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Multifunctionality and resilience of trees in cocoa-based agroforestry systems in central Côte d'Ivoire

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ABSTRACT: Agroecological approaches promoting healthy and sustainable production cannot succeed without the buy-in of producers. In terms of agroforestry, particularly cocoa-based agroforestry, several models exist in Côte d'Ivoire. These include traditional agroforestry systems that have been identified in several regions, including central Côte d'Ivoire. The motivation of producers in the centre to adopt and sustain these agroforestry systems remains strong despite the low yields observed compared to the national average. This study was conducted to understand how farmers' perceptions of associated trees influence the sustainability of traditional cocoa agroforestry systems. It set out to analyse producers' perceptions of trees, given that their empirical knowledge and cultural perceptions play a key role in the conservation of trees that contribute to the resilience, diversification of uses, and sustainability of cocoa-based agroforestry systems. To this end, ethnobotanical surveys were conducted among 102 producers in the Kokumbo sub-prefecture (central Côte d'Ivoire). These surveys were supplemented by floristic and phyto-ecological data collected on the respondents' plantations. Descriptive and textual analyses of the data collected show that trees are considered an integral part of cocoa plantations. They enable cocoa trees to withstand the long dry season imposed by the climate in this area. The plantation also provides various ecosystem services, as the associated woody species are selected for their beneficial contribution to the cocoa tree and/or the producer. This is the case with *Ricinodendron heudelotii,* a multifunctional tree that, in addition to being used in medicine and as a condiment, is beneficial to cocoa trees. However, the challenges faced by rural households are prompting some producers to turn away from the values they have been taught and increasingly move towards less sustainable full-sun production systems, thereby threatening the local climate balance and the food security of rural households.

KEYWORDS: Agroforestry; Trees; Smallholder know-how; Sustainable production; Côte d'Ivoire.

1 INTRODUCTION

For decades, cocoa agroforestry systems based on local knowledge have been helping to meet the needs of farmers and ecological requirements in Africa [1]. In Côte d'Ivoire, agroforestry has long been presented as a way of reconciling trees and farmers [2], [3]. Indeed, trees, as an essential component of cocoa plantations, play a crucial role that goes far beyond their simple production function. Their perception is shaped by a complex set of economic, ecological and cultural factors. In cocoa plantations, particularly in West Africa and Latin America, cocoa trees are not only sources of income but also central to maintaining biodiversity and regulating ecosystems [4].

Numerous studies have been conducted in central Côte d'Ivoire on the specific richness of cocoa plantations and associated ecosystem services [5], [6], [7], [8]. These studies have shown that introducing trees into cocoa plantations not only helps to preserve and conserve biodiversity, but also provides socio-economic goods and services to local populations. However, the management of these trees involves practices that seek to balance production and conservation, reflecting varied and often conflicting perceptions between economic exploitation and environmental preservation [9]. Given this situation, it is worth considering how to interpret the differences between farmers' and scientists' perceptions of the usefulness of trees in cocoa plantations, given that agroforestry projects implemented by external actors are struggling to achieve their objectives and local farmers' initiatives are poorly integrated into these approaches [10].

In Côte d'Ivoire, where most cocoa is still produced in monoculture systems, the adoption of agroforestry approaches has been observed in several regions, including the Centre [6], [7]. It therefore seems essential to understand producers' perceptions and attitudes towards integrating trees into their cocoa farming systems in order to develop effective strategies to promote the adoption of agroforestry practices. This study examines the perceptions of cocoa producers in central Côte d'Ivoire in order to understand and inform the interactions between producers and the trees they associate with cocoa trees. Specifically, the aim was to:

- inform the factors underlying the choice of associated trees;
- determine the relationships that exist between the producer and the tree;
- identify the constraints faced by producers in the sustainable management of their cocoa plantations.

2 Study Area

This study was conducted in the localities of Niamkey-Konankro and Langossou, which belong to the sub-prefecture of Kokumbo, located in the forest-savannah transition zone in central Côte d'Ivoire, on the western branch of the "V Baoulé", between latitudes 6°19'37.81'" N and 6°34'51.18"' N and longitudes 5°19'58.35'" W and 5°20'02.54"' W [6]. It belongs to the administrative region of Bélier and the department of Toumodi. It is bordered to the north by the sub-prefecture of Toumodi, to the west by the autonomous district of Yamoussoukro and the department of Oumé, and to the east by the department of Djékanou (Fig. 1). In the study area, three types of cocoa agroforestry systems (AFSc) can be distinguished, namely complex AFSc, mixed AFSc and simple AFSc, based on the quality and density of the flora associated with cocoa trees [6], [8], [11].

3 Methodology

3.1 Data Collection

Ethnobotanical surveys were conducted among farm managers based on a questionnaire administered individually to each of them. These surveys aimed to establish the characteristics of their plantations (cultivated varieties, production cycle, soil type, associated tree species, reasons for maintaining the various trees associated with cocoa trees, disease management, etc.) [7], [12]. Farmers were selected based on their individual willingness to contribute to the study. The survey was conducted among 102 cocoa farm managers, 46 in Niamkey-Konankro and 56 in Langossou. The questions focused on the impact of associated species on the development of cocoa trees and their uses [7]. The aim was to identify the species that had been spared and the introduced species that were used in one way or another by farmers and the local population. This identification involved, with the help of the farmer, recording the vernacular name or commonly used name of the species encountered or mentioned during the interviews. On the other hand, the aim was to explain the motivations and reasons for maintaining, introducing or eliminating certain tree species associated with cocoa cultivation.

