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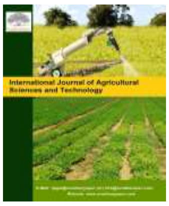

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Dynamics and Floristic Structure of Kouampante Community Forest (Savannahs' Region, Togo)

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Abstract

Community forests are being promoted in Togo as an alternative to the degradation of protected areas and as a means of restoring forest landscapes. The present study is carried out within Kouampante Community Forest (KCF) in Ogaro (Togo, West Africa). It intends to contribute to the sustainable management of KCF. Specially, it aims at: (i) mapping forest ecosystems and analysing their dynamics and (ii) characterising the floristic diversity of the KCF. Forest ecosytems are mapped and their dynamics evaluated based on Google Earth images of 2010 and 2020. The floristic and silvicultural analyses are based on inventories carried out in 13 plots of 1,000 m^2 each. The KCF is made up mainly by tree/shrub savannahs (58.73%) and croplands/fallow (41.27%) in 2010. These two land use types have undergone changes over the period. In 2020, the KCF had two land use types: tree/shrub savannahs (84.30%) and croplands/fallows (15.70%). The flora census consisted of 59 species grouped in 6 families. The most important plant species are *Detarium microcarpum* and *Vitellaria paradoxa*. The Fabaceae were the most abundant and diversified families, followed by the Combretaceae. The demographic structure showed a high abundance of individuals with small diameter and height. This indicates the possibility of a rapid restoration of the native vegetation. Protecting the forest from anthropogenic threats could be crucial for achieving the desired objective.

Keywords: *Community forest, Landscape restoration, Biodiversity, Koampante, Savannah region, Togo*

1. Introduction

Community forests are forests collectively managed by local communities to protect biodiversity and support livelihoods. They are governed by customary rights, rules, and institutions that pre-date most modern governments, and continue

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to adapt to changing circumstances. They could have spiritual and cultural connotation (sacred groves and forest) exclusively (Adjonou *et al*., 2021; Atakpama, Badjare *et al*., 2022; Ehlui *et al*., 2024b) or not. They provide non-timber (foods, medicines products, cosmetics, honey, meats…), timber products and others services. Thus, community forests are important for several reasons, as they provide a wide range of social, political, environmental and economic benefits (Bhusal *et al*., 2018). They also provide primary source of livelihood, nutrition and employment. They contribute to biodiversity conservation, improve forest restoration and climate resilience (Baynes *et al*., 2015; Giri *et al*., 2023; Kombate *et al*., 2023a; Wulandari *et al*., 2021).

The protection of biodiversity through sacred and community forests is of growing international concern in Africa and elsewhere (Atakpama *et al*., 2023a; Atakpama *et al*., 2023b; Beukeboom *et al*., 2010; Ehlui *et al*., 2024a; Kombate *et al*., 2023a; Moayeri *et al*., 2022). These are the objectives of the Togolese government. Since 2015, it has produced a guide to community forestry. Several projects supporting community forest initiatives were then launched. Currently, 171 community forests can be found nationwide (Atakpama *et al*., 2023b). Fewer of these, however, comply with the Guide. Moreover, there is a lack of scientific data to help guide how to manage them. These data include knowledge of biodiversity, landscape structure and dynamics, timber resource status, management practices and the existence and functioning of management committees. Although several studies have investigated about the management of both community forests (Atakpama *et al*., 2022; Atakpama *et al*., 2023a; Atakpama *et al*., 2023b; Bawa *et al*., 2022; Folega *et al*., 2023; Folega *et al*., 2017; Kossi *et al*., 2022; Koumoi, 2023) and sacred groves and forests (Adjonou *et al*., 2021; Atakpama *et al*., 2021; Konko *et al*., 2018) , however, there is lack of relevant data on Savannah community forest dynamics. Thus, such knowledge can be helpful in enhancing our understanding of the role of local communities in managing forest resources (Musyoki *et al*., 2016). Our study will provide vital information necessary to improve sustainable community forest management practices.

As a result of climate change and the increase in population, the savannah region has had less forest cover. Agroforestry parklands cover most of the land (Folega *et al*., 2019a). Protected areas are sometimes the only forest ecosystems. Unfortunately, these protected areas have undergone significant degradation since the socio-political unrest in the 1990s (Folega *et al*., 2012; Dimobe *et al*., 2012; Polo-Akpisso *et al*., 2018a; Atakpama *et al*., 2023c; Folega *et al*., 2021). For species that have already disappeared or are threatened with extinction, sacred and community forests thus serve as true sanctuaries.

The present study, carried out on the KCF, aims to demonstrate the contribution made by the KCF to restoring forests and conserving biodiversity in Togo. More specifically, it: (i) analyzed the dynamics of the forest ecosystem from 2010 to 2020, (ii) assessed the diversity of plant species, and (iii) characterized the demographic structure of woody plants in KCF.

2. Methodology

2.1. Study Area

KCF is located in Ogaro Canton, Kpendjal-Ouest Prefecture, Savannahs Region, Togo (Figure 1). The target forest belongs to Togo's ecological zone I (Ern, 1979). The native vegetation of the Soudanian savannahs is dominated by

