International Journal of Current Science Research and Review

ISSN: 2581-8341

Volume 08 Issue 01 January 2025

DOI: 10.47191/ijcsrr/V8-i1-56, Impact Factor: 7.943

IJCSRR @ 2025

www.ijcsrr.org

Role of The Forest-Savanna Transition Zones in Mitigating Climate Change at Lamto Scientific Reserve, Côte d'Ivoire

Amani Abell Mike KOUAKOU[1*], Konan Edouard KOUASSI[2], Pagadjovongo Adama SILUE[2,3], Jonathan Arthur QUAYE-BALLARD[2,4], Nat Owusu PREMPEH[2,5], Michael THIEL[6]

[1]West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL), Graduate Research Programme on Climate Change and Land Use, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana.

[2]West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL), African Centre of Excellence in Climate Change, Biodiversity & Sustainable Agriculture (CEA-CCBAD), UFR Biosciences, Université Félix Houphouët-Boigny (UFHB), BP 582 Abidjan, Abidjan, Côte d'Ivoire

[2,3]Département de Biologie Végétale, UFR Sciences Biologiques, Université Peleforo Gon Coulibaly (UPGC), BP 1328 Korhogo, Côte d'Ivoire.

[2,4]Department of Geomatic Engineering, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana

[2,5]Department of Land Reclamation and Rehabilitation, Faculty of Forest Resources Technology, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana

[6]Earth Observation Research Cluster, Department of Global Urbanization and Remote Sensing, Institute of Geography and Geology, University of Würzburg, 97074, Germany.

ABSTRACT: In the context of global climate change, forests play a crucial role as carbon sinks, contributing to regulating greenhouse gases and stabilising the climate. This study evaluates the role of forest-savanna transition zones in mitigating climate change at Lamto Scientific Reserve, Côte d'Ivoire, by assessing their carbon sequestration capacity and economic value. The study employed a combination of field surveys, remote sensing and statistical analysis to gather and analyse the data. The floristic inventory recorded 4,018 individuals, distributed among 142 species, 92 genus, and 37 families. The stem density ranges from 510 stems/ha (shrub savanna) to 758 stems/ha (moist semi-deciduous forest), with a basal area varying from 5.65 m²/ha (open forest) to 11.79 m²/ha (gallery forest). The vegetation structure, characterised by a "bell-shaped" vertical stratification and an "inverted J" horizontal distribution, reflects active regeneration. In terms of biomass and carbon sequestration, the gallery forest dominates with 287.37 ± 201.68 t/ha of biomass, 143.69 ± 100.84 tC/ha of carbon, and an exceptional capacity to sequester 526.856 tCO_2/ha, accounting for 57.6% of the total carbon sequestered. Its economic value, supported by mechanisms such as REDD+ High, reaches 13,171 EUR/ha (8,639,880 FCFA). In contrast, the shrub savanna, with a biomass of 9.38 ± 8.41 t/ha and limited sequestration of 17.203 tCO_2/ha, offers a maximum value of 430 EUR/ha (282,111 FCFA). The results highlight the key role of the gallery forest as the primary carbon sink and the economic potential of Lamto's ecosystems. They underscore sustainable management's importance in maximising climate regulation, preserving biodiversity, and enhancing ecological resilience.

KEYWORDS: Plant biodiversity, Carbon sequestration, Climate change mitigation, Forest-savanna transition zones, Lamto Scientific Reserve, Côte d'Ivoire.

I. INTRODUCTION

Plant biodiversity, the structure of forest ecosystems and the associated biomass play a dominant role in regulating ecological cycles, particularly in carbon storage and protection against the effects of climate change. On a global scale, tropical forests act as major carbon sinks, sequestering around 50% of terrestrial carbon and thereby helping to mitigate the impacts of greenhouse gas emissions **(Pan *et al.*, 2011).** However, deforestation and forest degradation result in the release of significant amounts of CO_2 into the atmosphere, exacerbating climate change **(Seymour et Harris, 2019).**

In Africa, forests represent about 25% of global forest ecosystems, and their role in carbon sequestration is crucial at the continental scale **(Lewis *et al.*, 2015).** However, increasing anthropogenic pressures, such as intensive agriculture and logging, threaten these forests, leading to a decline in carbon stocks and an increase in GHG emissions **(FAO, 2024; FAO, 2020)**. Despite this, there is a lack of data on the biomass and carbon storage capacity of African forests, making it challenging to develop effective GHG mitigation strategies **(Nkem *et al.*, 2010)**.

In West Africa, forest ecosystems, particularly those located in forest-savanna transition zones or preforest zone, play a major role in regional climate regulation. However, these regions are particularly vulnerable to climate change, which affects their ecological dynamics and their capacity to store carbon **(Mayaux *et al.*, 2013)**. Deforestation, habitat fragmentation, and recurrent bushfires severely undermine the ecological integrity of these ecosystems and diminish their effectiveness as carbon sinks. A thorough evaluation of forest biomass and carbon sequestration is crucial for quantifying the magnitude of these disturbances and assessing their impact on regional greenhouse gas (GHG) emissions. Such an assessment provides critical insights into ecosystem resilience, carbon flux dynamics, and the broader implications of land use/land cover change on climate regulation **(Gonzalez et al., 2012).**

In Côte d'Ivoire, tropical forests, which once made up almost half of the country's land cover, have been drastically reduced, mainly as a result of agricultural expansion **(Chatelain *et al.*, 2010)**. Indeed, the country's forest area has shrunk from 7.85 million hectares in 1986 to 5.09 million hectares in 2000, and then to 3.6 million hectares in 2015 **(SEP-REDD+ et FAO, 2017)**. Although agricultural expansion is often identified as the main direct cause of deforestation, weak forest governance is also mentioned as a major indirect cause **(Madron *et al.*, 2015; Etc Terra, 2015)**. This has increased the country's vulnerability to the impacts of climate change, particularly soil erosion, reduced rainfall and rising temperatures. Anthropogenic pressures, such as the conversion of forests into farmland and degradation into secondary forests or savannas are creating changes in ecosystems. These changes not only modify the vegetation's composition and structure but also influence these ecosystems' capacity to store carbon. The Lamto Scientific Reserve (LSR), located in the transition zone between savanna and forest or pre-forest zone, is one of a key site for studying these ecological dynamics. This region, which is also subject to anthropogenic pressures, serves as a natural laboratory for understanding how these interactions influence the capacity of ecosystems to store carbon **(Kpangba *et al.*, 2022)**.

The main objective of this study is to provide a comprehensive assessment of the vegetation structure and forest biomass in the Lamto Scientific Reserve (LSR), a key ecosystem for climate regulation. Specifically, the study aims to: (1) characterize the structural parameters of the vegetation and (2) quantify the living biomass to estimate the amount of carbon sequestered. This assessment will contribute to a better understanding of the carbon storage potential of these ecosystems and their role in mitigating climate change.

Unlike previous studies, which often focus solely on the dynamics of deforestation or changes in land use/land cover, this study aims to provide an in-depth local assessment, through analyses of biomass and flora concerning GHG emissions. Previous work has explored various aspects of the ecosystem. Indeed, **Kpangba *et al.*, (2022)** looked at seed germination and resistance to fire in their work. Although, **N'Dri *et al.*, (2018)** studied vegetation dynamics in Lamto concerning the impacts of bushfires on soil fertility and agricultural production, while **Gnahoré *et al.*, (2018**) analysed the structure of plant communities. Furthermore, **Douffi *et al.*, (2021)**, mapped the evolution of land use/land cover and analysed the impact of land surface temperature (LST) and precipitation on vegetation dynamics. However, these studies did not provide data on quantifying the biomass or carbon storage of all the biotopes in the Lamto Scientific Reserve (LSR) in the face of climate change and anthropogenic pressures. This will provide critical information for managing forest ecosystems and implementing carbon offset strategies **(Goetz *et al.*, 2009; Goetz and Dubayah, 2011; Asner *et al.*, 2014).**

This study has the potential to bring significant economic and social benefits. By contributing to global efforts to conserve and combat climate change, it opens up the possibility of accessing carbon credit programs, which could generate funding for ecosystem conservation and sustainable development (**Gnahoré *et al.*, 2018**). It could also support ecotourism and boost local communities' sources of income while contributing to the sustainable management of natural resources. Finally, the study intentions to promote environmental justice by ensuring that conservation benefits are accessible to local populations, thereby supporting a balance between conservation and sustainable development **(Muray *et al.*, 2011; Brown *et al.*, 2010**; **Lapointe and Gagnon, 2012**; **Brondizio *et al.*, 2019**). This study could provide a solid basis for designing sustainable forest management policies and developing climate financing mechanisms. These initiatives, which have already been implemented in other tropical regions such as the Congo Basin (DRC, Gabon), the Amazon (Brazil, Colombia) and Southeast Asia (Indonesia, Malaysia), would benefit from local data on the carbon sequestration potential of the Lamto Scientific Reserve, making them more effective and relevant at the regional level **(Molua, 2019; Djomo *et al.*, 2016; Nkem *et al.*, 2010**).

