World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

Impacts of Cocoa Farm Establishment on Original Vegetation Formations in Western Côte d'Ivoire: The Case of the Bakouma Department Landscape

Kadio Attey Noël KOUA *, Kouassi Bruno KPANGUI, Kouame Jean-Marc KOUMAN, Adjo Annie Yvette ASSALE, Golou Gizèle ZANH and Yao Sadaiou Sabas BARIMA

Interdisciplinary Research Group in Landscape Ecology and Environment, UFR Environment / Jean Lorougnon Guédé University, BP 150 Daloa, Côte d'Ivoire.

World Journal of Advanced Research and Reviews, 2025, 28(01), 1832-1841

Publication history: Received on 15 September 2025; revised on 22 October 2025; accepted on 25 October 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.28.1.3584

Abstract

The mountainous relief of the western region of Côte d'Ivoire, combined with the presence of extensive savannas adjacent to forest areas, did not originally make this part of the country a prime zone for cocoa production. The objective of this study is to assess the impact of cocoa farm establishment on the original vegetation formations within the landscapes of Western Côte d'Ivoire, using the Biankouma Department as a case study. To achieve this, the methodology first consisted of a series of digital processing operations applied to a satellite image from the Landsat sensor covering the study area, in order to produce a land use map. Subsequently, direct field observations coupled with botanical inventories were conducted to determine the floristic diversity within cocoa plantations. Results reveal that in 2018, the Biankouma landscape was mainly composed of savanna and cocoa plantation classes, occupying respectively 35% (169,260 ha) and 30.3% (146,640 ha) of the total area. Floristic inventory data indicate a loss of species associated with the conversion of forest areas into cocoa plantations. Forests contained 141 species compared to only 51 species recorded in cocoa plantations established on former forest lands. Conversely, for shading young cocoa plants, a higher number of species was observed in plantations established on former savanna lands (129 species) than in natural savannas (98 species).

Keywords: Cocoa Plantation; Floristic Diversity; Land Cover Map; Transect Survey; Côte d'Ivoire; Shannon Index

1. Introduction

In Côte d'Ivoire, forest cover has been considerably reduced as a result of logging activities and the expansion of cultivated areas (Koné et al., 2014). Indeed, as in many parts of the world, a large number of households in Côte d'Ivoire depend on agriculture, which is predominantly family-based and relies on a shifting cultivation system with slash-and-burn practices (Ferraton & Touzard, 2009). This technique has long been considered a major cause of unsustainable agriculture and is regarded as one of the main drivers of forest cover degradation.

Farming practices within forested areas have led to the depletion of numerous plant species and the isolation of classified forests and national parks (Aké-Assi, 1998; Adou Yao & N'Guessan, 2006). Since 1977, Côte d'Ivoire has been the world's leading cocoa producer, but it is now facing a drastic reduction in its forest cover (Desdoigts & Kouadio, 2013). Cocoa cultivation is estimated to account for about 30% of the country's deforestation (Higonnet et al., 2017). Forests are perceived by farmers as the most fertile lands and, therefore, the most suitable for crop establishment (Barima et al., 2016). This dependence on forests has led to the progressive shift of the cocoa economy's epicenters—from the eastern regions of Côte d'Ivoire toward the forested zones of the Central-West and South-West, passing through the pre-forest areas of the Central-East (Brou & Chelard, 2007; Barima et al., 2020). In the early 2000s, the

* Corresponding author: Kadio Attey Noël KOUA

aging of cocoa orchards and the stagnation or decline in production observed in the South-West—the country's last major cocoa-producing area (Ruf & Agkpo, 2008) prompted planters and agricultural laborers to migrate toward the western forest region (Desdoigts & Kouadio, 2013). In rural areas, the establishment of cocoa farms has been reported in both forest and savanna zones of this western region, notably in the Departments of Danané, Bangolo, and Biankouma (Kouassi et al., 2014; N'Da, 2015; Tiébré et al., 2016). The present study hypothesizes that the agricultural practices adopted by cocoa producers in western Côte d'Ivoire have led to a loss of plant species within the original vegetation formations. Accordingly, the general objective of this study is to assess the impact of the cocoa-based economy on the original vegetation formations of the western Ivorian landscape, using the Biankouma Department as a case study. Specifically, the study aimed to (1) map land use in the Biankouma Department, and (2) analyze floristic diversity across different land use types within the department.

2. Methodology

2.1. Study Area

The present study was conducted in the western part of Côte d'Ivoire, within the Tonkpi Region, specifically in the Biankouma Department (Figure 1). The study area comprises ten protected areas, the most important of which is the Mont Sangbé National Park.