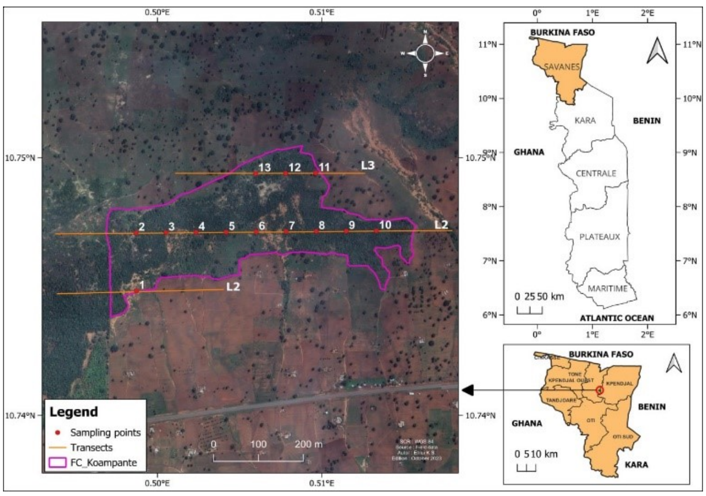


Figure 1: Location and Sampling Design within KouampanteCommunity Forest in Togo

thorny species (Akpagana and Bouehet, 1994; Brunel *et al*., 1984). Due to the increasing human population, the native ecosystems have been transformed into croplands and agroforestry parklands (Folega *et al.,* 2021). Several agroforestry parklands have been found. The predominant agroforestry trees are raost palms (*Borassus* spp), african locust bean (*Parkia biglobosa* Jacq), tamarind (*Tamarindus indica* L.), African baobab (*Adansonia digitata*) (Atakpama *et al*., 2022; Folega *et al*., 2019a; Kebenzikato *et al.,* 2014; Padakale *et al.,* 2015; Samarou *et al.,* 2022). These agroforestry trees play an important role in improving local nutrition and livelihoods (Kebenzikato *et al*., 2023; Samarou *et al*., 2023). In addition to cropland expansion (Folega *et al*., 2021; Folega *et al.,* 2019a), grazing is highlighted as a second threat to plant communities (Ibrahim-naim *et al.*, 2021). Protected areas of the savannahs region, long known as a technique to conserve biodiversity and ecosystems, are also highly degraded and invaded (Atakpama *et al.,* 2023c; Badjare *et al*., 2021; Polo-Akpisso *et al.,* 2018b). To counter this degradation, community forests and sacred forest/grove practices are seen as an opportunity to conserve biodiversity (Atakpama *et al*., 2023b).

2.2. Data Collection

2.1.1. Satelite Image Acquisition

LocustMap, a mobile application, was first used to delineate the boundaries of the KCF. The KML shapefile was then projected onto Google Earth images supplied by Astrium Service to Google Inc 2010, 2014, 2020 for the digitisation of the land use units. These images were chosen due to their high resolution (up to 1.5 m) and the small area covered by the KCF (Egbelou *et al*., 2021; Folega *et al.,* 2017).

2.1.2. Sampling Sesign

Thirteen sample plots, equidistant by 100 m, were established along three transects separated by 200 m. Four types of inventories were carried out: the phytosociology, the ecology, the forestry and the regeneration. The phytosociology of the woody species, the ecology and the forestry parameters were assessed within plots of 50 m x 20 m in size (Atakpama *et al*., 2022). For the phytosociology of herbaceous species, sub-plots of 10 m x 10 m were established in the centre of the main plot (Polo-Akpisso *et al.,* 2015). Within the main plot, 3 subplots of 5 m x 5 m were defined for regeneration inventories, one in the centre and the other two in the opposite corners on both sides of the central plot, arranged diagonally (Atakpama *et al*., 2021; Polo-Akpisso *et al*., 2015; Thiombiano *et al*., 2015).

2.1.3. Inventories

The phytosociological inventory of plants has been carried out on the basis of the Braun-Blanquet (1932) abundance/ dominance scale. This scale is defined as follows: rare species, coverage 0-1% (+); coverage 1-5% (1); coverage 5-25% (2); coverage 25-50% (3); coverage 50-75% (4); coverage 75- 100% (5). Vegetation type, grazing, wildfire, erosion were recorded as ecological parameters. Tree diameter, stem height and total height of woody plants with DBH e" 5 cm were measured during the forest inventory(Folega and Ekoungoulou, 2022). A forestry compass was used to measure tree diameter at 1.30 m above the ground. Stem height and total height were assessed by visual evaluation. All woody species with DBH < 5 cm (Samarou *et al*., 2022) were defined as potential regeneration.

2.2. Data Analysis

2.2.1. Land Use Unit Mapping

The different land-use units of KCF were digitised using Google Earth Pro software. To validate the digitised occupation units, ground truth points were projected. The resulting shapefiles were transferred to QGIS 2.30 for mapping (Egbelou *et al*., 2021). WGS 84_UTM Zone 31N was used as the projection background. Land use dynamics and transition were determined by comparison of the different maps (Kokou *et al*., 2023).

2.2.2. Assessment of The Floristic Diversity

The vegetation data collection was downloaded in Microsoft Excel spreadsheet format. A list of the plants of the Kouampante forest were then drawn up. The genera and botanical families were used to classify each species listed. Classification used was APG IV (Atakpama *et al.,* 2023a), which was accessed from the website: https://africanplantdatabase.ch/en. Biotypes and chorology were established (Assi-Ake, 1985; White, 1986). The following biotypes were considered: phanerophytes (Ph), chamephytes (Ch), hemicryptophytes (He), geophytes (Ge), therophytes (Th) and epiphytes (Ep). Phanerophytes include: megaphanerophytes (MP) (trees over 30 m), mesophanerophytes (mP) (trees 10 to 30 m), microphanerophytes (mp, trees 2 to 10 m), nanophanerophytes (np, trees 0.4 to 2m), lianaceous forms

(Lnp, Lmp, LmP, LMP) (Dimobe *et al.*, 2012). A tropical African context was used for the chorology. These are as follows: GC = species known in Guineo-Congolese zone, GCW = species belonging to western forest massif, GCE = species belonging to eastern forest massif, SZ = species known in Sudano-Zambesian zone, GC-SZ = species found in both zones, I = species introduced for agriculture, forestry or horticulture.

2.2.3. Forest Characteriscics Analysis

Four major dendrometric parameters were evaluated: tree density per hectare (D), mean lorry height (HL in m), mean diameter (Dm in cm) and basal area (G in m2/ha) (Bawa *et al.*, 2022; Samarou *et al.*, 2022). Trees with DBH e" 5 cm were considered. Mean Lorey Height is calculated by averaging tree heights weighted by basal area (West, 2004). Trees are classified into diameter and height classes. The minimum diameter is 5 cm and the minimum height is 2 m. To fit the demographic structure of the trees to the theoretical distribution, the 3 Weibull parameters (a = location parameter, b = scale or size parameter and c = shape parameter related to the diameter or height structure) were used (Samarou *et al.*, 2022).