It should be noted that field observations were made in the plantations to confirm or refute the statements made by the interviewees (condition of the trees, bark samples taken, fruit collected, etc.) concerning the associated tree species. These observations were made during a mobile inventory of the plantations of the producers interviewed.

3.2 Processing Of Ethnobotanical Data

Analysis of the various information collected during the surveys made it possible to first establish the floristic list for each plot, then for each AFSc, resulting in a general floristic list. In addition, interviews and field observations made it possible to classify the different types of use of associated species into broad categories such as food, traditional medicine, timber, etc. Finally, the impact of these associated species in relation to the microclimate, soil and phenology of cocoa trees was recorded.

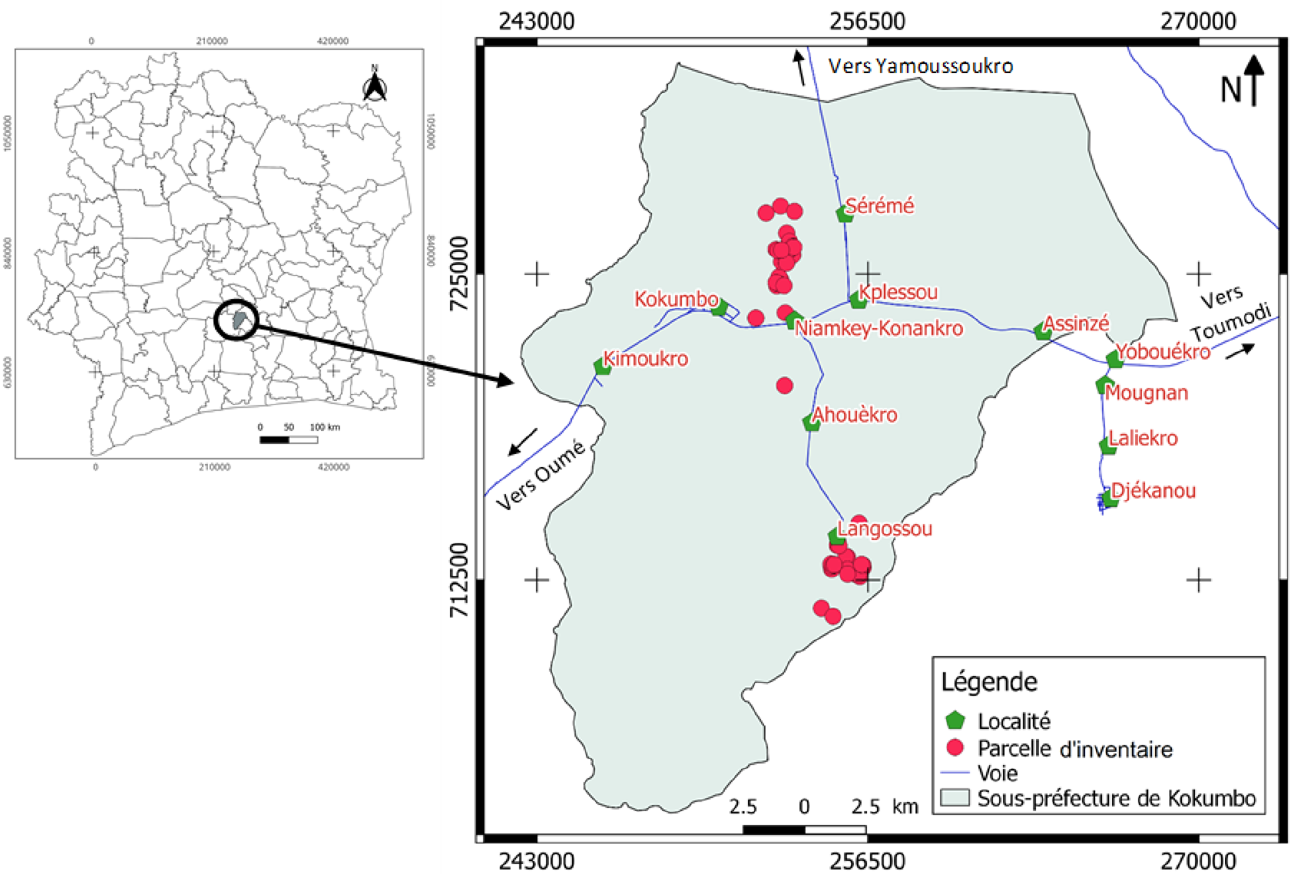

Fig. 1. Map showing the distribution of inventory plots in cocoa plantations in the Kokumbo sub-prefecture

4 RESULTS

4.1 FLORISTIC DIVERSITY

Floristic inventories and ethnobotanical surveys have identified 66 plant species associated with cocoa trees, 52 of which are tree species. The general flora includes 37 introduced species, 23 of which are woody species and 15 herbaceous species. Figure 2A shows that, among the woody species, *Persea americana* (avocado tree) is the most frequently cited woody species (88%), followed by *Citrus sinensis* (orange tree) (61%) and *Mangifera indica* (mango tree) with a percentage of 33%. The most common introduced woody species in the complex AFSc are *Persea americana* (33%), *Mangifera indica* (20%) and *Citrus sinensis* with 13% (Figure 3A). *Crescentia cujete, Citrus limon* and *Psidium gujava* are the least common (10%).

