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Floristic Diversity and Forest Stand Structure across Vegetation Strata in the Woteva Community Forest, Mount Cameroon Landscape

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ABSTRACT

Aims: This study assessed the floristic diversity and stand structure of the Woteva Community Forest, Mount Cameroon Landscape, Cameroon, to establish a baseline for conservation and management.

Study Design: A quantitative, field-based approach was employed across five vegetation strata.
Place and Duration of Study: Woteva Community Forest, South West Region, Cameroon, between May and August 2023.

Methodology: The WCF was stratified into sub-montane forest, montane forest, savannah, grassland, and lava strata. Eleven plots of 100 × 100 m were systematically established. All live trees with DBH ≥ 2.6 cm were measured at 1.3 m, and heights recorded using a hypsometer. Diversity was assessed using species richness, Shannon diversity (H'), Simpson dominance (D), Pielou evenness (J), and the Importance Value Index (IVI). Stand structural parameters — stem density, basal area, mean DBH, quadratic mean diameter (QMD), and mean height — were computed per stratum and for the whole forest. One-way ANOVA tested for differences among strata.

Results: A total of 878 trees across 45 species, 43 genera, and 26 families were recorded. The sub-montane forest was the most diverse stratum (42 species; H' = 3.109; D = 0.939; J = 0.448), while the lava stratum was the most depauperate (3 species; H' = 1.011). Whole-forest diversity was moderate (H' = 1.966; D = 0.765; J = 0.259). Species richness and abundance differed significantly among strata ($p = 0.042$; $p < 0.001$). Sterculia tragacantha dominated the whole-forest IVI. All structural parameters differed highly significantly across strata ($p < 0.001$), with whole-forest mean stem density of 528 stems ha^{-1}, basal area of 24.0 $m^2\ ha^{-1}$, mean DBH of 21.5 cm, and mean height of 13.8 m.

Conclusion: Results provide a critical baseline for management plan revision, biodiversity reporting, and carbon stock estimation, underscoring the importance of stratum-specific ecological data for effective community forest management.

1. INTRODUCTION

Tropical forests represent the most species-rich terrestrial biomes on Earth, covering less than 10% of the global land surface yet harboring more than half of all known vascular plant species[1]. Within this global context, the Guinea-Congolian rainforest belt of Central Africa—anchored in Cameroon—ranks among the continent's foremost centers of plant diversity and endemism. The Mount Cameroon landscape is especially remarkable: rising from sea level to 4,095 m, it supports an unbroken continuum of natural vegetation spanning coastal lowland rainforest to sub-alpine grassland, and hosts at least 50 strictly endemic plant species alongside approximately 50 near-endemics[2].

Despite the outstanding conservation significance of the Mount Cameroon landscape, its forests are under escalating anthropogenic pressure. Agricultural encroachment, informal logging, and unplanned land conversion have driven substantial and progressive forest loss across the region[3], and Cameroon's national deforestation rate doubled between 2016 and 2023, placing the country among the world's top ten for tropical primary forest loss[4]. Community forests, which constitute a major category of managed forest within the landscape, are particularly vulnerable because management decisions are frequently made in the absence of rigorous botanical baseline data [5]. Without systematic, stratum-specific floristic inventories and stand structural assessments, it is impossible to identify ecologically sensitive zones, track vegetation change over time, or quantify the biodiversity at risk—leaving conservation planning and sustainable resource management inadequately informed[6][7].

A rigorous, multi-strata floristic and structural inventory provides the most direct and empirically grounded basis for addressing this knowledge gap. By sampling across the vegetation strata, such an approach captures the full spectrum of plant diversity within a forest stand and generates dendrometric parameters (species richness, diversity indices, stem density, basal area, and diameter class distributions) that are directly applicable to management plan formulation, biodiversity monitoring frameworks, and conservation prioritisation exercises [8,9]. Applied to the Woteva Community Forest in the Mount Cameroon landscape, this approach would yield the first comprehensive ecological baseline for the forest, enabling evidence-based decisions on resource allocation.

Floristic diversity and stand structure have been investigated in several community and production forests across Cameroon's ecological zones, collectively demonstrating the utility of standardized inventory methods in revealing vegetation patterns and informing management. Manfothang *et al.* documented high species richness and heterogeneous stand structure across vegetation types in the Ngambe-Ndom-Nyanon communal forest in the Littoral Region[9]. Mounmemi *et al.* further showed that logging history significantly modifies plant diversity and structural attributes in semi-deciduous forests of eastern Cameroon[10]. Fomete *et al.* similarly demonstrated that logging regime type—artisanal versus industrial—has contrasting effects on species diversity and stand structure in community forests adjacent to the Dja Biosphere Reserve[11]. Maffo Maffo *et al.* further extended this line of inquiry to sacred forests in western Cameroon, linking floristic diversity to carbon stock estimates[12]. Collectively, these studies affirm the scientific rigour and policy relevance of multi-strata forest inventories, yet no concrete assessment has been conducted within the Mount Cameroon community forest belt, leaving a clear geographic and ecological gap in the literature.

This study focused on the Woteva Community Forest, located within the Mount Cameroon Landscape in the South West Region of Cameroon—an area of recognized conservation importance that remains floristically under-documented at the community forest level. The assessment encompassed all major vegetation strata and recorded key structural parameters for all plants meeting established diameter thresholds. The work is justified by the urgent need to generate site-specific baseline data capable of guiding the review of the forest's Simple Management Plan, supporting national biodiversity reporting obligations, and contributing to the broader scientific documentation of plant diversity in one of Africa's most botanically significant landscapes. Accordingly, this study aimed to assess the floristic diversity and forest stand structure across vegetation strata in the Woteva Community Forest, Mount Cameroon Landscape, in order to provide the ecological baseline needed for effective biodiversity conservation and sustainable forest management.

2. MATERIAL AND METHODS

2.1 Study Area

The Woteva Community Forest is located on the Eastern flanks of Mount Cameroon, Fako Division, southwest region of Cameroon. It is a montane community forest located between approximately 4.15°N and 9.18°E. It covers a total surface area of 1,846 hectares[13]. Climatically, there are two distinct seasons: a long wet season (April/May to October/November) and a shorter, relatively humid dry season (December to March) . Annual rainfall ranges between 2000mm to 5000mm [13]. Temperatures are consistently warm with low seasonal variation, generally ranging from 25 °C to 35 °C at low to mid-altitudes. Despite high drainage, there are no springs or lakes in the community forest [13].

The forest has a heterogenous mix of tree species, notably *Polyscias fulva, Strombosia grandifolia, Macaranga occidentalis, and Cylicomorpha solmsii*. In the upper montane areas, the forest differs slightly as a result of climate variation but the major tree species are *Drypetes staudtii, Staudtia stiptata, Prunus africana* and various cola species [13]. Hard and softwood timber species documented in the community forest include African mahogany (*Entandrophragma angolense*), tiger wood (*Microberlinia bisulcata*), pygeum (*Prunus africana*), ironwood (*Lophira alata*), and country onion (*Afrostyrax lepidophyllus*), many of which are of high conservation concern [13]. The WCF has been a site of active reforestation efforts targeting these threatened tree species, with over 14,000 trees planted within the forest and adjacent farmlands between 2014 and 2015 under the Global Trees Campaign and ERuDeF [14] [15].

