

SPECIES COMPOSITION AND ABUNDANCE OF NON-TIMBER FOREST PRODUCTS AMONG THE DIFFERENT-AGED COCOA AGROFORESTS IN SOUTHEASTERN CAMEROON

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ABSTRACT The study has been conducted to clarify the species composition and abundance of Non-Timber Forest Products (NTFPs) of the cocoa agroforests in the Gribé village, southeastern Cameroon. A total of 40 cocoa-farmed plots were sampled and divided into four age-classes. The number of sampled plots by age class are: (a) 10 plots with 0–10-year-old plot, (b) 10, 10–20-year-old, (c) 10, 20–30-year-old and (d) 10, over 30-year-old. A vegetation survey on these plots recorded a total of 3,879 individual trees. They were classified into 166 species, 131 genera and 45 families. The most diversified families were Rubiaceae (including 13 species), Annonaceae (12) Sterculiaceae (10), Euphorbiaceae (9), Caesalpiniaceae and Moraceae (8 for each). The top ten leading dominant species were *Musanga cecropioides*, *Terminalia superba*, *Ficus mucoso*, *Celtis mildbraedii*, *Pterocarpus soyauxii*, *Triplochiton scleroxylon*, *Margaritaria discoidea*, *Markhamia lutea*, *Trilepisium madagascariense*, and *Ficus exasperata*. The mean values of the Shannon-Wiener diversity index (H') increased with the age of cocoa plot: 4.8 for the age class of 0–10-year-old, 4.7 for 10–20-year-old, 5.1 for 20–30-year-old and 5.6 for over 30-year-old. An ethnobotanical survey revealed that majority of the recorded species were used either as food (54%), medicine (33%) or for other purposes. We conclude that the cocoa agroforests, maintained by the Gribé people, include a high diversity of NTFP species.

Key Words: Cocoa agroforest; NTFP diversity; Ethnobotanical survey.

INTRODUCTION

The cocoa agroforest is an agricultural system composed of major two elements, cocoa trees and other scattered shade trees, the crowns of which expand above the cocoa trees' layer to protect them from strong sunlight. Due to the fact that such shade trees include numerous species, this agroforest system has been considered as an excellent example of harnessing biodiversity conservation and the livelihood of the local people (Rice & Greenberg, 2000; Ruf & Schroth, 2004). Moreover, many researchers pointed out that the shade trees have environmental, social and economic values and play important role in reducing the vulnerability of household economies depending on the cocoa cultivation and cocoa bean trade (Sonwa et al., 2007; Tschamtké et al., 2011).

Shade trees provide a variety of services including food, firewood, medicine, fiber, construction materials, timber, etc. (Somarriba, 2007). These Non-Timber Forest Products (NTFPs) obtained from the shade trees become alternative sources of income in the short and long term (Corven, 1993), since the farmers' income from the cocoa cultivation varies widely throughout the year. Thus, shade trees can save the farmers' resilience against the high variability in cocoa market prices (Somarriba, 2007).

Sonwa et al. (2007) estimated that, in Cameroon, about 400,000 farmers practice cocoa cultivation on about 400,000 ha of land. The majority of the cocoa agroforests exist in the Center, South and East Regions of the country (Sonwa et al., 2001). Due to their importance, as mentioned above, many studies on the cocoa agroforest have been carried out. In the humid forest zone of the Central and South Regions of Cameroon, Sonwa et al. (2007) reported a total of 206 tree species, with an average of 21 tree species per farmed plot. Also, the most frequent species growing in these plots were oil palm (*Elaeis guineensis*), African plum (*Dacryodes edulis*) and avocado (*Persea americana*). These trees were used by local people as timber, food and other purposes (Wilkie, 2000). A similar study conducted in the villages of Ngomedzap, Bakoa, Talba, Kedia and Obala, located in the five major cocoa cultivation Regions of the country, reported a total of 102 non-cocoa tree species and 260 herbaceous species (described as "companion") in the five traditional cocoa agroforests. The most common tree species were *Albizia adianthifolia* and *Ficus exasperata* (Bisseleua et al., 2008). In the Southwestern Region of Cameroon, Eyoho Ewane (2012) reported 1,399 plant individuals (belonging to 58 species) in 30 plots.

By comparison, significant differences in species richness and composition are seen among the cocoa agroforests. On the other hand, all the studies pointed out the importance of improvement in the structural complexity of the cocoa agroforests, as well as keeping the total benefits obtained from both the cocoa itself and many types of the ecosystem services brought by the "companion" plants.

Unlike the other cocoa-growing areas in Cameroon, few studies have been conducted in the East Region of the country. Thus, this study investigates the composition, population structure, abundance of tree species growing in different-aged cocoa agroforests, in the Gribé village of the East Region. It also describes the use of the trees by the local people.

METHODS

I. Study Area

The study was carried out in the Gribé village in southeastern Cameroon (Fig. 1). The inhabitants consist of two ethnic groups: the Baka hunter-gatherers and the Konabembe Bantu-speaking agriculturalist. The population is estimated at 700. The vegetation in this area is classified as semi-deciduous forest, rich in Sterculiaceae and Ulmaceae (Letouzey, 1968). Rainfall varies between 1300 to

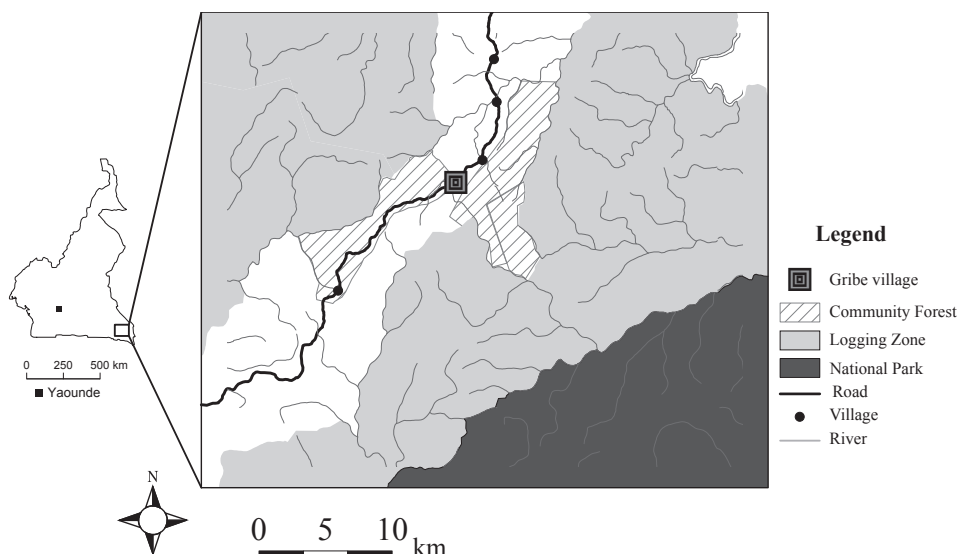


Fig.1. Study area.

1600 mm per year.

Introduced in Cameroon in 1886 by the German colonial administration, cocoa production shifted from an enclave model of plantations owned by foreign planters to a system based on indigenous smallholders in the mid 1920s (Gockowski & Dury, 1999). The people in southeastern Cameroon (both the Baka and Bantu-speakers) began their cocoa cultivation as a cash crop, since 1920–30s (Oishi, 2012). Liberalization of the cocoa market in Cameroon in 1993 resulted in the heavy decline of producer prices of cocoa (Duguma et al., 2001). A renaissance period of new plantation creation started with the rise of cocoa prices, caused by the decline of production in the Ivory Coast and other West African cocoa producing countries suffering from civil wars and other political crises (Oishi, 2012).

II. Data Collection and Analysis

In order to conduct a vegetation survey, a total of 40 cocoa-farmed plots were sampled and divided into four age-classes. The number of sampled plots by age class are: (a) 10 plots with 0–10-year-old plot, (b) 10, 10–20-year-old, (c) 10, 20–30-year-old and (d) 10, over 30-year-old (Table 1). The areas of all plots were measured using GPS and GIS. All individual trees were recorded and their diameter at breast height (DBH) were measured. In addition, information related to the plant uses by the villagers was collected: usage, parts, processing method and method of plant collection. According to Prance et al. (1987), the usage types were classified into five categories: (1) Food, (2) Material for building, (3) Material for tools, (4) Medicine and (5) Others (e.g., ornamentals, magico-religious uses).