In the mixed CFS, *Persea americana* (25%), *Citrus sinensis* (20%) and *Mangifera indica* (14%) are the most common (Figure 3B). The least common species are *Citrus reticulata, Ricinodendron heudelotii* and *Manihot esculenta* (6% each).

In simple AFSc, the introduced woody species are dominated by *Persea americana* (35%), *C. sinensis* (20%) and *Psidium gujava* with a proportion of 9% (Figure 4). The least introduced species in simple AFSc are *C. reticulata, Gliricidia sepium* and *M. indica* (1% each). With regard to associated non-woody plant species (Figure 2B), the most frequently cited are *Musa paradisiaca* (plantain, cited by 65% of farmers), *Musa sapientum,* sweet banana (60%), *Xanthosoma mafaffa,* taro (21%) and *Elaeis guineensis,* palm (14%).

In complex AFSCs, the most common are *M. paradisiaca* (29%), *M. sapientum* and *X. mafaffa* (21% each), and *E. guineensis* (14%). On the other hand, *Ananas comosus* (pineapple) and *Dioscorea* spp (yam), each cited 7% of the time, are the least associated with it. In mixed AFSc, *X. mafaffa* and *Musa paradisiaca* (23% each), *E. guineensis* (18%), *Carica papaya* (14%) and *Musa sapientum* (9% each) are the most common. The species least associated with cocoa trees are *Ananas comosus, Capsicum* sp and *Dioscorea* sp (5% each).

In simple AFSc, *M. paradisiaca* (28%), *X. mafaffa* (17%), *M. sapientum, E. guineensis* (14% each) and *Dioscorea* sp (11%) are the most associated. The species least associated with it are *Carica papaya, Abelmoschus esculentus* and *Capsicum* sp (3% each).

Thirty-two (32) woody species are spared when the plantation is established (Table 1). The most frequently cited by producers are *Ceiba pentandra,* the kapok tree (Gninh; 44%), *Terminalia superba,* the fraké (Flah; 42%), *Milicia regia,* the iroko (Allah; 31%) and *Alstonia boonei* (Amienh) with 27% (Figure 2). The most commonly spared species in complex AFSc are *Antiaris toxicaria* (15%), *C. pentandra* (13%), *A. boonei* (12%), *M. regia* (10%) and *T. superba* (9%). In mixed AFSc, they are *Ceiba pentandra* (23%), *M. regia* (12%), *Entandrophragma angolense* (10%), *T. superba* and *Triplochiton scleroxylon* (9% each). In the simple AFSc, the most spared species are *Spathodea campanulata* (40%), *C. pentandra* (40%) and *Ficus exasperata* (20%).

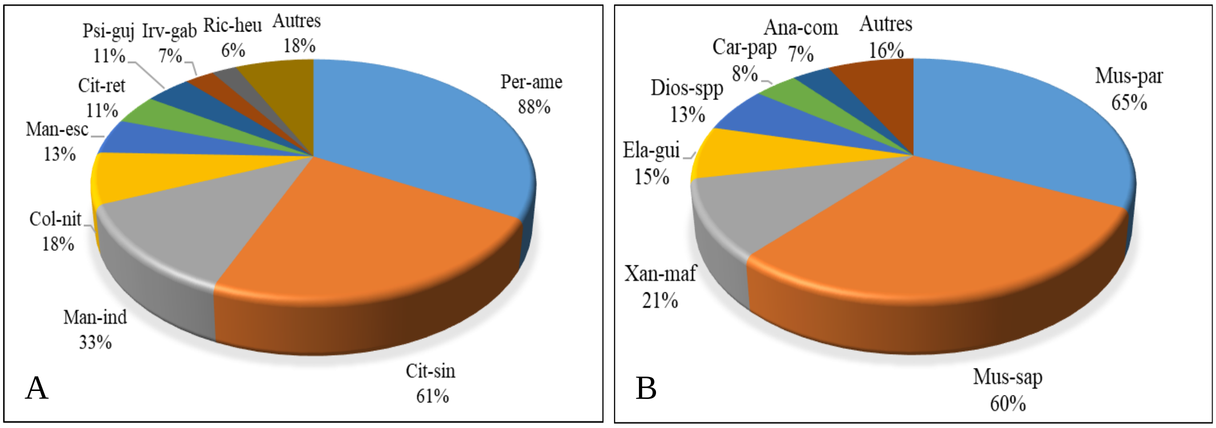

Fig. 2. Distribution diagrams of woody species (A) and herbaceous species (B) spared or introduced into plantations

Ana-com: Ananas comosus; Car-pap: Carica papaya; Cit-ret: Citrus reticulata; Cit-sin: Citrus sinensis; Col-nit; Cola nitida; Irv-gab: Irvingia gabonensis; Dios-spp: Dioscorea sp; Ela-gui: Elaeis guineensis; Man-ind: Mangifera indica; Man-esc: Manihot esculenta; Mus-par: Musa paradisiaca; Mus-sap: Musa sapientum; Per-ame: Persea americana; Psi-guj: Psidium gujava; Ric-heu: Ricinodendron heudelotii; Xan-maf: Xanthosoma mafaffa.