3. Results

3.1. Land Use Units Dynamic

An analysis of Google Earth images shows that the Kouampante community forest in 2010, 2014 and 2020 consists of tree savannah/shrub savannah and arable/fallow land (Figure 2). The same occupations were represented in 2014. Tree/shrub savannahs accounted for 33% of the forest. Croplands/Fallows accounted for 67%. In 2010, tree savannah/shrub savannah covered 58.73% of the forest, followed by cropland and fallow (41.27%). In 2020, tree savannahs/shrub savannahs occupy 84.30% of the Kouampante CF. This is followed by croplands/ fallow land (15.70%).

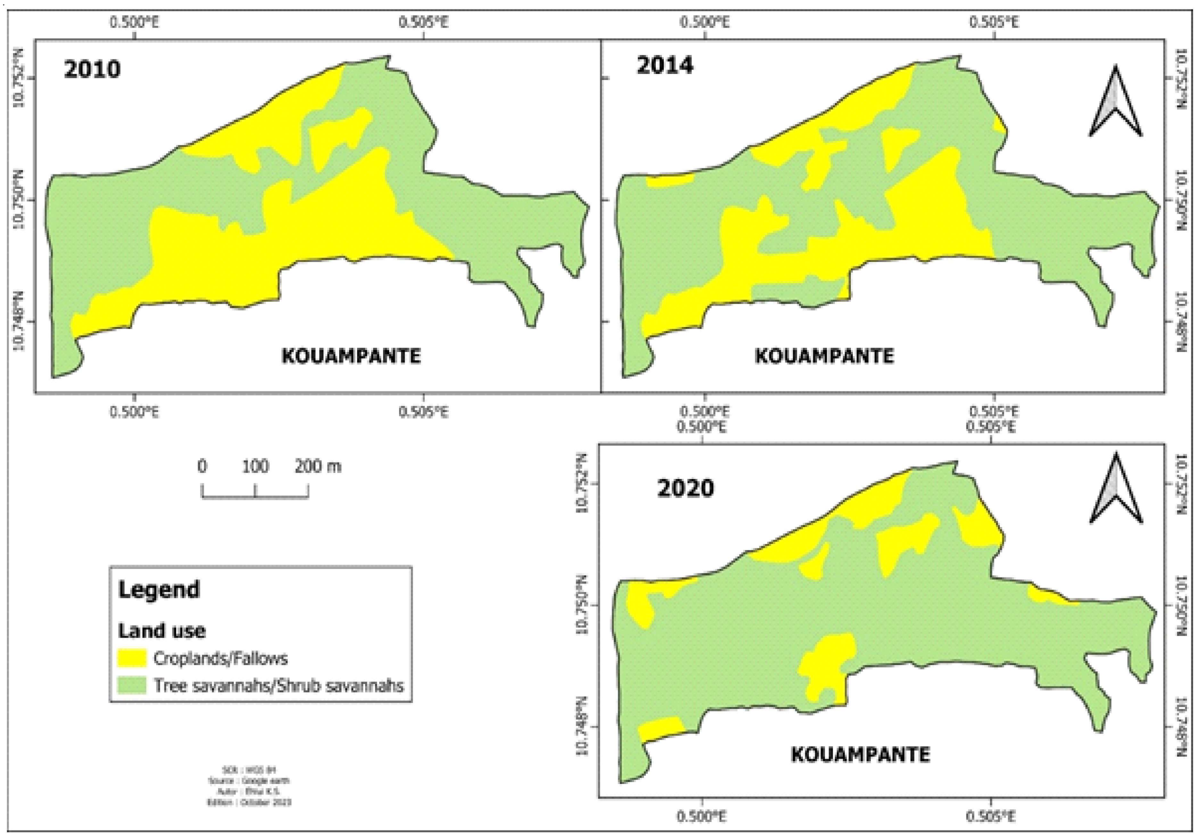


Figure 2: Land Use Units within Kouampante Community Forest

Between 2010 and 2020, the Kouampante community forest was characterised by a decrease in croplands/fallows (-61.97%). This contrasts with an increase in tree/shrub savannah (43.55%) (Table 1).

By analyzing the land use transition matrix for the Kouampante community forest (Table 2), it was possible to identify the main conversions between 2010 and 2020. A conversion rate of 4.23% was applied to the conversion of trees/shrub savannahs to croplands/fallows. Stability exists for 11.06% croplands/fallows and 53.04% tree/shrub savannahs (Figure 3).

Table 1: Change Rate of Land use of Kouampante Community Forest from 2010 to 2020

Land Use Units	2010		2014		2020		Change Rate (%)		
	Superficie (ha)	%	Superficie (ha)	%	Superficie (ha)	%	2010-2014	2014-2020	2010-2020
Croplands/Fallows	11.28	41.27	9.02	33.00	4.29	15.70	-20.04	-52.44	-61.97
Tree/Shrub savannahs	16.05	58.73	18.31	67.00	23.04	84.3	14.08	25.83	43.55
Total	**27.33**	**100**	**27.33**	**100**	**27.33**	**100**			

Table 2: Land Use Transition Matrix 2010-2014, 2014-2020, and 2010-2020

To		2014			To		2020			To		2020		
		C/F	TS/SS	Total			C/F	TS/SS	Total			C/F	TS/SS	Total
2010	C/F	**30.68**	11.25	41.93	**2014**	C/F	**9.99**	22.98	32.97	**2010**	C/F	**11.06**	31.66	42.73
	TS/SS	1.99	**56.08**	58.07		TS/SS	6.06	**60.97**	67.03		TS/SS	4.23	**53.04**	57.27
	Total	32.67	84.7	100		Total	16.05	83.95	100		Total	15.3	84.7	100

Note: C/F : Croplands/Fallows, TS/SS : Tree Savannahs/Shrub Savannahs.

