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Phytodiversity and structure of the woody flora of cocoa, coffee and cashew agrosystems in the peri-urban area of Daloa (Centre-West, Côte d'Ivoire)

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Abstract

Since independence in 1960, Côte d'Ivoire has based its economy mainly on export agriculture (cocoa, coffee, rubber, oil palm, cashew nuts, etc.). However, the development of these crops is considered the main cause of forest cover degradation. In Daloa (Centre-West), a comparative study of the phytodiversity and structure of cocoa, coffee and cashew agrosystems was conducted in order to optimize and intensify production systems in a sustainable manner. The objective is to characterize the cocoa, coffee and cashew agrosystems of Daloa in order to put in place a strategy for the sustainable management and intensification of cash crops. Surface and itinerant inventories on the one hand, and dendrometric measurements on the other, were carried out in order to collect floristic data and illustrate the structure of the agrosystems. Floristically, 54 species (43 genera, 26 families) in cocoa, 48 species (38 genera, 22 families) in coffee and 45 species (41 genera, 21 families) in cashew were recorded. Mimosaceae, Moraceae and Euphorbiaceae dominated all agrosystems and microphanerophytes dominated the biological types. Taxa from the guinean-congolian zone were the most important chorological affinities. Floristically, cocoa agrosystem was the most diverse. Furthermore, a good distribution of individuals within plant species constituting the agrosystems was noted. Also, a similarity was observed between all agrosystems, especially between cocoa-coffee and cashew agrosystems. In the structural organisation, shrubs from introduced species and large diameter individuals dominated vertical and horizontal structure of the agrosystems respectively. In Daloa, the perennial agrosystems can allow the constitution of the forest.

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Introduction

Since independence, Côte d'Ivoire's economic performance has been driven by exports from the agricultural sector (Essola, 2009). As agricultural production of coffee, cocoa and cashew nuts has grown, so has the revenue from commodity exports. Coffee, which for many years was the main cash crop in Côte d'Ivoire, has seen a decline in production since 1980. This decline is due to a number of reasons, including the ageing of the orchard, the decline in field prices, insufficient labour and the predominance of cocoa cultivation (Koua 2007). Despite this, coffee still represented 1.4% of ivorian exports in 2014-2015. Cocoa cultivation has a prominent place in Ivorian's economy. Economically, cocoa contributes more than 15% to GDP and provides more than 50% of export earnings (ICCO, 2015; Dufumier, 2016). Estimated at 410,000 tonnes between 1983 and 1984, production reached 2,100,473 tonnes between 2019 and 2020, i.e. almost 43% of world supply. Cocoa farming employs more than one million farmers, i.e. 15% of the rural population. Socially, around 600,000 farm managers provide a living for nearly 6 million people. Since 1978, Côte d'Ivoire has been the world's leading producer and exporter of cocoa beans (Oro, 2011). Cashew nut cultivation has developed spontaneously in Côte d'Ivoire and ranks first in the world among raw cashew nut producers and exporters, ahead of India and Brazil. In 2017, production was estimated at 711,000 tonnes (Kouassi, 2017). In recent years, cashew production has grown significantly in line with the increasing demand of the world market (Koulibaly, 2016). Despite this high production, yields in Ivorian orchards remain low. These yields vary between 350 and 500kg/ha compared to 2 t/ha for countries like India, Vietnam and Brazil. This situation is due to the use of unimproved plant material, still traditional production techniques and, above all, to the persistence of phytosanitary problems, particularly insect pest attacks (Viana *et al.*, 2007).

However, these important socio-economic gains linked to the development of these three crops should not make us lose sight of the many environmental problems, including a significant loss of forest area and biodiversity (Koulibaly, 2008; Goetze *et al.*, 2010). In Côte d'Ivoire, studies have revealed that a large part of the loss of biodiversity is due to agriculture (Dro *et al.*, 2013; Kpangui, 2015, Koulibaly, 2019). Indeed, from 16 million hectares of forest in 1960, the area has rapidly declined to 2.97 million hectares today (Kassoum, 2018). Yet forest products are an important natural resource in the daily lives of the population, providing food, medicine, energy, timber and various other products (Koulibaly, 2008). According to Bationo (2012), forest products play an important role in the daily life of local populations.

In order to cope with this galloping loss of natural resources, farmers generally preserve and introduce into their plantations certain species that are useful to them. This association of cash crops with other plant species is an excellent compromise between biodiversity conservation and poverty alleviation in tropical regions (Bhagwat *et al.*, 2008). These systems, depending on their level of complexity (floristic and/or structural), offer a diversity of habitats on which the main crop, associated crops and populations directly depend (Ruf and Schroth, 2004; Deheuvels *et al.*, 2011).

Faced with increasing anthropogenic pressures on forest areas, leading to the rarefaction or disappearance of vulnerable species, agrosystems could make a considerable contribution to biodiversity conservation. However, the woody flora of cocoa, coffee and cashew agrosystems have been little studied in the Daloa department.