Table 1. Number and area of the sampled plot, by age class

	Age class (year-old)				Total
	0–10	10–20	20–30	> 30	
Number of sampled plot	10	10	10	10	40
Total area (ha)	2.3	3.7	6.4	6.5	18.9
Mean area (ha)	0.2	0.4	0.7	0.7	1.9
Min–Max area (ha)	0.1–0.4	0.1–0.7	0.2–2.2	0.1–1.8	0.1–2.2
Standard deviation	0.1	0.2	0.6	0.6	0.5

To show the plant diversity for all plots, the Shannon-Wiener diversity index (H') was calculated. The equation is as follow:

$$H' = -\sum_{i=1}^S p_i \log_2(p_i) \text{ where } S \text{ is the number of species, } p_i \text{ is the proportion of the species } i.$$

We also calculated the density of each species as follow:

$$D = n_i / A, \text{ where } A \text{ is the area of sampled plot, } n \text{ is number of individual of species } i.$$

The Importance Value Index (IVI) of NTFP species was computed as the sum of relative abundance, relative dominance and relative frequency of species:

$$IVI = \text{Relative abundance} + \text{Relative dominance} + \text{Relative frequency}.$$

$$\text{Relative abundance} = \frac{\text{Number of individuals of a species}}{\text{Total number of sample individuals}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Basal area}}{\text{Total basal area}} \times 100$$

where basal area = $\sum \pi L_i^2 / 4$, L denotes DBH.

$$\text{Relative frequency (RFR)} = \frac{\text{Frequency of a species}}{\text{Total number of sampling unit}} \times 100$$

Pearson's correlation was calculated to examine whether the age of a cocoa plot relates to number of useful trees.

RESULTS

I. Species Composition

A total of 166 tree species were recorded across all plots. These species were classified into 131 genera and 45 families. The mean density was 208.8 stems/ha for NTFP species. The most diversified family was Rubiaceae with 13 species, followed by Annonaceae (12 species) and Euphorbiaceae (9 species) (Table 2).

The top 10 species with the highest value of IVI, and considered as the most ecologically important species in the studied cocoa plots, were *Musanga cecropioides* (IVI = 105.9), *Terminalia superba* (92.9), *Ficus mucoso* (79.3), *Celtis mildbraedii* (77.0), *Pterocarpus soyauxii* (66.7), *Triplochiton scleroxylon* (60.2), *Margaritaria discoidea* (59.7), *Markhamia lutea* (59.4), *Trilepisium madagascariense* (58.4) and *Ficus exasperata* (55.0).

The NTFP abundances were different in the age-classes of the cocoa plots (Table 3). The highest number of species (N = 126) was found in the plots aged 20–30-year-old, while the highest tree density (282.7 stems/ha) was marked in the plots aged 0–10 year-old. H' value increased with the rising of the age-class. The trees with the largest diameter, among all the individuals, were found in the oldest plots.

Table 2. Recorded families and their number of species

Family	Number of species
Rubiaceae	13
Annonaceae	12
Sterculiaceae	10
Euphorbiaceae	9
Moraceae, Meliaceae, Caesalpiniaceae	8
Apocynaceae	7
Mimosaceae, Ulmaceae	6
Sapotaceae, Olacaceae, Anacardiaceae	5
Irvingiaceae, Burseraceae, Putranjivaceae	4
Tiliaceae, Myristicaceae, Sapindaceae, Clusiaceae, Ebenaceae	3
Bombacaceae, Samydaceae, Salicaceae, Combretaceae, Cecropiaceae, Lauraceae, Bignoniaceae, Verbenaceae	2
Myrtaceae, Huaceae, Flacourtiaceae, Passifloraceae, Ixonanthaceae, Arecaceae, Rhamnaceae, Hypericaceae, Menispermaceae, Boraginaceae, Rutaceae, Pandaceae, Lecythidaceae, Lepidobotryaceae, Violaceae	1

Table 3. Density and diversity of NTFP by age class of cocoa plots

	Age-class (year-old)			
	0–10	10–20	20–30	> 30
Density (stems/ha)	274.7	182.3	226.6	180.0
Species richness	102	91	125	110
Shannon-Wiener index	4.8	4.7	5.1	5.7
Mean DBH (cm)	20.0	34.0	27.0	36.0
Basal area (m ² /ha)	12.6	15.5	9.3	15.0

Table 4. Top ten NTFP species with highest Importance Value Index (IVI) by the age-class

Species	IVI values by age-class (year-old)				IVI for whole 40 plots
	0–10	10–20	20–30	> 30	
<i>Musanga cecropioides</i>	53.3	51.1	47.7	35.3	105.9
<i>Celtis mildbraedii</i>	23.5	21.0	22.2	30.8	76.9
<i>Terminalia superba</i>	20.0	18.0	41.4	41.8	92.8
<i>Trilepisium madagascariense</i>	14.8	12.8	18.9	30.6	58.4
<i>Ficus mucuso</i>		24.5	44.3	32.5	79.3
<i>Pterocarpus soyauxii</i>		23.1	20.5	32.9	66.7
<i>Markhamia lutea</i>			33.2	34.3	59.4
<i>Pycnanthus angolensis</i>			21.3	29.3	54.1
<i>Entandrophragma candollei</i>			21.0	25.2	46.0
<i>Staudtia kamerunensis</i>	14.3	16.7			48.4
<i>Celtis adolfi-friderici</i>	16.6	12.1			51.0
<i>Entandrophragma cylindricum</i>	15.6	12.8			36.8
<i>Albizia glaberrima</i>				34.0	49.6
<i>Coelocaryon preussii</i>			20.6		30.4
<i>Macaranga spinosa</i>	19.6				46.4
<i>Trema orientalis</i>	16.9				38.7
<i>Detarium macrocarpum</i>	15.2				5.5
<i>Harungana madagascariensis</i>		13.2			33.0

Table 5. Sorensen similarity index of pairs of age-class (year-old) of sampled plot

Age-class	0–10	10–20	20–30	> 30
0–10	1			
10–20	0.70	1		
20–30	0.70	0.67	1	
>30	0.60	0.59	0.75	1

Table 4 shows the IVI value of NTFP species by age-class. The leading dominant species for the plots aged 0–10 years were: *Musanga cecropioides*, *Celtis mildbraedii*, *Terminalia superba*, *Macaranga spinosa*, and *Trema orientalis*. Those for the 10–20-year-old plots were: *Musanga cecropioides*, *Ficus mucuso*, *Celtis mildbraedii*, *Pterocarpus soyauxii*, and *Margaritaria discoidea*. Those for the 20–30-year-old plots were: *Musanga cecropioides*, *Ficus mucuso*, *Terminalia superba*, *Triplochiton scleroxylon* and *Alstonia boonei*. Those for the plots above 30-year-old were: *Terminalia superba*, *Musanga cecropioides*, *Markhamia lutea*, *Albizia glaberrima*, and *Pterocarpus soyauxii*.

The similarities in species composition among the four age-class plots were examined using the Sorensen Similarity Index (Table 5). Overall, all the pairs showed relatively high values, which indicates that the species composition did not differ so much among the four age-class plots.

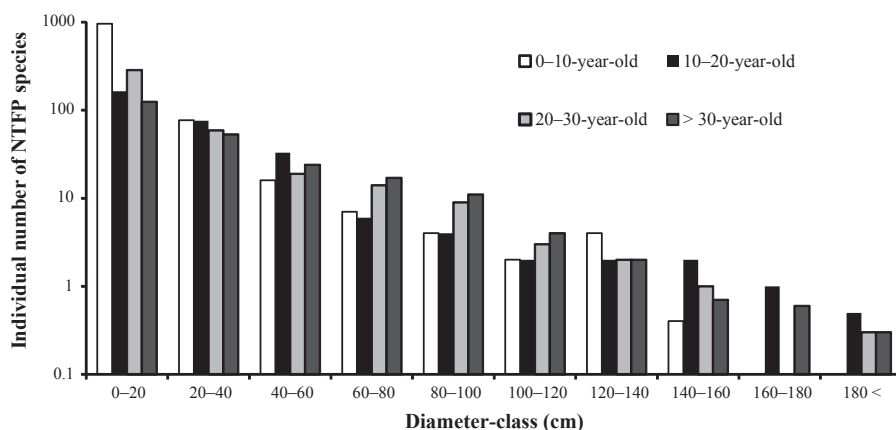


Fig. 2. Size (DBH)-class distribution of NTFP species in the cocoa plots by age-class.