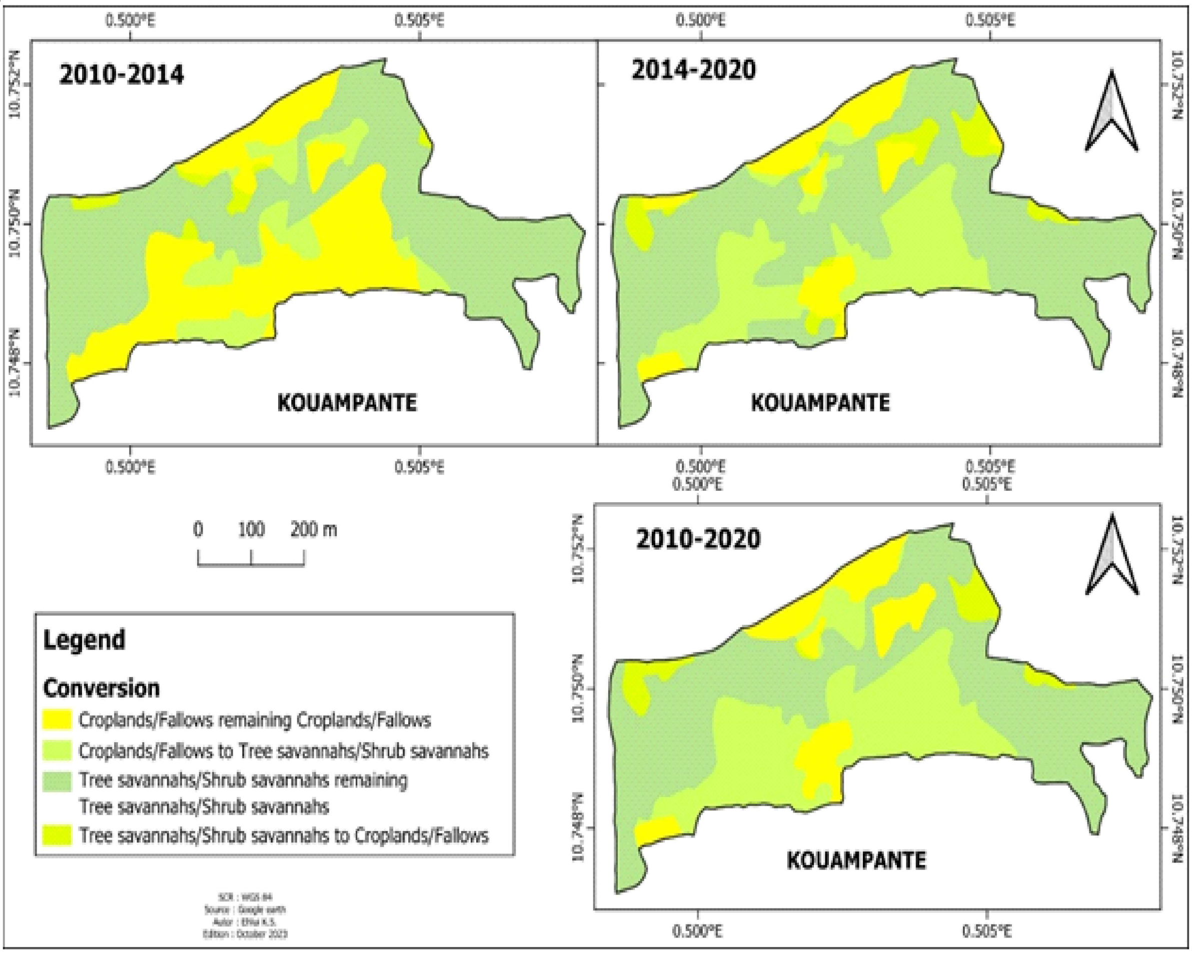


Figure 3: Change of land use in Kouampante Community Forest in Togo

3.2. Floristic Diversity of Kouampante Community Forest (KCF)

A total of 59 species from 50 genera and 24 families were recorded. *Detarium microcarpum* Guill. & Perr. is the dominant and frequent species in the whole landscape. Occupying 37.73%, this species was recorded in all plots. Guiera senegalensis J.F.Gmel. is the second most abundant species (11,39 %). Apart from *D. microcarpum*, the most frequent species are: *Vitellaria paradoxa* C.F.Gaertner subsp. *paradoxa* and *Combretum collinum* Fresen (Figure 4).

