, and the leaves of *Adansonia digitata*, *Bombax costatum* and *Ceiba pentendra* were cooked and eaten in sauce in the regions of Bounkani, Gontougo and Kabadougou. The leaves of *Lippia multiflora* were boiled and consumed as morning tea in Bounkani and Kabadougou regions.

Weeds in traditional medicine

Thirty-five (35) weeds have been recognized by farmers as plants with therapeutic virtues for human health. The organ parts used were the fruits, the leaves, the roots and the stems. Thus, the useful species could be classified into three groups.

The first group gathers 29 weeds species whose the leaves only were used. In the Marahoué region, the leaves of *Albyzia zygia, Antiaris toxicaria, Blighia sapida, Diospyros mespiliformis, Griffonia simplicifolia* and *Vernonia amygdalina* were used by farmers to heal themselves. In both the Kabadougou and Bounkani regions, the leafy branches of *Annona senegalensis, Parkia biglobosa, Piliostigma thonningii, Sarcocephalus latifolius, Vitellaria paradoxa* and *Vitex doniana* were used to heal several diseases. In the Gontougo region, farmers used the leaves of *Alchornea cordifolia, Deinbollia pinnata, Mallotus oppositifolius, Motandra guineensis* and *Paullinia pinnata* to heal themselves.

The second group of *Diospyros mespiliformis, Mangifera indica, Lippia multiflora, Alchornea cordifolia* and *Sarcocephalus latifolius* whose both the roots and leaves were used simultaneously to heal the diseases all the studied area.

The third and smallest group encompasses *Anchomanes difformis, Phyllanthus amarus,* and *Thonningia sanguinea* whose the entire plants were used against diseases.

Minor uses of weeds

Twenty-two (22) weeds species were used as fodders, in the crafts, as resting place for both animals and men, as source of income and as spiritual significance in the visited regions.

The leaves of *Albizia adianthifolia, Albyzia zygia, Antiaris toxicaria, Ficus exasperata* and *Ficus sur* were used as fodders for domestic animals. The stems of *Anthocleista djalonensis, Borassus aethiopum, Ceiba pentendra, Diospyros mespiliformis, Griffonia simplicifolia, Hevea brasiliensis* and *Milicia excelsa* were used in construction, in carpentry, to make furnitures (chairs and stools) and as kitchen equipment (pestle). The fruits of *Arachis hypogaea, Coffea canephora, Coffea arabica, Theobroma cacao*and *Zea mays* are a significant source of income for the cashew farmers. *Daniellia oliveri* and *Khaya senegalensis* were supposed to be the farmers' spiritually protection plants against the evil spirits or witchcraft in all the study area.

Discussion

The total number of 73 useful weed species accessed with 108 farmers represents almost 17% of the total weed richness found in 261 cashew orchards in the savanna area of Côte d'Ivoire (Konaté et al. 2020). At the families and genera levels, the useful weeds represent respectively 45 % and 24 % of the current known cashew orchards' flora in Côte d'Ivoire (Konaté et al. 2020). The generic diversity index of 1.08-1.29 of the useful weeds in the cashew orchards is lower than those of all the weeds found by Konaté et al. (2020) and shows the high diversity of this useful weeds' flora.

The higher number of useful weeds species (36-42 species) in Bounkani and Gontougo both regions with 18 questioned farmers each than those in Kabadougou region (26 species) with a twice number of questioned farmers shows the lack of the interviewed farmers number's impact on the knowledge of the weeds uses in the study area. The higher representatives of the spontaneous weeds (57-63 %) than those of the cultivated species in all regions shows that the cashews orchards in the study are more colonized by local natural pioneer species which germinate or resprout in these areas despite the human local activities. But the proportion between 36 % and 42 % of the introduced useful species by the farmers in their orchards experience also the high contribution of the cashew farmers to the flora of their farms. The lower representatives of both Lianas (0-21.95 %) and herbaceous (10.25-29.16 %) to the useful weeds flora in all regions reveals the higher contribution of both trees and shrubs to the useful weeds dominated by the food (13-26 species) and the medicinal (16-28 species) uses in the study area.

Many ethnobotanical studies have been carried out in the Sudanian zone (Kouamé et al. 2008, Kouamé and Gnahoua 2009, Dro et al. 2013, Soro et al. 2014) and in the Guinean zone (Tra Bi 1997, Ambé 2001) of Côte d'Ivoire but none was on the cashew orchards. The 73 species of useful weeds found in cashew orchards of the four regions is close to the 75 species of useful plant species obtained by Ambé

(2001) in the natural vegetation of the northern-western Côte d'Ivoire. And this richness is also very similar to those of the 72 food plants species found by Kouamé et al. (2008) in the natural vegetation of the central-western Côte d'Ivoire.