The objective of this work is to compare and characterize floristic and structural characteristics of cocoa, coffee and cashew agroforestry systems in the peri-urban area of Daloa in order to implement a strategy for the sustainable management and intensification of cash crops. Specifically, it was necessary to, (1) determine the woody phytodiversity of the cocoa, coffee and cashew agrosystems and (2) identify the structural characteristics of the associated woody species in these different agrosystems.

Material and methods

Description of the study site

This study was carried out in Dérahouan and Zepreguhé, two villages in the peri-urban area of Daloa located in Haut-Sassandra region (central-western, Côte d'Ivoire). This region, located between 6°53' North Latitude and 6°27' Longitude, is characterized by dense forest vegetation with a regressive evolution and a high rainfall exceeding 1500mm (Fig. 1). The average annual temperature is 26°C (Koffié-Bikpo and Kra, 2013). The relief is made up of plateaus with an altitude of 200 to 400m (Avenard, 1971). Hydrographically, the region is influenced by the Sassandra river and its tributaries (the Lobo and the Davo) and the Buyo dam lake (Koffié-bikpo *et al*, 2013). The soil is of ferralitic type of granitic origin with low denaturation (Perraud, 1971; Lecomte, 1990).

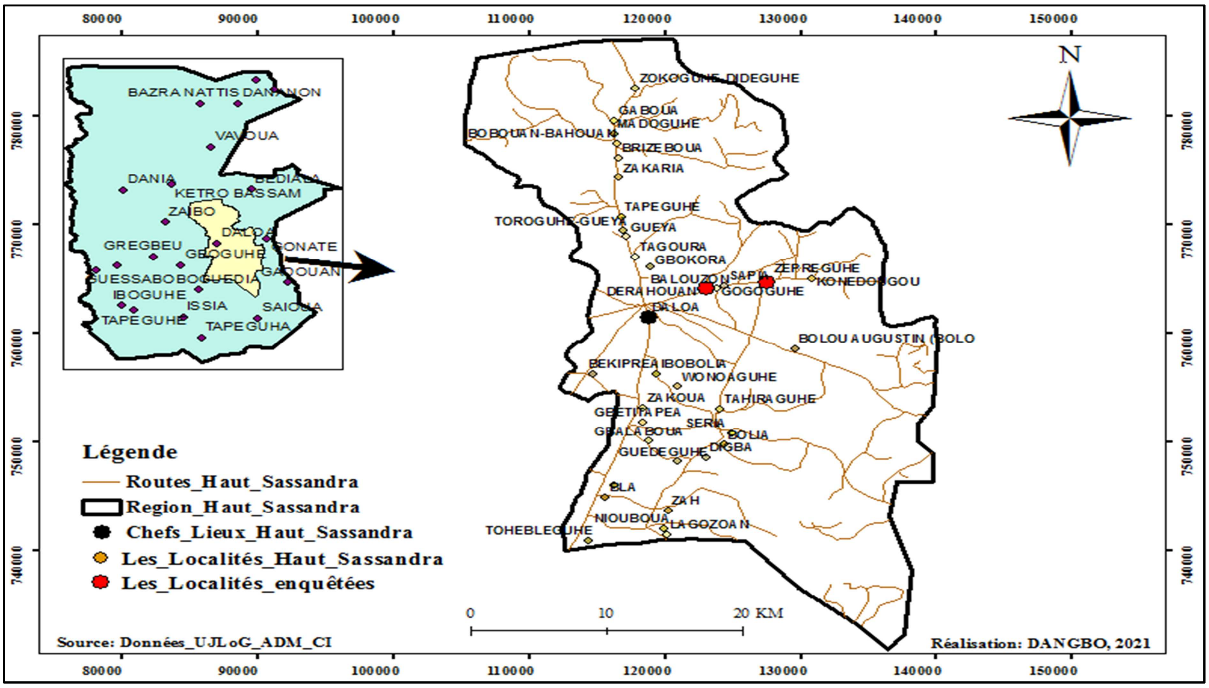

Fig. 1. Localization of study of zone.

Methods of data collection

Inventory of associated woody flora

Area and roving survey methods were used as an inventory technique to collect floristic data from agrosystems. Dendrometric measurements of height and diameter were made to collect stand structure. To do this, square plots of 20m x 20m (400m²) were randomly placed within a one-hectare area delimited in each of the cocoa, coffee and cashew agrosystems. Three plantations of at least one hectare each in each agrosystem were surveyed. Thus, 18 plots were set up in each of the two peri-urban sites, nine in Dérahouan and nine others in Zépréguhé. In each plot of 400 m², all woody species other than the main crop were inventoried. This method has been used by many authors including Koulibaly (2008) and Konan (2009). Species not identified in the field were collected for determination using the works of Lebrun and Stork (1995; 1997).

Dendrometric measurements

The dendrometric data concerned the height and girth of all woody individuals other than cocoa, cashew and coffee. Thus, all trees taller than 1.50 m were measured. Circumference was measured with a tape measure placed at 1.30 m from the ground or above the buttresses in a plane perpendicular to the main stem axis. The total height was measured with a 9.30 m measuring pole from the ground to the last buds.