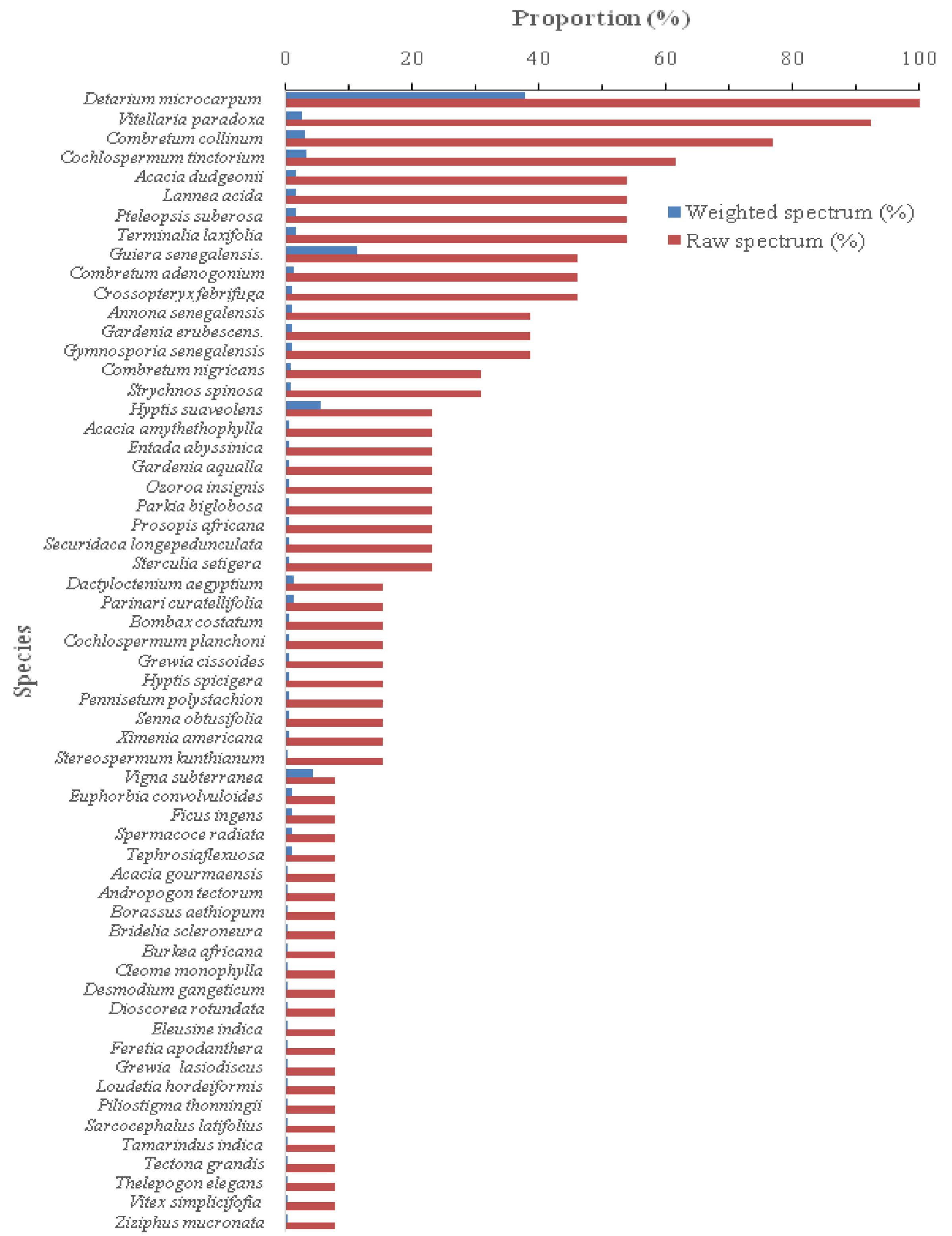


Figure 4: Weighted and Raw Spectrums of the Plant Species in the KCF

Fabaceae is the most diverse and abundant of the families. It accounts for 48.68% and is made up of 14 plant species. Combretaceae follows with 6 species (19.41%). Rubiaceae and Poaceae each have 6 species and Malvaceae has 4 species. The other families are less diverse (Figure 5).

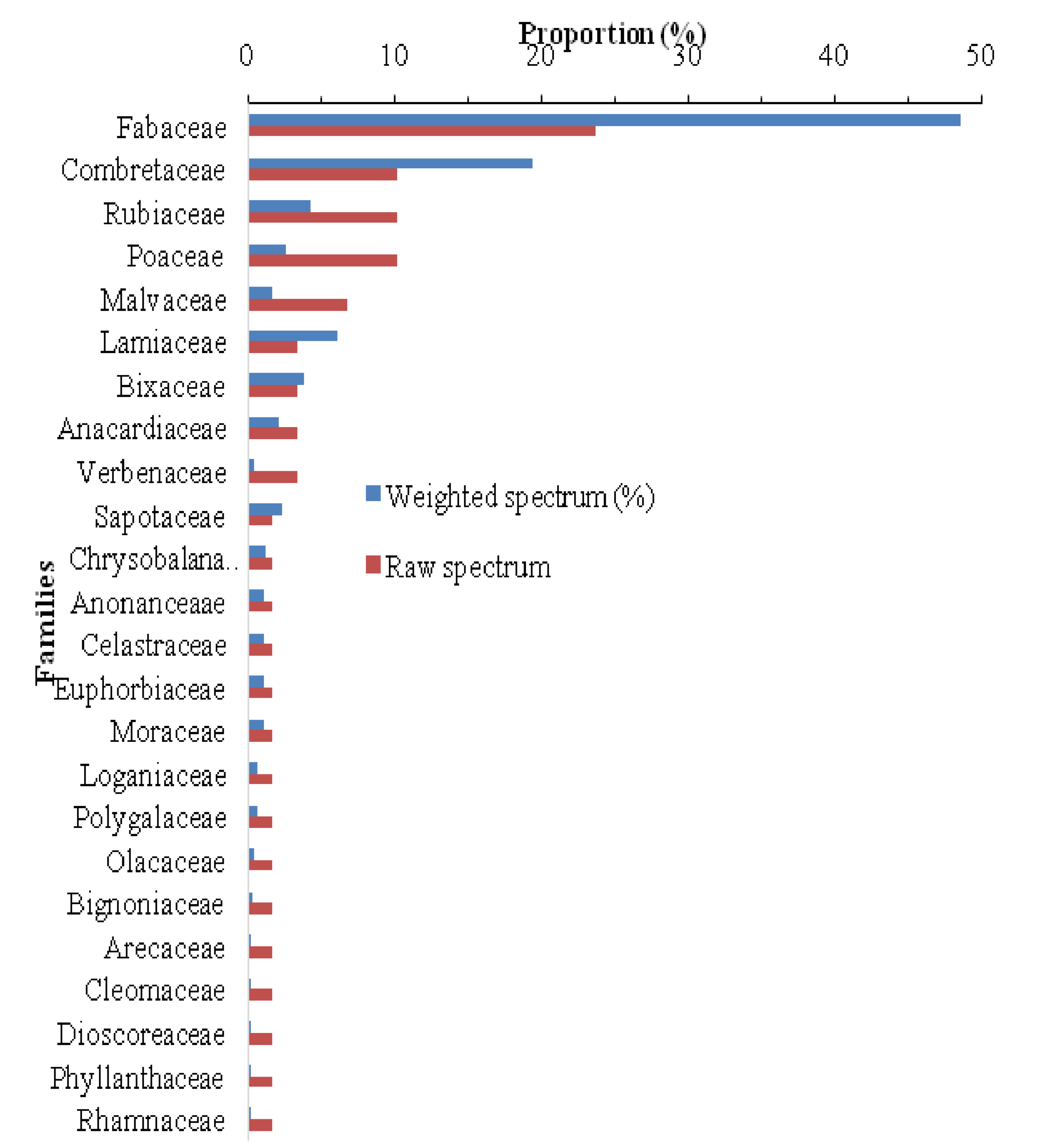
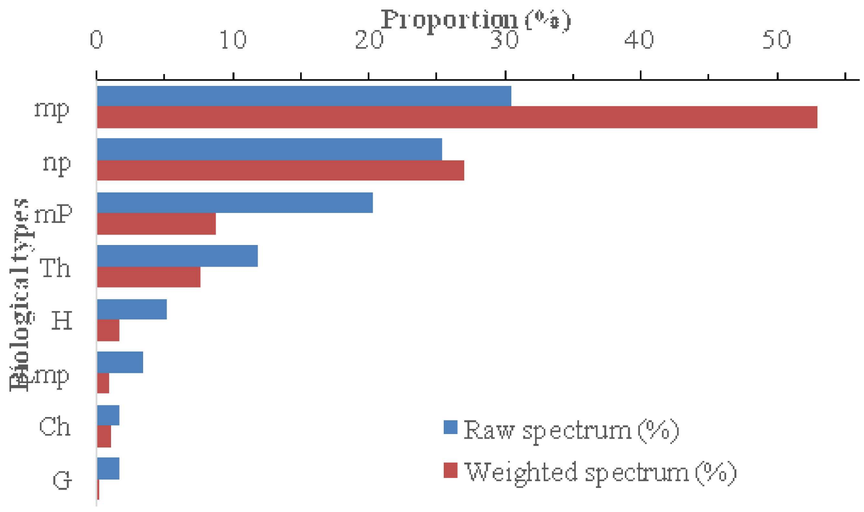