Pertaining to wildlife, key mammalian species documented in the community forest include the Nigeria-Cameroon chimpanzee (*Pan troglodytes ellioti*), and the drill (*Mandrillus leucophaeus*) [13]. Species of hornbills, monkeys, bush pigs, porcupine, giant rats, vipers, pangolins, galagos, tortoise and numerous species of birds have been recorded in the forest[13].

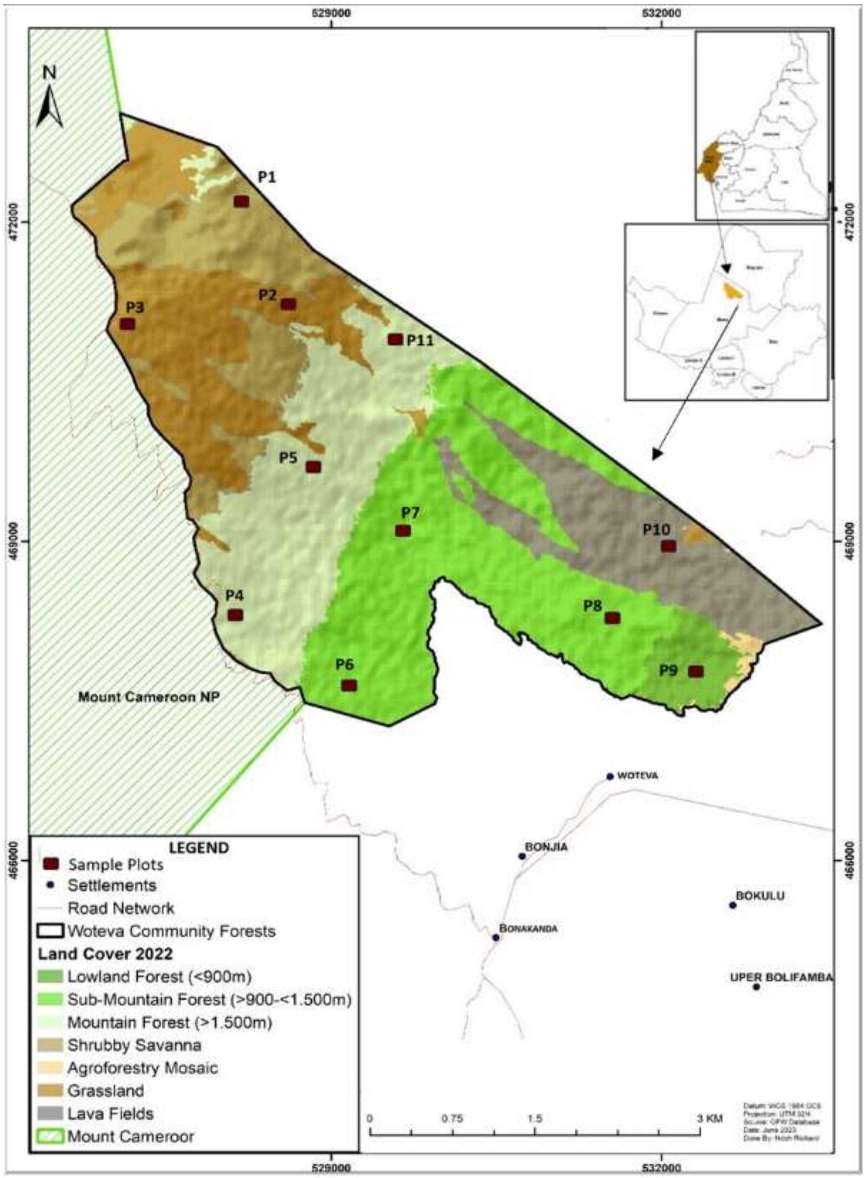

Figure 1: Location map of the study area

2.2 Methods

2.2.1 Botanical Inventory

The community forest was stratified into five vegetation strata namely sub-montane forest, mountain forest, shrubby savannah, grassland and lava. A stratified systematic sampling design with a random start was employed using temporary area plots[16]. Plots were systematically placed within each stratum, with the first plot located randomly and subsequent plots at regular intervals, ensuring proportional representation and operational efficiency [16] [17] [18] [19]. Plots were assigned to each stratum based on the size of the land cover, accessibility and estimated cost [20] [21]. Plots of 100 x 100 meters were established at equidistant intervals [22][23]. Wooden stakes of 1.5 meters linked together with red ropes, were used to demarcate each plot. A Silva Polaris compass was used to obtain accurate plot bearings. GPS Garmin 60CSx was employed to collect precise geographical coordinates at the center of each plot [21][24]. In all there were 11 plots, making up 11 hectares. The inventory team consisted of a botanist, two macheteers and four technical assistants. Trees were identified using standard botanical principles such as the general form of the tree (leaf type and shape, slash colour, bark texture), flowers and fruits [25][26]. Manuals and field books on tropical plants were used to assist in tree species identification.

2.2.2 Tree Mensuration

Each live tree (≥ 2.6 cm DBH) was measured individually at 1.3meters height using a stick of similar length (1.3m) placed against the tree trunk and the diameter obtained using a diameter tape [21][27]. In sloppy terrain, measurements were done at the upper side of the trunk [27]. Tree height was measured using a hypsometer (Vitax) and also by estimation [28][29]. Conventional tree mensuration protocols such as marker marking were implemented to ensure that individual trees were not sampled more than once [30][31]. All data was recorded in field data sheets.

2.2.3 Data Analysis

Data was collected for three months from June 2023 to August 2023. Data was inputted from field sheets into Microsoft Excel 2010 and later imported into the statistical package R version 4.1.2, which was used to perform statistical tests. Data was analyzed for species richness, abundance, composition and diversity. Shannon diversity index (H') and the Simpson's dominance index were used to estimate species diversity [32][33][34]. Evenness indice (J) , which is a structural composition index reflecting the dominance of species were also calculated [35]. For assessing the ecological importance or significance of a species, the IVI were used. To assess taxonomic and structural composition between the forest types, the IVI value was calculated at the level of families [36]. The Shannon index is defined as:

$$H' = -\sum_{i-1}^{s} p_i \ln(p_i)$$

where S equals the total number of species; p_i equals the proportion of individuals belonging to species i, and ln equals the natural logarithm.

The Simpson dominance index (D), which measures the probability that two individuals randomly selected from a sample belong to different species, is defined as:

$$D = \sum_{i-1}^{S} p_i^2$$

where D is equals to the Simpsons dominance index, p_i is the proportion of individuals belonging to species i ; and S equals to the total number of species. Pielou's Evenness Index measures the degree to which individuals are evenly distributed among species within a community, and was calculated as follows:

$$E = \frac{H'}{LnS}$$

where H' is equal to the Shannon-Weiner diversity index; S is equal to the total number of species in a site and *Ln* is equal to the natural logaritm.

The Shapiro-Wilk tests were carried out to ascertain that the data was normally distributed. Pertaining to ecological measurements, vegetation data was analyzed using ecological parameters such as richness and abundance, basal area, stem density, relative frequency and relative dominance.