The presence of both spontaneous weeds species and introduced weeds species in all assessed farms shows that the cashew orchards in Côte d'Ivoire are not single crop farms as a part of local and native flora is preserved in these orchards. Moreover, the presence of trees and shrubs indicate that an agroforestry system could be developed in these cashew orchards. Tiébré et al. (2016a, 2016b) showed that utilitarian species are scarcely available in savannah and degraded opened forests. However, these authors argued that the cultivated areas, the fallows and the opened forests are the reservoirs of utilitarian plants in northern Côte d'Ivoire. This study showed similar results in the Marahoué region in the central-western Côte d'Ivoire where 40 weeds species were preserved in cashew orchards.

Among the four identified ecosystems services described by Brauman et al. (2007), only the provisioning services and a lesser extent cultural services seemed to drive farmer's decision to conserve or not weeds species in their orchards. In fact, the weeds kept preserved in the cashew orchards are used most often for food (42.39%), traditional medicine (34.78%) and minor uses. Touré et al. (2018) found similar results in central-eastern Côte d'Ivoire. More awareness among the cashew farmers about other services provided by plants could lead to the maintenance of more biodiversity in cashew orchards. Tra Bi (1997) indicated that the people of the Central-western Côte d'Ivoire consumed the fruits of *Deinbollia pinnata and* the leaves of *Triplochiton scleroxylon*. The consumption of *Deinbollia pinnata*'s fruit is confirmed in the studied area but the edibility of *Triplochiton scleroxylon* was not cited by farmers during this survey. Kouamé and Gnahoua (2009) found that the young leaves of *Sterculia tragacantha* and *Triplochiton* scleroxylon were consumed by the populations of central-western Côte d'Ivoire. Tiébré et al. (2016b) showed that *Adansonia digitata* and *Vitellaria pardoxa* were widely consumed in the sudanian zone of Côte d'Ivoire. Guinko and Pasgo (1992) noted that the availability and consumption of the wild fruits constitute a considerable contribution to household diets. Cunninghan (1993) Ngalamulume et al. (1995), Kasuku et al. (1999) and Dounias et al. (2000) advocated that the traditional use of medicinal plants forms was the basis of curative medicine for low-income populations. Ambé (2001), Soro et al. (2012), Dro et al. (2013) and Olivier et al. (2013) demonstrated the empirical know-how of the use of therapeutic plants by rural populations. The other uses of some weeds in the study area are not similar to those other areas. Thus, Tra Bi (1997) and Touré et al. (2018) mentioned that the trunk of *Nesogordonia papaverifera* was used for making pestle and mortar, and as a framework among the populations of central-western and western Côte d'Ivoire.

Conclusion

This study shows that the cashew orchards in the four studied regions in Côte d'Ivoire host 73 useful weed species including the shrubs, the trees, the lianas and the herbaceous in a decreasing percentage order. These useful weeds represent 17% of the total weed richness known in the cashew orchards in Côte d'Ivoire and their flora is highly diverse. Their number varies with the regions independently of the number of the questioned farmers. These weeds provide many services (food, medicine, craft and fodder) to the focal population but the consumed species and those in traditional medicine are most abundant. All their organs are used except the flowers. Hence, the
weeds that are sometimes taken to be the pest of the cashew should have another

consideration because in the current context of the natural vegetation very fast disappearing, the services of these plants to the local population become more important and pertinent. Off course, if the local population knew the implication of the Fabaceae weeds in the local soil fertilization process, the total number of these useful weeds in the cashew orchards would be higher than the 73 species found in this work.

Declarations

List of abbreviations: FAO: food and agriculture organization, APG: angiosperm phylogeny group; Cul: cultivated, Spo: spontaneous, Foo: food, Med: medicinal, Cra: crafts, Fol: Fodder, Oth: other, Fru: fruits, Lea. leaves, Roo: roots, Rod: rods, Bou: Bounkani, Gon: Gontougo, Kab: Kabadougou, Mar: Marahoué

Ethics approval and consent to participate: The data were collected with respect to confidentiality, anonymity and consent. All respondents were informed about the aim of this study.

Consent for publication: Not applicable

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

Competing interests: The authors declare no conflict of interest.

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Authors' contributions: Latif Mory Konaté developed the research protocol, collected the data and wrote this article. François N'Guessan Kouamé supervised and improved this article from its protocol to its writing. Doudjo Noufou Ouattara and Adama Bakayoko helped with data analysis and the provision of literature to consolidate the discussion.

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Appendix: Survey sheet according to Touré et al. (2018)

Collector information

N°

Collector name..... Collection date.....

Socio-demographic characteristics and constraints

District..... Village/Camp..... Field No..... Name of the respondent ..... Age of producer |__|__| years; Ethnicity .....Level of education 0=none; 1=primary; 2=secondary; 3=higher education |__|

Asked questions

1. What useful plants do you know in your orchard?
2. Which part of the plant do you use and how?
3. Why do you keep these species orchard?
4. Did you or someone else planted it?

N°	Weeds' scientific names	Frequency	Used organs				Use categories	Origin of weeds	
			Fruit	Leave	Root	Stem		Cultivated	Spontaneous
1									
2									
3									
4									
5									
6									
7									