Figure 5: Weighted and Raw Spectrums of Families in the KCF

In the KCF, tree phytogeographical plant species are represented. Soudano-Zambezian species (SZ, 54.24%) were the most common. They were followed by the transitional species (GC-SZ: Guinea-Congolese/Soudano-Zambezian 42.37%). Introduced species were the least represented (I: 3.39%).

The most represented biotypes in the KCF are microphanerophytes and nanophanerophytes (Figure 6). The less diverse and abundant species are the chamephytes and the geophytes.

One endangered species (*Vitellaria paradoxa*) and one near-threatened species (*Terminalia laxifolia Engl.*) were included in the KCF floras. IUCN Red List criteria are not applicable to 38.98%. A proportion of 61.02% of the plants are of least concern.



Note: Ch = chamephyte, G = geophyte, H = hemicryptophyte, Lmp = liana mesophanerophyte, np = nanophanerophyte, mp = microphanerophyte, mP = mesophanerophyte, Th = therophyte.

Figure 6: Weighted and Raw Spectrums of Plant Biological Types in the KCF

3.3. Descriptrion of Woody Plant Communities

There were 16 species in the woody plant community of KCF. *Detarium microcarpum* was the most important species (IVIsp = 128.68%). This key species is followed by *Vitellaria paradoxa* (Table 3). The 16 woody species are divided into

Table 3: Woody Plant Species Importance Value Indices (IVI) within Kouampante Community Forest of Togo

Scientific Name	DENR	DOM	FR	IVI
Detarium microcarpum Guill. and Perr.	37.50	6.56	84.62	128.68
Vitellaria paradoxa C.F.Gaertner subsp. *paradoxa*	12.50	4.80	69.23	86.54
Combretum collinum Fresen.	9.38	1.73	53.85	64.95
Parkia biglobosa (Jacq.) R.Br. ex Benth.	7.81	20.74	30.77	59.32
Lannea acida A.Rich. s.l.	7.03	3.92	46.15	57.11
Entada abyssinica Steud. ex A.Rich.	4.69	33.46	15.38	53.53
Sterculia setigera Delile	4.69	5.84	30.77	41.30
Terminalia laxifolia Engl.	5.47	1.17	30.77	37.41
Acacia dudgeonii Craib ex Holland	4.69	1.66	23.08	29.42
Bombax costatum Pellegr. and Vuillet	1.56	5.41	15.38	22.35
Tamarindus indica L.	1.56	8.67	7.69	17.92
Prosopis africana (Guill. and Perr.) Taub.	0.78	2.92	7.69	11.39
Ficus ingens (Miq.) Miq.	0.78	2.76	7.69	11.23
Parinari curatellifolia Planch. ex Benth.	0.78	0.24	7.69	8.71
Lannea microcarpa Engl. ad K. Krause	0.78	0.12	7.69	8.59

genera and 7 families. The Fabaceae family is the most diverse family with 6 species (Table 4). It is also the most dominant and densest family. As a result, it is so far the most important of the KCF (FIV = 168.54%). Average density was estimated at 99 stems/ha. Mean diameter and basal area were 18.11 cm and 2.53 m²/ha respectively. Mean height was 7.57 m.

Table 4: Family Important Values (FIV) of Woody Plants within Kouampante Community Forest of Togo

Families	DENR	DOM	DIV	FIV
Fabaceae	57.03	74.01	37.5	168.54
Combretaceae	14.84	2.91	18.75	36.50
Anacardiaceae	6.25	11.25	12.5	30.00
Malvaceae	7.81	4.04	12.5	24.35
Chrysobalanaceae	12.50	4.80	6.25	23.55
Moraceae	0.78	2.76	6.25	9.79

3.4. Demographic Structure

There is an inverted J-shape (with c<1) in the distribution of trees by diameter and height classes. The most dominant trees are those with small diameter and height. More than half of the trees are between 5 and 10 m in diameter and between 2 and 4 m in height. They account for 59.69% and 58.14%, respectively.