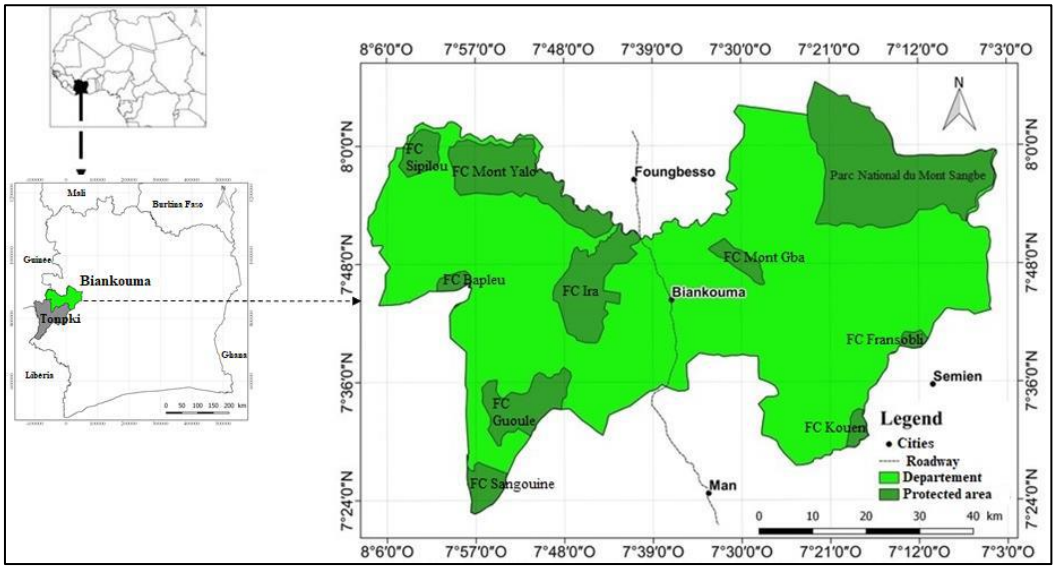

Figure 1 Location of the Biankouma department in the west of Côte d'Ivoire

2.2. Methods

2.2.1. Land Cover Mapping of the Biankouma Landscape

A Landsat satellite image with a spatial resolution of 30 meters, acquired in 2018 and covering the Biankouma area, was used together with georeferenced vector data representing the road network, settlements, and the administrative boundaries of the Biankouma Department. Using a vector file delineating the boundary of the Biankouma landscape, the study area was extracted from the full satellite scene. The reduced size of the working window had the advantage of minimizing the processing time required for various digital operations (Sangne, 2009). False-color compositions were subsequently generated from the reduced and/or raw spectral bands to identify the combinations that best discriminated the different land use classes. Several field campaigns were conducted between March and October 2018 to describe and validate the various land use classes identified during preliminary image processing. Vegetation formations were characterized based on physiognomic criteria such as stratification, structure, and dominant plant species (Chatelain, 1996; Kouadio, 2007; Koné, 2015). A supervised classification approach, which involves the use of training areas defined by the precise locations of field-verified sites (Oszwald, 2005), was applied in this study. The classification results were validated using accuracy indices derived from a confusion matrix (Girard, 1999; Carloz & Collet, 2011). After classifying the 2018 image of the Biankouma landscape, the surface areas of each land use class were determined through a post-classification analysis performed in the ENVI software. These surface areas were then used to calculate the proportional representation of each land use category.

2.2.2. Floristic Inventory

Site selection for the floristic inventory and ecological study was based on the land use map derived from the classification of the 2018 satellite image of the Biankouma Department. This map provided the various vegetated land use types present in the area. To assess the impact of cocoa plantation establishment on the floristic composition of original vegetation formations, floristic inventories were conducted in forests, savannas, cocoa plantations established on former forest lands, and cocoa plantations established on former savanna lands. The forest and savanna areas selected for inventory were well-preserved sites, free from any anthropogenic disturbances. Botanical inventories were carried out by combining plot-based surveys and itinerant observations. The plot-based method is commonly used for forest inventories in tropical regions (Cheek & Cable, 1997; Adou Yao et al., 2007). In this study, square plots of 625 m^2 (25 m × 25 m) were established in forests, savannas, and cocoa plantations on both forest and savanna precursors (Oke & Odebiyi, 2007). The choice of 625 m^2 plots allowed for optimal representation of species diversity and better characterization of the floristic composition of each vegetation type (Oke & Odebiyi, 2007; Vroh et al., 2010). For large cocoa plantations, more than one plot was installed. Within the cocoa plantation plots, all associated woody species were recorded. In the forest and savanna plots, all woody species were inventoried as well. In total, 151 plots of 625 m^2 were established: 10 in forest areas, 20 in savannas, and 121 in cocoa plantations. The Angiosperm Phylogeny Group III (APG III) classification system was used to assign species to their respective families, and plant names were standardized according to Lebrun & Stork (1997). A floristic list was compiled for each plot. From these lists, species associated with cocoa trees were identified and enumerated. Quantitative diversity was assessed using the Shannon diversity index (Shannon, 1948) and Pielou's evenness index (Pielou, 1966).

3. Results

3.1. Land Use Mapping

Digital processing of the 2018 multispectral imagery covering the Biankouma landscape enabled the production of the land cover map for the study area (Figure 2). The image classification of the study area was relatively accurate (Overall Accuracy = 95.34%; Kappa Coefficient = 0.87).