Methods of data analysis

Qualitative analysis of the flora of agrosystems

The qualitative floristic analysis (family, genus, species, phytogeographical affinities, biological type) was carried out on the basis of the synthesis of the floristic lists of the inventories. The biological types were assigned to Raunkiaer (1934). Phytogeographical affinities were referred to Aké-Assi (2002).

Quantitative analysis of flora of agrosystems

The quantitative analysis was carried out by calculating the Shannon-weaver (1948), Pielou (1966) and sørensen (1948) equitability indices. The shannon index (*H'*) measures the species composition of a stand. For a better appreciation of floristic diversity, the calculation of the Shannon index is accompanied by Pielou's equitability (E) (Marcon, 2015). This index gives an idea of the homogeneous distribution of species in the different surveys. It combines the relative abundance of species and the total species richness (Loubier, 2001). The Shannon index was calculated according to the following mathematical formula:

$$H' = -\sum_{i=1}^{s} \mathrm{Pi}\ln\left(\frac{n_i}{N}\right)$$

With ni, abundance (number or density of plants) of species i and N, total abundance in the unit.

This index varies according to the number of species present. It is higher when a large number of species are involved in the land cover. It takes into account not only the number of species but also the distribution of individuals within these species.

The Pielou equitability Index describes the distribution of individuals among different species in a stand (Wala *et al.*, 2005). Its formula is as follows:

$$E = \frac{H'}{\ln(S)}$$

With S, total number of species in the unit.

It varies between 0 and 1. It tends towards 0 when almost all the individuals correspond to a single species in the given environment. It tends towards 1 when all species tend to be represented by the same number of individuals. These indices have been used by several authors including Vroh *et al.* (2015). The coefficient of similarity was evaluated to characterize the degree of similarity of the species lists from different agrosystems with the formula of Sørensen (1948) defined by:

$$Ks = \frac{2C}{(A+B)} \times 100$$

Where A and B are the respective numbers of species in the two lists and C is the number of species common to both lists. If Ks = 0%, the two environments have no species in common. If Ks = 50%, half of their species list is similar. If Ks = 100%, all species in the two environments are identical.

Analysis of structure of the associated agrosystem stand

The analysis of the structure was carried out on the basis of the distribution of species in height and diameter classes, with reference to Koulibaly *et al.* (2010). Thus, four height classes and four diameter classes were selected. These are as follows:

- for height classes: HC1 =] 2-4 m [; HC2 = [4-8 m [; HC3 = [8-12 m [and HC4 > 12 m;
- for diameter classes: DC1 < 5cm ; DC2 = [5-10cm [; DC3 = [10-20cm [; DC4 > 20cm.

Statistical analysis method

To compare the diversity (Shannon and Pielou index) and number of individuals in the diameter and height classes of different agrosystems, one-factor analysis of variance tests (ANOVA 1) were performed. When a significant difference is observed between the means for a given parameter, Fisher's test at the 5% significance level is performed to identify the homogeneous classes (Dagnelie, 1980). STATISTICA software version 7.1 was used for the analysis of variance (ANOVA) test. In order to determine the floristic diversity of the different agrosystems (cocoa, coffee, cashew), a Correspondence Factorial Analysis (CFA) was coupled with a Hierarchical Ascending Classification (HAC) based on the abundance of species found in these types of agrosystems. The AFC made it possible to group together the types of agrosystems and the species. The CFA, which complements the HAC, was used to classify the different groups in order to highlight the similarity between the groups obtained. These analyses were carried out using R studio software version 3.6.3.

Results

Floristic composition of agrosystems

In cocoa agrosystems, 54 species were inventoried. These species belonged to 43 genera and 26 families. In these agrosystems, the dominant families in terms of number of species were Mimosaceae (15%), Moraceae (8%) and Sterculaceae with 7% (Fig. 2A). In the coffee agrosystems 48 species were recorded. These species came from 38 genera and 22 families. The predominant families were Moraceae and Euphorbiaceae with respectively 11% and 8% of species encountered (Fig. 2B).

In cashew agrosystems, the inventory recorded 45 species from 41 genera and 21 families. The main families were Mimosaceae (14%), Moraceaes and Sterculaceae with 9% each (Fig. 2C).

Species found in all three types of agrosystems were presented under four biological types which are Microphanerophytes, Mesophanerophytes, Megaphanerophytes and Nanophanerophytes (Fig. 3). Microphanerophytes were the most dominant in number of species in all agrosystems with 52% for cocoa agrosystem (Fig. 3 A), 50% for coffee agrosystem (Fig. 3B) and 46% for cashew agrosystem (Fig. 3 C).