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 01 January 2025
DOI: 10.47191/ijcsrr/V8-i1-56, Impact Factor: 7.943
IJCSRR @ 2025
www.ijcsrr.org

II. MATERIAL AND METHODS

A. Study area

The Lamto Scientific Reserve was established on 12 July 1968 by decree no. 857 AGRI/DOM. Located at the tip of V-Baoulé, between coordinates 6°13‘and 6°15’ North latitude and 4°06‘and 5°03’ West longitude **Gnahoré *et al.*, (2018)**, it lies in the Department of Taabo, in central Côte d'Ivoire **(Figure 1)**. Lamto is recognised as a one of reference area for ecological studies in West Africa **(N'Dri *et al.*, 2018; Bigiot *et al.*, 2004; Vuattoux *et al.*, 2006)**. The reserve extends covering a total area of 2,617 hectares. Lamto has a humid tropical climate, marked by four distinct seasons: a long rainy season (March to July), a short rainy season (September to November), a long dry season (December to February) and a short dry season in August **(Tiémoko *et al.*, 2020)**. The average annual rainfall is around 1,200 mm, while the average temperature is 25.9°C **(climate-data.org, 2024; Témoko *et al.*, 2023).**

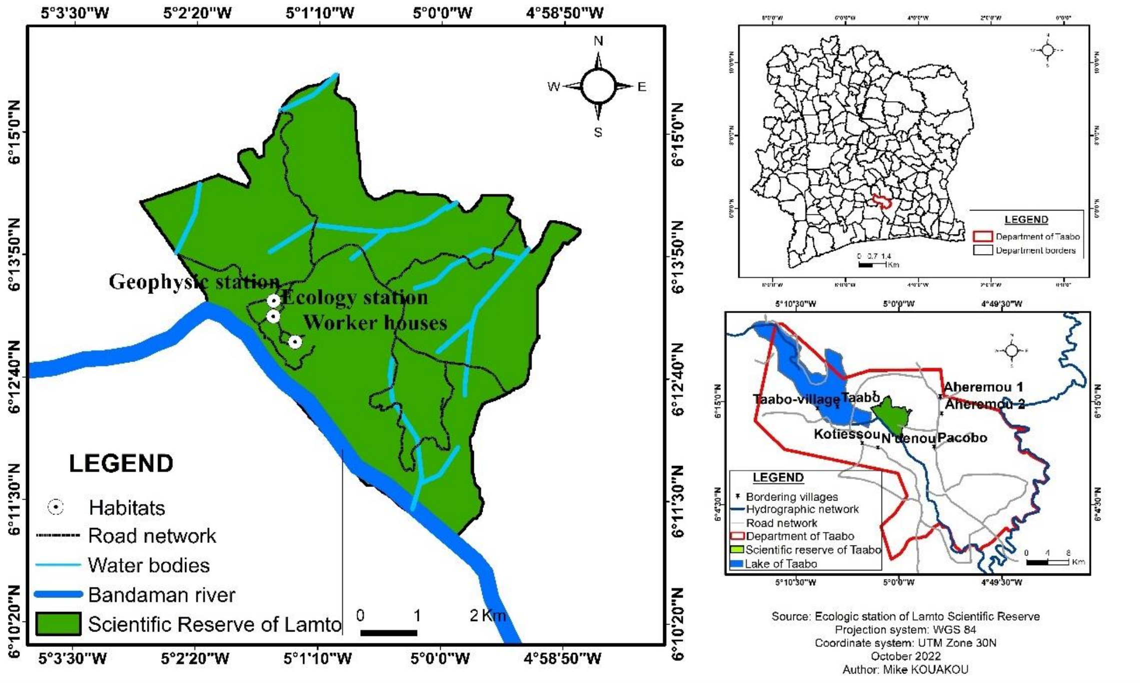

Figure 1: Geographical location of the Lamto Scientific Reserve (LSR)

The vegetation at Lamto is a mosaic of savannas and forests **(Figure 2).** There are wooded savannas, tree savannas and shrubs savannas, as well as gallery forests, dense semi-deciduous forests and open forests. The gallery forests line the watercourses, particularly the River Bandama and its tributaries, offering dense, permanent vegetation **(SEP-REDD+ et FAO, 2017)**. The dense semi-deciduous forests found in the wetlands are home to deciduous and semi-deciduous trees, while the open forests are located in transition zones between dense or open vegetation **(Vuattoux *et al.*, 2006; Tiémoko *et al.*, 2020)**.

The reserve has a grassy stratum dominated by grasses of the genera Andropogon (31%) and Hyparrhenia (30%), while the woody savanna vegetation, 80% trees and shrubs, includes species such as *Crossopteryx febrifuga*, *Piliostigma thonningii*, *Bridelia ferruginea*, *Cussonia arborea*, *Pterocarpus erinaceus*, *Terminalia schimperiana* and *Annona senegalensis* **(Vuattoux *et al.*, 2006)**. The woody flora of the forests is composed of *Diospyros heudelotii*, *Erythroxylum emarginatum*, *Afzelia africana*, *Erythrophloeum suaveolens*, *Drypetes ineaqualis*, *Baphia nitida*, *Mansonia altissima*, *Sterculia traganta*, *Cynometra amanta*, *Alstonei boonei*, *Dialium guineense*, *Cola heterophylla*, *Mimusops andongensis*, *Futumia africana* etc. **(Vuattoux *et al.*, 2006)**. Lamto's soils, which are mainly tropical ferruginous, influence the heterogeneous vegetation that develops there **(climate-data.org, 2024; Témoko *et al.*, 2023; Soro *et al.*, 2018; Devineau, 1975; Avenard *et al.*, 1971, Riou, 1974, Kone *et al.*, 2020)**.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 01 January 2025
DOI: 10.47191/ijcsrr/V8-i1-56, Impact Factor: 7.943
IJCSRR @ 2025
www.ijcsrr.org

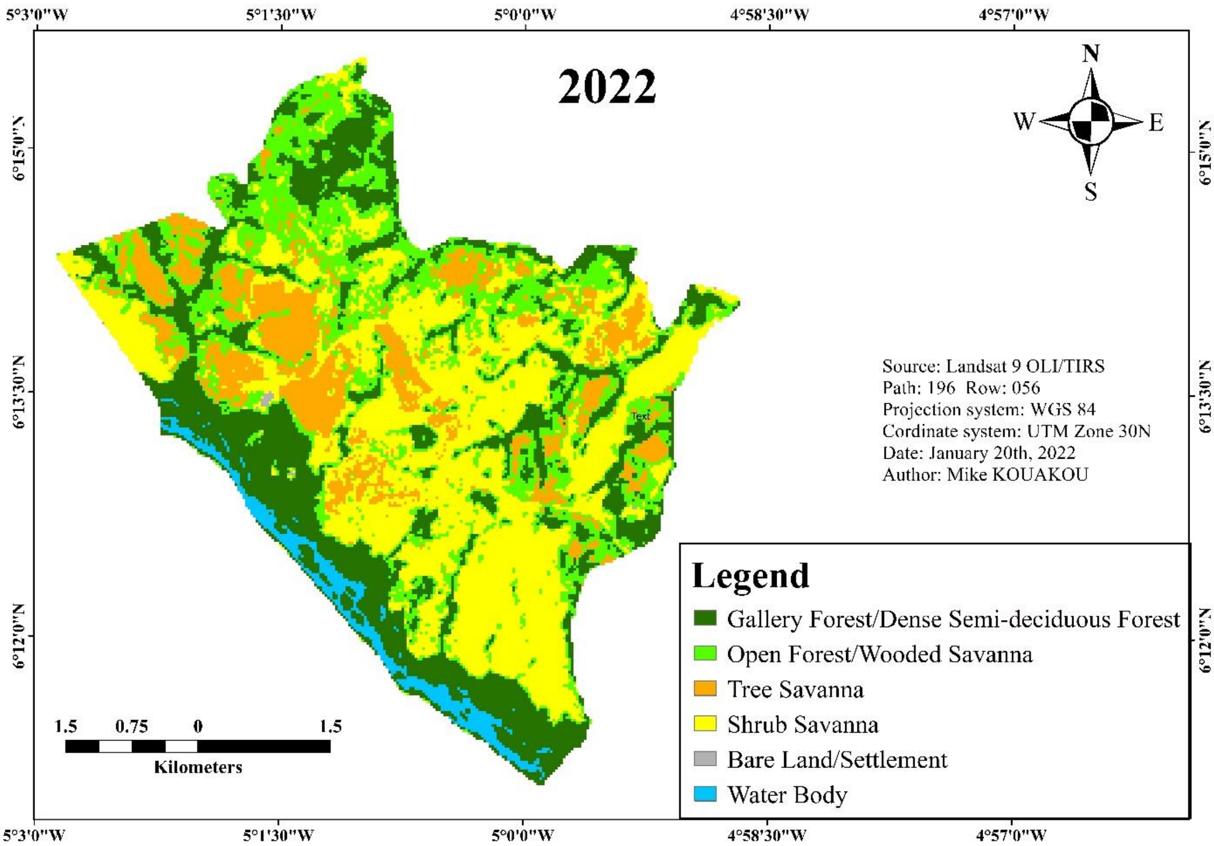

Figure 2: Land Use/Land Cover (LULC) Map of Lamto Scientific Reserve

B. Materials

The study material can be divided into two main categories: biological material and technical material. The biological material comprises the plant species from the plant formations studied. The technical equipment includes the tools commonly used by botanists, such as GPS, metric tape, electronic dendrometer, tape measure and laser rangefinder, among others.

C. Data collection method

During this study, the surface survey method was used to inventory the vegetation in the various biotopes. This method consisted of installing 900 m² square plots (30 m x 30 m) in each of the biotopes identified, namely the gallery forest (GF), the dense semi-deciduous forest (DSF), the open forest (OF), the wooded savanna (WS), the shrub savanna (SS). This classification is based on **(Yangambi, 1956)** Yangambi's system, the work of **(Aké-Assi, 1984)** and previous studies carried out in the Lamto Scientific Reserve (**Yapo *et al.*, 2023; Témoko *et al.*, 2020; Témoko *et al.*, 2023; Ossohou *et al.*, 2021; Kouamé *et al.*, 2022; Koffi *et al.*, 2018; N'Dri *et al.*, 2021; Chatelain *et al.*, 2010; Silué *et al.*, 2022; Koné et al., 2022; Gignoux *et al.*, 2011; Konaté and Kampmann, 2010)**.

In all, 60 plots were set up, i.e. 10 plots per biotope. These plots were used to collect dendrometric data on woody species. All species with a minimum circumference greater than or equal to 10 cm (corresponding to a diameter at breast height, or DBH, of 3.18 cm) were measured at a standard height of 1.30 m above ground level. The trees whose total height exceeded 2 m were also measured. The 10 cm circumference threshold was chosen to ensure data collection uniformity and accurately reflect ecosystem structure. The trees with a circumference of at least 10 cm are considered mature, which makes them essential for assessing biomass and carbon storage. Trees of smaller circumference, on the other hand, are deemed to be regenerating and are generally taken into account in biodiversity analyses. By focusing on mature trees, forest inventories enable optimising collection resources while obtaining accurate estimates of biomass and contributions to biodiversity. These data are fundamental for the sustainable management of forests and the implementation of climate change mitigation strategies **(FAO, 2005; Chave *et al.*, 2005; Gignoux *et al.*, 2011; Silué *et al.*, 2021; Adou Yao *et al.*, 2013; Vroh *et al.*, 2014; Gbozé *et al.*, 2020).**

D. Data analysis method

Once the data had been collected in the field, many analyses were carried out in the laboratory. These analyses included the measurement of vegetation structure, tree density and total basal area. Density refers to the number of individuals per unit area, while basal area represents the surface area occupied by tree trunks, measured at 1.30 metres from the ground. The trees were then classified according to their diameter, and distribution histograms were produced to illustrate the horizontal and vertical structures of the plant formations. The biomass, carbon stock and market value of carbon credits were then estimated using appropriate mathematical formula. The woody biomass is made up of above-ground and below-ground biomass. The above-ground biomass corresponds to the mass of dry plant matter per unit area, including both trunk and branches. In the absence of specific equations for Ivorian forests, the GlobAllomeTree tool was used to fill this gap. The above-ground biomass (AGB) was quantified using an adapted pantropical allometric equation.