Visually, it can be observed that the Biankouma landscape in 2018 was dominated by cocoa plantations and savanna. In 2018, the landscape was primarily composed of savanna and cocoa plantation classes, occupying 35% (169,260 ha) and 30.3% (146,640 ha) of the department, respectively. The dense forest class covered only 33,190 ha, representing 6.9% of the study area (Figure 3). The cultivated and fallow land class, as well as bare soil and settlements, accounted for 4.8% (23,070 ha) and 4.5% (21,870 ha), respectively.

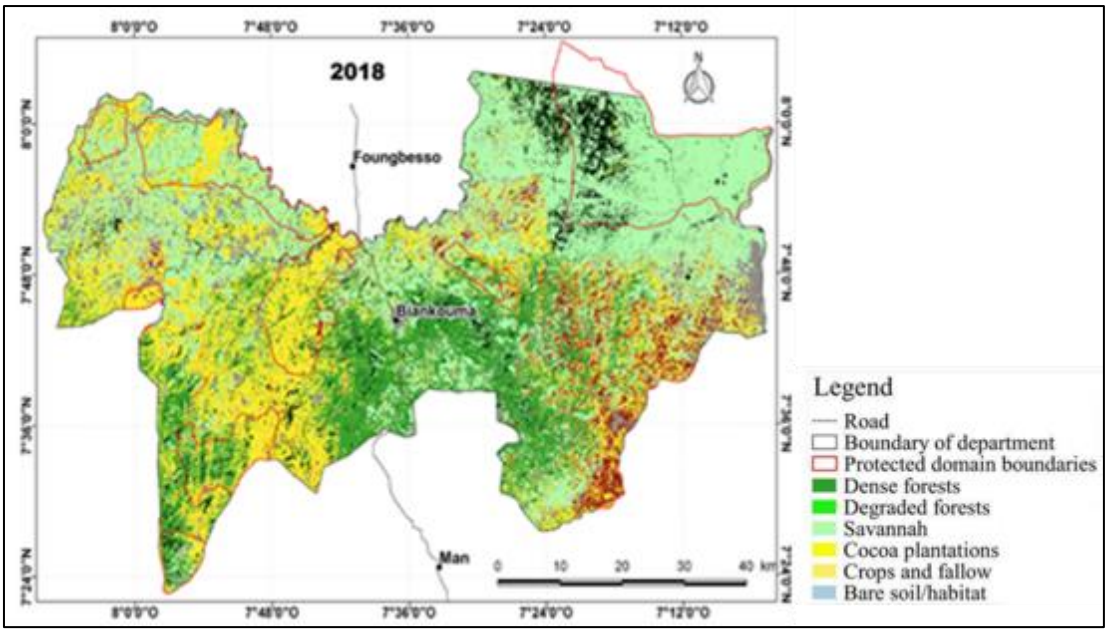

Figure 2 Land use map of the Biankouma department from 2018

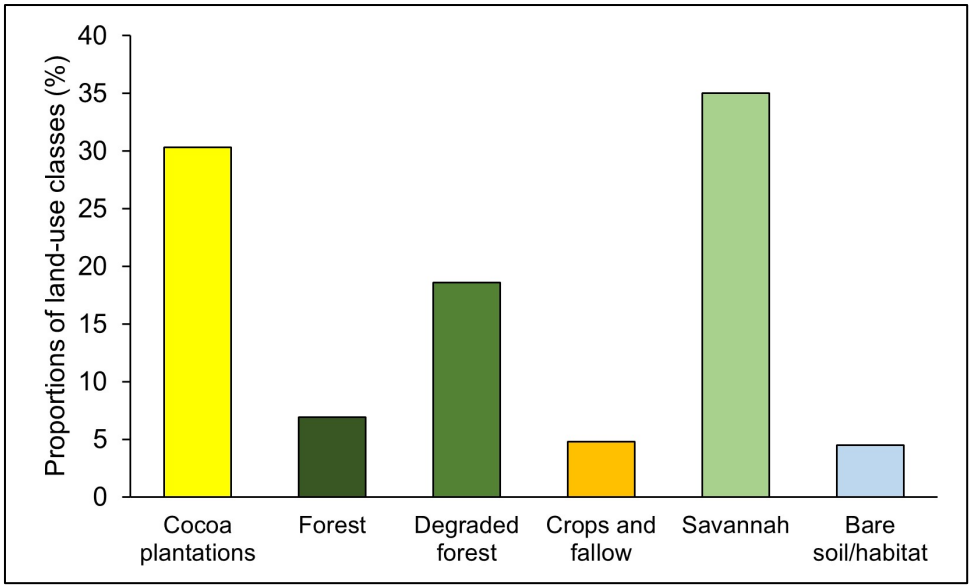

Figure 3 Proportions of land use classes in the Biankouma Department

3.2. Comparative Analysis of Forest and Former-Forest Cocoa Plantation Flora

3.2.1. Floristic Richness

The synthesis of the flora, derived from the itinerant inventory and plot surveys in forest areas, yielded a list of 141 species distributed across 50 families and 112 genera. The most represented families were Euphorbiaceae with 14 species (12% of the total) and Moraceae with 11 species (10% of the total) (Figure 4).