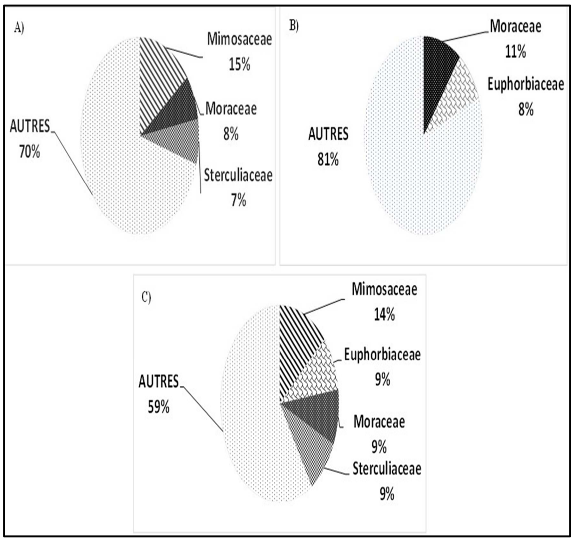

Fig. 2. Spectrum of dominant families of different agrosystems.

A-agrosystem cacao-tree, B-agrosystem coffee-tree, C-agrosystem cashew tree; Autres-Others

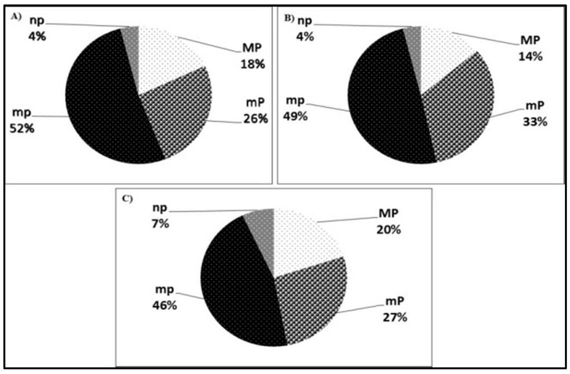

Fig. 3. Biological types of different agrosystems.

A- cacao-tree agrosystem, B- coffee-tree agrosystem, C- cashew tree agrosystem; NP-Nanophanerophyte; mp-Microphanerophyte; MP - Mesophanerophyte; MP-Megaphanérophyte;; Lmp(mp)- lianescent Microphanerophyte (Microphanerophyte); LmP- lianescent Mesophanerophytes

Regarding phytogeographical affinities, taxa from the guinean-congolese regions were the most distributed in all agrosystems with 48% each of the species in cocoa and coffee agrosystems (Fig. 4 A and B) and 45% for cashew agrosystem (Fig. 4C). In all agrosystems, taxa from the Sudan-Zambia regions were the least represented with respectively 4% for cocoa (Fig. 4A), 2% for coffee (Fig. 4B) and 5% for cashew (Fig. 4C).

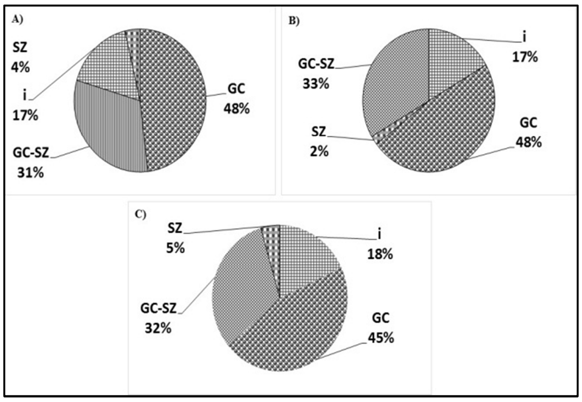

Fig. 4. Phytogeographical distribution of the different agrosystems.

A- cacao-tree agrosystem, B- coffee-tree agrosystem, C- cashew tree agrosystem; GC-SZ- Taxon of the transition zone between the Guineo-Congolese region and the Sudano-Zambezi region;Gc- Taxon of the guineo-congolese region; SZ-Taxon of the Sudano-Zambezi region ; i- introduced or cultivated taxon.

Floristic diversity in agrosystems

Across all agrosystems, the mean value of the calculated Shannon index was 2.17. The Shannon indices varied from one agrosystem to another. The highest index was recorded in cocoa agrosystem *(H'* = 2.39). The lowest index was observed in cashew agrosystem (*H'* = 2.02). Across agrosystems, there was a significant difference between the Shannon indices (*P= 0.0101; chi-squared = 9.1898*; Fig.5). In the same agrosystems, the mean value of the Pielou equitability index reached 0.96 (Fig. 6). The cashew agrosystem had the highest value (0.97) while cocoa and coffee agrosystems had the lowest indices with 0.96 each. Unlike Shannon indices, Pielou indices did not differ significantly between agrosystems (*P = 0.8099; chi-squared = 0.42178*). The values of Sørensen's indices calculated through the comparison of the woody stands taken in pairs made it possible to note similarities between the agrosystems. The similarity is higher between cocoa and cashew agrosystems (Ks = 78.00) and between cocoa and coffee agrosystems (*Ks = 71.15*). It is lower between coffee and cashew agrosystems (*Ks* = 53.19; Table 1).