II. Population Structure of NTFP Species

Overall, the distribution pattern of NTFPs in diameter-class was the inverted-J shape (Fig. 2). As it is the case in most tropical rain forests, this structure reflects a dominance of small diameter species in cocoa agroforests. In the lower classes (below 40 cm DBH), the most abundant species were *Celtis zenkeri*, *Ficus mucoso*, *Musa sapientum* and *Musanga cecropioides*. In the upper classes (above 100 cm DBH), the most abundant were *Terminalia superba* and *Triplochiton scleroxylon*.

III. Use of NTFP in Cocoa Agroforests

The majority of NTFP species recorded in the sampled plots were used either as food or as medicine (Fig. 3). Most frequent food products included *Myrianthus arboreus*, *Persea Americana*, *Elaeis guineensis*, *Mangifera* sp., *Fagara heitzii*, *Tetrapleura tetraptera*, *Ricinodendron heudelotii* and *Cola acuminata*. Most common

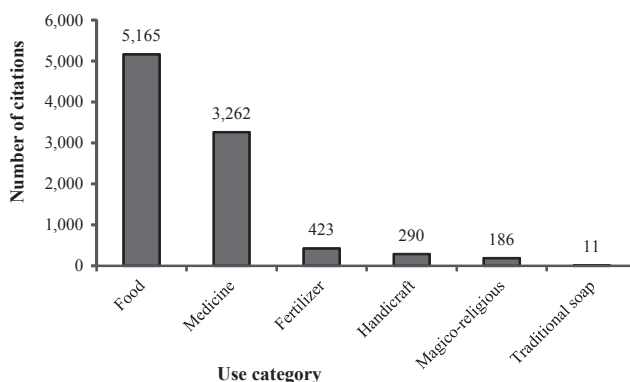


Fig. 3. Numbers of citations for NTFP-use categories.

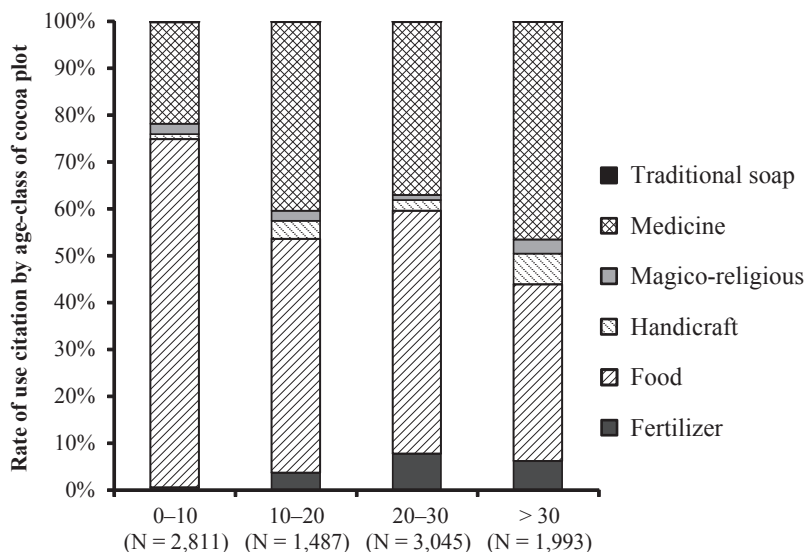


Fig. 4. Rate of use citation by age-class (year-old) of the cocoa plots.

medicinal products were *Musanga cecropioides*, *Terminalia superba*, *Celtis zenkeri*, *Myrianthus arboreus*, *Margaritaria discoidea*, *Markhamia lutea*, *Macaranga spinosa*, *Celtis mildbraedii*, *Trema orientalis* and *Mansonia altissima*.

Younger cocoa plots (0–10 years) were richer in food products while medicinal products were the most represented in older cocoa plots (Fig. 4).

DISCUSSION

I. Species Composition and Plant Diversity in Cocoa Agroforests

Cocoa agroforests are purported as having great potential for the conservation of biodiversity, as they can create a forest-like habitat that harbours biodiversity, while providing economic and social benefits to small-hold farmers. The number of species recorded in our cocoa plots (166 species) is lower than that of the humid forest zone of Cameroon (206 tree species) by Sonwa et al. (2007). The Southwestern and Central Regions of Cameroon are characterized by intensive cocoa farming; whereas the South and East Regions tend to have more extensive cocoa systems (Duguma et al., 1998). The overall species richness of our studied cocoa plots was likely to be greater, as Bisseleua et al. (2008) found a decreasing gradient of plant species numbers from extensive farms to intensive ones.

Musanga cecropioides, *Terminalia superba*, *Celtis mildbraedii*, *Ficus mucoso*, *Pterocarpus soyauxii*, *Margaritaria discoidea*, *Markhamia lutea*, *Trilepisium madagascariense*, *Triplochiton scleroxylon* and *Pycnanthus angolensis* were found

to be the leading dominant species of the cocoa plots in our study area. In the Center Region of Cameroon, Jiofack et al. (2013) noted a great importance of *Albizia adianthifolia*, *Albizia ferruginea*, *Albizia* sp., *Albizia zygia* and *Annona muricata*. Sonwa et al. (2007) found that *Elaeis guineensis*, *Dacryodes edulis*, *Persea Americana*, *Ficus exasperata*, *Terminalia superba*, *Ficus mucoso*, *Musa Paradisiaca* and *Spathodea campanulata* were among the most frequent species in cocoa agroforests.

Species richness did not vary with the age of cocoa plots. However, the H' value showed a rise with the increasing age of cocoa plots. Thus, this rise might be interpreted as an effect of changes in proportion of individual number for some species.

The Sorensen Similarity Index did not show much difference in terms of species composition among the different aged cocoa plots. However, we can predict that the rate of biomass accumulation will probably decline as cocoa plots age because the most dominant tree species (such as *Terminalia superba*) are commercial timber species, with an economic importance, and could be sold if there is a drastic drop in household income. Also the common *Musanga cecropioides*, which is the second leading dominant species of these cocoa plots, is a pioneer short-lived species (life-span around 20 years) dying before it is overshadowed by taller species.

In terms of diversity, the studied cocoa plots are relatively diversified compared to the studies done in other sites in the country. The Shannon-Wiener index (H') varied from 4.7 in young cocoa plots to 5.7 in old cocoa plots, with a general pattern of an increase in diversity with the age of cocoa plots. Eyoho Ewane (2012) and Zapfack et al. (2002) found, respectively, 3.0 and 4.39. Sonwa et al. (2007) obtained values of 3.9 (Ebolowa Area), 4.2 (Mbalmayo Area) and 3.1 (Yaounde Area).

II. NTFP Use in Cocoa Agroforests

Almost all trees growing in the cocoa agroforest supply the local people with diverse goods (food, medicine, building material, handicraft materials, etc.) and services (shade for cocoa trees, fertilizer, amenities for traditional rites, etc.). Cocoa agroforests with diverse tree species may be used to sustain both livelihoods of smallholders and ecological benefits within human-dominated tropical landscapes. The villagers have wide knowledge of the benefits obtained from trees: soil improvement, food, medicine, handicraft, religious and spiritual uses. Food and medicine trees were the most common tree species in the cocoa agroforests. Beside common crop-like species such as oil palm (*Elaeis guineensis*), banana and plantain (*Musa* spp.), they included local NTFPs like *Ricinodendron heudelotii*, *Irvingia gabonensis*. Sonwa et al. (2007) reported a relative abundance of edible species (17%), low value timber species (11%) and species with medicinal uses. They also pointed out that the farmers did not specify any important uses for 53% of the tree species associated with cocoa cultivation.

In addition, cocoa agroforests have been reported to provide habitat for a large number of bird species which depend, to some degree, on forests (Reitsma et al., 2001). Diverse cocoa and banana agroforestry systems contribute to conservation

efforts by serving as habitats to high numbers of bird and bat species, including some, but not all, forest-dependent species and species of known conservation concern (Harvey & Villalobos, 2007).