In contrast, cocoa plantations established on former forest areas contained 51 species distributed among 27 families and 43 genera. The most represented families were Moraceae (14%), Rubiaceae (13%), and Musaceae (13%). Moving from forests to cocoa plantations, the average number of species decreases. In forests, the mean species richness per plot is 366.24 species/ha, whereas in cocoa plantations, the mean number of species is 60.16 species/ha (Table 1).

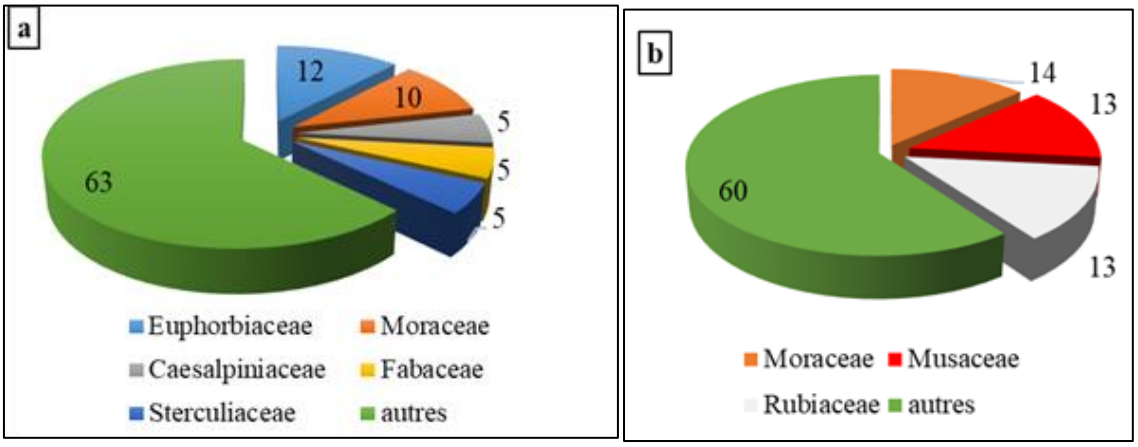

Figure 4 Dominant families (%) in forests (a) and cocoa plantations (b)

Table 1 Floral richness of forests and cocoa plantations

Floristic parameters		**forests**	**cocoa plantations**
Number of species	Total	141	51
	Mean per hectare	366,24	60,16

Number of genera	Total	112	43
Number of families	Total	50	27

3.3. Species with Special Conservation Status

In this study, 72 species with special conservation status were recorded in the forest, whereas 10 species were identified in cocoa plantations (Table 2). The endemic species recorded across the different habitats belong to the West African forest block (GCW). In forests, twelve endemic species were documented (Table XIX). Among these forest endemics are Cleistanthus libericus N.E.Br. (Euphorbiaceae), Cola caricaefolia (G. Don) K. Schum. (Sterculiaceae), Cordia vignei Hutch. & Dalz. (Boraginaceae), Dicranolepis persei H.A. Cummins (Thymelaeaceae), Diospyros heudelotii Hiern (Ebenaceae), Maesobotrya barteri (Sc. Elliot) Keay (Euphorbiaceae), and Ouratea schoenleiniana (Klotzsch) Gilg (Ochnaceae). In cocoa plantations, two endemic species, Cola caricaefolia (Sterculiaceae) and Milicia regia A. Chev. (Moraceae), were present. Among all species collected, 13 are listed on the IUCN Red List (2020), including 10 vulnerable species (VU) and 3 species of least concern but near threatened (LR). No species classified as rare by Aké-Assi (1998) or considered endangered were recorded in either the cocoa plantations or the forest.

Table 2 Species with Special Conservation Status Recorded in the Study Area in Forests and Cocoa Plantations

	Statut	**Forests**	**Cocoa Plantations**	**Total**
Endemism	GCW	12	2	14
Threatened	LC	53	4	57
	LR	2	1	3
	VU	7	3	10
Total		74	10	84

GCW = Species endemic to West Africa; LR = Low Risk of extinction; VU = Vulnerable species; LC = Least Concern

3.3.1. Specific Diversity Indices of the Studied Habitats

The mean values of diversity indices varied between habitats (Table 3). The differences in mean Shannon diversity indices among the different habitats were statistically significant ($p < 0.05$). Forests were more diverse than cocoa plantations (Table 3). Indeed, the mean Shannon index for forests was 2.36, compared to 0.94 for cocoa plantations. Furthermore, individuals within the surveyed habitats were fairly evenly distributed ($E > 0.5$). The distribution of individuals among the different habitats did not differ significantly ($p > 0.05$).

Table 3 Values of Diversity Indices in Forests and Cocoa Plantations

	Shannon diversity index	**Pielou's evenness index**
Forest	2,36[a]	0,82[a]
Cocoa Plantations	0,94[b]	0,71[a]

The letters associated with the diversity indices indicate significant differences at the 5% level according to the Chi-square test. Values sharing the same letters are not significantly different.