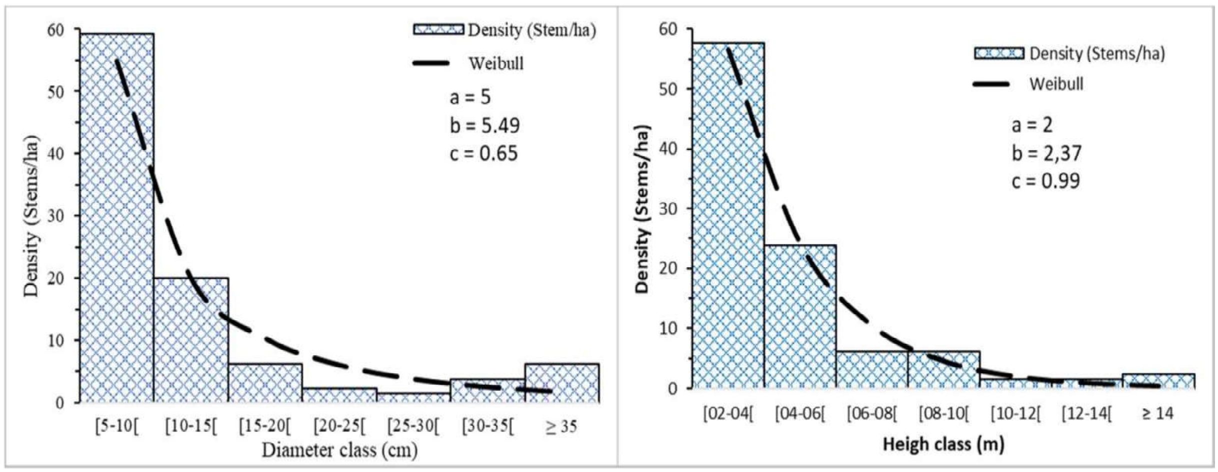


Figure 7: Kouampante Community Forest Woody Plant Diameter and Height Structure

4. Discussion

Between 2010 and 2020, the analysis of Google Earth images of the Kouampante community forest shows a progressive vegetation dynamic. A regression of croplants/fallows to tree/shrub savannahs was observed. This result is comparable to that found in Alibi 1 community forest (Kombate *et al.*, 2023a) and in the Aboudjokopé forest (Egbelou *et al.*, 2021) in the Central Region and the Plateaus Region of Togo respectively. These studies highlighted the contribution of community forest in forest restoration. The progression of tree/shrub savannah in 2020 is due to the protective measures implemented by the community. This could be due to the lasting management of these forest by local communities following reforestation (Atakpama *et al.*, 2022b). Protection against wildfire, plantation of several plants, regulation of human activities and promotion of socioeconomic activities in and around community forests recently by the means of several projects could justify this state (Atakpama *et al.*, 2018; Atakpama *et al.*, 2023b). With the exception of the Abdoulaye wildlife reserve (Atakpama *et al.*, 2021), all protected areas of Togo experience anthropogenic pressure conducing to regression of forest lands (Atakpama *et al.,* 2023d; Polo-Akpisso *et al.,* 2018b; Polo-Akpisso *et al.*, 2015, 2020). The same trends were described in West African protected areas (Biaou *et al.*, 2019; Dimobe *et al.*, 2017).

KCF has an estimated flora diversity of 59. Compared to most other community forests in ecological zones 3, 4 and 5 of Togo (Atakpama *et al.*, 2017; Atakpama *et al.*, 2023a; Folega *et al.*, 2017; Folega *et al.*, 2023; Koumoi, 2023), this diversity was low. The smaller size of this forest and the climatic conditions of the area may explain this difference. The low rainfall limited the diversity. KCF plant species diversity was comparable to that of Dankpen district (Atakpama *et al*., 2022b) with a similar climatic conditions.

Globally, the most common families are Fabaceae and Combretaceae. The climatic conditions and vegetation type of the area are confirmed by this finding. Native vegetation was Sudanese savannah with Fabaceae (sometimes thorny *Acacia*) and Combretaceae(Akpagana and Bouehet, 1994; Brunel *et al.,* 1984). This finding was comparable to that of the sacred groves of the Savannahs Region (Atakpama *et al.*, 2021b). In contrast, within the complex of protected areas of Oti-Kéran-Mandouri, located in the same ecological zone, the study of Polo-Akpisso *et al.* (2015) showed that the Poaceae were the most represented. This showed that KCF had more woody vegetation. However, the structural characteristics of the woody vegetation showed that there were more young trees in the KCF. Meliaceae (represented mainly by *Azadirachta indica*, an introduced and invasive species), recently described as dominant in ecological zone 1 (Folega *et al*., 2019b; Folega and Ekoungoulou, 2022) was not present in NCF.

High woody plant abundance was confirmed by high representation of phanerophytic plant species. This was an indication of the reduction of anthropogenic threats in comparison with the protected areas of the zone, which are under high human pressure (Atakpama et al., 2023c; Polo-Akpisso *et al.*, 2015). Therefore, managing this vegetation in a sustainable way may result in having open forests.

As a feature of the area, the KCF is dominated by Soudano-Zambezian species. This is comparabl e to several studies in Ecological Zone 1 (Atakpama *et al.*, 2019; Folega and Ekoungoulou, 2022; Polo-Akpisso *et al*., 2015). The transitional species were the most abundant in the sacred groves of Savannahs Region and the classified forest of Doungh Pit (Atakpama *et al.*, 2023c; Atakpama *et al.,* 2021b). This showed that the KCF was less humid than the latter two.

Inverted J-shape diametric and height distribution observed in KCF. This suggests a high presence of young individuals in the KCF. It also underlines the recent forest protection measures. This is a consequence of the absence of large diameter trees (Atakpama *et al.*, 2023c). It also suggests the presence of several future stems to ensure that the forest continues to recover (Tsoumou *et al.*, 2016). This condition has been described in several community forests in Togo (Atakpama *et al.*, 2017; Bawa *et al.*, 2022; Folega *et al.,* 2017a; Folega *et al.,* 2017b).