The searches of the GlobAllomeTree database revealed the existence of at least 73 allometric equations specific to Côte d'Ivoire. However, most of these equations are adapted mainly to cultivated forests like *Tectona grandis*, *Gmelina arborea*, *Acacia siamea* or precious wood species used in joinery and cabinet-making such as *Khaya grandifoliola* and *Tarrietia utilis*. Nevertheless, these equations are not suitable for large-scale use in all of the country's phytogeographical regions.

To comprehensively represent all ecosystem types, the pantropical allometric equation model 4 developed by **Chave *et al.*, (2014)** was used. This equation was preferred for converting field data into aboveground biomass estimates because of its robustness (standard error = 0.357; Akaike Information Criterion (AIC) = 3130; degrees of freedom = 4002), recency, and ability to cover a wide range of vegetation types. The study included a total of 4,004 trees with diameters at breast height (DBH) ranging from 5 cm to 212 cm. The integrated data also came from other pantropical equations, such as those of **Brown, (1997); Chave *et al.*, (2005)** and **Fayolle *et al.*, (2013**), which include specificities for African trees.

The model 4 by **Chave *et al.*, (2014)** used for biomass estimates, is based on three key variables: diameter at breast height (DBH), tree height, and anhydrous wood density. Thus, above-ground biomass was calculated by following the mathematical expression of this allometric equation:

$$AGB = 0.0673 \times (\rho DBH^2 H)^{0.973} \quad (1)$$

AGB is the estimated above-ground biomass in t/ha; *DBH* is the diameter at breast height in cm; *H* is the total height of the tree (m); ρ: the specific density of the wood (g/cm^3).

It is important to note that the allometric equation used to predict biomass incorporates the specific density of the wood. To this end, a database of wood densities for African species was consulted, in particular that of **(Brown, 1997)**. For each species studied, a specific match was sought in the Global Wood Density Database.

Though, when the specific density of a species was not available, the default value for African tropical forests was used. This default value is 0.58 g/cm³ **(Brown, 1997; Reyes *et al.*, 1992)**.

The Below-ground biomass is generally estimated by applying the stem-root ratio (*Tx*), depending on the ecological zone **(IPCC, 2006)**. In this study, a T_x ratio of 0.37 was used for dense tropical forests, following the work of **(Fittkau and Klinge, 1973)**. Below-ground biomass (BGB) was thus calculated from the following equation:

$$BGB = T_X \times AGB \quad (2)$$

T_x is a tonne root/tonne shoot = 0.37 **(Fittkau and Klinge, 1973)**; *BGB* is the Below Ground Biomass; *AGB* is the Above Ground Biomass.

The total biomass (*BT*) of standing woody plants is then estimated by summing the two values for above-ground and below-ground biomass.

$$BT = AGB + BGB \quad (3)$$

BT is the Total Biomass in t/ha

This estimated total biomass was converted into sequestered carbon stock. The carbon stock is linked to the biomass by the following relationship:

$$C = BT \times CF \quad (4)$$

C is the carbon stock*; BT* is the Total Biomass*; CF* is the biomass to carbon conversion factor.

It has been reported that the carbon contained in the dry biomass of a tree is 50 percent of the total biomass (BT) **(IPCC, 2006; Malhi *et al.*, 2004)**. The carbon stock values calculated in the sampling area were extrapolated into hectares for the entire study area. The quantity of CO_2 sequestered was then determined using the ratio between the molar masses of carbon and CO_2. The mass of CO_2 was calculated using the following formula:

$$R_{eq}CO_2 = m_{CO_2} = C \times \frac{M_{CO_2}}{M_C} = C \times \frac{44}{12} \quad (5)$$

In this formula, $R_{eq}CO_2$ is the equivalent Rate of CO_2 sequestered, m_{CO_2} the mass of CO_2, C is the carbon in each tree, M_{CO_2} is the molar mass of CO_2 et M_c is the molar mass of carbon.

E. Estimation of CO_2 and economic values

Due to the economic importance of the carbon stock, an estimate of the financial cost of carbon in the Lamto Scientific Reserve has been carried out. Since the 2000s, several carbon markets have been established. Regulated markets include international, national or local commitments, such as the Kyoto Protocol at the international level and the European Union Emissions Trading Scheme (EU-ETS) at the regional level. Voluntary markets, on the other hand, allow players to make a voluntary commitment to reduce their emissions and buy credits to offset their climate impact, thus creating a retail market for voluntary credits. The prices of carbon credits vary according to the market, reflecting the different approaches to reducing CO_2 emissions.

For the Clean Development Mechanism (CDM), the price is now €5 per tonne of CO_2 equivalent, in line with the latest estimates **(UNFCCC, 2024)**. The voluntary markets, including Over the Counter (OTC) transactions, show an average price of €6 per tonne of CO_2 equivalent **(World Bank, 2024)**. The OTC transactions allow private players to trade carbon credits directly, without going through organised exchanges, which explains their price fluctuations.

In the context of REDD+ (Reducing Emissions from Deforestation and Forest Degradation), the prices vary from the others. Yet, low-cost REDD+ credits are valued at €12 per tonne of CO_2 equivalent, while high-cost REDD+ credits can cost up to €25 per tonne of CO_2 equivalent **(World Bank, 2024; FAO, 2024; EDF, 2024)**. The discounted prices used in this study come mainly from voluntary and over-the-counter markets, taking into account the specific variations of these markets **(Chenost et al., 2010; Boulier and Simon, 2010)**.

F. Statistical analysis

The Analyses were performed using Microsoft Excel (2024), RStudio (2024) and XLSTAT (2024) software. The Kruskal-Wallis (K-W) test, with a confidence level of 5%, was used to assess significant differences between means. Beforehand, the normality of the data and the homogeneity of the variances were tested using the Shapiro-Wilk normality test **Shapiro and Wilk, (1965)** and the Levene test for homogeneity **(Levene, 1960).** Given that the data were neither normally distributed nor homogeneous, the non-parametric Kruskal-Wallis's test was chosen as an alternative to the parametric ANOVA **(Kruskal and Wallis, 1952).** Whenever the overall Kruskal-Wallis's test revealed a significant difference, a Dunn post hoc test was performed to compare the means two by two and evaluate the significant differences between them **(Dunn, 1961).**

III. RESULTS

A. *Floristic Diversity and Composition of the Different Types of Biotopes*

The floristic inventory, taking only woody plants into account, recorded a total of 4,018 tree individuals, divided into 142 species belonging to 92 genera and 37 families **(Table 1).** The dense semi-deciduous forest stands out for its exceptional floristic richness, with 100 species. The gallery forest is a close second with 69 species, while the open forest has 57 species. In contrast, the wooded savanna has the lowest diversity, with just 26 species.

The diversity indices show significant variations between biotopes **(Table 2).** The Shannon index, which measures diversity, is highest in dense semi-deciduous forests (2.55 bits), while wooded savanna has the lowest (2.04 bits). In terms of equitability, the semi-deciduous dense forest also had the highest value at 0.99, indicating a more uniform distribution of species. As for, the wooded savanna, on the other hand, had an equitability of 0.91.

Table I: Richness and floristic composition of the biotope types in the Lamto Scientific Reserve

Biotopes	Species	Genus	Families
Gallery Forest	69	51	26
Dense Semi-deciduous Forest	100	69	31
Open Forest	57	44	25
Wooded Savanna	26	22	15
Tree Savanna	36	31	22
Shrub Savanna	36	31	19
Total	142	92	37

Table II: Diversity index values in the various Lamto Scientific Reserve (LSR) biotopes

Biotopes	Shannon	Pielou's Evenness	Simpson
Gallery Forest	2.52	0.99	0.92
Dense Semi-deciduous Forest	2.55	1.00	0.92
Open Forest	2.29	1.00	0.90
Wooded Savanna	2.04	0.91	0.82
Tree Savanna	2.23	0.98	0.89
Shrub Savanna	2.20	0.98	0.88

B. *Structural diversity of vegetation*

Density and basal area

For the whole of the Lamto Scientific Reserve, the average density was evaluated at 676.43 ± 346.23 stems/ha **(Table 3).** This density varies from one habitat to another, highlighting differences in the density and dispersion of the data that help to understand the varied vegetation structures between the different biotopes. The gallery forest (GF) and the dense semi-deciduous forest (DSF) have the highest mean values of stem density per hectare, with mean values of 693.162 ± 251.85 and 758.974 ± 249.91 respectively. This indicates a higher stem density in these forest types compared with the other biotope types. The wooded savanna (WS) shows the greatest variability in the data, with a standard deviation of 712.379, suggesting a great diversity in stem densities within this category.

The average basal area in the reserve as a whole is 4.74 ± 6.73 m²/ha. The basal areas of the various biotopes show statistically significant differences, grouped into three categories: high, intermediate and low, depending on whether the value is above or below the overall average for the reserve. The gallery forest has the highest average value, at 10.84 ± 11.791 m²/ha. The shrub savanna, on the other hand, has the lowest mean value at 1.215 ± 0.804 m²/ha **(Table 3).**

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 01 January 2025
DOI: 10.47191/ijcsrr/V8-i1-56, Impact Factor: 7.943
IJCSRR @ 2025
www.ijcsrr.org

Table III: Mean values of densities and basal areas of the different biotopes of the Lamto Scientific Reserve

Biotopes	Density (stem/ha)	Basal Area (m^2/ha)
Gallery Forest	693.162 ± 251.857 [a]	10.823 ± 11.791 [b]
Dense Semi-deciduous Forest	758.974 ± 249.913[a]	6.236 ± 3.335 [b]
Open Forest	661.111 ± 200.907[a]	4.428 ± 5.659 [ab]
Wooded Savanna	702.222 ± 712.379[a]	1.812 ± 1.734 [a]
Tree Savanna	703.333 ± 234.947[a]	1.610 ± 0.635 [a]
Shrub Savanna	510.000 ± 228.098[a]	1.215 ± 0.804[a]
Test statistics (Kruskall-Wallis)	*K (Observed value) =9.003; K (Critical value) =11.070; DF=5; p-value=0.109*	*K (Observed value) = 35.438; K (Critical value) = 11.070; DF=5; p-value<**0.0001***

Mean values marked with the same letter are not significantly different at the α threshold of 5 p.c. Bonferroni corrected significance level: 0.0033

C. Horizontal and vertical structure

The distribution of individuals tree by height class follows a bell-shaped distribution (unimodal distribution) overall, with medium-height individuals being the most abundant in all the biotopes of the reserve **(Figure 2).** Majority of individuals are found in the 5-10 m height class. In terms of horizontal structure, the different habitats of the Lamto Scientific Reserve (LSR) show similar profiles. The histograms of stem distribution by diameter class show an inverted 'J' curve **(Figure 3),** typical of the demographic structures of forest populations. This indicates a dominance of individuals belonging to small-diameter classes, while large-diameter individuals are less represented. The structure of this stand shows a high proportion of young trees and a gradual decrease towards the larger diameter classes, typical of a dynamic population where regeneration is strong, but where larger and older trees are rare.