3.4. Comparative Analysis of Savannah and Former-Savannah Cocoa Plantation Flora

3.4.1. Floristic Richness

Savannas exhibited a floristic richness of 98 species distributed across 40 families and 87 genera, whereas cocoa plantations established on former savanna areas contained 129 species distributed among 98 genera (Figure 5). The most predominant families in savannas were Euphorbiaceae (9%), Caesalpiniaceae (8%), and Mimosaceae (7%) (Figure 24). In cocoa plantations, the dominant families were Moraceae (9%), Rubiaceae (9%), and Anacardiaceae (7%). The mean number of species per hectare in savannas was 356 species, while in cocoa plantations it was 105.28 species/ha (Table 4).

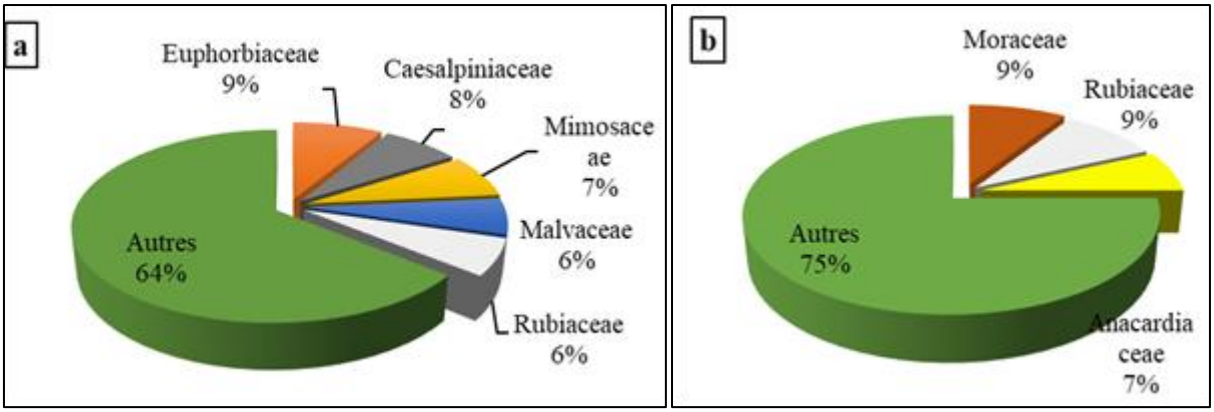

Figure 5 Dominant families (%) in savannah (a) and cocoa plantations (b)

Table 4 Floral richness of savannah and cocoa plantations

Floristic parameters		**savannah**	**cocoa plantations**
Number of species	Total	98	129
	Mean per hectare	356	105,28
Number of genera	Total	87	98
Number of families	Total	40	53

3.4.2. Species with Special Conservation Status

In savannas and cocoa plantations, 61 species with special conservation status were recorded, including 8 endemic species and 53 threatened species. Across the surveyed habitats, 41 species were recorded in forests and 20 species in cocoa plantations established on former savanna areas (Table 4). The endemic species recorded in the different habitats belong to the West African forest block (GCW).

In savanna habitats, 3 endemic species were recorded, while 5 endemic species were documented in cocoa plantations (Table 5). In both savannas and cocoa plantations established on savanna, Samanea dinklagei (Harms) Keay (Mimosaceae) was the endemic species common to these two habitats.

Among all collected species, 53 species are listed on the 2020 IUCN Red List. These include 5 vulnerable species (VU), 47 species of least concern (LC), and 1 endangered species (EN). In cocoa plantations, no endangered species were recorded, whereas one endangered species, Pterocarpus erinaceus Poir. (Fabaceae), was documented in savanna areas.

Table 5 Species with Special Conservation Status Recorded in the Study Area in Savannahs and Cocoa Plantations

	Status	**Savannahs**	**Cocoa Plantations**	**Total**
Endemism	GCW	3	5	8
Threatened	EN	1	0	1
	LC	34	13	47
	VU	3	2	5
Total		41	20	61

GCW = Species endemic to West Africa; LR = Low Risk of extinction; VU = Vulnerable species; LC = Least Concern

3.5. Specific Diversity Indices of the Studied Habitats

The mean values of diversity indices varied between habitats (Table 6). The differences in mean Shannon diversity indices among the different habitats were statistically significant ($p < 0.0001$). Savannas were more diverse than cocoa plantations (Table 6). Indeed, the Shannon index for savannas was 2.36, compared to 1.06 for cocoa plantations

established on savanna. Furthermore, individuals within the surveyed habitats were fairly evenly distributed (E > 0.5), with mean values of Pielou's evenness index ranging from 0.64 to 0.79. The distribution of individuals among the different habitats did not differ significantly (p > 0.05).

Table 6 Values of Diversity Indices in Savannahs and Cocoa Plantations

	Shannon diversity index	**Pielou's evenness index**
Cocoa Plantations	1.06[a]	0.64[a]
Savannahs	2.36[b]	0.79[a]

The letters associated with the diversity indices indicate significant differences at the 5% level according to the Chi-square test. Values sharing the same letters are not significantly different.

4. Discussion

4.1. Land Cover Mapping of the Biankouma Landscape

Vegetation cover in the western part of Côte d'Ivoire, exemplified by the Biankouma Department, has undergone profound transformation under the influence of cocoa cultivation. The forest and savanna, which once constituted the dominant landscape matrix, have been largely replaced by perennial crops, primarily cocoa. This transformation has affected forested areas more severely than savanna zones (Koua et al., 2020).