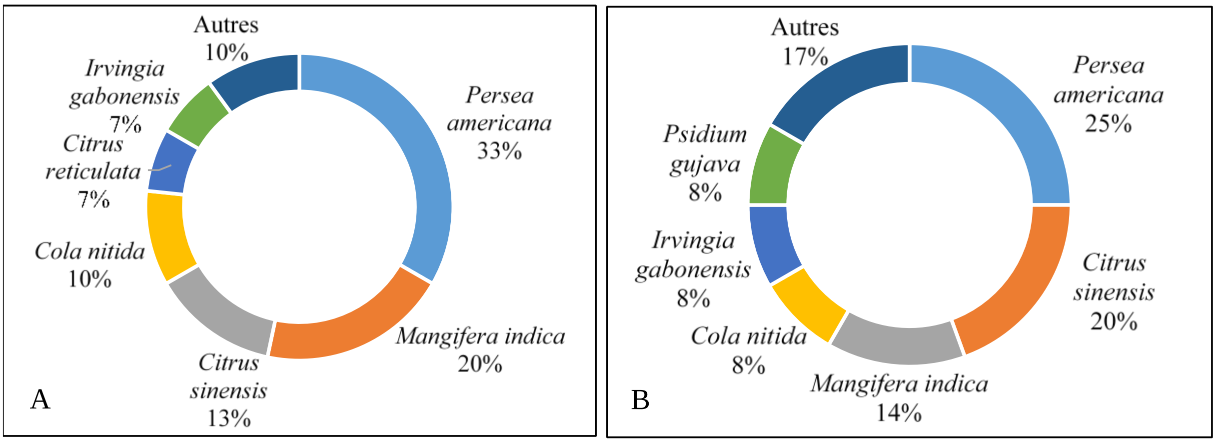

Fig. 3. Distribution spectrum of woody species introduced into the complex AFSc (A) and mixed AFSc (B)

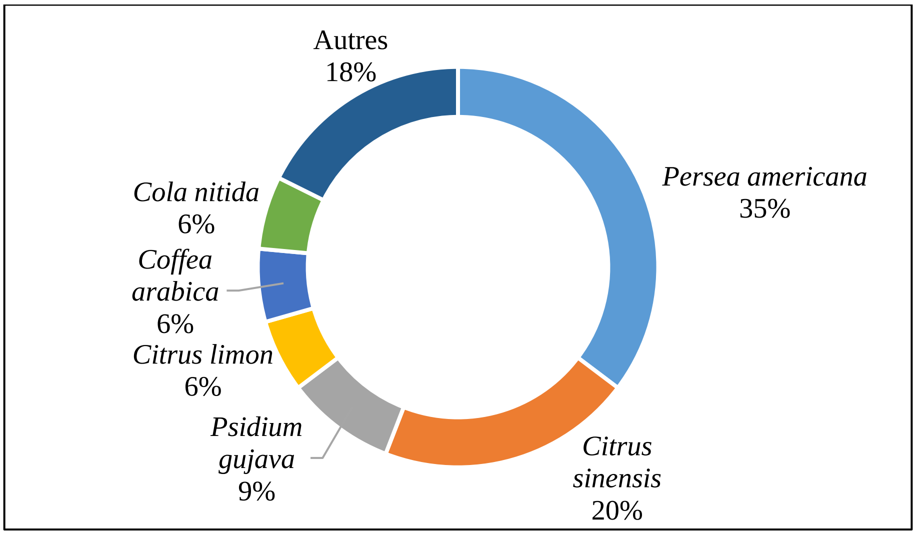

Fig. 4. Distribution spectrum of woody species introduced into the simple AFSc

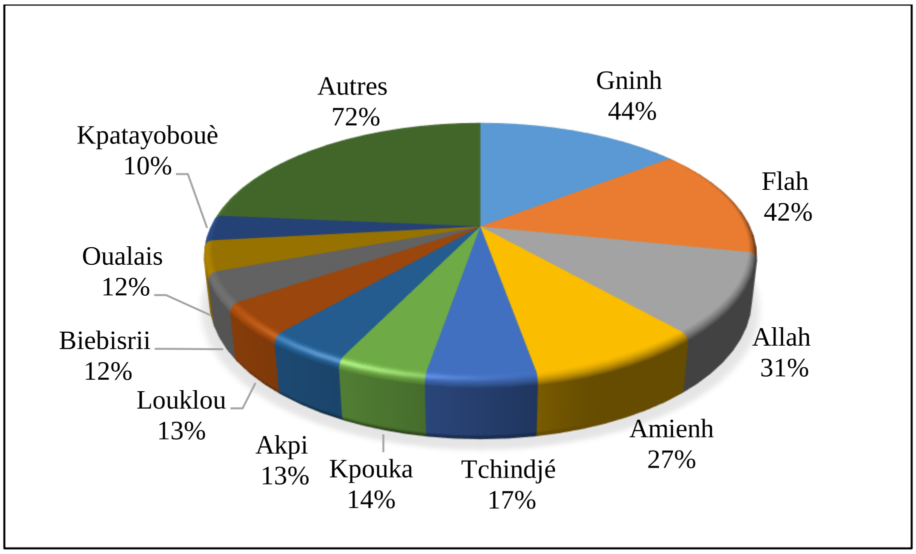

Fig. 5. Diagram showing the distribution of species spared according to their frequency of citation