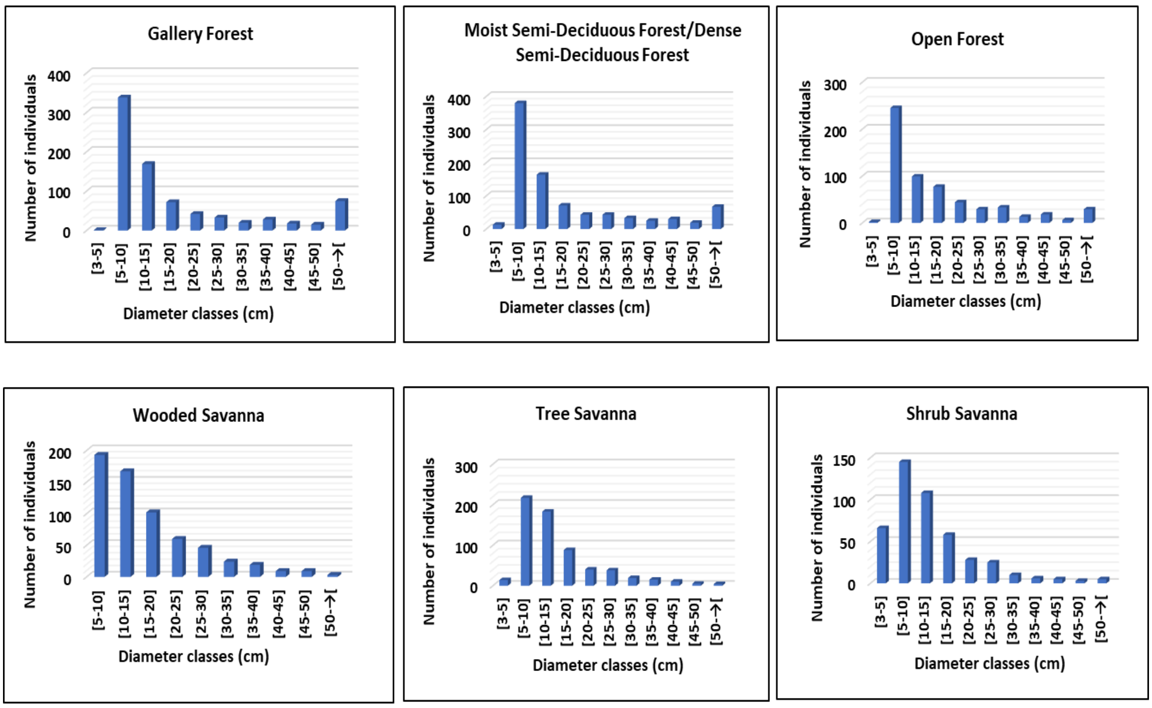

Figure 3: Distribution of trees by diameter class in the different biotopes of the Lamto Scientific Reserve

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 01 January 2025
DOI: 10.47191/ijcsrr/V8-i1-56, Impact Factor: 7.943
IJCSRR @ 2025
www.ijcsrr.org

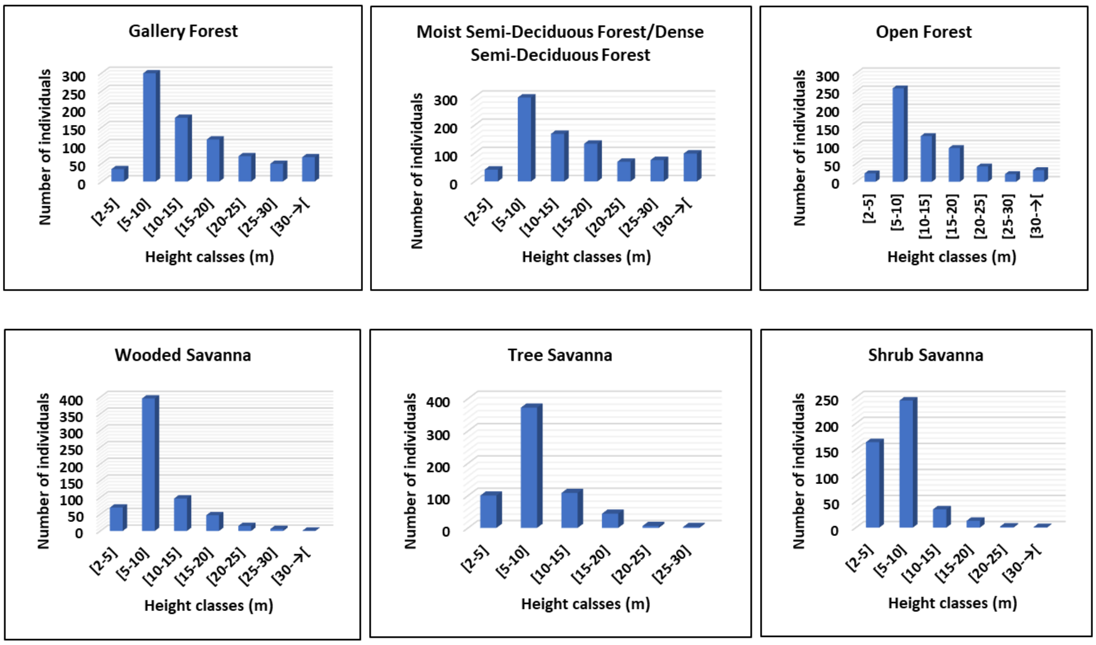

Figure 4: Distribution of woody plants by height class in the different biotopes of the Lamto Scientific Reserve

D. Etimation of biomass and sequestered carbon stock

The table 4 shows the amount of biomass and carbon stock sequestered in the different biotopes of the Lamto Scientific Reserve (LSR). Generally speaking, the reserve has an average biomass value of 151.36 ± 76.53 t/ha, a carbon stock value of 75.68 ± 38.26 t/ha, a CO_2 equivalent value of 277.50 ± 140.30 t/ha and a basal area value of 6.73 ± 4.73 m^2/ha.

The gallery forest recorded the highest average value for total biomass, at 287.37 ± 201.68 t/ha. Its sequestered carbon stock is estimated at 143.69 ± 100.84 t/ha. The lowest value is found in the shrub savanna, at 9.38 ± 8.41 t/ha, for an estimated carbon stock of 4.69 ± 4.21 t/ha. The differences observed between these mean values are statistically significant, with three categories: high, medium and low, depending on whether the value is above or below the overall mean value for the Lamto reserve.

Table IV: Mean values of total biomass and carbon stock sequestered by the different ecosystems in the Lamto Scientific Reserve

Biotopes	Biomass (t/ha)	Carbon Stock (tC/ha)
Gallery Forest	201.679 ± 287.376[b]	100.839 ± 143.688[b]
Dense Semi-deciduous Forest	106.098 ± 65.677[b]	53.049 ± 32.839[b]
Open Forest	68.605 ± 107.290[ab]	34.302 ± 53.645[ab]
Wooded Savanna	14.121 ± 13.124[a]	7.061 ± 6.562[a]
Tree Savanna	12.852 ± 6.615[a]	6.426 ± 3.307[a]
Shrub Savanna	9.384 ± 8.414[a]	4.692 ± 4.207[a]
Test statistics (Kruskall-Wallis)	*K (Observed value) = 41.703; K (Critical value) = 11.070; DF=5; p-value <0.0001*	

Mean values marked with the same letter are not significantly different at the α threshold of 5 p.c. Bonferroni corrected significance level: 0.0033

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 01 January 2025
DOI: 10.47191/ijcsrr/V8-i1-56, Impact Factor: 7.943
IJCSRR @ 2025
www.ijcsrr.org

E. Estimated CO_2 and economic values

The average value of the total biomass of the gallery forest is 287.37 t/ ha. This corresponds to a rate of 526.856 tCO_2/ha. The financial cost of the sequestered CO_2 rate varies from 2.634 EUR (or 1,727,976 FCFA) to 13.171 EUR (or 8,639,880 FCFA) depending on the markets considered. As for that of the shrub savanna, the biomass is 9,384 t/ha, which corresponds to 17,203 tCO_2/ha. The financial cost of the rate of CO_2 sequestered varies from 86 EUR (i.e. 56,422 FCFA) to 430 EUR (i.e. 282,111 FCFA), depending on the market. Finally, the biomass of the open forest is 68,605 t/ha, which corresponds to 125,775 tCO_2/ha. The financial cost of such sequestration varies from 629 EUR (i.e. 412,515 FCFA) to 3,144 EUR (i.e. 2,062,575 FCFA). The financial values are calculated by taking into account the different markets and their cost per tonne of CO_2 sequestered **(Table 5).**

Table V: Estimation of CO_2 and equivalent cost in the various biotopes inventoried in the Lamto Scientific Reserve

Biotope	**CO_2 Total (t/ha)**	**Price MDP (5 EUR/tCO2) (EUR)**	**Price AR (6 EUR/tCO_2) (EUR)**	**Price REDD+ Low (12 EUR/tCO_2) (EUR)**	**Price REDD+ High (25 EUR/tCO_2) (EUR)**	**Price Voluntary (5 EUR/tCO_2) (EUR)**
Gallery Forest	526.856	2,634	3,161	6,322	13,171	2,634
Dense Semi-Deciduous Forest	194.514	973	1,167	2,334	4,863	973
Open Forest	125.775	629	755	1,509	3,144	629
Shrub Savanna	17.203	86	103	206	430	86
Tree Savanna	23.562	118	141	283	589	118
Wooded Savanna	25.889	129	155	311	647	129
TOTAL	913.7994776	4568.997388	5,483	10,966	22,845	4,569

IV. DISCUSSION

A. Floristic richness and biodiversity indices

The results of the floristic inventory at the Lamto Scientific Reserve, taking into account the woody stratum only in this work, with 142 species belonging to 92 genera and 37 families, are in line with a similar dynamic observed in other studies of the forest-savanna transition zone (GC-SZ) in Côte d'Ivoire. Our results are superior to those of **Guelou *et al.*, (2020)** in terms of individuals, species and genus, who obtained 1946 individuals, 39 families, 76 genera and 92 species during their work at Lamto. The difference could be explained by the method used, the number of biotopes considered and the number of plots installed during data collection. The work by **Guelou *et al.*, (2020)** was confined to the installation of 32 rectangular plots of 200 m² (20 x 10 m) only in the patches of dense forest and gallery forest. This work considered all the biotopes found in the reserve (shrub savanna, tree savanna, wooded savanna, open forest, semi-deciduous dense forest and gallery forest) and installed 60 plots, i.e. 10 plots per habitat. Previous work, in particular that of **Etc Terra, (2016)**, has also shown significant floristic richness in similar biotopes, underlining the importance of these ecosystems for preserving biodiversity in the forest-savanna transition zone in Côte d'Ivoire and West Africa.