The predominance of forest areas as the previous land use for cocoa plantations may be explained by the fact that these ecosystems provide optimal environmental conditions for cocoa cultivation. Indeed, forest zones are the primary areas for cocoa and coffee production in Côte d'Ivoire (Koua, 2007). Furthermore, the conversion of forested areas (both dense and degraded forests) into agricultural land has been reported by Freud et al. (2000), who showed that 89% of agricultural fields in Côte d'Ivoire were established on cleared primary and secondary forests. The current landscape matrix of the Biankouma Department, now dominated by cocoa farming, suggests that agriculture is the main driver of vegetation cover change in this region of Côte d'Ivoire, as observed across Sub-Saharan Africa (Lambin et al., 2003; Wood et al., 2004; Avakoudjo et al., 2014).

4.2. Anthropogenic Activities, and Changes in Vegetation Floristic Composition

The results of the floristic inventories conducted during this study revealed a significant loss of species following the establishment of cocoa plantations in forest areas. The forest flora of the Biankouma Department comprises 141 species, whereas cocoa plantations contain only 51 species. In forest ecosystems, 366.24 species per hectare were recorded, compared to 60.16 species per hectare in cocoa farms. The lower number of plant species in cocoa plantations could be explained by the progressive elimination of species during the development of cocoa farms. Indeed, at the juvenile stage of the plantation, farmers remove understory species and large trees whose presence may hinder cocoa tree growth (Kpangui, 2015). Later, when the cocoa plantation enters the production phase, farmers reduce stand density by eliminating surplus individuals (Sangne et al., 2008). Finally, as plantations age, farmers tend to remove all redundant individuals, retaining only the most useful species (Duguma et al., 2001).

The process of establishing cocoa plantations in savanna areas differs from that in forests. It first involves the removal of the herbaceous cover—often dominated by Imperata cylindrica—followed by the planting of high-density oil palms or short-cycle food crops (Durot, 2013). In the first case, the oil palms are gradually replaced by cocoa trees and fruit trees. In the second case, farmers introduce palms and fruit trees to provide the shade necessary for the growth of young cocoa trees (Jagoret et al., 2012). The higher number of plant species observed in cocoa plantations established in savanna areas of the Biankouma Department may be attributed to the introduction of additional species intercropped with cocoa trees. Indeed, 131 species were recorded in savanna-based cocoa plantations compared to 98 species in natural savanna. Thus, this anthropogenic dynamic, far from being purely destructive, contributes to the establishment of a "cultivated forest ecosystem" in areas originally dominated by savanna vegetation (Camara et al., 2012). Moreover, the establishment of cocoa plantations in savanna environments helps mitigate the impacts of climate change through substantial carbon storage. An agroforestry system based on cocoa trees established on savanna soils can store up to 85 tons of carbon per hectare, compared to only 9 tons per hectare for unmanaged savannas (Durot, 2013). During forest clearing, farmers employ cultivation techniques that lead to a loss of floristic diversity (Assalé et al., 2016). Consequently, both forests and savannas are more floristically diverse than cocoa plantations. However, the Shannon diversity index of cocoa plantations established in savanna zones is higher than that of those established in forest zones. The loss of forest or savanna conditions during cocoa plantation establishment likely results in the disappearance of

endemic or threatened species, highlighting the need to maintain strictly protected conservation areas (Kpangui, 2015). Indeed, a smaller number of endemic and threatened species was recorded in cocoa plantations of the Biankouma Department compared to their original forest and savanna ecosystems. This finding is consistent with observations from other areas, including protected zones in Côte d'Ivoire, where the decline in these species is largely attributable to agricultural activities (Adou Yao et al., 2013).

5. Conclusion

This study revealed that the landscape of the Biankouma Department in 2018 was dominated by cocoa plantations and savanna. In 2018, the landscape was primarily composed of savanna and cocoa plantation classes, occupying 35% (169,260 ha) and 30.3% (146,640 ha) of the department, respectively. The results of the floristic inventories conducted during this study highlighted a loss of species following the establishment of cocoa plantations in forest areas. Indeed, the forest flora of the Biankouma Department comprises 141 species, compared to only 51 species in cocoa plantations. In forested areas, 366 species per hectare were recorded, whereas cocoa plantations contained 60 species per hectare. In cocoa plantations established in savanna areas, 131 species were recorded compared to 98 species in the original savanna formations. Moreover, a lower number of endemic and threatened species was observed in the cocoa plantations of the Biankouma Department compared to their previous forest and savanna land uses.

Compliance with ethical standards

Acknowledgements

The present study is part of the project entitled "Dynamics of Cocoa Farm Expansion and Impacts on Biodiversity and Food Security in Western Côte d'Ivoire", carried out by the Interdisciplinary Research Group on Landscape Ecology and Environment (GRIEPE) and funded by the Academy of Arts and Cultures of Africa and African Diasporas (ASCAD) of Côte d'Ivoire.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Adou Yao, C.Y., Kpangui, K.B., Adou, L.M.M., Vroh, B.T.A. and N'Guessan, K.E. (2013). Diversité floristique et valeur de la forêt sacrée Bokasso (Est de la Côte d'Ivoire) pour la conservation. Vertigo, 13(1) : 1-16.