3. RESULTS AND DISCUSSION

3.1 Species Richness and Abundance

Out of a total of 11 plots and 5 vegetative strata, the study recorded 26 families, 43 genera and a total of 45 plant species, which represents the overall forest richness. Specifically, estimated richness for grassland was 14, lava was 3, montane forest was 23, savannah was 6 and submontane forest was 42. This level of richness is modest in comparison to values reported for larger, more intensively sampled forest tracts in Cameroon but is broadly consistent with what would be expected from a community forest of approximately 1,846 ha subject to multiple anthropogenic land uses and encompassing a mosaic of vegetation types—from productive forest to open grassland and volcanically disturbed lava terrain. For instance, Mounmemi *et al.* recorded 108 plant species across 37 families and 77 genera in the understory strata of semi-deciduous forests in Cameroon[37], while Fomete *et al.* documented 289 species from 58 families in community forests of the Dja Biosphere Reserve peripheral zone [38]. On a larger scale, the Mbalmayo Forest Reserve yielded 129 tree species from 33 families[39], and the Cobaba community forest in Eastern Cameroon harboured 65 commercial timber species from 26 families[40]. The relatively lower species count in the Woteva Community Forest is consistent with the observation that community forests with heterogeneous land-cover mosaics—particularly those incorporating non-forest strata such as grasslands and lava fields—tend to yield lower aggregate species richness than contiguous, structurally mature tropical forest stands.

The submontane forest stratum recorded the highest estimated richness (42 species) among all strata, despite not being the largest stratum by area (538.5 ha). This finding aligns strongly with established ecological theory and empirical evidence from tropical mountains. Species richness along tropical elevational gradients frequently peaks at intermediate elevations, typically within the submontane belt (roughly 800–2,000 m), where climatic conditions—moderate temperatures, high and reliable rainfall, and persistent cloud cover—support high productivity, habitat heterogeneity, and diverse microhabitats[41]. This hump-shaped richness pattern along elevational gradients has been documented across African mountain systems. On Mount Kenya, the lower montane wet forest supported the highest species richness and phylogenetic diversity among all vegetation zones[42]. Similarly, in the Rumpi Hills Forest Reserve of south-western Cameroon, species richness peaked in lowland-to-submontane transition zones before declining at higher altitudes[43].

Specie abundance is presented in Table 1.

Table 1. Species abundance per strata and for the entire forest

	STRATA					
Species	Grassland	Lava	Montane forest	Savannah	Sub-montane forest	**Whole Forest**
Sterculia tragacantha	12564.3	0.0	0.0	7909.3	101.8	20575.3
Polyscias fulva	1196.6	0.0	2279.4	0.0	3970.0	7446.0
Khaya ivorensis	957.3	0.0	1288.3	0.0	4173.6	6419.2
Trilepisium madagascariense	0.0	0.0	3171.3	0.0	3053.9	6225.2
Prunus africana	3111.2	0.0	594.6	1107.3	1018.0	5831.0
Macaranga occidentalis	1435.9	0.0	495.5	0.0	3766.4	5697.9
Voacanga africana	1076.9	0.0	99.1	0.0	3868.2	5044.3
Hypericum revolutum	837.6	0.0	0.0	3954.6	0.0	4792.2
Strombosia grandifolia	0.0	0.0	1982.1	0.0	2646.7	4628.8
Bridelia micranta	2273.5	0.0	198.2	0.0	407.2	2878.9
Eriocoelum macrocarpum	0.0	0.0	198.2	0.0	2646.7	2844.9
Cylicomorpha solmsii	0.0	0.0	198.2	0.0	2341.3	2539.5
Drypetes leonensis	0.0	0.0	0.0	2056.4	407.2	2463.6
Ficus sur Forssk	239.3	359.7	991.0	0.0	509.0	2099.0
Ficus exasperata	0.0	539.5	495.5	0.0	814.4	1849.4
Schefflera barteri	598.3	0.0	297.3	632.7	0.0	1528.3
Cola nitida	0.0	0.0	0.0	0.0	1425.1	1425.1
Spathodea campanulata	0.0	179.8	1189.2	0.0	0.0	1369.1
Daniellia ogea	0.0	0.0	0.0	0.0	1119.8	1119.8
Entandrophragma angolense	0.0	0.0	891.9	0.0	203.6	1095.5
Anthonotha fragrans	0.0	0.0	0.0	0.0	1018.0	1018.0
Trichilia rubescens	0.0	0.0	0.0	0.0	1018.0	1018.0
Entandrophragma cylindricum	0.0	0.0	297.3	0.0	712.6	1009.9
Pseudospondias microcarpa	0.0	0.0	0.0	0.0	814.4	814.4
Kigelia africana	0.0	0.0	198.2	0.0	610.8	809.0
Croton longiracemosus	0.0	0.0	198.2	0.0	610.8	809.0
Duguetia staudtii	0.0	0.0	0.0	158.2	509.0	667.2
Monodora myristica	0.0	0.0	0.0	0.0	610.8	610.8
Millettia barteri	359.0	0.0	0.0	0.0	203.6	562.6
Pycnanthus angolensis	0.0	0.0	198.2	0.0	305.4	503.6
Harungana madagascariensis	119.7	0.0	297.3	0.0	0.0	417.0
Terminalia superba	0.0	0.0	99.1	0.0	305.4	404.5
Aningeria robusta	0.0	0.0	99.1	0.0	305.4	404.5
Myrianthus arboreus	0.0	0.0	99.1	0.0	305.4	404.5
Pterocarpus mildbraedii	119.7	0.0	0.0	0.0	101.8	221.5
Xylopia staudtii	119.7	0.0	0.0	0.0	101.8	221.5
Musanga cecropioides	0.0	0.0	0.0	0.0	203.6	203.6
Alangium chinense	0.0	0.0	0.0	0.0	101.8	101.8
Ricinodendron heudelotii	0.0	0.0	0.0	0.0	101.8	101.8
Rauvolfia vomitoria	0.0	0.0	0.0	0.0	101.8	101.8
Microberlinia bisulcata	0.0	0.0	0.0	0.0	101.8	101.8
Ceiba pentandra	0.0	0.0	0.0	0.0	101.8	101.8
Cedrela mexicana	0.0	0.0	0.0	0.0	101.8	101.8
Canarium schweinfurthii	0.0	0.0	0.0	0.0	101.8	101.8
Zanthoxylum macrophyllum	0.0	0.0	0.0	0.0	101.8	101.8

The estimated abundance data (Table 1) reveal a strongly skewed distribution in which a small number of species account for the overwhelming majority of projected individuals across the community forest. *Sterculia tragacantha* is by far the most abundant species in the whole forest, with an estimated 20,575 individuals, representing approximately 27% of the entire community forest's projected abundance. The top five species — *Sterculia tragacantha, Polyscias fulva, Khaya ivorensis, Trilepisium madagascariense,* and *Prunus africana* — together account for approximately 46,497 individuals (roughly 60% of total projected abundance), while many of the remaining 40 species have estimated abundances below 1,000 individuals at the landscape scale. Seventeen species are recorded exclusively in the submontane forest stratum, and the lava stratum is represented by only two species (*Ficus sur* and *Ficus exasperata*) with a combined estimated abundance of 899 individuals, the lowest of any stratum.