The distribution of species at Lamto shows a predominance of gallery forests and dense semi-deciduous forests, which have a high biodiversity, with 69 and 100 species recorded respectively. These results are in line with those obtained in the Guinea-Congolese-Sudanese-Zambezian transition zone (GC-SZ), where forests generally show a higher floristic richness than savannas **(Doumbia *et al.*, 2020)**. At Lamto, the wooded and shrubby savannas show lower Shannon diversity indices (between 2.04 and 2.23

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 01 January 2025
DOI: 10.47191/ijcsrr/V8-i1-56, Impact Factor: 7.943
IJCSRR @ 2025
www.ijcsrr.org

bits), a phenomenon linked not to anthropogenic activities such as grazing or agriculture, which are absent in this strictly protected reserve, but to controlled bushfires to maintain the balance between forest and savanna within the reserve. These fires, used every year by the managers to maintain the ecological balance between forest and savanna, influence the structure and floristic composition of the savanna, with the dominance of pyrophytic and heliophilous species.

The Shannon biodiversity index (H'), which measures the specific diversity of an ecosystem, takes into account both the richness (number of species present) and the relative abundance of each species. A Shannon index H' > 3 is common in dense tropical forests because of the richness of the species and their even distribution. When H' is between 1 and 2 is typical of savannas or forest-savanna transition zones. A higher value (>2) would indicate exceptional diversity for this type of ecosystem. Whereas an H' value close to 0.5 or lower is characteristic of degraded or anthropised areas where habitats are dominated by a few species **(Magurran, 2004; Pielou, 1975; Whitmore, 1998)**. Therefore, a high value of this index, such as the 2.55 bits observed in the semi-deciduous dense forest in this study, reflects high biological diversity. In the context of tropical ecosystems, a value of 3 bits is typical of complex and stable environments, indicating a relatively balanced distribution of species and significant floristic richness.

This level of diversity is particularly relevant to conservation, as it highlights the structural complexity of the ecosystem and its resilience to environmental disturbance. In comparison, the savannas studied have lower Shannon indices, highlighting the importance of forest conditions, such as increased moisture and fire protection, in sustaining high biodiversity. In the context of dense semi-deciduous forests, high Shannon indices are often observed, highlighting the complexity and resilience of these ecosystems to environmental disturbance. This trend is corroborated by regional studies, such as that of **Tiébré *et al.*, (2016)**, who analysed floristic diversity in the Foungbesso region, a forest-savanna transition zone in western Côte d'Ivoire. These results are supported by regional studies, such as those by **Adou Yao *et al.*, (2013)** and **Ouattara *et al.*, (2016)**, which show that in the forest-savanna transition zones between the Guinean-Congolese and Sudanese-Zambezian regions (GC-SZ), forests generally have a richer floristic diversity than savannas. These observations confirm the crucial role of forests in maintaining regional biodiversity and their ecological importance for ecosystem stability.

B. Density and basal area

The results obtained at Lamto, with an average density of 676.43 stems/ha, are consistent with observations made in other forest-savanna transition zones in Côte d'Ivoire. In addition, a study by **Kouakou, (2019)** recorded 140.44 stems/ha in the Classified Forest of Haut Sassandra. Nonetheless, the work in the Marahoué National Park by **Dibi *et al.*, (2008)** recorded an average density of 336 and 344 stems/ha with basal areas of 35.08 to 35.11 m^2/ha in gallery forests and semi-deciduous dense forest, which is more than double the 693.162 and 758.97 stems/ha observed in the gallery forests and semi-deciduous dense forest of Lamto.

In the savannas, the highest density is that of the wooded savanna with 712 stems/ha, followed by the tree savanna with 703 stems/ha and 510 stems/ha for the shrub savanna. These densities are much higher than those obtained by **Dibi *et al.*, (2008)** in the Marahoué National Park: 237 and 56 stems/ha with basal areas of 7.05 to 4 m^2/ha. The basal areas in the Lamto forest ranged from 11.79 m^2/ha in gallery forest to 6.23 m^2/ha in dense semi-deciduous forest and 5.65 m^2/ha in open forest. These basal areas are lower than the basal areas in the Marahoué National Park according to **Dibi *et al.*, (2008)**, which recorded 35.08, 35.11 and 10.98 m^2/ha.

Given that the Classified Forest of Haut Sassandra and the Marahoué National Park also have forest-savanna mosaic vegetation like Lamto, the differences in stem density observed between these sites may be more related to protection management, the level of human pressure, and specific local conditions. Although the three sites share a similar vegetation type, the intensity of human activities such as logging and poaching is generally higher in classified forests and some national parks, which can limit natural regeneration and reduce stem density. In Lamto, where protection and management are stricter and human pressure lower, vegetation can flourish and reach a higher stem density. Even in similar mosaic ecosystems, site-specific microclimatic variations, soil resources and water availability can influence plant density differently. Thus, the difference is not based solely on the type of vegetation, but also on management and specific local characteristics that favour or limit stem density.

In terms of basal areas, the difference in basal areas between the Marahoué National Park and the Lamto Scientific Reserve could be linked to the variation in abundance of large-diameter trees. In the Marahoué National Park, a greater frequency of large-diameter trees could be the result of increased anthropogenic influence. Human activities, such as selective clearing or controlled bush fires, often reduce the density of small-diameter trees, thereby limiting competition for light. This creates a favourable environment for the development of the remaining trees, which can grow in diameter without strong competition for resources, particularly light and nutrients.

Conversely, in the Lamto Scientific Reserve, where human impact is minimised and conservation is more rigorous, human pressure is low. This situation preserves a natural balance in the vegetation, in which trees of different diameters coexist with less disturbance. This low level of disturbance leads to greater competition between species for light and other resources, limiting the rapid development of large-diameter trees. In addition, the Lamto ecosystem is subject to annual fires, which can limit the growth of large trees and promote the resilience of the forest and savanna mosaic.

C. Vegetation structure

The bell-shaped distribution of height classes, dominated by 5-10 m trees, and the inverted 'J' structure (5-10 cm) observed in the diameter classes at Lamto, are classic configurations in the Guinean-Sudanese transition zones (GC-SZ). These structures reflect a natural balance in the vegetation, marked by active and continuous regeneration, without major disturbance, contributing to the stability of these dynamics. The inverted 'J' structure, indicating a high proportion of young trees, bears witness to a natural renewal cycle that maintains the composition and density of the forest stand. These characteristics are similar to the dynamics observed in forest-savanna transition ecosystems in Côte d'Ivoire **Assale *et al.*, (2021); Koulibaly *et al.*, (2010)**, particularly in the fire-protected savanna of the Lamto Scientific Reserve, which has a stable dynamic structure with no significant disturbances **(Gnahoré *et al.*, 2018**).

The bell-shaped distribution of height classes by 5-10 m ligneous trees and the inverted 'J' structure in diameter classes, observed in the forests and savannas, reflect active regeneration and constant renewal, favoured by vegetation without major disturbance. These types of vegetation structures are classic configurations in the Guinean and Sudanese transition zones (GC-SZ). The distribution of strata in the biotopes also explains these structures. The gallery forests, with 4 or more strata, and dense semi-deciduous forests, with 3 to 4 strata, have a complex stratification that favours a dominance of intermediate-sized trees and strong regeneration. In wooded and arboreal savannas, which have 3 strata, fires limit the progression of trees to larger sizes. Finally, the shrub savannas, with only 2 strata, show vegetation dominated by small diameters due to the nutrient-limited soil type, climate and fires, keeping these formations in a pioneer or intermediate state.

The different soil types, notably ferralitic, hydromorphic and sandy-clay, also influence these structures by favouring vegetation adapted to each biotope. These dynamics are in line with the work of **Assale *et al.*, 2021** and **Koulibaly *et al.*, (2010)**, who reported similar inverted 'J' structures in forest-savanna transition zones, and with the observations of **Gnahoré *et al.*, (2018)** on the structural stability of fire-protected savannas at Lamto. These comparisons show that interactions between stratification, disturbance, soils and regeneration are shaping convergent dynamics in these ecosystems.

D. Biomass and sequestered carbon stock in the Lamto Scientific Reserve (LSR)

The results obtained show that the Lamto Scientific Reserve (LSR) generally sequestered an average biomass of 151.36 ± 76.53 t/ha and an average carbon stock of 75.68 ± 38.36 tC/ha. The highest biomass was recorded in the gallery forests with 287.37 ± 20.68 t/ha and a carbon stock that was also highest in these zones (143.68 ± 100.84 tC/ha). In comparison, the shrub savanna has the lowest biomass (9.38 ± 8.41 t/ha) and carbon stock (4.69 ± 4.20 tC/ha) values among the biotopes. These results are consistent with trends observed in other similar ecological zones in Côte d'Ivoire and the Guinea-Congolese and Soudanese-Zambezian (GC-SZ) region, where dense forests and gallery forests are recognised for their high carbon storage capacity compared with more open savannas. This overall average biomass and carbon stock value for the LSR is higher than the 123.83 t/ha and 58.20 tC/ha average biomass and carbon stock sequestered on average by the pre-forest sector or forest-savanna transition zone according to the Referencing level of the Forests of Côte d'Ivoire **(NERF, 2024)**.