Shade trees can also be maintained for various benefits to the agroecosystem. Tree species representing Mimosaceae such as *Albizia* spp. are widely used for their nitrogen fixation from atmospheric nitrogen. In Peru, shade trees were even successfully used for the rehabilitation of cocoa agroforests where production had stagnated after soil depletion (Krauss & Soberanis, 2001). In addition, shade tree stands in cocoa agroforests have been related to lower pest pressures (Beer et al., 1998), high carbon storage and sequestration (Verchot et al., 2007; Eyoho Ewane, 2012), microclimate stabilization (Sporn et al., 2009) and soil protection against heavy rainfall (Dietz et al., 2006).

CONCLUSION

This study illustrated a high diversity of NTFPs in cocoa agroforests in Gribé village, southeastern Cameroon. It revealed the multiple uses of companion species tree in these cocoa agroforests. Economically high valued NTFPs (*Ricinodendron heudelotii*, *Irvingia gabonensis*, *Cola acuminata*) and timber species growing in the cocoa agroforests have been conserved by the villagers. Cocoa agroforests in this area can be considered more sustainable than those of southern Cameroon where, because of increasing market access and land use intensity, native forest species were increasingly replaced with common and often exotic tree crops such as oil palm, banana, plantain and avocado. The increase in NTFP species diversity, with the age of cocoa plots, suggests existing traditional management systems favoring constant enrichment of the stands through maintenance of natural regeneration or planting. Investigating ethnosylvicultural knowledge among local people will be necessary to clarify this hypothesis.

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Appendix I. Importance value index of species: 0–10-year-old cocoa plots

No.	Species name	Number of individuals	DBH (cm)			IVI
			Mean	Standard deviation	Max	
1	<i>Afrostrax lepidophyllus</i>	4	16.16	9.19	29.62	5.81
2	<i>Albizia glaberrima</i>	4	22.04	13.67	39.81	8.45
3	<i>Allanblackia floribunda</i>	2	30.41	1.58	31.53	3.40
4	<i>Angylocalyx vermeulenii</i>	5	25.36	6.00	31.85	8.71
5	<i>Aningeria robusta</i>	3	14.92	3.42	17.20	5.62
6	<i>Anonidium mannii</i>	1	24.04	-	24.04	3.02
7	<i>Anthothona macrophylla</i>	1	17.83	-	17.83	2.86
8	<i>Antrocaryon klaineianum</i>	4	46.74	46.60	113.69	12.01
9	<i>Beilschmiedia louisii</i>	1	11.62	-	11.62	2.75
10	<i>Blighia welwitschii</i>	3	15.55	14.35	31.85	5.64
11	<i>Bombax buonopozense</i>	1	26.34	-	26.34	3.09
12	<i>Brenania brieyi</i>	1	50.96	-	50.96	4.28
13	<i>Breviea leptosperma</i>	1	19.11	-	19.11	2.89
14	<i>Carapa</i> sp.	1	19.94	-	19.94	2.91
15	<i>Ceiba pentandra</i>	1	34.14	-	34.14	3.39
16	<i>Celtis adolfi-friderici</i>	7	27.99	16.20	57.64	16.62
17	<i>Celtis mildbraedii</i>	16	37.77	34.69	127.39	23.48
18	<i>Celtis philippensis</i>	1	16.46	-	16.46	2.83
19	<i>Celtis zenkeri</i>	4	8.41	4.84	14.17	5.69
20	<i>Chlorophora excelsa</i>	1	123.89	-	123.89	12.22
21	<i>Chytranthus atrovioleaceus</i>	1	8.12	-	8.12	2.70
22	<i>Cleistopholis patens</i>	4	8.74	2.61	12.10	3.19
23	<i>Coelocaryon preussii</i>	3	35.08	14.38	45.22	8.75
24	<i>Cola acuminata</i>	3	13.32	2.00	15.45	5.60
25	<i>Cola altissima</i>	2	25.16	30.63	46.82	5.72
26	<i>Cola</i> sp.	4	22.25	8.38	30.25	5.96
27	<i>Detarium macrocarpum</i>	1	142.04	-	142.04	15.23
28	<i>Diospyros canaliculata</i>	7	21.34	9.15	35.03	8.92
29	<i>Diospyros crassiflora</i>	2	68.95	9.68	75.80	8.28
30	<i>Discoglyprena caloneura</i>	3	19.00	14.14	31.21	5.71
31	<i>Drypetes gossweilerii</i>	2	40.45	1.35	41.40	6.34
32	<i>Duboscia macrocarpa</i>	2	29.22	14.30	39.33	5.86
33	<i>Elaeis guineensis</i>	1	74.84	-	74.84	6.15
34	<i>Enantia chlorantha</i>	1	41.94	-	41.94	3.76
35	<i>Entandrophragma candollei</i>	2	70.06	67.56	117.83	8.38
36	<i>Entandrophragma cylindricum</i>	8	53.78	43.35	133.76	15.60
37	<i>Erythrophleum suaveolens</i>	1	57.32	-	57.32	4.71
38	<i>fagara heitzii</i>	2	39.33	32.65	62.42	6.29
39	<i>Fernandoa adolfi-friderici</i>	1	8.28	-	8.28	2.70
40	<i>Ficus exasperata</i>	4	17.17	15.40	38.54	5.83
41	<i>Ficus mucoso</i>	9	13.95	13.39	46.66	11.58
42	<i>Funtumia elastica</i>	1	35.67	-	35.67	3.45
43	<i>Gambeya lacourtiana</i>	2	18.63	0.23	18.79	3.04
44	<i>Garcinia kola</i>	1	13.06	-	13.06	2.77
45	<i>Guarea thompsonii</i>	5	17.12	8.74	28.60	10.99
46	<i>Hallea stipulosa</i>	1	6.05	-	6.05	2.68
47	<i>Harungana madagascariensis</i>	7	9.76	4.05	14.49	11.19
48	<i>Homalium letestui</i>	2	19.11	6.76	23.89	3.05
49	<i>Irvingia excelsa</i>	2	81.85	14.86	92.36	9.50
50	<i>Irvingia gabonensis</i>	5	44.87	32.42	83.44	12.06
51	<i>Irvingia grandifolia</i>	1	98.73	-	98.73	8.73
52	<i>Keayodendron bridelioides</i>	2	46.82	23.42	63.38	6.69
53	<i>Klainedoxa gabonensis</i>	3	97.01	28.92	121.02	13.85
54	<i>Lannea welwitschii</i>	3	13.80	13.87	29.30	8.10
55	<i>Lepidobotrys staudtii</i>	3	16.30	12.09	30.25	8.15
56	<i>Macaranga spinosa</i>	44	5.87	5.14	32.80	19.64

Appendix I. (continued)