[2] Adou Yao, C.Y., Denguéadhé, K.T.S., Kouamé, D. and N'Guessan, K.E. (2007). Diversité et distribution des ligneux dans le Sud du Parc National de Taï (Pnt) Côte d'Ivoire. Agronomie Africaine, 19 (2) : 113-122.

[3] Adou Yao, C.Y. and N'Guessan, E.K. (2006). Diversité floristique spontanée des plantations de café et de cacao dans la forêt classée de Monogaga, Côte d'Ivoire. Schweizerische Zeitschrift fur Forstwesen, 157(2): 31-36.

[4] Aké-Assi, L. (1998). Impact de l'exploitation forestière et du développement agricole sur la conservation de la biodiversité biologique en Côte d'Ivoire. Le flamboyant, 46 : 20-22.

[5] Avakoudjo, J., Mama, A., Toko, I., Kindomihou, V. and Sinsin, B. (2014). Dynamique de l'occupation du sol dans le Parc National du W et sa périphérie au Nord-Ouest du Bénin. International Journal of Biological and Chemical Sciences, 8(6) : 2608-2625.

[6] Barima, Y.S.S., Konan, G.D., Kouakou, A.T.M. and Bogaert, J. (2020). Cocoa Production and Forest Dynamics in Ivory Coast from 1985 to 2019. Land, 9(12), 524.

[7] Barima, Y.S.S., Kouakou, A.T.M., Bamba, I., Sangne, Y.C., Godron, M., Andrieu, J. and Bogaert, J. (2016). Cocoa crops are destroying the forest reserves of the classified forest of Haut Sassandra (Ivory Coast). Global Ecology and Conservation, 8 : 85-98.

[8] Brou, Y.T. and Chaléard, J.L. (2007). Visions paysannes et changements environnementaux en Côte d'Ivoire. Annales de géographie, 653(1) : 65-87.

[9] Camara, A.A., Dugué, P. and Foresta, H.D. (2012). Transformation des mosaïques de forêt-savane par des pratiques agroforestières en Afrique subsaharienne (Guinée et Cameroun). Cybergeo : European Journal of Geography, [En ligne], Environnement, Nature, Paysage, document 627, 25 p.

[10] Carloz, R. and Collet, C. (2001). Précis de télédétection : traitements numériques d'images de télédétection : Presses de l'Université du Québec (Canada). Agence Universitaire de la Francophonie, 3 :1-386.

[11] Chatelain, C. (1996). Possibilités d'application de l'imagerie satellitaire à haute résolution pour l'étude des transformations de la végétation en Côte d'Ivoire forestière. Thèse Doctorat ès-Science., Faculté des Sciences, Université de Genève, Suisse, 206 p.

[12] Cheek, M. and Cable, S. (1997). Plant inventory for conservation management: the Kew Earth match Programme in western Cameroon, 1993-1996. African rainforests and the conservation of biodiversity, 29: 1-38.

[13] Desdoigts, A. and Kouadio, H.K. (2013). Deforestation, Migration, Land Appropriation and Reforms: Rural resilience against the backdrop of the Malthusian crisis in Ivory Coast. Erudite, 2013(01), 47p.

[14] Duguma, B., Gockowski, J. and Bakala, J. (2001). Smallholder cacao (Theobroma cacao Linn.) cultivation in agroforestry systems of West and Central Africa : challenges and opportunities. Agroforestry Systems, 51 : 177 - 188.

[15] Durot, C. (2013). Evaluation et comparaison des stocks de carbone des systèmes agroforestiers à base de cacaoyers du Centre Cameroun. Cas de l'arrondissement de Bokito. Mémoire de fin d'étude, Lille, France, 83 p.

[16] Ferraton, N. and Touzard, I. (2009). Comprendre l'agriculture familiale : diagnostic des systèmes de production, 1e édition, Gembloux, Editions Quae, CTA Presse Agronomique de Gembloux, 132 p.

[17] Freud, E.H., Petithuguenin, P. and Richard, J. (2000). Les champs de cacao : un défi de compétitivité Afrique-Asie. Éditions Karthala et CIRAD, Collection Économie et développement, Paris, France, 210 p.

[18] Girard, M.C. (1999) Traitement des données de télédétection. Dunod, Paris (France), 529 p.

[19] Higonnet, E., Bellantonio, M. and Hurowitz, G. (2017). La déforestation amère du chocolat : Comment les forêts classées deviennent du "cacao classé". Rapport d'étude, 24 p.

[20] Jagoret, P., Michel-Dounias, I., Snoeck, D., Ngnogué, H.T. and Malézieux, E. (2012). Afforestation of savannah with cocoa agroforestry systems: a small-farmer innovation in central Cameroon. Agroforestry Systems, 86(3): 493-504.

[21] Koné, M. (2015). Evolution du couvert forestier dense et impact de la déforestation sur la migration de la boucle du cacao en Côte d'Ivoire. Thèse de doctorat en science de la nature, UFR sciences de la nature, Université Nangui Abrogoua (Abidjan, Côte d'Ivoire), 156 p.