Tableau 1. Indices de similarité entre les différents agrosystèmes.

Type oosystem	Cocoa	Cafee	Cashew
Cocoa	-		
Cafee	71,15	-	
cashew	78,00	53,19	-

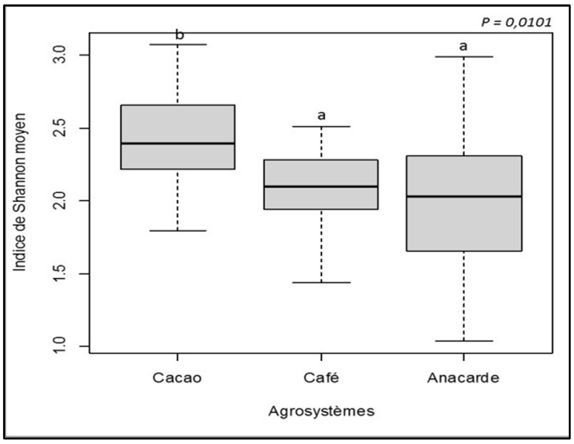

Fig. 5. Variation in the diversity of different the agrosystems.

Means assigned the same letter are not significantly different at 5% level; Indice de Shannon moyen-Average Shannon Index ; Cacao-Cocoa ; Café-coffee ; Anacarde- cashew tree

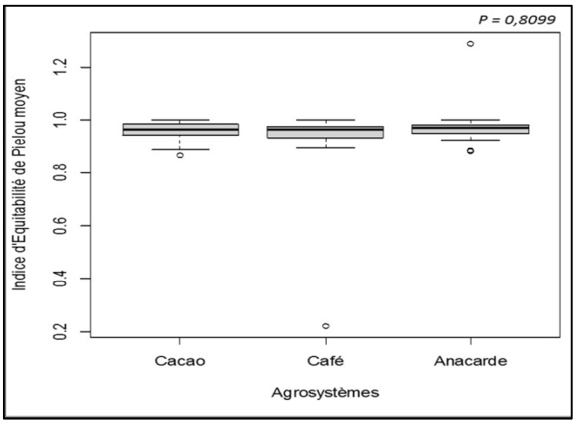

Fig. 6. Variation of the Pielou Equitability indices of the different agrosystems.

Means assigned the same letter are not significantly different at 5% level; A- cacao-tree agrosystem, B- coffee-tree agrosystem, C- cashew tree agrosystem

Analysis of vertical and horizontal structures of agrosystems

The analysis of vertical structure showed that each height class contained individuals. In all agrosystems, the average density reached 116 stems/ha in cocoa, 78 stems/ha in coffee and 73 stems/ha in cashew (Fig. 7). The histogram of the height distribution of individuals in the three agrosystems showed a 'bell' shape with a deficit in numbers in the larger classes. Height class HC2 contained the highest number of woody individuals with 73.33 stems/ha in cocoa, 170 stems/ha in coffee and 133.33 in cashew. Class HC4 had the lowest number of individuals with 23.33 stems/ha, 5 stems/ha and 15 stems/ha respectively in the cocoa, coffee and cashew agrosystems. From one height class to another, there were highly significant differences in the distribution of individuals within the cocoa (*P = 0.001; F = 181.12*), coffee (*P = 0.001; F = 203.29*) and cashew agrosystems (*P = 0.001; F = 84.08*; Fig. 7). The analysis of the horizontal structure showed that each diameter class contained individuals (Fig. 8). The histogram of the distribution of individuals in cocoa and coffee agrosystems also showed a 'bell' shape. In both stands, the DC3 diameter class had the highest number of individuals with 151.66 stems/ha in the cocoa agrosystem and 140 stems/ha in the coffee agrosystem. The diameter classes DC1 on the one hand, with 81.66 stems/ha in the cocoa tree and on the other hand, the diameter classes DC1 and DC4 with 53.33 stems/ha each had the lowest densities. In cashew agrosystem, the distribution histogram showed a "U"-shaped pattern. In this agrosystem, the largest trees were found in the DC4 diameter classes. The smallest trees were measured in the diameter class DC2. Analysis of the variation in the number of individuals according to diameter class showed a highly significant difference between them in the cocoa agrosystem (*P = 0.001; F = 181.12*) and in the coffee agrosystem (*P = 0.001; F = 203.29*). However, this difference was not significant in cashew agrosystem (P = 0.506; F = 84.08; Fig. 8).