No.	Species name	Number of individuals	DBH (cm)			IVI
			Mean	Standard deviation	Max	
57	<i>Maesopsis eminii</i>	4	17.04	14.00	36.31	8.33
58	<i>Mammea africana</i>	5	20.64	8.96	32.55	6.07
59	<i>Mansonia altissima</i>	1	49.81	-	49.81	4.21
60	<i>Margaritaria discoidea</i>	5	24.55	18.80	54.46	6.18
61	<i>Markhamia lutea</i>	3	8.60	7.88	17.52	8.03
62	<i>Massularia acuminata</i>	2	9.47	2.36	11.15	5.38
63	<i>Musanga cecropioides</i>	205	10.49	11.25	98.73	53.24
64	<i>Myrianthus arboreus</i>	1	32.48	-	32.48	3.32
65	<i>Neosloetiopsis kamerunensis</i>	1	9.87	-	9.87	2.72
66	<i>Nesogordonia papaverifera</i>	4	20.70	25.93	57.96	8.41
67	<i>Ochthocosmus africanus</i>	1	53.50	-	53.50	4.44
68	<i>Oddoniodendron micranthum</i>	4	18.14	14.85	39.59	5.85
69	<i>Omphalocarpum lecomteanum</i>	1	8.76	-	8.76	2.71
70	<i>Ongokea gore</i>	2	61.77	4.30	64.81	7.70
71	<i>Ophiobotrys zenkeri</i>	1	42.68	-	42.68	3.80
72	<i>Pachypodanthium staudtii</i>	4	18.59	12.42	33.12	3.36
73	<i>Panda oleosa</i>	2	35.19	25.90	53.50	3.59
74	<i>Pausinystalia johimbe</i>	4	20.94	10.24	30.73	10.92
75	<i>Penianthus longifolius</i>	1	17.20	-	17.20	2.85
76	<i>Pentaclethra macrophylla</i>	9	38.69	36.30	130.57	12.39
77	<i>Pericopsis elata</i>	1	107.32	-	107.32	9.84
78	<i>Persea americana</i>	8	8.20	4.77	17.99	6.34
79	<i>Picralima nitida</i>	1	12.10	-	12.10	2.75
80	<i>Polyalthia suaveolens</i>	6	29.17	4.82	35.67	14.00
81	<i>Psychotria</i> sp.1	5	8.80	3.41	11.46	8.36
82	<i>Pterocarpus soyauxii</i>	6	28.30	10.39	46.82	8.97
83	<i>Pycnanthus angolensis</i>	4	11.98	11.55	26.75	8.24
84	<i>Ricinodendron heudelotii</i>	8	24.76	43.30	126.11	11.68
85	<i>Rinorea elliotii</i>	2	22.45	1.58	23.57	5.64
86	<i>Santiria trimera</i>	1	22.29	-	22.29	2.97
87	<i>Schumanniphyton magnificum</i>	1	4.78	-	4.78	2.68
88	<i>Staudtia kamerunensis</i>	10	18.64	5.98	30.89	14.33
89	<i>Sterculia tragacantha</i>	1	20.38	-	20.38	2.92
90	<i>Stipularia</i> sp.	5	5.15	1.38	7.32	5.83
91	<i>Strombosia pustulata</i>	4	26.71	11.59	34.87	8.59
92	<i>Strombosiopsis tetrandra</i>	2	53.18	8.56	59.24	4.59
93	<i>Terminalia superba</i>	20	52.41	47.72	130.57	19.95
94	<i>Tetrapleura tetraptera</i>	6	22.82	21.41	57.20	11.30
95	<i>Trema orientalis</i>	42	11.98	6.37	26.14	16.89
96	<i>trichilia tessmannii</i>	1	11.94	-	11.94	2.75
97	<i>Trichilia welwitschii</i>	1	17.83	-	17.83	2.86
98	<i>Trichoscypha acuminata</i>	3	24.04	22.60	47.61	5.85
99	<i>Trilepisium madagascariense</i>	7	43.71	14.83	63.69	14.82
100	<i>Triplochiton scleroxylon</i>	4	23.24	28.53	65.13	5.98
101	<i>Xylopia aethiopica</i>	1	14.33	-	14.33	2.79
102	<i>Xylopia</i> sp.	1	42.36	-	42.36	3.78

Appendix II. Importance value index of species: 10–20-year-old cocoa plots

No.	Species name	Number of individuals	DBH (cm)			IVI
			Mean	Standard deviation	Max	
1	<i>Afrostrax lepidophyllus</i>	2	51.91	5.86	56.05	6.66
2	<i>Albizia glaberrima</i>	8	22.25	18.88	64.78	8.94
3	<i>Alstonia boonei</i>	1	26.75	-	26.75	3.01
4	<i>Angylocalyx verzeulenii</i>	2	38.95	0.14	39.04	6.07
5	<i>Aningeria robusta</i>	1	26.11	-	26.11	2.99
6	<i>Anonidium mannii</i>	1	27.39	-	27.39	3.03
7	<i>Antrocaryon klaineianum</i>	1	31.53	-	31.53	3.15
8	<i>Aubrevillea kerstingii</i>	2	33.28	14.64	43.63	3.36
9	<i>Barteria fistulosa</i>	2	9.41	2.91	11.46	5.34
10	<i>Beilschmiedia louisii</i>	1	35.48	-	35.48	3.29
11	<i>Blighia welwitschii</i>	3	13.78	8.40	23.09	8.04
12	<i>Brevia leptosperma</i>	1	84.39	-	84.39	6.25
13	<i>Canarium schweinfurthii</i>	1	21.34	-	21.34	2.88
14	<i>Carapa</i> sp.	3	22.29	11.55	34.08	3.20
15	<i>Celtis adolfi-friderici</i>	7	46.63	11.27	58.76	12.14
16	<i>Celtis mildbraedii</i>	14	52.08	32.37	127.39	20.96
17	<i>Celtis philippensis</i>	1	67.52	-	67.52	4.96
18	<i>Celtis zenkeri</i>	3	25.00	13.31	40.13	5.76
19	<i>Chlorophora excelsa</i>	1	56.05	-	56.05	4.24
20	<i>Cleistopholis patens</i>	10	27.58	23.65	59.24	14.38
21	<i>Cola acuminata</i>	2	25.00	7.88	30.57	5.61
22	<i>Cola altissima</i>	4	21.14	24.60	57.96	8.32
23	<i>Cola ballayi</i>	2	24.36	5.18	28.03	3.10
24	<i>Cordia platythyrsa</i>	1	75.16	-	75.16	5.51
25	<i>Diospyros canaliculata</i>	1	14.01	-	14.01	2.75
26	<i>Discoglyprena caloneura</i>	1	27.71	-	27.71	3.04
27	<i>Donella ubanguiensis</i>	1	16.88	-	16.88	2.79
28	<i>Duboscia macrocarpa</i>	3	41.79	28.02	72.29	6.33
29	<i>Elaeis guineensis</i>	1	70.06	-	70.06	5.13
30	<i>Entandrophragma candollei</i>	6	18.61	14.20	34.08	8.57
31	<i>Entandrophragma cylindricum</i>	8	56.27	44.07	114.14	12.79
32	<i>Erythrophloeum suaveolens</i>	1	57.96	-	57.96	4.35
33	<i>fagara heitzii</i>	4	17.20	8.83	27.71	5.75
34	<i>Fernandoa adolfi-friderici</i>	16	37.13	13.15	55.10	18.08
35	<i>Ficus etrangulator</i>	5	47.24	29.35	89.17	11.87
36	<i>Ficus exasperata</i>	6	18.98	20.84	60.19	13.58
37	<i>Ficus mucoso</i>	43	33.47	18.83	80.48	24.48
38	<i>Funtumia elastica</i>	2	18.68	4.35	21.75	2.97
39	<i>Gambeya lacourtiana</i>	1	15.29	-	15.29	2.77
40	<i>Guarea cedrata</i>	1	46.62	-	46.62	3.75
41	<i>Guarea thompsonii</i>	1	120.70	-	120.70	10.02
42	<i>Guibourtia demeusei</i>	1	23.25	-	23.25	2.92
43	<i>Hallea stipulosa</i>	1	27.39	-	27.39	3.03
44	<i>Harungana madagascariensis</i>	21	9.56	4.13	20.22	13.18
45	<i>Hexalobus crispiflorus</i>	2	43.92	3.11	46.11	3.77
46	<i>Holoptelea grandis</i>	1	153.50	-	153.50	14.57
47	<i>Homalium</i> sp.	1	28.60	-	28.60	3.06
48	<i>Irvingia excelsa</i>	1	106.69	-	106.69	8.41
49	<i>Irvingia grandifolia</i>	1	31.50	-	31.50	3.15
50	<i>Keayodendron bridelioides</i>	3	47.61	2.00	49.68	9.09
51	<i>Klainedoxa gabonensis</i>	4	73.60	39.21	132.17	10.84
52	<i>Lannea welwitschii</i>	4	34.99	23.42	62.58	11.22
53	<i>Lepidobotrys staudtii</i>	1	16.56	-	16.56	2.79
54	<i>Macaranga spinosa</i>	4	10.47	4.58	14.33	5.65
55	<i>Maesopsis eminii</i>	7	25.76	17.84	53.82	11.38
56	<i>Mangifera</i> sp.	16	34.16	12.67	58.60	12.97

Appendix II. (continued)