The Lamto Scientific Reserve (LSR) has remarkable carbon sequestration capacity, particularly within its gallery forests. Several factors explain this performance. Firstly, the species richness and diversity of tree types in these forests contribute to a high above-ground and below-ground biomass. The species present, which are often adapted to conditions of high humidity, favour dense and rapid growth, thereby increasing total biomass. In addition, the LSR is located in a pre-forest zone that enjoys a humid tropical climate, with significant rainfall of around 1,477.7 mm per year. These optimal climatic conditions favour increased photosynthesis, which translates into increased biomass and carbon storage. In addition, the absence of frequent disturbances, such as extensive agriculture or grazing, allows the forests to develop and store more carbon over the long term. Finally, gallery forests, located near watercourses, are generally richer in nutrients and moisture, which encourages vigorous tree growth. The results show biomasses of up to 287.38 t/ha and carbon stocks of 143.68 tC/ha.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 01 January 2025
DOI: 10.47191/ijcsrr/V8-i1-56, Impact Factor: 7.943
IJCSRR @ 2025
www.ijcsrr.org

These results surpass those of **Guelou *et al.*, (2020)** who obtained 47.25 t/ha of biomass and 22.21 tC/ha of carbon stock in the Lamto Scientific Reserve. This difference could be explained by the methodology used, the area sampled and the types of biotopes considered. **Guelou et al., (2020)** only considered dense semi-deciduous forests and gallery forests in his sampling. This study took into account all the biotopes found in the Lamto Reserve, i.e. dense semi-deciduous forests, gallery forests, open forests, wooded savannas, wooded savannas s and shrub savannas. The work of **Akpa *et al.*, (2019)** reported biomass values in the forest-savanna transition zone of eastern Côte d'Ivoire (Tanda department) of around 36.17 ± 5.35 t/ha, lower levels than those measured at Lamto for gallery forests, where biomass can reach 287.37 t/ha. This corresponds to high carbon stocks, estimated at 143.68 tC/ha. These data confirm that the gallery forests of Lamto are representative of the carbon storage potential of gallery forests in Côte d'Ivoire, underlining their key role in carbon sequestration and their ecological importance in the region.

The results for the shrub savanna at Lamto, similar to those of **Tra Bi *et al.*, (2023)** in the Mont Sangbé National Park, also located in the pre-forest zone, highlight low biomass and carbon stocks. These similarities reflect shared ecological traits, such as sparse vegetation and a limited capacity to sequester carbon, confirming the consistency of observations for shrub savannas in these two areas of Côte d'Ivoire.

Generally speaking, forests sequester more carbon than savannas, largely due to their structure and environmental conditions. The forests (dense semi-deciduous, gallery and open) are characterised by their generally denser vegetation and higher carbon storage capacity. The semi-deciduous dense forests have a closed canopy and a high biomass, although some species lose their leaves in the dry season. The gallery forests, located along watercourses, benefit from constant access to moisture, favouring a soil rich in organic matter and high carbon accumulation. The open forests, although less dense, retain a tree structure that distinguishes them from savanna formations. The savannas (wooded savanna, tree savanna and shrub savanna), on the other hand, are characterised by sparser vegetation and a lower carbon storage capacity. In contrast, the wooded savannas, with their spaced trees and dense herbaceous vegetation, form a transition to open forests. Whereas, the arboreal or tree savannas, characterised by scattered trees, have even more open vegetation. While, shrub savannas, dominated by shrubs and herbaceous plants, are frequently subject to recurrent bushfires, limiting vegetation growth and reducing the accumulated biomass, which affects their carbon sequestration capacity.

The forests are characterised by their structural complexity and high carbon storage capacity, whereas savannas, which are more open and often disturbed by fire, show more limited biomass accumulation and carbon sequestration. These fires, which are used in a controlled way in the Lamto reserve, play a crucial role in maintaining the balance between savannas and forests. Without fire, the savannas would naturally evolve into forests over the years. Fire management therefore makes it possible to preserve the diversity of plant formations, while promoting an ecological mosaic and a high level of biodiversity.

E. CO_2 estimation and economic values

Data on CO_2 sequestration in Lamto reveal marked differences between forest and savanna formations, both in terms of storage capacity and associated economic values. Gallery forests, with sequestration of 526,856 tCO_2/ha, largely dominate, accounting for around 57.6% of the total carbon sequestered. Their economic value, supported by mechanisms such as High REDD+, can reach 13,171 EUR/ha (or 8,639,880 FCFA), reflecting their dense biomass and complex structure with 4 or more strata. In comparison, shrub savannas, with only 17,203 tCO_2/ha, show much lower values, peaking at 430 EUR/ha (or 282,111 FCFA) for the same mechanism. The forest formations stand out for their high capacity to sequester carbon thanks to their plant composition rich in large trees and high biomass, particularly in dense semi-deciduous forests (194,514 tCO_2/ha) and open forests (125,775 tCO_2/ha). These biotopes, with their numerous strata, offer favourable conditions for carbon accumulation in above-ground and below-ground biomass. These results highlight the strategic importance of forests in the fight against climate change. In contrast, savanna formations, dominated by herbaceous plants and shrubs of low height and diameter, have limited storage capacity. For example, wooded and tree savannas sequester 25,889 tCO_2/ha and 23,562 tCO_2/ha respectively, while shrub savannas, with only 2 strata, show the lowest contribution.

Despite these disparities, savanna formations play a key role in maintaining Lamto's ecosystem resilience. They provide essential services such as preserving biodiversity by serving as a habitat for numerous species, regulating nutrient and water cycles, and protecting against erosion thanks to their plant cover. These ecological functions, although less valued economically, complement the climate services provided by forests. The results of this study on CO_2 sequestration in Lamto are directly in line with the Sustainable Development Goals, in particular SDG 13 (climate action) and SDG 15 (life on earth), by highlighting the role of gallery forests and savannas in combating climate change and preserving ecosystems (**Groupe indépendant de scientifiques nommés par le Secrétaire général, 2020**). By including these ecosystems in carbon offset projects, such as REDD+ or voluntary markets, these natural formations could generate substantial income for local communities while helping to reduce net greenhouse gas emissions.

V. CONCLUSION

Ultimately, this study highlights the importance of forest-savanna transition zones, such as the Lamto Scientific Reserve in Côte d'Ivoire, for carbon sequestration and plant biodiversity conservation in the context of climate change. By examining biodiversity and forest biomass, the results have shown that these ecosystems are crucial for reducing greenhouse gases and offer significant economic opportunities. This study carried out highlights the strategic importance of this ecological zone for CO_2 sequestration and ecosystem resilience. The forest and savanna formations of Lamto, are proving essential in the fight against climate change. The forests, particularly gallery forests, have a high storage capacity (526,856 tCO_2/ha) and a maximum economic value of up to 13,171 EUR/ha (8,639,880 FCFA), thanks to their dense biomass, complex structure and well-defined vertical stratification. The savannas, although less efficient in terms of carbon sequestration, complete this ecological balance through their ecosystem services such as the regulation of nutrient cycles, the preservation of biodiversity and soil stabilisation.

Lamto's plant structure, characterised by a vertical 'bell' stratification and a horizontal 'inverted J' distribution, reflects active regeneration and a natural balance between young seedlings and mature trees. These dynamics, combined with an average density of 676.43 stems/ha and adapted basal areas (ranging from 11.79 m^2/ha in gallery forest to 5.65 m^2/ha in open forest), testify to the resilience of the ecosystems to natural disturbances such as annual fires. By developing the economic value of these ecosystems through mechanisms such as REDD+ and CDM, this study contributes to the Sustainable Development Goals (SDGs 13 and 15) by supporting the fight against climate change and the conservation of biodiversity. It highlights the strategic role of the Lamto Scientific Reserve as a model of integrated management, where forests and savannas, with their ecological and economic complementarities, maximise their contribution as carbon sinks while ensuring long-term ecological resilience.

REFERENCES

1. Adou Yao, C. Y., Kpangui, K. B., Kouao, K. J., Adou, L. M. D., Vroh, B. T. A., and N'Guessan, K. E., 2013. Diversité floristique et valeur de la forêt sacrée Bokasso (Est de la Côte d'Ivoire) pour la conservation. *VertigO*, 13. DOI: 10.4000/vertigo.13500.
2. Aké-Assi L., 1984. *Flore de la Côte d'Ivoire: Etude descriptive et biogéographique, avec quelques notes ethnobotaniques*. Faculté des Sciences, Abidjan. 1206 p.
3. Akpa, Y. L., N'da, D. H., Kyereh, B., and Kpangui, K. B., 2019. Impact of Cashew Plantation on Carbon Stock in the Forest-Savanna Transition Zone (North-East Côte d'Ivoire). *International Journal of Innovation and Applied Studies*, 27(2), pp. 591–598.
4. Asner, G.P., Anderson, C.B., Martin, R.E., Knapp, D.E., Tupayachi, R., Sinca, F., and Malhi, Y., 2014. Targeted carbon conservation at national scales with high-resolution monitoring. *Proceedings of the National Academy of Sciences (PNAS)*, 111(47), pp. E4787–E4796. DOI: 10.1073/pnas.1419550111.
5. Assale, A. A. Y., Kouakou, K. A., Kouakou, A. T. M., Kpangui, K. B., and Barima, Y. S. S., 2021. Diversité végétale et potentiel de séquestration de carbone des espaces domaniaux anthropisés : cas de la forêt classée du Haut-Sassandra (Centre-Ouest de la Côte d'Ivoire). *Agronomie Africaine*, Sp. 33(1), pp. 15–28.
6. Avenard, J.-M., Eldin, M., Girard, G., Sircoulon, J., Touchebeuf, P., Guillaumet, J.-L. and Adjanohoun, E., 1971. *Le milieu naturel de la Côte d'Ivoire*. Paris: ORSTOM, 391 p. (Mémoires ORSTOM ; 50).
7. Bigot, S., Oszwald, J., Brou Yao, T., Diedhiou, A., Konaré, A., Fofana, M., and Assamoi, P., 2004. Le suivi des variations climatiques et écologiques en Afrique de l'Ouest : le rôle de la station de mesures de Lamto (Côte d'Ivoire). In: *Climat, mémoire du temps… : Thème 2 - Le Climat : son évolution et ses excès*, AIC 2004.
8. Boulier, C., & Simon, C. 2010. Economic Impacts of Carbon Trading on Market Prices. *Journal of Environmental Economics and Management*, *60*(3), 225-236. https://doi.org/10.1016/j.jeem.2010.07.001