The dominance of a small number of species in the Woteva Community Forest is consistent with a well-established pan-tropical pattern described as hyperdominance. Cooper *et al.*, in an analysis of over one million old-growth tropical forest trees, demonstrated that approximately 2.2% of species comprise 50% of all individuals in African, Amazonian, and Southeast Asian forests[44]. In the Woteva Community Forest, *Sterculia tragacantha* alone accounts for roughly 27% of all projected individuals, a level of dominance considerably more extreme than the pan-tropical average, potentially reflecting the grassland stratum's large area and *S. tragacantha's* documented capacity for vigorous establishment in open, disturbed, and fire-maintained habitats across West and Central Africa. In Cameroon specifically, comparable patterns of mono- or bi-dominance in open forest types have been documented; Manfothang *et al.* found that a handful of pioneer species dominated the abundance and basal area of disturbed strata in the Ngambe-Ndom-Nyanon communal forest[41], and Mounmemi *et al.* similarly noted that logged strata in eastern Cameroonian forests were characterised by a narrower, disturbance-adapted dominance hierarchy than undisturbed forest[37]. In Senegal's Patako Forest, Ifo *et al.* demonstrated that in shrub savannah environments, just four species accounted for over 90% of individual importance values[45], a finding closely mirrored by the savannah stratum of the Woteva Community Forest where *Hypericum revolutum* and *Sterculia tragacantha* together dominate.

Table 2 presents the analysis of variance of species richness and diversity between strata and within strata.

Table 2. **Analysis of Variance of Species Richness and Abundance Between and Within Strata**

Index	df_between	df_within	F	P-value
Estimated Richness for entire stratum	4	6	4.905	0.042*
Estimated abundance for entire stratum	4	6	49.565	<0.001***

The ANOVA results (Table 2) demonstrated that estimated total species richness across the full stratum area differed significantly among vegetation strata ($F_{4,6}$ = 4.905, p = 0.042), and that estimated total abundance varied even more strongly across strata ($F_{4,6}$ = 49.565, p < 0.001). These results indicate that the five vegetation strata do not support equivalent plant diversities or population sizes, and that the differences in total abundance among strata are particularly pronounced. The significance of abundance differences is likely driven by the large contrasts in both area and stem density among the strata: the submontane forest (538.5 ha) and montane forest (392.2 ha) have the two largest surface areas and the densest woody vegetation, generating far higher projected total individuals than the open grassland, shrubby savannah, or lava strata. Structurally comparable results have been reported by Deng *et al.* in south-eastern Cameroon, where abundance and species richness of regenerating plants varied significantly across land-use types and strata, with closed-canopy forest consistently supporting higher stem densities than open or disturbed habitats[46]. Globally, studies in Amazonian forests have similarly shown that species richness and individual abundance are strongly differentiated among forest strata and biogeographic regions, with pronounced differences in productivity translating into significant variation in both measures[47]. The highly significant difference in abundance (p < 0.001) compared to the moderately significant difference in richness (p = 0.042) in the present study further suggests that area and habitat structure have a stronger influence on individual abundance than on local species richness, since species richness is subject to diminishing returns with area (the species–area relationship), whereas total abundance scales more linearly with productive area[48].

3.2 Forest Composition

To assess forest composition, the important value index (IVI) was used. IVI values for the most dominant and least dominant species per strata, and for the entire forest, is presented in Table 3.

Table 3. Species Important Value Index per Stratum and for the Entire Forest

Strata	Most Dominant Specie and IVI		Least Dominant Specie and IVI	
Grassland	*Sterculia tragantha*	81.63	*Pterocarpus mildbraedii*	6.37
Lava	*Ficus sur Forssk*	121.15	*Spathodea campanulata*	79.05
Montane forest	*Trilepisium madagascariense*	53.16	*Voacanga africana*	3.57
Savannah	*Hypericum revolutum*	120.48	*Duguetia staudtii*	19.38
Sub-montane forest	*Canarium schweinfurthii*	27.59	*Rauvolfia vomitoria*	1.50
Entire Forest	***Sterculia tragantha***	**26.98**	***Cedrela mexicana***	**0.82**

The IVI, calculated as the sum of relative density, relative frequency, and relative dominance, provides a composite measure of a species' ecological importance within a plant community, with a theoretical maximum of 300[49]. Across the five strata examined in this study, there was notable variation in both the identity of dominant species and the magnitude of IVI scores (Table 3). Across the five vegetation strata of the Woteva Community Forest (WCF), IVI values for the most dominant species ranged from 27.59 (*Canarium schweinfurthii*, sub-montane forest) to 121.15 (*Ficus sur* Forssk., lava stratum), revealing pronounced variation in the intensity of ecological dominance among strata. The high IVI of *Ficus sur* in the lava zone is consistent with the fast-growing, pioneer character of the species, which occupies a broad ecological range from coastal forests to elevations of up to 2,500 m across tropical Africa [50], and reflects the early-successional nature of lava substrates generated by the repeated volcanic eruptions of Mount Cameroon [51]. The co-occurrence of *Spathodea campanulata* with a relatively high IVI (79.05) in the same stratum aligns with its well-documented role as a secondary coloniser that rapidly invades disturbed tropical habitats, including heavily eroded volcanic soils[52]. A similar pattern of pioneer species attaining high IVI scores in disturbed or early-successional strata was reported by Kengne et al. in the production forests of eastern Cameroon, where disturbance-adapted species disproportionately dominated IVI rankings in logged plots [5], and by Wassingsa et al. in the Mayo-Oulo Forest Reserve, North Cameroon, where stress-tolerant species recorded the highest IVI values in structurally impoverished vegetation types [53]. The narrow IVI gap between the dominant and least dominant species in the lava stratum therefore points to co-dominance by pioneer taxa rather than a mature successional community, whereas the wider IVI gaps in the montane and sub-montane forests indicate stronger niche differentiation and more pronounced dominance hierarchies characteristic of older-growth forest ecosystems [54]. The dominance of *Hypericum revolutum* in the savannah (IVI = 120.48) mirrors its hallmark status as the defining shrub-tree of Afromontane and Cameroon Highland savannahs [55], while the prominence of *Trilepisium madagascariense* in the montane forest (IVI = 53.16) is ecologically expected given the species' documented affinity for submontane and riverine evergreen forests across tropical Africa [56]. These stratum-level patterns collectively underscore the high habitat heterogeneity of the WCF landscape, driven by the unique interaction of volcanic substrate, altitudinal gradient, and proximity to the Atlantic coast.