No.	Species name	Number of individuals	DBH (cm)			IVI
			Mean	Standard deviation	Max	
57	<i>Mansonia altissima</i>	5	62.71	25.91	96.50	10.23
58	<i>Margaritaria discoidea</i>	19	14.25	17.47	78.66	20.43
59	<i>Markhamia lutea</i>	2	19.43	3.38	21.82	5.49
60	<i>Musanga cecropioides</i>	222	31.09	15.07	112.10	51.07
61	<i>Myrianthus arboreus</i>	17	15.51	8.68	27.07	10.16
62	<i>Nesogordonia papaverifera</i>	2	31.53	6.76	36.31	5.80
63	<i>Oncoba glauca</i>	3	5.70	0.99	6.46	5.46
64	<i>Ongokea gore</i>	2	55.42	30.62	77.07	4.35
65	<i>Pachyelasma tessmannii</i>	3	10.28	2.91	13.63	3.00
66	<i>Panda oleosa</i>	1	37.26	-	37.26	3.35
67	<i>Pentaclethra macrophylla</i>	3	44.15	33.06	78.15	6.43
68	<i>Persea americana</i>	12	21.22	12.00	37.26	19.52
69	<i>Petersianthus macrocarpus</i>	3	20.70	10.01	31.53	5.66
70	<i>Picralima nitida</i>	4	32.46	9.79	44.90	11.13
71	<i>Pseudospondias longifolia</i>	1	10.19	-	10.19	2.70
72	<i>Psychotria</i> sp.1	8	8.90	2.52	13.22	6.23
73	<i>Pterocarpus soyauxii</i>	18	29.34	17.42	59.24	23.12
74	<i>Pycnanthus angolensis</i>	8	42.39	21.63	80.45	12.10
75	<i>Rauvolfia vomitoria</i>	2	22.30	21.18	37.28	5.55
76	<i>Ricinodendron heudelotii</i>	1	8.28	-	8.28	2.68
77	<i>Santiria trimera</i>	3	21.35	4.48	25.48	3.18
78	<i>Staudtia kamerunensis</i>	8	31.24	16.05	51.91	16.69
79	<i>Sterculia tragacantha</i>	4	68.87	40.97	94.27	13.00
80	<i>Stipularia</i> sp.	3	25.91	21.00	50.16	5.79
81	<i>Strombosiopsis tetrandra</i>	1	27.07	-	27.07	3.02
82	<i>Terminalia superba</i>	30	43.58	47.14	129.90	17.93
83	<i>Tetrapleura tetraptera</i>	9	16.45	14.64	52.23	11.48
84	<i>Trema orientalis</i>	3	14.65	5.13	20.06	8.06
85	<i>Trichoscypha acuminata</i>	2	6.21	0.23	6.37	2.82
86	<i>Trilepisium madagascariense</i>	7	58.48	18.82	96.18	12.77
87	<i>Triplochiton scleroxylon</i>	16	119.41	49.20	181.53	19.60
88	<i>Vitex grandifolia</i>	3	133.86	79.06	203.82	14.51
89	<i>Xylopia aethiopica</i>	1	11.97	-	11.97	2.72
90	<i>Xylopia hypolampra</i>	1	58.41	-	58.41	4.38
91	<i>Xylopia</i> sp.	1	36.78	-	36.78	3.33

Appendix III. Importance value index of species: 20–30-year-old

No.	Species name	Number of individuals	DBH (cm)			IVI
			Mean	Standard deviation	Max	
1	<i>Azela bipindensis</i>	2	16.32	11.82	24.68	7.03
2	<i>Albizia ferruginea</i>	1	6.69	-	6.69	3.44
3	<i>Albizia glaberrima</i>	10	22.80	15.68	62.26	14.46
4	<i>Alchornea laxiflora</i>	1	11.94	-	11.94	3.52
5	<i>Allanblackia floribunda</i>	3	18.37	10.74	27.07	7.16
6	<i>Alstonia boonei</i>	44	58.83	26.55	111.46	35.93
7	<i>Amphimas pterocarpoides</i>	3	54.25	55.07	117.83	9.35
8	<i>Angylocalyx verweuleni</i>	3	31.32	10.62	42.36	7.70
9	<i>Aningeria robusta</i>	1	9.71	-	9.71	3.48
10	<i>Anthonothea macrophylla</i>	2	8.12	2.48	9.87	3.53
11	<i>Antrocaryon klaineianum</i>	4	22.37	3.97	27.71	10.69
12	<i>Aubrevillea kerstingii</i>	1	7.32	-	7.32	3.45
13	<i>Barteria fistulosa</i>	5	7.52	4.80	14.33	3.72
14	<i>Bertiera racemosa</i>	1	22.61	-	22.61	3.83
15	<i>Brevia leptosperma</i>	3	29.30	12.14	43.31	7.59
16	<i>Bridelia grandis</i>	1	9.55	-	9.55	3.48
17	<i>Canarium schweinfurthii</i>	2	18.31	7.88	23.89	3.75
18	<i>Carapa</i> sp.	1	10.67	-	10.67	3.50
19	<i>Ceiba pentandra</i>	2	46.97	59.68	89.17	8.66
20	<i>Celtis adolfi-friderici</i>	3	64.23	17.89	84.08	13.67
21	<i>Celtis mildbraedii</i>	13	39.11	40.78	146.50	22.18
22	<i>Celtis philippensis</i>	2	43.79	28.15	63.69	8.42
23	<i>Celtis zenkeri</i>	107	10.70	10.90	95.54	30.76
24	<i>Chlorophora excelsa</i>	2	48.41	43.91	79.46	8.77
25	<i>Chytranthus</i> sp.	1	5.73	-	5.73	3.43
26	<i>Cleistopholis patens</i>	17	19.37	14.26	60.51	24.81
27	<i>Cleistopholis</i> sp.	1	35.03	-	35.03	4.43
28	<i>Coelocaryon preussii</i>	8	8.76	3.99	12.74	20.61
29	<i>Cola acuminata</i>	8	26.89	7.77	34.24	11.16
30	<i>Cola altissima</i>	5	27.20	18.89	51.91	10.96
31	<i>Cola chlamydanthia</i>	1	26.11	-	26.11	3.98
32	<i>Cola</i> sp.	2	22.45	2.48	24.20	3.89
33	<i>Corynanthe pachyceras</i>	5	18.76	15.34	36.31	13.97
34	<i>Dacryodes edulis</i>	2	21.42	19.25	35.03	3.86
35	<i>Detarium macrocarpum</i>	4	31.13	43.15	95.86	4.42
36	<i>Diospyros canaliculata</i>	15	10.58	10.52	36.46	14.46
37	<i>Diospyros mannii</i>	1	25.16	-	25.16	3.93
38	<i>Discoglypema caloneura</i>	2	34.16	19.70	48.09	7.78
39	<i>Drypetes afzelii</i>	1	5.10	-	5.10	3.42
40	<i>Drypetes gossweileri</i>	2	6.53	4.28	9.55	6.84
41	<i>Drypetes klainei</i>	1	39.17	-	39.17	4.69
42	<i>Drypetes</i> sp.	1	11.15	-	11.15	3.51
43	<i>Duboscia macrocarpa</i>	2	29.62	7.66	35.03	7.54
44	<i>Elaeis guineensis</i>	20	52.76	26.31	99.36	27.04
45	<i>Entandrophragma candollei</i>	12	11.90	6.16	22.29	20.94
46	<i>Entandrophragma cylindricum</i>	2	53.34	16.89	65.29	9.20
47	<i>Eribroma oblonga</i>	3	33.76	14.63	44.90	11.16
48	<i>Erythrophleum suaveolens</i>	1	83.44	-	83.44	9.26
49	<i>fagara heitzii</i>	17	15.24	16.09	54.30	18.03
50	<i>Fernandoa adolfi-friderici</i>	4	22.81	10.49	36.94	10.71
51	<i>Ficus estrangulador</i>	2	60.91	71.50	111.46	9.92
52	<i>Ficus exasperata</i>	26	13.46	13.31	63.06	21.93
53	<i>Ficus mucoso</i>	204	19.48	18.11	111.46	44.30
54	<i>Ficus</i> sp.1	2	29.30	3.60	31.85	4.19
55	<i>Funtumia elastica</i>	10	26.07	21.73	58.92	17.92
56	<i>Gambeya lacourtiana</i>	2	19.98	3.27	22.29	3.81

Appendix III. (continued)