[22] Koné, M., Kouadio, Y.L., Neuba, D.F.R., Malan, D.F. and Coulibaly, L. (2014). Évolution de la couverture forestière de la Côte d'Ivoire des années 1960 au début du 21e siècle. International Journal of Innovation and Applied Studies, 7(2) : 782-794.

[23] Koua, A. (2007). Situation de la production de café en Côte d'Ivoire : cas du département d'Aboisso. Mémoire ingénieur, Ecole Supérieur d'Agronomie, Institut National Polytechnique Houphouët Boigny (Yamoussoukro, Côte d'Ivoire), 90 p.

[24] Koua, K.A.N., Barima, Y.S.S., Kpangui, K.B. and Bamba, I. (2020). Impact of cocoa farming on the landscape in rural and state-owned areas of West Côte d'Ivoire. International Journal of Innovation and Scientific Research, 50(2) : 128–137.

[25] Kouadio, K. (2007). Études de la flore, de la végétation et de l'impact de l'éclaircie sélective par dévitalisation sur les essences principales de la forêt classée de Bossematié, Est de la Côte d'Ivoire. Thèse de Doctorat Unique, UFR Biosciences, Université de Cocody, Abidjan, 192 p.

[26] Kouassi, K.H., Kouassi, R.H., Ayolié K. and N'Guessan, K. (2014). Evolution of floristic diversity according to altitude in the localities of Bangolo and Logoualé west of Côte d'Ivoire. Research & Reviews in BioSciences, 9(2) : 63-69.

[27] Kpangui, K.B. (2015). Dynamique, diversité végétale et valeurs écologiques des agroforêts à base de cacaoyers de la Sous- préfecture de Kokumbo (Centre de la Côte d'Ivoire). Thèse de Doctorat, UFR Biosciences, Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire, 227 p.

[28] Lambin, E.F., Geist, H.J. and Lepers, E. (2003). Dynamics of land-use and land-cover change in tropical regions. Annual review of environment and resources, 28(1) : 205-241.

[29] Lebrun, J.P. and Stork, A.L. (1997). Enumération des plantes à fleurs d'Afrique tropicale. Gamopétales : Clethraceae à Lamiaceae. Conservatoire et Jardin Botaniques, Genève, Suisse, 712 p.

[30] N'Da, E. (2015). Mission d'étude d'Impact Environnemental et Social préliminaire des projets d'aménagements hydroélectriques des barrages de Gao et Tayaboui dans les régions du Bafing, Tonkpi, Guemon et Haut Sassandra. Rapport d'étude floristique, 78p.

[31] Oke, D.O. and Odebiyi, K.A. (2007). Traditional cocoa-based agroforestry and forest species conservation in Ondo State, Nigeria. Agriculture, Ecosystems and Environment, 122 : 305 - 311.

[32] Oszwald, J. (2005). Dynamique des formations agroforestières en Côte d'Ivoire (des années 1980 aux années 2000), Suivi par télédétection et développement d'une approche cartographique. Thèse de Doctorat, Université des Sciences et Technologies (Lille, France), 304 p.

[33] Piélou, E.C. (1966). Species diversity and pattern diversity in the study of ecological succession. Journal of theoretical biology, 10(2) : 370 - 383.

[34] Ruf, F. and Agkpo, J.L (2008). Etude sur le revenu et les investissements des producteurs de café et de cacao en Côte d'Ivoire. Rapport final, Cardno Agrisystems Limited-Lead Member of Agrisystems Consortium, 115 p.

[35] Sangne, Y.C. (2009). Dynamique du couvert forestier d'une aire protégée soumise aux pressions anthropiques : cas de la forêt classée de Téné (Département d'Oumé, Centre-ouest de la Côte d'Ivoire). Thèse de Doctorat, UFR des Sciences de la Terre et des Ressources Minières. Université de Cocody (Abidjan, Côte d'Ivoire), 175 p.

[36] Sangne, Y.C., Adou, Yao, Y.C. and N'Guessan, K.E. (2008). Transformations de la flore d'une forêt dense semi décidue : impact des activités humaines (Centre Ouest de la Côte d'Ivoire). Agronomie Africaine, 20 (1): 1 - 11.

[37] Tiébré, M.S., Ouattara, D., Kpangui, K.B., Kouassi, D.F. and N'guessan, K.E. (2016). Diversité floristique de la région de Foungbesso en zone de transition forêt–savane à l'ouest de la Côte d'Ivoire. International Journal of Biological and Chemical Sciences, 10(3): 1007-1016.

[38] Vroh, B.T.A., Adou Yao, C.Y., Kouamé, D., N'Da, D.H. and N'Guessan, K.E. (2010). Diversités Floristique et Structurale sur le Site d'une Réserve Naturelle Volontaire à Azaguié, Sud-est de la Côte d'Ivoire. European Journal of Scientific Research, 45 (3): 411 - 421.

[39] Wood, E.C., Tappan, G.G. and Hadj, A. (2004). Understanding the drivers of agricultural land use change in south-central Senegal. Journal of Arid Environments, 59(3) : 565-582.