When all strata were pooled to represent the WCF as a single ecological unit, *Sterculia tragacantha* emerged as the most ecologically dominant species (IVI = 26.98). This result reflects the species' occurrence and relatively consistent representation across multiple strata — most notably the grassland — rather than extreme dominance in any single vegetation type. *Sterculia tragacantha* is a wide-ranging West and Central African tree of the family Malvaceae (formerly Sterculiaceae), native from Sierra Leone to Tanzania and Zambia and classified as Least Concern by the IUCN[57]. As presented in the study results, the species' capacity to persist across ecologically disparate strata — from open grassland to forest margins — is consistent with the findings of other recent Cameroonian studies recent Cameroonian studies. Tchaleu et al.[58] found that the overall dominant species when vegetation types were pooled were those with wide ecological tolerances capable of persisting across the forest-savannah ecotone rather than specialists restricted to one habitat. Similarly, in the Kimbi Fungom National Park, North West Cameroon, *Terminalia superba* and *Musanga cecropioides* attained the highest IVI values at the landscape scale precisely because their distributions spanned multiple habitat blocks within the park[59]. At the continental scale, Kengne et al. in eastern Cameroon found that species with the highest overall IVI in multi-habitat datasets were typically those distributed across both logged and unlogged forest plots [5], paralleling the role of wide-ranging species in inflating landscape-level IVI in the Woteva community forest. Globally, analogous patterns have been reported in tropical forests of Cambodia, where species with the highest landscape-level IVI were consistently those capable of occupying both the overstorey and mid-storey across contrasting forest types [60], and in tropical cloud forests of southern China (Bawangling), where species with IVI > 10 reflected high frequency and density across multiple forest strata rather than extreme local abundance [61].

At the opposite end of the dominance spectrum, *Cedrela mexicana* M.Roem. (synonymous with *Cedrela odorata* L. in its broader circumscription) recorded the lowest IVI of all species across the entire WCF (IVI = 0.82), indicating negligible ecological importance at the landscape scale. This result is ecologically and biogeographically significant: *Cedrela mexicana* is a neotropical timber tree native to Mexico, Central America, and the Caribbean that has been widely planted across tropical Africa for timber production since the late 19th century[62]. In Cameroon and the broader West African forest zone, it is occasionally planted in community forests and plantation margins as an exotic timber species but has not achieved widespread naturalisation in intact forest[63]. The very low IVI (0.82) in the WCF is therefore consistent with its status as a planted exotic whose establishment in the WCF has been sporadic and limited to small, isolated individuals, likely introduced through past reforestation or agroforestry initiatives rather than natural regeneration. This contrasts markedly with findings from Côte d'Ivoire, where *Cedrela odorata* achieved high local population densities in secondary forests following large-scale plantation establishment, enabling it to spread into adjacent natural forest [63], and from West African secondary forests studied by Ligot et al.[64], who documented *Cedrela odorata* invasions in natural forest plots of Benin and Côte d'Ivoire where fire-driven disturbance opened the canopy. The absence of such disturbance dynamics at the relevant WCF plots, combined with the species' primary distribution in plantation and edge habitats, likely accounts for its marginal IVI at the WCF landscape scale. Moreover, at the sub-montane forest stratum — the stratum closest in character to the plantation and community forest margin conditions where *Cedrela* might be expected — the stratum dominant was the native *Canarium schweinfurthii*, suggesting that native species maintain ecological priority.

3.3 Species Diversity

Three indices were used to assess species diversity: Shannon weaver, Simpson Index (D) and Pielou eveness. Table 4 presents diversity indices per strata and for the entire forest.

Table 4. Diversity Indices Per Strata and for the Entire Forest

Strata	Observed Plot abundance	Observed Plot richness	Shannon (H)	Simpson/ Dominance Index (D)	Evenness (J)
Grassland	209	14	1.778	0.713	0.231
Lava	6	3	1.011	0.611	0.155
Montane forest	160	23	2.613	0.899	0.326
Savannah	100	6	1.319	0.664	0.133
Sub-montane forest	403	42	3.109	0.939	0.448
Whole Forest	**878**	**45**	**1.966**	**0.765**	**0.259**

As presented in Table 4, the sub-montane forest stratum recorded the highest values for all indices, with 403 individuals across 42 species, a Shannon index of 3.109, a dominance index of 0.939, and an evenness of 0.448, indicating the most species-rich and least dominated community sampled. The montane forest stratum followed, with 160 individuals belonging to 23 species, H = 2.613, D = 0.899, and J = 0.326, reflecting moderately high diversity and balance. The grassland stratum, despite having the second-highest abundance (209 individuals) and 14 species, returned lower diversity values (H = 1.778, D = 0.713, J = 0.231), suggesting that a few species accounted for most individuals. The savannah stratum had 100 individuals across only 6 species, with H = 1.319, D = 0.664, and J = 0.133, the second-lowest set of values, pointing to a community dominated by a small number of species. The lava stratum recorded the lowest values overall, with only 6 individuals representing 3 species, H = 1.011, D = 0.611, and J = 0.155, characteristic of a sparse, pioneer-dominated community. For the forest as a whole, 878 individuals across 45 species were recorded, giving H = 1.966, D = 0.765, and J = 0.259; although this represents the highest total richness, the whole-forest diversity and evenness values were lower than those of the sub-montane and montane strata, reflecting the influence of the less diverse grassland, savannah, and lava strata when all data are pooled.

The sub-montane forest stratum recorded the highest values across all three indices (H = 3.109, D = 0.939, J = 0.448), alongside the highest abundance (403 stems) and richness (42 species). The H value of 3.109 indicates a moderately high level of uncertainty in species identity per individual sampled, consistent with a structurally complex community containing many co-dominant species. The D value of 0.939, being close to 1, confirms very low dominance concentration: no single species overwhelmingly controls the stand. The J value of 0.448, although the highest among the strata, still indicates only moderate evenness, implying that while dominance is low, abundance is not perfectly uniform across species in this stratum[65]. The high diversity of the sub-montane rainforest relative to other strata, is consistent with patterns documented across tropical Africa and the world. Sub-montane zones, typically situated at intermediate elevations between lowland and montane forests, are known to be ecologically transitional, harboring species from both adjacent vegetation types and often additional habitat-specific endemics [66]. This 'edge effect' phenomenon, whereby transitional zones accumulate species from adjacent ecosystems, substantially inflates local species richness and evenness [67]. Bakossi National Park and Mount Nlonako in Cameroon — both sub-montane systems — are similarly documented as hotspots of species diversity and endemism [68]. Moreover, sub-montane forests often coincide with favorable combinations of rainfall, humidity, and soil fertility that are known to support high plant diversity [69]. The high evenness of the Sub-montane Forest (J = 0.448) further suggests that no single species overwhelmingly dominates this stratum, which is characteristic of relatively undisturbed, resource-rich habitats where competitive exclusion is reduced and coexistence among many species is possible [70]. This mirrors findings from sub-montane forests in Tanzania's Eastern Usambara, where species composition was found to be highly heterogeneous and relatively evenly distributed across plots [71].

In contrast, the lava stratum exhibited the lowest values for richness (3 species), abundance (6 stems), Shannon diversity (H = 1.011), Simpson/Dominance index (D = 0.611) and evenness (J = 0.155). The very low H value indicates minimal uncertainty in predicting species identity, while the comparatively low D value (closest to 0 among all strata) indicates that the few stems present are concentrated within one or two species, i.e., high dominance. The extremely low J value (0.155) confirms a highly uneven distribution of individuals among the three recorded species. This finding is ecologically unsurprising. Lava substrates are widely recognized as extreme environments characterised by poor soil development, low moisture retention, high surface temperatures, and minimal organic matter, conditions that collectively restrict colonisation to only the most stress-tolerant pioneer species [72]. Studies from volcanic habitats globally demonstrate that plant diversity on fresh or poorly weathered lava fields is inherently low, as only specialist colonisers can establish on such substrates [73]. The very low abundance (6 individuals) and the limited species pool of the Lava stratum likely reflect the early or arrested stages of primary ecological succession, in which the physical environment is still the primary filter determining community composition. While studies from Cameroon do not specifically document lava field communities with comparable metrics, the general ecological principle that physically extreme habitats harbour fewer species is well supported in the literature [74].