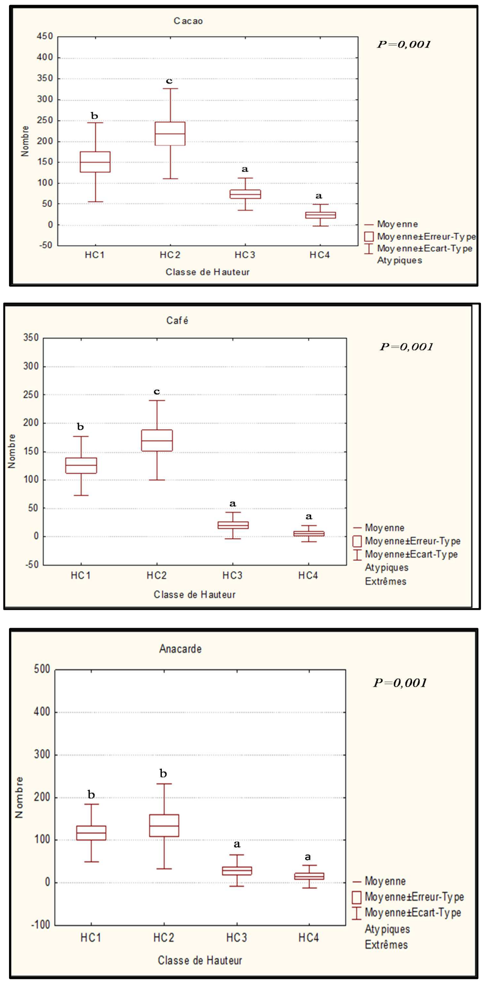

Fig. 7. Distribution of individuals in the height classes of different agrosystems.

HC1:]2 –4 m [, HC2: [4 –8 m [, HC3: [8 –12 m [, HC4: > 12 m

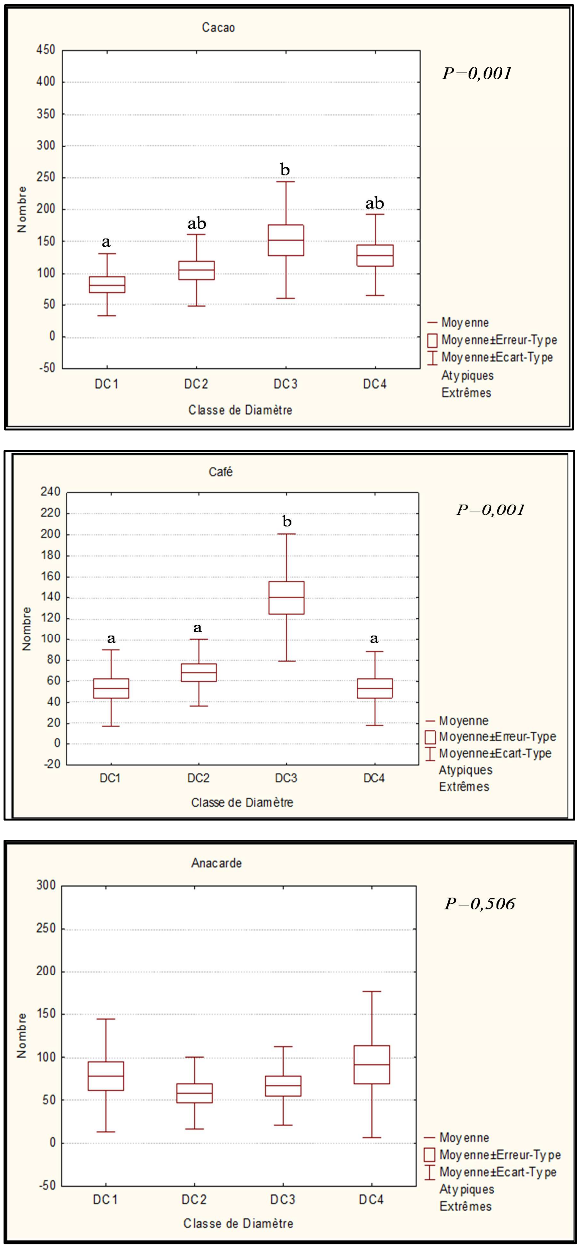

Fig. 8. Distribution of the individuals in the classes of diameter of the different agrosystems.

HC1:]2 –4 m [, HC2: [4 –8 m [, HC3: [8 –12 m [, HC4: > 12 m

Impact of crops on stand diversity associated with agrosystems

In this study, a Correspondence Factor Analysis was coupled with a Hierarchical Ascending Classification (Fig. 10). They were carried out on the basis of the number of individuals of the associated species encountered in the different agrosystems. The first two axes put together allow 100%. of the information to be observed with 54.74% for axis 1 and 45.26% for axis 2.

The projection of these parameters onto the different axes reveals three distinct groups. Group 1 (G1), which contains the cashew agrosystem, is not very diverse and includes forest species such as *Alstonia boonei*, *Terminalia ivorensis* and *Holarrhena floribunda*. Group 2 (G2) includes the cocoa agrosystem, which is highly diversified and consists of introduced species (*Persea americana*, *Gmelina arborea*, *Cola nitida*, *Annona muricata*, *Mangifera indica*), spontaneous species (*Ficus sur*, *Ficus exasperata*, *Blighia sapida*) and forest species (*Entandrothragma angolensis*, *Milicia excelsa*, *Triplochiton scleroxylon*) Group 3 (G3) is not very diverse and consists of the coffee agrosystem and spontaneous species such as *Sterculia tragancata*, *Pycnanthus angolensis*, *Albizia zygia* and *Albizia adianthifolia*.