Gninh: Fromager (Ceiba pentandra); Flah: Fraké (Terminalia superba); Allah: Iroko (Milicia regia); Amienh: Alstonia boonei; Tchindjé: Antiaris toxicaria; Kpouka: Kapokier (Bombax buenoposense); Akpi: Riccinodendron heudelotii; Louklou: Entendrophragma angolense; Biebisri: Spathodea campanulata; Oualais: Cola gigantea; Kpatayobouè: Samba (Triplochiton scleroxylon).

PRODUCERS' PERCEPTION OF TREES

In addition to the universal function of providing shade, which was mentioned by all the producers interviewed, producers associate trees with cocoa trees for various other reasons. Ethnobotanical surveys and floristic inventories have made it possible to group the uses those producers make of the 52 associated tree species into eight categories (Fig.6). Among these species, 26 (50%) are used for medicinal purposes (*Ricinodendron heudelotii, Khaya ivorensis, Morinda lucida,* etc.). Tree species used for food or commercial purposes (their fruits) come in second place with 23 species (44%). Species used for cultural purposes and those used as fuelwood are the least represented, with 1 (2%) and 4 (8%) species respectively.

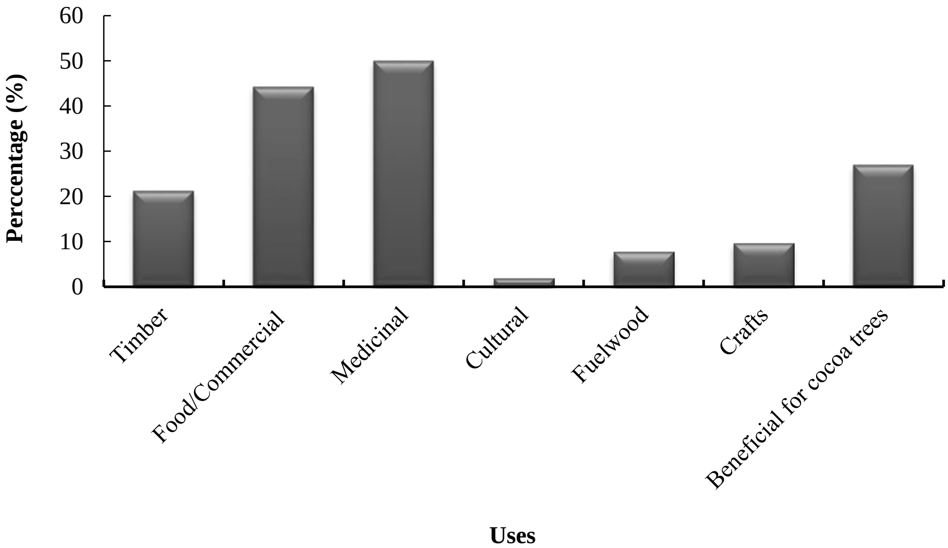

Fig. 6. Distribution of tree species according to producers' uses

Trees associated with cocoa trees may have no use, one or more uses, in addition to their function as shade trees. Thus, 28 tree species (53.85%) are used for at least two purposes by producers, 18 (34.62%) are used for a single purpose, and 6 species (11.54%) are not used for any purpose (Figure 7). There are a large number of species with two uses (21, or 40.38%) compared to the other categories. These include species such as *Newbouldia laevis* (beneficial to cocoa trees and used for medicinal purposes) and *Khaya ivorenis* (a timber species with medicinal uses). Tree species with a single use come next, with a total of 18 species (34.62%), including *Terminalia superba* (timber), *Spondias mombin* (food) and *Rauvolfia vomitoria* (medicinal). Trees with three uses (five species), four uses (one species) and five uses (one species) are the least represented. For example, Mangifera indica has three uses: food or commercial, medicinal and fuel wood. *Ricinodrendon heudelotii* (Akpi) is a multifunctional tree with four uses: food, timber, food/commercial and beneficial to cocoa trees. The greatest number of uses (5) is attributed to the kapok tree, *Ceiba pentandra* (food, timber, medicinal, firewood and beneficial to cocoa trees).