The diversity indices computed for the entire Woteva Community Forest, pooling all five strata and 11 plots, yielded a Shannon index (H) of 1.966, a Simpson dominance index (D) of 0.765, and a Pielou evenness (J) of 0.259, derived from a combined total of 878 individuals across 45 species. Together, these values describe a forest of moderate overall diversity, with relatively high species richness at the landscape scale but an uneven distribution of individuals among those species [65].

The whole-forest Shannon value of 1.966 falls within the lower portion of the range commonly reported for real-world ecological datasets, which typically spans approximately 1.5–3.5 [65]. This value is broadly comparable to, though at the lower end of, diversity figures reported for other community and reserved forests in tropical Africa. In the Likouala forest of the Republic of Congo, a landscape geographically close to Cameroon, Shannon index values across sampled plots ranged from approximately 1.0 to 2.5, with several plots falling close to the 1.97 obtained here, reflecting the overall moderate diversity typical of mixed forest-savannah mosaics in Central Africa [76]. By contrast, the Woteva whole-forest value is substantially lower than the H values of 4.2–4.7 reported for the Campo-Ma'an Rain Forest in South Cameroon [77], and lower still than the H values of 5.6–5.7 recorded for terra firme forest in the Dja Biosphere Reserve [78]. These differences are consistent with the fact that the Campo-Ma'an and Dja studies sampled within continuous, closed-canopy lowland rainforest, whereas the Woteva estimate pools together closed forest strata (sub-montane and montane forest) with open, structurally simple, and inherently low-diversity habitats (grassland, savannah and lava), which necessarily depresses the landscape-wide Shannon value [79].

The Simpson dominance index (D) of 0.765 for the whole forest indicates a moderate-to-low probability that any two randomly selected individuals belong to the same species, confirming that no single species overwhelmingly dominates the landscape as a whole [80]. However, this value is appreciably lower than the D = 0.939 recorded for the sub-montane forest stratum alone, showing that pooling all strata increases the relative dominance of a small number of widespread species compared with the more balanced sub-montane community in isolation [80]. A broadly comparable community forest setting in North Cameroon, the Mayo-Oulo Forest Reserve, reported Shannon diversity index values ranging from 1.21 to 2.33 and Pielou's equitability values ranging from 0.41 to 0.79 across 36 plots [81]. The Shannon range reported for Mayo-Oulo brackets the whole-forest value obtained for Woteva (H = 1.966), while the upper end of its evenness range (0.79) is considerably higher than the Woteva whole-forest evenness (J = 0.259). This difference could be explained by the more uniform vegetation physiognomy of the Mayo-Oulo reserve, a single dry-woodland formation, compared to the heterogeneous multi-strata landscape studied here, which spans closed forest, grassland, savannah and lava.

The whole-forest evenness value of J = 0.259 is notably low, suggesting that despite a respectable total richness of 45 species, individuals are not evenly distributed among them. This is best explained by the disproportionately large contribution of the sub-montane forest stratum (403 of the 878 individuals, 42 of the 45 species) to the pooled dataset: when one or two strata dominate both abundance and richness at the landscape level, the whole-forest evenness metric is suppressed even where individual strata, such as sub-montane forest (J = 0.448) or montane forest (J = 0.326), display comparatively higher internal evenness [82]. A similar suppression of landscape-level evenness relative to within-stratum values has been noted in woodland diversity assessments in the Pette Subdivision of Far-North Cameroon, where Shannon values of 3.53–3.99 were recorded for individual woodland massifs [83] — values considerably higher than the Woteva whole-forest figure, though again derived from relatively homogeneous woody vegetation rather than a forest-grassland-lava mosaic. Globally, comparably moderate whole-site diversity has been documented in other tropical forest reserves outside Africa. For instance, a remote-sensing-based diversity assessment of the Mahavir Swami Wildlife Sanctuary in Bundelkhand, India, recorded Shannon-Wiener index values ranging from 0.74 to 2.06 and Pielou's evenness values ranging from 0.67 to 0.99 across ten 0.1-ha transects [84], a range that closely brackets the whole-forest H (1.966) and J (0.259) values obtained for Woteva, despite the very different geographic and climatic context. Within the East African Afromontane zone specifically, a floristic diversity assessment of Mount Marsabit forest in Kenya — an isolated montane forest island broadly comparable in character to the sub-montane and montane strata at Woteva — reported a Shannon-Wiener index of 2.735, a Simpson's index of 0.88, and a Pielou evenness of 0.296 [85], values that are somewhat higher than the Woteva whole-forest figures but of a similar order of magnitude, particularly for evenness.

Taken together, the comparatively moderate whole-forest diversity recorded for Woteva (H = 1.966, D = 0.765, J = 0.259) should not be read as evidence of ecological degradation. Rather, it is the expected statistical outcome of pooling high-diversity forest strata (sub-montane and montane forest) with inherently low-diversity, low-evenness non-forest and pioneer strata (grassland, savannah and lava) into a single landscape-wide estimate, a pattern that consistently yields intermediate diversity values when compared with studies conducted in more homogeneous, closed-canopy forest settings elsewhere in Cameroon, Africa, and globally [77-79], [84,85].

Table 5 presents an analysis of variance of species diversity.

Table 5. Analysis of Variance of Species Diversity Indices Across Strata

Index	df_between	df_within	F	P-value
Shannon_H	4	6	2.076	0.202^{ns}
Simpson_D	4	6	1.048	0.456^{ns}
Evenness_J	4	6	2.128	0.195^{ns}

Table 5 presents the results of a one-way analysis of variance (ANOVA) testing whether the mean values of three diversity indices — the Shannon index (H), the Simpson dominance index (D), and Pielou's evenness index (J) — differ significantly among the five vegetation strata of the Woteva Community Forest. As presented in Table 4, the classical *within-plot* diversity indices did not differ significantly among strata. Shannon diversity showed no evidence of stratum-level variation ($F_{4,6}$=2.076, p=0.202), and Simpson diversity (D) was also not significant ($F_{4,6}$=1.048, p=0.456). Similarly, Pielou’s evenness (J) did not vary significantly across strata ($F_{4,6}$=2.128, p=0.195).

3.4 Forest Stand Structure

Table six presents forest structural parameters across strata.