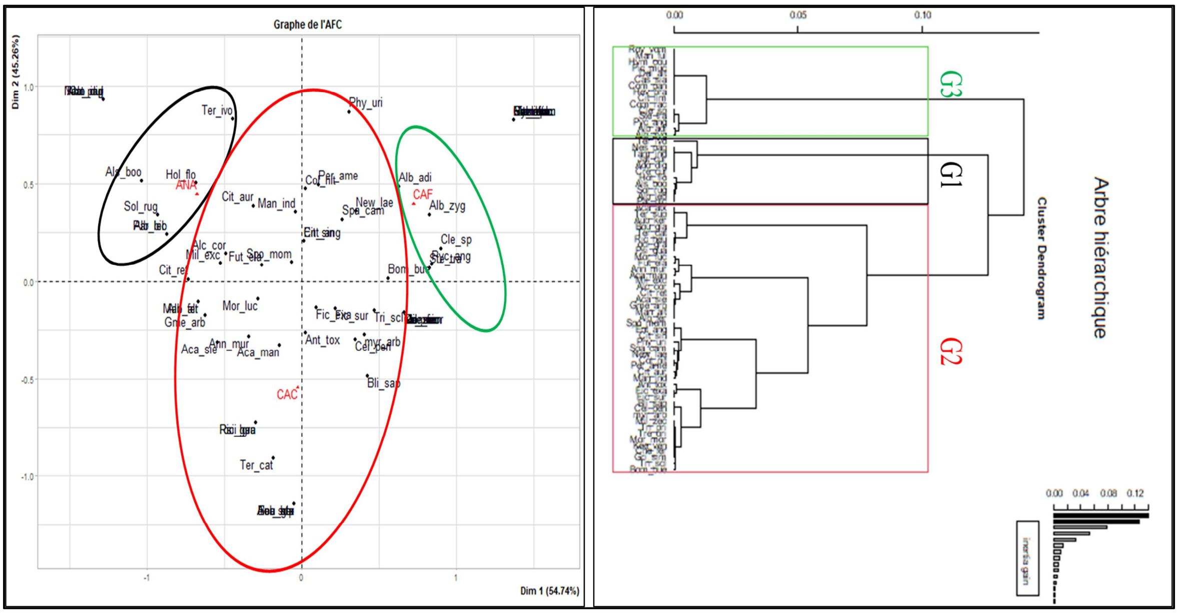

Fig. 9. Graphic representation of agrosystems and species according to axes 1 and 2 of the AFC coupled with the CAH G1-Groupe 1; G2-Groupe 2; G3- Groupe 3

Discussion

Floristic diversity of agrosystems

The study of the comparison of phytodiversity and floristic structure of agrosystems from peri-urban areas has allowed the identification of a variability of species belonging to various genera and families. This study enabled us to identify 54 species belonging to 43 genera and 26 families in cocoa agrosystems, 48 species belonging to 38 genera and 22 families in coffee agrosystems and 45 species belonging to 41 genera and 21 families in cashew agrosystems. The specific richness of these agrosystems is very close to each other. These values are close to those obtained by Boko *et al.* (2020) in cocoa agrosystems of Doboua (central-western, Côte d'Ivoire) which were 59 species. Mimosaceae, Moraceae and Euphorbiaceae were the most dominant families in these agrosystems. This set of families has already been reported as characteristic of the forest zone of african continent and of ivorian forests (Adou Yao and N'guessan, 2006; Vroh *et al.*, 2013). Thus, the presence of these species could be explained by the location of agrosystems in semi-deciduous forest zone which is the preferred domain of these families (Aké-Assi, 2002).

The analysis of the biological spectrum revealed in all agrosystems a strong dominance of Phanerophytes in the broad sense and more particularly of Microphanerophytes. The predominance of Microphanerophytes is due to their perennial life form including vegetative regrowth, which is the quantitatively important mode of regeneration in cocoa agrosystems as reported in the department of Oumé and the Lamto reserve region (Piba *et al.*, 2011; Koulibaly *et al.*, 2016). These Microphanerophytes will eventually induce a tree structure constituting an agroforestry microclimate favourable to perennial crops, particularly cocoa. Taxa from the guinean-congolese zone dominated chorological affinities of the agrosystems studied. This dominance can be explained by the strong affinity of these species for this zone and reflects the type of vegetation that supported the agrosystems studied. These results corroborate the work of Kouakou (2019) in the classified forest of Bouaflé with a high impact of perennial crops.