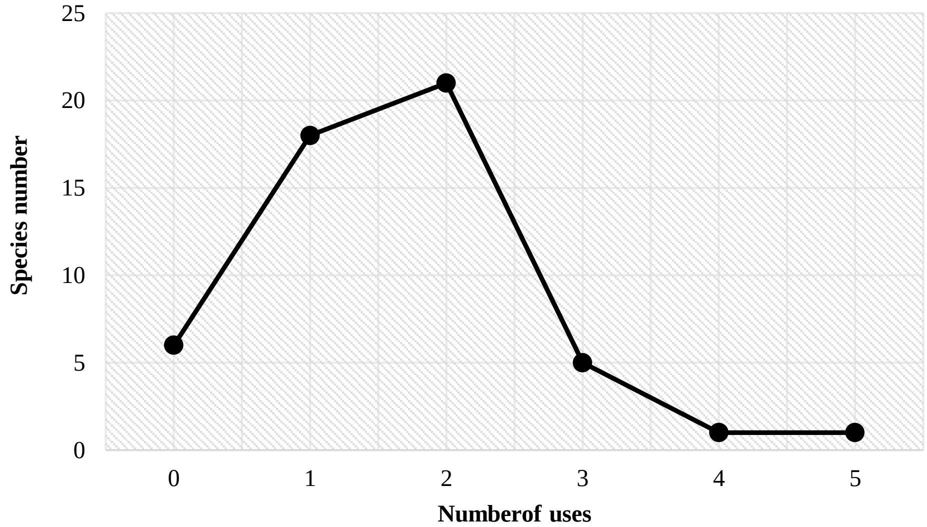

Fig. 7. Distribution of tree species according to the number of uses

5 Discussion

The results showed that, in managing their plantations, farmers generally save and introduce woody plants as well as banana and papaya trees. All of this is done according to the farmers' perceptions and their uses of these species. This situation has already been described by [6], [12] and [7], who noted that farmers' management of agroforestry systems includes the maintenance, introduction or elimination of various local or exotic species. The density of planted species differs depending on the type of AFSc but retains the same function, which is to meet the family's food needs and, where possible, to sell any surplus produce [13], [14]. The species spared in AFSc are generally local species found mainly in complex and mixed AFSc. Unlike most planted species, the species spared fulfil several needs of farmers, including part of their food requirements, in addition to their basic function of providing shade for the cocoa trees [7]. Thus, the complex AFSc differs from other SAFs in its age, the cocoa variety (Amelonado, which is a Low Amazonian Forastero) and the quantity and quality of the woody species found there. Indeed, plantations in this system are generally more than thirty years old and contain an abundance and wide diversity of local species such as *Ceiba pentandra* (kapok tree), *Milicia regia* (iroko) and *Khaya ivorensis* (mahogany). Farmers believe that these species can promote cocoa production or be used for various other purposes. The trees in the strata above the cocoa trees are dense and form a closed canopy. In simple AFSc, farmers have gradually removed the trees in order to increase their production [15] or because they considered them harmful to the production of their cocoa plantations. According to [16], native trees from natural forests are better shade trees than fruit trees introduced by farmers to reduce the incidence of pests such as moniliosis in Costa Rica and mirid density in Cameroon. Mixed AFSCs fall between these two types of systems and are characterised by a low density of local species compared to complex AFSCs, a high density of exotic species and an open canopy. These local species are the same as those found in complex AFSCs and are located in the first and second strata above the cocoa trees.