9. Brondizio, E.S., Le Tourneau, F.-M., and Nobre, C.A., 2019. The global significance of tropical forests. *Science*, 365(6457), pp.1226-1229. DOI: 10.1126/science.aax3100.
10. Brown, H.C.P. and Lassoie, J.P., 2010. Institutional choice and local legitimacy in community-based forest management: lessons from Cameroon. *Environmental Conservation*, 37(3), pp.261-269. DOI: 10.1017/S0376892910000603.
11. Brown, S., 1997. *Estimation of Biomass and Biomass Change of Tropical Forests: A Primer*. FAO Forestry Paper 134. Rome: Food and Agriculture Organization of the United Nations.
12. Chatelain, C., Dao, H., Gautier, L., and Spichiger, R., 2010. Forest cover changes in Côte d'Ivoire and Upper Guinea. In: *Atlas of Biodiversity of West Africa*. pp. 20-23. CABI Digital Library. Available at: https://cabidigitallibrary.org [Accessed 2 Nov. 2024].
13. Chave, J., Andalo, C., Brown, S., et al. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. *Oecologia, 145*(1), 87-99. https://doi.org/10.1007/s00442-005-0100-x
14. Chave, J., Réjou-Méchain, M., Búrquez, A., Chidumayo, E., Colgan, M. S., Delitti, W. B. C., Duque, A., Eid, T., Fearnside, P. M., Goodman, R. C., Henry, M., Martínez-Yrízar, A., Mugasha, W. A., Muller-Landau, H. C., Mencuccini, M., Nelson, B. W., Ngomanda, A., Nogueira, E. M., Ortiz-Malavassi, E., Pélissier, R., Ploton, P., Ryan, C. M., Saldarriaga, J. G., Vieilledent, G., 2014. Improved allometric models to estimate the aboveground biomass of tropical trees. *Global Change Biology*, 20(10), pp. 3177-3190. DOI: 10.1111/gcb.12629.
15. Chenost, C., Gardette, Y. M., Demenois, J., Grondard, N., Pierrier, M. and Wemaëre, M., 2010. *Les marchés du carbone forestier. Bringing forest carbon projects to the market*. PNUE-ONFI-AFD-BioCF. 172p.Devineau, J.L. (1975). "Etude quantitative des forets galeries de Lamto (moyenne Côte d'Ivoire)", Thèse de Doctorat de 3 ème cycle de l'université de Paris VI, 190 p.
16. Climate-data.org, 2024. www.climate-data.org assessed le 3 novembre 2024.
17. Devineau, J.L., 1975. *Etude quantitative des forêts galeries de Lamto (moyenne Côte d'Ivoire)*. Thèse de Doctorat de 3ème cycle, Université de Paris VI, 190 p.
18. Dibi, N. H., Adou, Y. C. Y., N'Guessan, K. E., Koné, M., and Sagne, Y. C., 2008. Analyse de la diversité floristique du parc national de la Marahoué, Centre-Ouest de la Côte d'Ivoire. *Afrique SCIENCE*, 4(3), pp. 552–579. ISSN: 1813-548X.
19. Djomo, A.N., Ibrahima, A., Saborowski, J., and Gravenhorst, G., 2016. Tree allometry for estimation of carbon stocks in African tropical forests. *Forestry: An International Journal of Forest Research*, 89(4), pp.446-457. DOI: 10.1093/forestry/cpw021.
20. Douffi, K.G.-C., Yao, A.C., Koffi, K.J., Traoré, A.S. and Koné, M., 2021. Afforestation in response to thermal change in the forest-savanna transition of the Lamto Scientific Reserve, Côte d'Ivoire. *European Journal of Forest Engineering*, 7(2), pp.45-56. DOI: 10.33904/ejfe.978520.
21. Doumbia, M., Kouassi, H. R., Ambe, A. S. A., Nomel, G. J. R., and N'Guessan, K. E., 2020. Analyse de la diversité de la forêt classée d'Orumbo-Boka (Centre de la Côte d'Ivoire). *European Scientific Journal*, 16(24), pp. 184–198. DOI: 10.19044/esj.2020.v16n24p184.
22. Dunn, O. J., 1961. Multiple Comparisons Among Means. *Journal of the American Statistical Association*, 56(293), pp. 52–64. DOI: 10.1080/01621459.1961.10482090.
23. Environmental Defense Fund (EDF), 2024. *Navigating Jurisdictional REDD+: A Pricing Guide for Tropical Forest Nations*. Available at: https://www.edf.org [Accessed 3 November 2024]
24. Etc Terra. 2016. Étude qualitative des facteurs de la déforestation et de la dégradation des forêts désagrégés par zone agroécologique. Programme National ONU-REDD - FAO / SEP-REDD+.
25. FAO 2020. *Global Forest Resources Assessment 2020*. Food and Agriculture Organization of the United Nations. Available at: https://www.fao.org/forest-resources-assessment/2020.
26. FAO 2024a. *The State of the World's Forests 2024*. Food and Agriculture Organization of the United Nations. Available at: https://www.fao.org/publications/home/fao-flagship-publications/the-state-of-the-worlds-forests/en.
27. FAO, 2005. *Global Forest Resources Assessment 2005: Progress towards sustainable forest management*. FAO Forestry Paper 147. Rome: Food and Agriculture Organization of the United Nations.

28. FAO, 2024. *The State of the World's Forests 2024*. Food and Agriculture Organization of the United Nations. Available on : https://www.fao.org/forests.
29. Fayolle, A., Douce, J.-L., Gille, J.-F., Bourland, N. and Lejeune, P., 2013. Tree allometry in Central Africa: Testing the validity of pantropical multi-species allometric equations for estimating biomass and carbon stocks. *Forest Ecology and Management*, 305, pp. 29-37. DOI: 10.1016/j.foreco.2013.05.012.
30. Fittkau, E. J. and Klinge, N. H., 1973. On biomass and trophic structure of the central Amazonian rainforest ecosystem. *Biotropica*, 5, pp. 2-14.
31. Gbozé, A. E., Sanogo, A., Amani, B. H. K. and Kassi, N. J., 2020. Diversité floristique et valeur de conservation de la forêt classée de Badénou (Korhogo, Côte d'Ivoire). *Agronomie Africaine*, 32(1), pp. 51-73.
32. Gignoux, J., Barot, S., N'Dri, A.B., Konaté, S., Dembélé, A., and Werner, P.A. 2011. The dynamics of hollowing in annually burnt savanna trees and its effect on adult tree mortality. *Plant Ecology*, 212(12), pp. 2071–2083. DOI: 10.1007/s11258-013-0276-9.
33. Gnahoré, L.O., Konaté, S., N'Guessan, K.E., Bakayoko, A. and Kouassi, K.E., 2018. Dynamique et structure de la flore de la savane protégée des feux dans la Réserve Scientifique de Lamto (Centre de la Côte d'Ivoire). *European Scientific Journal*, 14(36), pp.432-451. DOI: 10.19044/esj.2018.v14n36p432.
34. Goetz, S. and Dubayah, R., 2011. Advances in remote sensing technology and implications for measuring and monitoring forest carbon stocks and change. *Carbon Management*, 2(3), pp.231-244. DOI: 10.4155/cmt.11.18.
35. Goetz, S.J., Baccini, A., Laporte, N.T., Johns, T., Walker, W., Kellndorfer, J., Houghton, R.A., and Sun, M., 2009. Mapping and monitoring carbon stocks with satellite observations: a comparison of methods. *Carbon Balance and Management*, 4(2). DOI: 10.1186/1750-0680-4-2.
36. Gonzalez, P., Tucker, C.J. and Sy, H., 2012. Tree density and species decline in the African Sahel attributable to climate. *Journal of Arid Environments*, 78, pp.55-64. DOI: 10.1016/j.jaridenv.2011.11.001.
37. Groupe indépendant de scientifiques nommés par le Secrétaire général, 2020. *Le Futur c'est maintenant : la science au service du développement durable, Rapport mondial sur le développement durable 2019*. Nations Unies, New York.
38. Gueulou, N., Kouakou, G.-C. D., Soro, Y., Koné, M. and Bakayoko, A., 2020. The forest cover and the forest carbon stock assessment of Lamto Scientific Reserve (Côte d'Ivoire). *International Journal of Innovation and Applied Studies*, 28(3), pp. 682–689.
39. IPCC, 2006. *IPCC Guidelines for National Greenhouse Gas Inventories - Volume 4 - Agriculture, Forestry and Other Land Use*. Institute for Global Environmental Strategies, Japan.
40. Koffi, K.F., N'Dri, A.B., Lata, J.C., Konaté, S., Srikanthasamy, T., Konan, M. and Barot, S. 2018. Effect of fire regime on the grass community of the humid savanna of Lamto, Ivory Coast. *Journal of Tropical Ecology*, 35, pp. 1–7. Available at: https://doi.org/10.1017/S0266467418000391.
41. Konaté, S. et Kampmann, D. (éds), 2010. *Atlas de la biodiversité de l'Afrique de l'Ouest, Tome III : Côte d'Ivoire*. Abidjan et Francfort-sur-le-Main : BIOTA.
42. Koné, A.W., Kassin, E.K., Ettien, J.B.D., Konaté, Z. and Gnahoua, G.M., 2020. Le carbone des sols des zones de forêts et de savanes en Côte d'Ivoire : Impacts de Chromolaena odorata et des légumineuses. In: T. Chevallier, T.M. Razafimbelo, L. Chapuis-Lardy and M. Brossard, eds. *Carbone des sols en Afrique. Impacts des usages des sols et des pratiques agricoles*. FAO/IRD Editions, Rome/Marseille, pp. 191-208.
43. Koné, F., Dosso, K., & Konaté, S. 2022. Agronomical potentiality of termite mound soils in a transitional zone in central Côte d'Ivoire. *Journal of Soil Science and Plant Nutrition*, 22, 1394–1402. DOI: 10.1007/s42729-021-00740-5.
44. Kouakou, A. T. M., 2019. *Dynamiques spatio-temporelles du couvert végétal et diversité floristique de quelques parcs nationaux et forêts classées de Côte d'Ivoire dans un contexte de crises politico-militaires*. Thèse de Doctorat, Université Jean Lorougnon Guédé, UFR Environnement, Spécialité : Écologie végétale. Année académique 2017-2018. Numéro d'ordre : 003. Soutenue le 16 mars 2019.
45. Kouamé, Y. A. G., Millan, M., N'Dri, A. B., Charles-Dominique, T., Konan, M., Bakayoko, A., Gignoux, J., 2022. Multispecies allometric equations for shrubs and trees biomass prediction in a Guinean savanna (West Africa). *Silva Fennica*, 56(2), pp. 10617. DOI: 10.14214/sf.10617.