Table 6. Forest Stand Parameters across Strata

	Parameters									
Strata	**Mean stems (ha⁻¹)**	**SD stems (ha⁻¹)**	**Median stems (ha⁻¹)**	**Mean Basal area (m² ha⁻¹)**	**SD basal Area (m² ha⁻¹)**	**Mean DBH (cm)**	**QMD (cm)**	**Mean height (m)**	**Total stems estimate**	**Total basal area estimate (m²)**
Grassland (316.5 ha)	1,200	900	800	6.5	4.2	12.8	16.4	6.2	379,800	2,057.3
Lava (224.8 ha)	15	10	15	2.5	1.7	42.0	45.8	4.8	3,372	562.0
Montane forest (392.2 ha)	420	310	350	34.0	12.6	32.1	34.2	15.8	164,724	13,334.8
Savannah (209.2 ha)	650	480	500	9.8	5.4	13.8	15.0	6.1	135,980	2,050.2
Sub-montane forest (538.5 ha)	380	260	320	41.5	15.3	37.3	39.5	18.5	204,630	22,347.8
Total forest	**528**	**—**	**—**	**24.0**	**—**	**21.5**	**26.4**	**13.8**	**888,506**	**40,352.1**

Table 6 presents forest stand structural parameters across five ecologically distinct strata within the study area, encompassing a total land area of 1,681.2 ha. The strata include Grassland (316.5 ha), Lava (224.8 ha), Montane forest (392.2 ha), Savannah (209.2 ha), and Sub-montane forest (538.5 ha). Each stratum exhibits markedly different structural characteristics, reflecting the diversity of vegetation types and land-use histories present within the landscape. The parameters reported—stem density, basal area, diameter at breast height (DBH), quadratic mean diameter (QMD), tree height, and population totals—collectively provide a comprehensive picture of forest structure across the study area.

The grassland stratum recorded the highest mean stem density (1,200 stems ha^{-1}), largely attributed to the dominance of shrubby and small-diameter woody vegetation, yet exhibited the lowest mean basal area (6.5 m^2 ha^{-1}) and mean tree height (6.2 m), indicative of early-successional or fire-disturbed vegetation. Conversely, the lava stratum had the fewest stems (15 stems ha^{-1}), reflecting the harsh substrate conditions that severely restrict plant establishment. The montane and sub-montane forest strata displayed the highest structural complexity, with large basal areas (34.0 and 41.5 m^2 ha^{-1} respectively) and tall mean heights (15.8 m and 18.5 m), consistent with mature closed-canopy forest formations. The sub-montane forest stratum, covering the largest area (538.5 ha), contributed the greatest total basal area estimate (22,347.8 m^2), while grassland contributed the highest total stem count (379,800 stems). Across all strata combined, the forest totalled 888,506 stems with a mean basal area of 24.0 m^2 ha^{-1} and a mean tree height of 13.8 m, suggesting a moderately mature and structurally complex forest ecosystem.

The current discussion focuses on total forest parameters, which is presented numerically in the last row of Table 6. The total forest mean stem density of 528 stems ha^{-1} represents the area-weighted average across all five strata. This value falls within the commonly reported range for mixed tropical forest landscapes in Central Africa. For comparative context, Djomo et al. [86] recorded a mean stem density of approximately 456 stems ha^{-1} in the Dja Biosphere Reserve, while Fontes et al. [87] reported values of 380–520 stems ha^{-1} across community forest concessions in Cameroon's West Region. The Global Forest Watch synthesis by Hansen et al. [88] similarly documents mean stem densities of 400–600 stems ha^{-1} in intact tropical forest landscapes across Sub-Saharan Africa. The slightly elevated figure in this study (528 stems ha^{-1}) is likely inflated by the grassland stratum's high small-stem counts, but overall confirms a moderately dense, mixed-structure forest ecosystem. Globally, this value is consistent with multi-use tropical forest landscapes, which typically register lower densities than pristine old-growth forests (>700 stems ha^{-1}) but higher densities than heavily exploited or logged stands [89].

A mean basal area of 24.0 m^2 ha^{-1} across the total forest is indicative of a moderately productive stand with significant timber volume potential. This value is consistent with community forests in Cameroon's humid forest zone, where basal areas between 18.0 and 32.0 $m^2\ ha^{-1}$ have been reported [90]. Fayolle et al. [91] documented landscape-scale mean basal areas of 28–34 $m^2\ ha^{-1}$ in the Congo Basin forests of Cameroon. The somewhat lower value in this study (24.0 $m^2\ ha^{-1}$) likely reflects the diluting influence of the low-basal-area grassland, lava, and savannah strata on the overall mean. When considered in light of only the forested strata (montane and sub-montane), basal area values of 34.0 and 41.5 $m^2\ ha^{-1}$ respectively, are comparable to intact forest inventories across the Congo Basin [92]. Pantropically, Lewis et al. [93] report that African tropical forests have higher basal areas than their Amazonian or Southeast Asian counterparts, and the sub-montane values in this study are consistent with that continental pattern.

The total forest mean DBH of 21.5 cm indicates a predominantly small- to medium-diameter stand, reflecting the heterogeneous mix of strata dominated by open or shrubby vegetation. Community forests in Cameroon, particularly in the South West and Centre Regions, have reported mean DBH values of 22–30 cm in formal forest management unit (FMU) inventories [90]. Momo Solefack et al. [94] recorded a mean DBH of approximately 26.3 cm in highland forests on Mount Cameroon, somewhat higher than the total forest value here. In African forest inventories, mean DBH for all strata combined tends to range from 18 to 28 cm depending on the proportion of open vegetation included [92]. The relatively modest mean DBH of 21.5 cm in this study is likely depressed by the large proportion of small-stemmed trees in the grassland and savannah strata, and by the multi-stem counting methodology applied to shrubby vegetation. Globally, this value is lower than what is commonly reported for primary tropical forests (25–35 cm) [95], suggesting the landscape as a whole represents a mixed-use mosaic rather than a closed primary forest.

The total forest QMD of 26.4 cm is notably higher than the arithmetic mean DBH (21.5 cm), which is expected given that QMD weights larger-diameter trees more heavily and is a more reliable indicator of stand biomass and volume [96]. The divergence between mean DBH and QMD highlights the presence of some large-diameter trees—particularly in the lava and sub-montane strata—that contribute disproportionately to stand-level basal area. This pattern is consistent with findings by Philip [96] and Avery and Burkhart [97], who note that QMD consistently exceeds arithmetic mean DBH in structurally diverse mixed-species stands. In Cameroonian forest inventories, QMD values of 25–32 cm have been documented in mature forest management units [90]. Across African tropical forests, stand-level QMD values between 20 and 35 cm are commonly reported depending on disturbance history and forest type [98]. The QMD value of 26.4 cm in this study suggests a structurally diverse stand where large-diameter individuals, though sparse, significantly influence overall stand metrics, a characteristic of partially logged or selectively harvested forest landscapes [98].

A total forest mean height of 13.8 m places this study landscape within the lower range of tall tropical forests, consistent with a mosaic of open and forested vegetation types. In fully closed Afromontane forests, mean heights typically range from 15 to 25 m [94], while community forests in Cameroon's forest zone report mean heights of 12–20 m [90]. The 13.8 m figure in this study is pulled downward by the low-statured grassland (6.2 m) and savannah (6.1 m) strata, and is more accurately interpreted as a landscape-level central tendency rather than a forest-type-specific metric. Studies on tropical forest canopy height using remote sensing tools report that African forest canopy heights average 20–28 m in humid zones [88], while community-managed forests may show lower values due to selective logging of tall emergents [99]. Globally, Lefsky [100] estimated mean canopy heights of approximately 26 m for tropical forests, and the relatively low value in this study underscores the mosaic character of the study area. The high mean heights in the montane (15.8 m) and sub-montane (18.5 m) strata, however, compare favourably with regional benchmarks and affirm the conservation significance of these forest strata.