The maintenance of cocoa agroforestry systems or their tendency towards 'full sun' cocoa plantations depends on production objectives and farmers' perceptions and knowledge of the species associated with cocoa trees. Indeed, species considered beneficial to cocoa trees by most farmers are disparaged or considered of no major interest by other farmers. Among the latter, three categories stand out. The first includes those who would like to eliminate them. Their arguments are that these trees are reservoirs of disease for cocoa trees and harbour rodents, particularly squirrels. These views are shared by [15], who argue that the humidity caused by species associated with cocoa trees increases the risk of certain cocoa tree diseases. In addition, high levels of rodent activity damaging the pods have been observed in cocoa plantations with trees growing within or near them. Furthermore, according to some farmers, certain species have a negative impact on the soil and therefore on the nutrition of the cocoa tree. This is the case with *Nesogordonia papaverifera* and *Albizia adianthifolia,* which some producers are considering eliminating because these species dry out the soil around them. For all these reasons, some farmers have tried to eliminate them by burning them or making circular cuts in the bark at the base of the stem, but without success. Others plan to remove them by calling in forestry operators and their chainsaws. The second category includes farmers for whom the influence of associated trees on cocoa trees is of little importance. For some farmers in this category, these trees were spared by the parents from whom they inherited the plantation. They have therefore decided to keep them in turn, but they do not rule out the possibility of exploiting them for timber if necessary or if they need money. For others, they are simply responding to the certification requirements that have been piloted for a decade by several non-governmental organisations such as Rainforest Alliance and UTZ [17], [18]. Compliance with the environmental, ethical and good agricultural practice standards required for certification of their production enables farmers to earn an additional 50 francs CFA per kilogram of dry beans. Among these environmental standards is the requirement for farmers to preserve between 18 and 25 trees per hectare of cocoa plantation. However, these NGOs, along with the CNRA and ANADER, recommend carefully selecting the tree species that will coexist with the cocoa trees [19]. For the Fairtrade Platform (CE, a cocoa certification body), the ideal solution would be to combine cocoa trees with different species that share certain characteristics. These include species that provide light shade, have the ability to draw water from deep layers of the soil, can maintain sufficient humidity for nearby cocoa trees during the dry season through transpiration, and can attract and harbour beneficial insects capable of neutralising mirids and other pests. With this in mind, certification bodies such as the CE encourage the combination of certain forest species such as *Terminalia superba, Terminalia ivorensis,* Milicia Regia and *Ricinodendron heudelotii* for their fertilising effect [19]. Among the species recommended by the CE is, for example, iroko (*Milicia regia*), a species listed by the CNRA as a natural reservoir of swollen shoot (a viral disease of the cocoa tree [20]. Other species such as kapok, *spondias mombin, Cola nitida, Carica papaya* and *Citrus sinensis* (orange tree), most of which are frequently found in the plantations visited, are on the list of species hosting swollen shoot. For this reason, the CNRA advises their removal from cocoa plantations, a recommendation that not all farmers agree with. This is evidenced by the fact that kapok, iroko and orange trees are among the woody species most spared or planted in plantations in the sub-prefecture of Kokumbo. Work carried out by [21] in Nigeria has shown that *Cola nitida* and *Persea americana* attract mirids and promote the proliferation of brown rot. On the other hand, [22] showed that in Cameroon, their presence limits the number of mirids in plantations. Thus, some species considered harmful by certification and farmer support organisations may prove beneficial to cocoa trees, while other species considered beneficial may prove harmful. The kapok tree, for example, plays a very important role in the practices of producers in the region because, like other multifunctional species such as *Ricinodendron heudelotii* and *Alstonia boonei,* it is considered beneficial to cocoa trees by creating a humid microclimate that benefits them during the dry season. Its young leaves are also consumed by some producers as part of their diet, and it is used as timber. However, keeping trees on plantations for later use as timber provides a financial reserve for farmers. Fearing that certain cocoa trees may be damaged by falling trees, a final category of farmers is forced to come to terms with the trees present on their plantations. Cutting down these large-diameter, tall trees would cause considerable damage to the plantation, as each lost pod represents a loss of income for the farmer.

6 Conclusion

This work, carried out in central Côte d'Ivoire, aimed to understand farmers' perceptions of trees in cocoa-based agroforestry systems. The study focused on the influence of associated species on the development of cocoa trees and their uses. The results showed that producers exploit 52 tree species, relying on empirical skills to manage their farms. The study also grouped associated species into different types of use, the most prevalent being medicinal use, which accounts for 50% of the species identified.

In managing their plantations, producers preserve and introduce local and/or exotic species based on their perceptions and uses of these species. Thus, agroforestry systems involve the maintenance, introduction or elimination of various species, depending on the type of agroforestry adopted. Although the density of plant species varies according to the type of system adopted, all have the same objective, which is to meet the financial, health and nutritional needs of the family. The maintenance of agroforestry systems in the study area remains linked to the production objectives, perceptions and knowledge of farmers. Support for these producers by the structures involved in promoting cocoa cultivation would increase their income and food security by reconciling new agroecological approaches with the empirical knowledge of local producers.

References

[1] K. K. M. Adingra, V-P. G. Kouadio and F. Tra, «Détermination d'un profil agroforestier local à base de cacaoyers dans les environs de Kokumbo au Centre de la Côte d'Ivoire». *European Scientific Journal,* vol. 16, no. 6, pp. 542-556, 2020.

[2] O. F. Ruf an H. Zadi, «Cocoa: from deforestation to reforestation». First International Workshop on sustainable cocoa growing. Smithsonian Institute, Panama. 1988.

[3] F. Verdeaux and A. Alpha, «L'économie très politique d'une mise en valeur des ressources forestières: Côte d'Ivoire, 1900-1990», *Autre part,* vol. 9, pp. 33-51, 1999.

[4] R. Vignola, C. A. Harvey, P. Bautista-Solis, J. Avelino, B. Rapidel, C. Donatti and R. Martinez, «Ecosystem-based adaptation for smallholder farmers: Definitions, opportunities and constraints». *Agriculture, Ecosystems & Environment,* vol. 211, pp. 126-132, 2015.

[5] E. Smith-Dumont, G. M. Gnahoua, L. Ohouo, F. L. Sinclair and P. Vaast, «Farmers in Côte d'Ivoire value integrating tree diversity in cocoa for the provision of ecosystem services.» *Agroforestry Systems,* vol. 88, no. 6, pp. 1047-1066, 2014.

[6] K. B. Kpangui, D. Kouamé, B. Z. B. Gone, B. T. A. Vroh, B. J.-C. Koffi and C. Y. Adou Yao, «Typology of cocoa-based agroforestry systems in a forest-savannah transition zone: case study of Kokumbo (Centre, Côte d'Ivoire) ». *International Journal of Agronomy and Agricultural Research.* Vol. 6, no. 3, pp. 36–47, 2015.

[7] C. Y. Adou Yao, K. B. Kpangui, B. T. A. Vroh, D. Ouattara, «Pratiques culturales, valeurs d'usage et perception des paysans des espèces compagnes du cacaoyer dans des agroforêts traditionnelles au centre de la Côte d'Ivoire.» *Revue D'ethnoécologie,* 2016. http://ethnoecologie.revues.org/2474.