No.	Species name	Number of individuals	DBH (cm)			IVI
			Mean	Standard deviation	Max	
57	<i>Garcinia kola</i>	1	6.69	-	6.69	3.44
58	<i>Guarea thompsonii</i>	4	34.00	27.13	73.25	11.25
59	<i>Hallea stipulosa</i>	2	12.02	4.84	15.45	3.59
60	<i>Harungana madagascariensis</i>	4	12.78	7.23	23.25	10.41
61	<i>Hexalobus crispiflorus</i>	5	47.71	30.97	93.95	15.59
62	<i>Holoptelea grandis</i>	2	48.33	57.76	89.17	8.77
63	<i>Homalium</i> sp.	1	7.32	-	7.32	3.45
64	<i>Irvingia excelsa</i>	1	36.94	-	36.94	4.55
65	<i>Irvingia gabonensis</i>	4	46.14	35.33	92.99	12.06
66	<i>Irvingia grandifolia</i>	2	82.40	79.83	138.85	12.51
67	<i>Klainedoxa gabonensis</i>	5	20.70	6.58	28.66	7.37
68	<i>Lannea welwitschii</i>	4	4.38	1.03	5.25	6.96
69	<i>Macaranga</i> sp.	1	8.92	-	8.92	3.47
70	<i>Macaranga spinosa</i>	17	10.57	11.95	50.96	17.93
71	<i>Maesopsis eminii</i>	8	29.48	25.78	88.85	14.61
72	<i>Mallotus oppositifolius</i>	31	4.04	1.47	8.12	8.81
73	<i>Mangifera</i> sp.	11	19.12	10.50	35.03	17.73
74	<i>Mansonia altissima</i>	35	43.52	31.75	95.54	30.66
75	<i>Margaritaria discoidea</i>	50	12.30	8.43	35.35	26.89
76	<i>Markhamia lutea</i>	43	16.07	16.69	72.61	33.16
77	<i>Massularia acuminata</i>	2	5.57	0.68	6.05	3.50
78	<i>Millettia sanagana</i>	16	3.28	1.07	7.01	7.77
79	<i>Monodora myristica</i>	1	7.32	-	7.32	3.45
80	<i>Musanga cecropioides</i>	236	43.05	23.53	114.65	47.73
81	<i>Myrianthus arboreus</i>	20	15.30	9.16	47.13	21.57
82	<i>Nauclea diderrichii</i>	1	7.32	-	7.32	3.45
83	<i>Nesogordonia papaverifera</i>	3	13.85	11.46	27.07	10.37
84	<i>Ochthocosmus africanus</i>	1	14.97	-	14.97	3.59
85	<i>Oddoniodendron micranthum</i>	5	8.38	6.88	19.11	10.40
86	<i>Oncoba glauca</i>	2	16.72	14.64	27.07	3.71
87	<i>Oncoba</i> sp.	1	11.78	-	11.78	3.52
88	<i>Ophiobotrys zenkeri</i>	2	27.47	9.80	34.39	7.44
89	<i>Pachyelasma tessmannii</i>	5	16.46	8.23	24.84	10.57
90	<i>Pachypodanthium staudtii</i>	1	52.07	-	52.07	5.68
91	<i>Pausinystalia johimbe</i>	1	35.35	-	35.35	4.45
92	<i>Pavetta</i> sp.	6	4.75	2.25	8.76	3.76
93	<i>Penianthus longifolius</i>	1	2.55	-	2.55	3.41
94	<i>Persea americana</i>	43	18.34	10.54	60.03	26.56
95	<i>Petersianthus macrocarpus</i>	1	28.34	-	28.34	4.08
96	<i>Picralima nitida</i>	2	35.43	21.96	50.96	7.86
97	<i>Piptadeniastrum africanum</i>	2	21.42	7.32	26.59	7.19
98	<i>Polyalthia suaveolens</i>	1	28.18	-	28.18	4.07
99	<i>Polyscias fulva</i>	1	40.76	-	40.76	4.80
100	<i>Pseudospondias longifolia</i>	2	23.09	9.46	29.78	7.25
101	<i>Psychotria</i> sp.1	20	9.32	4.09	21.34	18.11
102	<i>Psychotria</i> sp.2	2	16.80	5.74	20.86	7.04
103	<i>Pteleopsis hylodendron</i>	4	30.21	17.73	52.87	11.04
104	<i>Pterocarpus soyauxii</i>	6	12.13	6.94	23.09	20.53
105	<i>Pycnanthus angolensis</i>	15	16.20	11.30	35.99	21.25
106	<i>Rauvolfia vomitoria</i>	4	13.89	17.54	40.13	13.77
107	<i>Ricinodendron heudelotii</i>	9	36.82	34.54	94.90	18.42
108	<i>Rinorea elliotii</i>	2	14.01	7.21	19.11	3.64
109	<i>Spondias cytherea</i>	1	25.96	-	25.96	3.97
110	<i>Staudtia kamerunensis</i>	12	25.56	18.89	72.13	14.70
111	<i>Sterculia tragacantha</i>	15	35.97	36.94	117.83	22.12
112	<i>Stipularia</i> sp.	8	9.28	4.40	14.81	7.29

Appendix III. (continued)

No.	Species name	Number of individuals	DBH (cm)			IVI
			Mean	Standard deviation	Max	
113	<i>Strombosia grandifolia</i>	1	80.25	-	80.25	8.82
114	<i>Strombosia pustulata</i>	2	25.00	8.56	31.05	7.33
115	<i>Tabernaemontana crassa</i>	9	5.40	3.16	10.51	10.64
116	<i>Terminalia superba</i>	102	35.32	40.15	133.76	41.37
117	<i>Tetrapleura tetraptera</i>	1	6.37	-	6.37	3.44
118	<i>Trema orientalis</i>	12	17.52	8.22	32.80	11.08
119	<i>Trichilia welwitschii</i>	4	6.85	6.26	16.24	10.31
120	<i>Trichoscypha acuminata</i>	1	27.71	-	27.71	4.05
121	<i>Trilepisium madagascariense</i>	15	37.35	26.58	90.45	18.87
122	<i>Triplochiton scleroxylon</i>	21	107.67	54.40	191.08	37.85
123	<i>Vitex</i> sp.	2	3.66	-	3.66	3.48
124	<i>Xylopiya aethiopica</i>	1	9.55	-	9.55	3.48
125	<i>Xylopiya hypolampira</i>	2	21.18	13.74	30.89	7.18