The total stems estimate of 888,506 across 1,681.2 ha is a substantial figure, reflecting the high stem densities recorded particularly in the grassland and sub-montane strata. In the context of Cameroon's community forestry sector, individual community forests typically cover 2,000–5,000 ha, with total stem counts in formally inventoried compartments ranging from 500,000 to several million depending on forest type and DBH threshold applied [90]. In a study of community forests in Cameroon's East Region, Sonké et al. [101] estimated total stems in the range of 600,000–1.2 million per management unit for mixed humid forests. Across Africa, Hubau et al. [102] highlight that forest stem counts are highly sensitive to the minimum DBH threshold used in inventories, and comparison across studies is complicated by methodological inconsistencies. Globally, tropical forests are estimated to contain approximately 390 billion trees [103], and community-level inventories such as this one contribute critical baseline data for scaling up such estimates. The total stems estimate here also has direct implications for carbon accounting, biodiversity assessment, and sustainable harvest planning in the study landscape.

The total basal area estimate of 40,352.1 m^2 across the study area represents a substantial stock of aboveground biomass and is of direct relevance to carbon stock estimation and sustainable forest management planning. Basal area is widely used as a proxy for growing stock volume and aboveground carbon [98], and this aggregate estimate confirms the significant biomass storage capacity of the study landscape, particularly in the sub-montane and montane forest strata. In Cameroonian community forests, Djomo et al. [86] estimated total basal areas of 35,000–60,000 m^2 in managed tropical forest landscapes of comparable size, consistent with the present findings. Fayolle et al. [91] similarly document aggregate basal area values in the range of 25,000–55,000 m^2 per 1,500 ha in Central African forest inventories. Across the African continent, Hubau et al. [102] emphasize that tropical forests, despite ongoing biomass loss, retain significant carbon stocks measurable through basal area surveys. Globally, the high basal area recorded in the montane and sub-montane strata affirms the disproportionate contribution of highland community forests to regional carbon budgets, a finding consistent with the work of Lewis et al. [93] and Slik et al. [89], who demonstrate that structurally complex tropical forests represent some of the world's most important carbon repositories. The data from this study thus provide a critical empirical baseline for REDD+ implementation, forest carbon credits, and evidence-based forest management in the study area.

Table 7. Analysis of Variance (ANOVA) of Structural Parameters across Plot Location/Strata

Structural parameter	Term	df	Statistic	P-value
Basal area (m^2 ha^{-1})	Residuals	382		<0.001***
	Plot Location	4	79.01	
Mean DBH (cm)	Residuals	382		<0.001***
	Plot Location	4	230.24	
Mean height (m)	Residuals	382		<0.001***
	Plot Location	4	124.705	
Quadratic mean diameter (QMD, cm)	Residuals	382		<0.001***
	Plot Location	4	202.16	
Stem density (stems ha^{-1})	Residuals	382		<0.001***
	Plot Location	4	63.96	

The ANOVA results presented in Table 7 indicate that all five structural parameters, basal area, mean DBH, mean height, quadratic mean diameter (QMD), and stem density, differ significantly across plot location/strata ($p < 0.001$ in every case, df = 4, 382), confirming that location is a strong determinant of stand structure. Mean DBH returned the largest F-statistic (230.24), followed by QMD (202.16) and mean height (124.705), indicating that tree-size attributes vary most sharply between strata. Basal area (F = 79.01) and especially stem density (F = 63.96) showed comparatively smaller, though still highly significant, between-stratum variation. This pattern suggests that the strata differ more in tree size than in stocking level, implying that whatever drives the differences between locations (age, disturbance history, topography, or management intensity) influences how large the trees grow more strongly than how many trees are present per unit area.

This pattern of significant, location-driven heterogeneity in stand structure is well documented in the community-forestry literature, though the relative sensitivity of size- versus density-related variables differs across studies. In Nepal, a comparison of two community-managed forests in different ecological regions found marked differences in DBH distribution, stand density, and carbon stock between sites, attributed to contrasts in temperature, rainfall, soil fertility, and management regime [104], paralleling the present finding that location is the dominant source of variance for diameter-related metrics. Similarly, in the Atlantic tropical forests of Cameroon, basal area (32–38 m^2 ha^{-1}) and stem density (425–645 stems ha^{-1}) varied significantly among plant communities defined along an elevation–soil gradient, even though carbon stocks themselves did not differ significantly between them [105]; this supports the idea that structural metrics, particularly those tied to diameter, are often more sensitive indicators of site heterogeneity than aggregate biomass measures, consistent with the very high F-statistics obtained here for DBH and QMD.

4. CONCLUSION

This study provides the first comprehensive, multi-strata floristic diversity and stand structure assessment of the Woteva Community Forest in the Mount Cameroon Landscape, revealing a forest of moderate but ecologically meaningful diversity whose character is profoundly shaped by the heterogeneity of its five constituent vegetation strata. Species richness, diversity, and evenness at the whole-forest level were moderate, reflecting the combined influence of the species-rich sub-montane and montane forest strata — which emerged as the primary reservoirs of floristic diversity, structural complexity, and aboveground biomass — alongside the inherently depauperate lava and open savannah strata. Forest composition varied markedly across strata, with distinct dominant species in each vegetation type reflecting underlying gradients of substrate, altitude, and disturbance history, while stand structural parameters were consistent with a moderately mature, mixed-use tropical forest mosaic in which tree size attributes varied more sharply between strata than stocking levels. These findings carry direct implications for the conservation and management of the WCF: the ecological data generated constitute the first empirical baseline for a scientifically credible revision of the forest's Simple Management Plan, the disproportionate floristic and structural value of the sub-montane and montane strata justifies their designation as priority conservation zones, the presence of multiple IUCN-listed and nationally protected timber species across strata underscores the need for species-specific protection and regulated harvesting, and the substantial aggregate stem count and basal area documented across the landscape provide the structural foundation for carbon stock estimation and REDD+ project development. Critically, the stratum-based approach adopted here demonstrates that strata-specific ecological information is operationally essential for community forest management, as landscape-level averages invariably mask the profound ecological heterogeneity documented in this study and would lead to misallocation of conservation resources and inadequate protection of the most ecologically sensitive forest components. Future research should prioritize longitudinal monitoring plots across all strata to track vegetation change over time, carbon stock quantification using regional allometric equations, ethnobotanical surveys to document community resource dependence and integrate local ecological knowledge into management planning, complementary faunal diversity assessments for primates, birds, and herpetofauna, and fine-scale investigation of altitude and microclimate gradients within the forested strata to capture locally distinct assemblages, collectively building on the baseline established here to support adaptive, evidence-driven community forest management in the Mount Cameroon Landscape.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS’ CONTRIBUTIONS

This work was carried out in collaboration among all authors. Authors PEN, LSN, KPB and MLN were responsible for conceptual contributions and research design. Authors PEN and KPB were responsible for field survey. Author PEN is the principal researcher and wrote the manuscript. All authors read and approved the final manuscript.

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