[8] V.-P. G. Kouadio, B. T. A. Vroh, K. B. Kpangui, A. S. F. Kossonou and C. Y. Adou Yao, «Incidence de l'ombrage sur les caractères phénotypiques du cacaoyer en zone de transition forêt-savane au centre de la Côte d'Ivoire.» *Cahiers Agricultures,* vol. 27, no. 5, pp. 1–12, 2018. doi: 10.1051/cagri/2018031.

[9] E. V. Dormon, A. Van Huis, C. Leeuwis, D. Obeng-Ofori and O. Sakyi-Dawson, «Causes of low productivity of cocoa in Ghana: farmers' perspectives and insights from research and the socio-political establishment.» *NJAS: Wageningen Journal of Life Sciences,* vol. *52, no.* 3-4, pp. 237-259, 2004.

[10] O. F. Ruf and A. Konan, «Le cacao aux portes d'Abidjan: de la forêt à la décharge publique. Traques et caches des innovations villageoises.» *Paris: Inter réseaux développement rural,* 14 p.

[11] V.-P. G. Kouadio, A. S. F. Kossonou, N. L. Diby, K. K. M. Adingra, and C. Y. Adou Yao, «Socio-economic assessment of different cocoa agroforestry systems in the forest-Savannah transition zone in central Côte d'Ivoire.» *Forests, Trees and Livelihoods,* vol. 30, no. 3, pp. 195-212, 2021. doi: https://doi.org/10.1080/14728028.2021.1958064.

[12] A. Cissé, J. C. K. Aka, D. Kouamé, B. T. A. Vroh, C. Y. Adou Yao and K. E. N'Guessan, «Caractérisation des pratiques agroforestières à base de cacaoyers en zone de forêt dense semi-décidue: cas de la localité de Lakota (Centre-Ouest, Cote d'Ivoire).» *European Scientific Journal,* vol. 12, no. 21, pp. 50-69, 2016.

[13] Sonwa, D. J., Weise, S. F., Tchatat, M., Nkongmeneck, B. A., Adesina, A. A., Ndoye, O. & Gockowski, J., *Rôle des agroforêts à cacao dans la foresterie paysanne et communautaire au sud-Cameroun*. Document RDFN, vol. 25, no. 1, 12 p, 2001.

[14] E. Périchon and R. Quique, «L'agroforesterie du cacao est-elle menacée dans le Soconusco ? Évaluation des savoirs paysans de sélection des semences et caractérisation de la diversité arborée (Chiapas, Mexique),», *Norois,* vol. 226, no. 1, pp. 79-89, 2013.

[15] J. E. Tondoh, N. F. Kouamé, A. Martinez, A. M. Guéi, B. Sey, A. W. Koné and N. Gnessougou, «Ecological changes induced by full-sun cocoa farming in Côte d'Ivoire.» *Global Ecology and Conservation,* vol. 3, pp. 575-595, 2015.

[16] Gidoin C., Relations entre structure du peuplement végétal et bioagresseurs dans les agroforêts à cacaoyers. Application à trois bioagresseurs du cacaoyer: la moniliose au Costa Rica, la pourriture brune et les mirides au Cameroun. Thèse de Doctorat, Supagro, Montpellier, France, 210 p, 2013.

[17] K. K. M. Adingra, «Pratiques agroforestières à base de cacao paysannes: étude de cas aux environs de Kokumbo, dans le Département de Djékanou au Centre de la Côte d'Ivoire» Mémoire de master, UFR Sciences de L'homme et de la Société, Université Félix Houphouët- Boigny, Abidjan, Côte d'Ivoire, 86 p, 2014.

[18] Sanial E., A la recherche de l'ombre: analyse du retour des arbres associés dans les plantations de cacao ivoiriennes. Mémoire de Master Interface Nature Société, Université Jean Moulin Lyon3, 203 p, 2015.

[19] Dufumier M., L'adaptation de la cacaoculture ivoirienne au dérèglement climatique: L'agroécologie pourrait-elle être une solution ? Rapport de mission, Plate-forme pour le Commerce Équitable. 16 p, 2016.

[20] Kébé B. I., N'Guessan K. F., Assiri A. A., Tahi G. M., N'Guessan W. P., Aka A. R. & Kouakou K., *Bien lutter contre la maladie du swollen shoot du cacaoyer en Côte d'Ivoire.* Fiche cacaoyer n°4, Centre National de Recherche Agronomique (CNRA) - CTA, DRSAD & DISI, 4 p, 2016.

[21] M. A. O. Oladokun and N. E. Egbé, «Yields of Cocoa/kola Intercrops in Nigeria.» *Agroforestry Systems,* vol. 10, pp. 153-60, 1990.

[22] R. Babin, H. G. M. Ten, C. Cilas, F. Enjalric, G. P. Yédé and J. P. Lumaret, «Impact of shade on the spatial distribution of Sahlbergella singularis in traditional cocoa agroforests.» *Agricultural and Forest Entomology,* vol. 12, no. 1, pp. 69-79, 2010.