5. Conclusion

Improving ecosystem functionality of community-managed forests is crucial for preserving biodiversity. The present investigation described qualitative vegetation characteristics in Kouampante Community Forest. The spatio-temporal dynamics indicate forest recovery within the Kouampante Community Forest. The originality of the climatic conditions of Ecological Zone 1 was demonstrated by the diversity of the KCF. The most dominant plants are woody species with small diameters and heights. This highlighted the recent measures taken to protect the previously anthropogenic threatened area. It represents an opportunity for restoring the forest. The forest must be enriched with useful and nationally threatened species. Special attention should be paid to fire management, as the ecosystems in the area are vulnerable to forest fires. The study details the ecological characteristics of Kouampante Community Forest in Togo. The findings can serve as a basis for the sustainable use and conservation of community-managed forests in the region.

6. Funding

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7. Data Availability Statement

WASCAL data is open access and will be made available when a formal request is received by the institution through the Data Administration Unit.

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9. Conflicts of Interest

The authors declare no conflicts of interest.

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Appendix A

List of Plant Species within Kouampante Community Forest (NCF)

Table A1: List of Plant Species Within Kouampante Community Forest (KCF) in Togo

Species	Families	TP	TB
Acacia amythethophylla Steud. ex A. Rich.	Fabaceae	SZ	mP
Acacia dudgeonii Craib ex Holland	Fabaceae	SZ	mp
Acacia gourmaensis A.Chev.	Fabaceae	SZ	mp
Andropogon tectorum Schumach. & Thonn.	Poaceae	GC-SZ	H
Annona senegalensis Pers.	Anonanceaae	GC-SZ	np
Bombax costatum Pellegr. & Vuillet	Malvaceae	SZ	mP
Borassus aethiopum Mart.	Arecaceae	GC-SZ	mP
Bridelia scleroneura Müll.Arg.	Phyllanthaceae	SZ	np
Burkea africana Hook.	Fabaceae	SZ	mp
Cleome monophylla L.	Cleomaceae	GC-SZ	Th
Cochlospermum planchonii Hook.f.	Bixaceae	SZ	np
Cochlospermum tinctorium A.Rich.	Bixaceae	SZ	np
Combretum adenogonium Steud. ex A.Rich.	Combretaceae	SZ	mp
Combretum collinum Fresen.	Combretaceae	SZ	mp
Combretum nigricans Lepr. ex var. *elliotii* (Engl. & Diels) Aubrev.	Combretaceae	GC-SZ	mP
Crossopteryx febrifuga (G.Don) Benth.	Rubiaceae	GC-SZ	mp
Dactyloctenium aegyptium (L.) Willd.,	Poaceae	GC-SZ	H
Desmodium gangeticum (L.) nc. var. *gangeticum*	Fabaceae	GC-SZ	np
Detarium microcarpum Guill. & Perr.	Fabaceae	SZ	mp
Dioscorea rotundata Poir.	Dioscoreaceae	GC-SZ	G
Eleusine indica (L.) Gaertn.	Poaceae	GC-SZ	H
Entada abyssinica Steud. ex A.Rich.	Fabaceae	GC-SZ	Lmp
Euphorbia convolvuloides Hochst. ex Benth.	Euphorbiaceae	SZ	Ch
Feretia apodanthera Delile ssp. *apodanthera*	Rubiaceae	SZ	mp
Ficus ingens (Miq.) Miq.	Moraceae	SZ	mp
Gardenia aqualla Stapf & Huteh.	Rubiaceae	GC-SZ	np
Gardenia erubescens Stapf & Huteh.	Rubiaceae	GC-SZ	np
Grewia lasiodiscus K. Schum.	Malvaceae	SZ	mp
Grewia cissoides Hutch. & DalzieI	Malvaceae	SZ	mp

Appendix A (Cont.)

Species	Families	TP	TB
Guiera senegalensis J.F.Gmel.	Combretaceae	SZ	np
Gymnosporia senegalensis (Lam.) Loes.	Celastraceae	SZ	np
Hyptis spicigera Lam.	Lamiaceae	SZ	np
Hyptis suaveolens (L.) Poit.	Lamiaceae	GC-SZ	np
Lannea acida A.Rich. s.l.	Anacardiaceae	GC-SZ	mP
Loudetia hordeiformis (Stapf) C.E.Hubbard	Poaceae	GC-SZ	Th
Ozoroa insignis Delile	Anacardiaceae	SZ	np
Parinari curatellifolia Planch. ex Benth.	Chrysobalanaceae	SZ	mp
Parkia biglobosa (Jacq.) R.Br. ex Benth.	Fabaceae	GC-SZ	mP
Pennisetum polystachion (L.) Sehult. *polystachion*	Poaceae	GC-SZ	Th
Piliostigma thonningii (Schumach.) Milne-Redh.	Fabaceae	GC-SZ	np
Prosopis africana (Guill. & Perr.) Taub.	Fabaceae	SZ	mP
Pteleopsis suberosa Engl. & Diels	Combretaceae	SZ	mp
Sarcocephalus latifolius (Sm.) E.A.Bruce	Rubiaceae	GC-SZ	Lmp
Securidaca longepedunculata Fresen.	Polygalaceae	SZ	mp
Senna obtusifolia (L.) H.S.Irwin & Barneby	Fabaceae	GC-SZ	np
Spermacoce radiata (DC.) Hiem	Rubiaceae	GC-SZ	Th
Sterculia setigera Delile	Malvaceae	SZ	mP
Stereospermum kunthianum Cham.	Bignoniaceae	SZ	mP
Strychnos spinosa Lam.	Loganiaceae	SZ	mP
Tamarindus indica L.	Fabaceae	GC-SZ	mP
Tectona grandis L.f.	Verbenaceae	I	mP
Tephrosiaflexuosa G.Don	Fabaceae	GC-SZ	Th
Terminalia laxifolia Engl.	Combretaceae	SZ	mp
Thelepogon elegans Roth ex Roem.	Poaceae	SZ	Th
Vigna subterranea (L.) Verde.	Fabaceae	I	Th
Vitellaria paradoxa C.F.Gaertner subsp. i	Sapotaceae	SZ	mP
Vitex simplicifolia Oliv.	Verbenaceae	SZ	np
Ximenia americana L.	Olacaceae	GC-SZ	mp
Ziziphus mucronata Willd.	Rhamnaceae	SZ	mp

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