The analysis of the diversity indices confirmed the floristic richness of the different agrosystems studied. Taking into account the abundance of species, the Shannon diversity index shows high values, which shows that the flora of the agrosystems studied is stable. According to Loubier (2001), when the specific diversity is high, the links between the different components of the biocenosis are complex. This complexity increases the stability of the system through numerous interactions between the different populations. These indices are close to those found by Jagoret *et al.* (2014) and Madountsap *et al.* (2017) who found respectively 2.42 and 2.68 in cocoa agrosystems in Cameroon. Our indices found are however higher than those found by Kpangui *et al.* (2015) with H' =1.55 in Central Côte d'Ivoire. The highest Shannon index was recorded in the cocoa agrosystem (H' = 2.4). This richness would be due to the fact that producers, when setting up cocoa farms, preserve forest species to shade young cocoa trees. Later, they introduce fruit species for self-consumption, sale and to establish a shade conducive to the good vegetative development of cocoa trees (Jagoret *et al.*, 2008). As for the coffee and cashew agrosystems, anthropic pressures are felt through the cutting of certain species to allow the crops to develop better. Thus, some authors (Vroh, 2008 and Martin, 2008) assert the idea that the formation of shade by crops favours the creation of a particular microclimate to which only a few species, including cashew and coffee, are adapted. The Pielou equitability index is high in the cashew agrosystems (E = 0.97), followed by the coffee agrosystem (E = 0.93) and finally cocoa agrosystem (E = 0.9). This shows a good distribution of individuals within the plant species. These results indicate that our study environment is an anthropised and not a natural ecosystem (Camara, 2007). Indeed, the impact of man on the ecosystem tends to accentuate the destruction of plant biodiversity. The calculation of Sorensen's coefficient of similarity showed a clear similarity between all agrosystems and more particularly cocoa and coffee agrosystems and cocoa and cashew agrosystems. The similarity between the agrosystems could be explained by the presence in the soils of the plantations of seeds of the original forest species when the plots were established. Also, the similarity between these agrosystems could be due to the fact that they are found in the same ecological environment.

Structural organisation of the associated stand in agrosystems

The study of the vertical and horizontal structure of the different agrosystems shows that all these systems have a similar structural organization. The variation in the number of woody individuals in the height classes showed a dominance of shrubs. This could be explained by the fact that farmers remove large trees and replace them with fruit trees and other trees important for their needs. Also, the high number of saplings could be partly due to the fact that these areas are dominated by trees introduced at the time of cultivation and the cutting of mature trees to reduce the shading of mature plantations, which generally serves agronomic (soil fertilization and shading) and social (medicine, food and timber use) purposes.

Such a structure is characteristic of even-aged stands where vegetation dynamics are permanently disturbed according to farmers' management objectives (Morou *et al.*, 2016). Regarding the diameter classes, we note that large diameter individuals are the most dominant. This makes it possible to account for the preservation of woody species by producers in the localities of Dérahouan and Zépréguhé. This preservation is however less important in cashew agrosystem. This result differs from some studies that showed that the diametric structure of the associated stand was dominated by small-diameter trees (Zapfack *et al.*, 2016; Temgoua, 2019).

Correspondence Factorial Analysis was used to relate the agrosystems to their associated flora. From this analysis, three groups were identified that correspond to the management strategy of the producers of the different agrosystems. In cashew and coffee agrosystems, the diversity of associated species is low, with a dominance of forest species in the cashew agrosystem and of spontaneous species in the coffee agrosystem. In contrast to the other two agrosystems, the cocoa farms are very diverse with the presence of forest, fruit and volunteer species. The low diversity in the cashew agrosystem is explained by the fact that cashew is a strict heliophile plant that needs a maximum of light for its optimal development, hence the elimination of woody species that could harm the plant (Trekpo, 2003). In coffee agrosystem, associated species are rare. This could be due to the high density of coffee trees and also to the regular maintenance of coffee plantations by farmers.

Introduced species, which are generally recommended for their ability to fix atmospheric nitrogen, are not represented in these systems. However, these species can provide an important source of nitrogen as well as protection against erosion, thus promoting a sustainable cropping system with low input use (Snoeck *et al*., 2000). Finally, farmers associate forest, spontaneous and fruit species with cocoa crops for food, shade, fertilization, pharmacopoeia and timber. The presence of species such as *Ricinedendron heudelotii*, *Termilania catappa*, *Morinda lucida* is widely used in food, which testifies to the knowledge of Daloa's producers of their culinary virtues and therapeutic nutritional values.

Conclusion

The study conducted in the peri-urban area of Daloa showed that farmers preserve and introduce several woody species in the different agrosystems (cocoa, coffee, cashew). The cocoa agrosystem was the richest and most diverse in woody species, while the coffee agrosystem was the least rich. As for the individuals inventoried in all agroforestry systems, the study showed a dominance of shrubs. Anthropogenic factors are believed to be the cause, through repeated and regular clearing, the felling of large trees in high numbers to reduce nutritional competition between woody species and the main crops, and the continued use of some preserved species. However, there are woody species with economic, ecological, health and food interests that are preserved by producers in agrosystems. Agroforestry could therefore contribute to the improvement of the living conditions of local populations insofar as it promotes the food sovereignty of peasant populations. Agroforestry systems are therefore part of the framework of sustainable development, as they simultaneously aim to conserve valuable species and improve the well-being of local populations.

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