Appendix IV. Importance value index of species: Above 30-year-old

No.	Species name	Number of individuals	DBH (cm)			IVI
			Mean	Standard deviation	Max	
1	<i>Azela bipindensis</i>	7	18.13	18.36	56.37	10.77
2	<i>Albizia ferruginea</i>	1	18.47	-	18.47	3.60
3	<i>Albizia glaberrima</i>	39	36.58	27.93	96.69	34.04
4	<i>Allanblackia floribunda</i>	7	23.98	11.75	37.90	7.57
5	<i>Alstonia boonei</i>	16	59.32	32.25	104.78	26.55
6	<i>Amphimas pterocarpoides</i>	3	49.21	18.77	70.41	11.53
7	<i>Angylocalyx vermeulenii</i>	1	35.03	-	35.03	4.06
8	<i>Anonidium mannii</i>	1	95.54	-	95.54	8.21
9	<i>Antiaris africana</i>	1	31.22	-	31.22	3.93
10	<i>Antrocaryon klaineum</i>	1	74.04	-	74.04	6.29
11	<i>Barteria fistulosa</i>	6	9.00	2.71	12.42	10.56
12	<i>Berlinia korupensis</i>	1	36.31	-	36.31	4.11
13	<i>Bertiera racemosa</i>	2	29.38	32.77	52.55	7.29
14	<i>Blighia welwitschii</i>	5	57.38	49.54	111.15	15.49
15	<i>Brevia leptosperma</i>	4	26.84	20.66	52.55	14.05
16	<i>Bridelia grandis</i>	17	29.98	17.14	54.62	18.59
17	<i>Ceiba pentandra</i>	6	65.46	50.04	135.35	16.09
18	<i>Celtis adolfi-friderici</i>	9	35.27	15.19	52.39	24.76
19	<i>Celtis mildbraedii</i>	28	57.06	34.12	139.49	30.77
20	<i>Celtis philippensis</i>	1	9.33	-	9.33	3.46
21	<i>Celtis zenkeri</i>	18	37.57	28.08	98.73	28.95
22	<i>Chlorophora excelsa</i>	6	81.53	64.33	163.69	20.67
23	<i>Cleistopholis patens</i>	11	34.63	16.15	70.06	18.24
24	<i>Coelocaryon preussii</i>	6	23.17	15.55	45.86	10.80
25	<i>Cola acuminata</i>	5	33.91	3.30	37.39	4.36
26	<i>Cola altissima</i>	7	31.83	14.11	54.46	7.80
27	<i>Corynanthe pachyceras</i>	3	26.27	21.96	50.96	7.29
28	<i>Dacryodes</i> sp.	1	43.95	-	43.95	4.43
29	<i>Desplatsia dewevrei</i>	1	7.64	-	7.64	3.45
30	<i>Diospyros canaliculata</i>	7	17.64	15.50	45.86	17.43
31	<i>Diospyros crassiflora</i>	1	44.59	-	44.59	4.46
32	<i>Discoglypemma caloneura</i>	3	38.70	17.48	58.44	7.71
33	<i>Drypetes gossweileri</i>	1	6.11	-	6.11	3.44
34	<i>Duboscia macrocarpa</i>	5	53.80	37.32	117.83	8.61
35	<i>Elaeis guineensis</i>	43	62.16	23.99	112.10	32.37
36	<i>Entandrophragma candollei</i>	15	33.93	20.94	82.80	25.22
37	<i>Entandrophragma cylindricum</i>	3	75.69	68.68	153.82	13.26
38	<i>Eribroma oblonga</i>	1	58.60	-	58.60	5.22
39	<i>Erythrina mildbraedii</i>	1	5.51	-	5.51	3.43
40	<i>Erythrophleum suaveolens</i>	2	17.77	1.44	18.79	3.67
41	<i>fagara heitzii</i>	8	26.16	9.78	42.58	17.71
42	<i>Fernandoa adolfi-friderici</i>	35	30.85	17.52	95.54	30.16
43	<i>Ficus estrangulator</i>	2	74.52	51.34	110.83	9.75
44	<i>Ficus exasperata</i>	62	24.50	22.40	76.43	32.29
45	<i>Ficus mucosa</i>	58	41.28	33.78	133.76	32.53
46	<i>Funtumia elastica</i>	8	24.51	9.03	38.85	17.67
47	<i>Funtunia</i> sp.	1	52.87	-	52.87	4.88
48	<i>Gambeya lacourtiana</i>	1	64.01	-	64.01	5.57
49	<i>Glyphaea brevis</i>	25	6.34	1.78	9.55	8.83
50	<i>Guarea thompsonii</i>	1	73.89	-	73.89	6.28
51	<i>Guibourtia demeusei</i>	1	18.15	-	18.15	3.59
52	<i>Harungana madagascariensis</i>	2	9.75	0.27	9.94	6.89
53	<i>Heisteria zimmereri</i>	3	13.91	5.92	18.79	3.69
54	<i>Hexalobus crispiflorus</i>	1	63.69	-	63.69	5.55
55	<i>Homalium</i> sp.	2	52.15	45.15	84.08	8.26
56	<i>Hunteria umbellata</i>	1	34.20	-	34.20	4.03

Appendix IV. (continued)

No.	Species name	Number of individuals	DBH (cm)			IVI
			Mean	Standard deviation	Max	
57	<i>Irvingia excelsa</i>	1	74.36	-	74.36	6.32
58	<i>Irvingia gabonensis</i>	2	71.02	43.69	101.91	9.48
59	<i>Irvingia grandifolia</i>	2	23.25	24.55	40.61	7.12
60	<i>Lannea welwitschii</i>	9	35.49	22.99	74.20	21.43
61	<i>Lovoa trichilioides</i>	1	27.07	-	27.07	3.80
62	<i>Macaranga spinosa</i>	22	16.42	12.82	49.84	22.02
63	<i>Maesopsis eminii</i>	4	31.66	23.86	63.06	14.20
64	<i>Mallotus oppositifolius</i>	4	10.68	5.97	19.11	10.40
65	<i>Mangifera</i> sp.	8	27.11	12.56	39.49	14.40
66	<i>Mansonia altissima</i>	21	49.33	30.15	95.54	23.07
67	<i>Margaritaria discoidea</i>	27	33.23	20.47	94.27	26.22
68	<i>Markhamia lutea</i>	49	15.25	11.75	54.46	34.32
69	<i>Milletia sanagana</i>	4	6.18	0.51	6.69	7.03
70	<i>Musanga cecropioides</i>	49	45.21	29.30	128.98	35.27
71	<i>Myrianthus arboreus</i>	94	15.32	9.36	52.23	24.84
72	<i>Nesogordonia papaverifera</i>	4	44.71	16.91	68.47	8.06
73	<i>Ochthocosmus africanus</i>	2	9.76	2.09	11.24	3.55
74	<i>Oddoniodendron micranthum</i>	1	7.48	-	7.48	3.45
75	<i>Oncoba glauca</i>	1	10.83	-	10.83	3.48
76	<i>Oncoba</i> sp.	3	19.27	3.13	22.13	3.78
77	<i>Ongokea gore</i>	1	40.76	-	40.76	4.29
78	<i>Ophiobotrys zenkeri</i>	3	47.45	14.24	60.83	8.10
79	<i>Pachyelasma tessmannii</i>	12	36.78	28.84	107.32	18.40
80	<i>Pachypodanthium staudtii</i>	1	15.70	-	15.70	3.55
81	<i>Pausinystalia johimbe</i>	1	31.53	-	31.53	3.94
82	<i>Pentaclethra macrophylla</i>	2	33.28	25.90	51.59	7.42
83	<i>Persea americana</i>	43	21.87	10.59	38.85	20.60
84	<i>Petersianthus macrocarpus</i>	3	50.90	28.33	78.03	8.28
85	<i>Picralima nitida</i>	19	24.16	13.94	47.77	28.60
86	<i>Piptadeniastrum africanum</i>	3	87.47	25.80	108.28	10.94
87	<i>Psychotria</i> sp.1	11	12.72	6.07	21.02	14.36
88	<i>Psidium guajava</i>	1	12.58	-	12.58	3.50
89	<i>Pteleopsis hylodendron</i>	4	17.04	10.46	28.66	3.83
90	<i>Pterocarpus soyauxii</i>	24	39.02	21.28	82.48	32.85
91	<i>Pycnanthus angolensis</i>	20	41.57	27.44	83.76	29.29
92	<i>Rauvolfia vomitoria</i>	10	24.12	40.23	137.58	14.49
93	<i>Ricinodendron heudelotii</i>	6	86.04	16.04	110.99	17.73
94	<i>Rinorea elliotii</i>	3	5.13	0.53	5.73	3.60
95	<i>Rothmannia</i> sp.	1	8.47	-	8.47	3.46
96	<i>Staudtia kamerunensis</i>	5	30.19	12.04	43.63	14.24
97	<i>Sterculia tragacantha</i>	6	58.81	28.19	95.54	12.33
98	<i>Stipularia</i> sp.	11	17.43	7.20	24.84	11.10
99	<i>Strombosia pustulata</i>	2	17.88	3.54	20.38	7.01
100	<i>Strombosiopsis tetrandra</i>	1	46.82	-	46.82	4.57
101	<i>Terminalia superba</i>	73	64.23	36.03	156.05	41.75
102	<i>Tetrapleura tetraptera</i>	13	17.32	14.17	50.48	17.94
103	<i>Trema orientalis</i>	14	17.91	7.00	27.71	18.03
104	<i>trichilia tessmannii</i>	1	5.86	-	5.86	3.44
105	<i>Trichoscypha acuminata</i>	2	22.93	5.41	26.76	7.11
106	<i>Trichoscypha patens</i>	1	21.66	-	21.66	3.66
107	<i>Trilepisium madagascariense</i>	32	48.17	38.89	153.31	30.62
108	<i>Triplochiton scleroxylon</i>	21	106.75	52.73	191.08	24.44
109	<i>Xylopia aethiopica</i>	2	9.28	1.60	10.41	3.55
110	<i>Xylopia quintasii</i>	1	28.34	-	28.34	3.84