46. Koulibaly, A., Goetze, D., Porembski, S., Traoré, D. and Aké-Assi, L., 2010. Vegetation characteristics and changes under cash crop cultivation in forest-savanna mosaics in Côte d'Ivoire. In: X. van der Burgt, J. van der Maesen and J.-M. Onana, eds. *Systematics and Conservation of African Plants*. Royal Botanic Gardens, Kew, pp. 805–814.
47. Kpangba, K.P., N'Dri, A.B., and Bakayoko, A., 2022. Capacité de germination des graines et résistance aux feux des plantules des principales espèces ligneuses en savane guinéenne (Afrique de l'Ouest). *REB-PASRES*, 7(1), pp.61-73. ISSN: 2520-3037. Available at: https://rebpasres.org.
48. Kruskal, W. H. and Wallis, W. A., 1952. Use of Ranks in One-Criterion Variance Analysis. *Journal of the American Statistical Association*, 47(260), pp. 583–621. DOI: 10.1080/01621459.1952.10483441.
49. Lapointe, D. and Gagnon, C., 2012. À l'ombre des parcs : la conservation comme enjeu de justice environnementale pour les communautés locales ? In: D. Blanchon et al., eds. *Justice et injustices environnementales*. Presses universitaires de Paris Nanterre. Available at: https://doi.org/10.4000/books.pupo.3427.
50. Levene, H., 1960. Robust Tests for Equality of Variances. In: I. Olkin, ed. *Contributions to Probability and Statistics: Essays in Honor of Harold Hotelling*. Stanford University Press, pp. 278–292.
51. Lewis, S.L., Edwards, D.P., & Galbraith, D. 2015. Increasing human dominance of tropical forests. Science, 349(6250), 827-832. DOI: 10.1126/science.aaa9932.
52. Madron, L. D., Gbalet, P. E. et Balou, B. T. 2015. *Rapport pour les Etats généraux de la forêt, de la faune et des ressources en eau*. *Thématique sur la Gestion durable des ressources forestières*. Abidjan, 89 pp.
53. Magurran, A. E., 2004. *Measuring Biological Diversity*. Oxford: Blackwell Publishing. 264 p.
54. Malhi, Y., Roberts, J. T., Betts, R. A., et al., 2004. Climate Change, Deforestation, and the Fate of the Amazon. *Science*, 319(5860), pp. 169-172. DOI: 10.1126/science.1146961.
55. Mayaux, P., Pekel, J.-F., Desclée, B., Donnay, F., Lupi, A., Achard, F., Clerici, M., Bodart, C., Brink, A., Nasi, R., and Belward, A., 2013. State and evolution of the African rainforests between 1990 and 2010. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 368(1625), 20120300. DOI: 10.1098/rstb.2012.0300.
56. Microsoft Excel 2024. Microsoft Corporation, Redmond, Washington, USA.
57. Molua, E.L., 2019. Global Warming and Carbon Sequestration in Africa's Forests: Potential Rewards for New Policy Directions in the Congo Basin. In: *New Frontiers in Natural Resources Management in Africa*. Springer, pp. 233-252. DOI: 10.1007/978-3-030-12957-1_13.
58. Murray, B.C., Pendleton, L., Jenkins, W.A., and Sifleet, S., 2011. Green Payments for Blue Carbon: Economic Incentives for Protecting Threatened Coastal Habitats. *Nicholas Institute for Environmental Policy Solutions, Duke University*. Available at: https://nicholasinstitute.duke.edu/sites/default/files/publications/blue-carbon-report-paper.pdf.
59. N'Dri, A. B., Koné, A. W., Guéi, A. M., Soro, D., Bakayoko, A., Konaté, S., 2021. Experimental Study of Fire Behavior in Annually Burned Humid Savanna of West Africa in the Context of Bush Encroachment. In: Leal Filho, W., Pretorius, R., de Sousa, L. O. (eds) *Sustainable Development in Africa*. Cham: Springer, pp. 485–500. DOI: 10.1007/978-3-030-74693-3_27.
60. N'Dri, A.B., Koné, A.W., Loukou, S.K.K., Barot, S., and Gignoux, J. 2018. Carbon and nutrient losses through biomass burning, and links with soil fertility and yam (*Dioscorea alata*) production. *Experimental Agriculture*, 54(5), pp. 1–14. DOI: 10.1017/S0014479718000327.
61. Niveau d'Émissions de Référence des Forêts de la Côte d'Ivoire (NERF), 2024. *Niveau de Référence des Forêts (NRF) et Niveau d'Émissions de Référence des Forêts de la Côte d'Ivoire*. Soumission à la Convention Cadre des Nations Unies pour le Changement Climatique, République de Côte d'Ivoire, janvier 2024, 41 p.
62. Nkem, J.N., Santoso, H., and Mebratu, D., 2010. Shaping forest safety nets with markets: adaptation to climate change under changing roles of tropical forests in Congo Basin. *Environmental Science & Policy*, 13(7), pp.535-544. DOI: 10.1016/j.envsci.2010.05.002.
63. Ossohou, M., Galy-Lacaux, C., Yoboué, V., Adon, M., Delon, C., Gardrat, E., Konaté, I., Ki, A., Zouzou, R., 2021. Long-term atmospheric inorganic nitrogen deposition in West African savanna over 16 year period (Lamto, Côte d'Ivoire). *Environmental Research Letters*, 16(1), pp. 015004. DOI: 10.1088/1748-9326/abd065.

64. Ouattara, D., Kouamé, D., Tiébré, M.-S., Kouadio, Y. J. C. et N'Guessan, K. E., 2016. Biodiversité végétale et valeur d'usage en zone soudanienne de la Côte d'Ivoire. *International Journal of Biological and Chemical Sciences*, 10(3), pp. 1122–1138. DOI : 10.4314/ijbcs.v10i3.18.
65. Pan, Y., Birdsey, R.A., Fang, J., Houghton, R., Kauppi, P.E., Kurz, W.A., Phillips, O.L., Shvidenko, A., Lewis, S.L., Canadell, J.G., Ciais, P., Jackson, R.B., Pacala, S.W., McGuire, A.D., Piao, S., Rautiainen, A., Sitch, S. and Hayes, D., 2011. A large and persistent carbon sink in the world's forests. *Science*, 333(6045), pp.988-993. DOI: 10.1126/science.1201609.
66. Pielou, E. C., 1975. *Ecological Diversity*. New York: Wiley. 165 p.
67. Reyes, G., Brown, S., Chapman, J. and Lugo, A. E., 1992. *Wood densities of tropical tree species*. New Orleans, LA: U.S. Department of Agriculture, Forest Service.
68. Riou, G., 1974. Les sols de la savane de Lamto. *Cherch. Lamto N° spécial* (2e partie) : Les caractéristiques du milieu physique. In: *Bulletin de Liaison*, pp. 5-39.
69. RStudio 2024. Integrated Development Environment for R. RStudio, PBC, Boston, MA.
70. SEP-REDD+ et FAO, 2017. Données de base pour la REDD+ en Côte d'Ivoire. Cartographie de la dynamique forestière de 1986 à 2015. Abidjan, Rome.
71. Seymour, F. and Harris, N.L., 2019. Reducing tropical deforestation: The interventions required to reduce deforestation differ widely across the tropics. *Science*, 365(6455), pp.756-757. DOI: 10.1126/science.aax8546.
72. Shapiro, S. S. and Wilk, M. B., 1965. An Analysis of Variance Test for Normality (Complete Samples). *Biometrika*, 52(3-4), pp. 591–611. DOI: 10.1093/biomet/52.3-4.591.
73. Silué, K. S., Koné, N. A., Konaté, S., Roisin, Y. and Korb, J., 2022. Conservation management and termites: a case study from central Côte d'Ivoire (West Africa). *Journal of Tropical Ecology*. Published online: 25 May 2022. DOI: 10.1017/S0266467422000141.
74. Silué, P. A., Koffi, K. A. D., Konan, E. K. and Kouakou, A. A. M., 2021. Espace boisé de l'Ecoferme de Lokoli (Sinématiali, nord de la Côte d'Ivoire) : un cas de compensation écologique. *International Journal of Advanced Research*, 9(5), pp. 119-130. DOI: 10.21474/IJAR01/13434.
75. Soro, Y., N'Dri, B. A., Bakayoko, A., et Gignoux, J. 2018. Analyse de la végétation dans un écotone forêt-savane d'Afrique de l'Ouest dans un contexte de boisement des savanes. *Revue de l'Environnement et de la Biodiversité - PASRES*, 3(1), pp. 54–72.
76. Tiébré, M. S., Ouattara, B., Kpangui, K. B., Kouassi, D. F. and N'Guessan, K. E., 2016. Diversité floristique de la région de Founbesso en zone de transition forêt-savane à l'Ouest de la Côte d'Ivoire. *International Journal of Biological and Chemical Sciences*, 10, pp. 1007-1016. DOI: 10.4314/ijbcs.v10i3.8.
77. Tiémoko, D. T., Yoroba, F., Diawara, A., Kouadio, K., Kouassi, B. K. and Yapo, A. L. M., 2020. Understanding the Local Carbon Fluxes Variations and Their Relationship to Climate Conditions in a Sub-Humid Savanna -Ecosystem during 2008-2015: Case of Lamto in Côte d'Ivoire. *Atmospheric and Climate Sciences*, 10, pp. 186-205. DOI: 10.4236/acs.2020.102010.
78. Tiémoko, D.T., Yoroba, F., Kouassi, K.B., Diawara, A., Kouadio, K., Bouo, F.-X.D.B., Yapo, A.L.M., Kouman, A. and Ramonet, M., 2023. CO_2, CH_4, and CO emission sources and their characteristics in the Lamto Ecological Reserve (Côte d'Ivoire). *Atmosphere*, 14(10), p.1533. DOI: 10.3390/atmos14101533. Available at: https://hal.science/hal-04234781v1.
79. Tra Bi, T. J., Kouassi, K. K., and Keulai, M. C., 2023. Evaluation de l'Impact des Activités Anthropiques Sur la Séquestration de Carbone dans le Parc National Du Mont Sangbé, en Côte d'Ivoire. *European Scientific Journal, ESJ*, 19(6), p. 367. DOI: 10.19044/esj.2023.v19n6p367.
80. UNFCCC, 2024. *2024 NDC Synthesis Report*. United Nations Framework Convention on Climate Change. Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs/2024-ndc-synthesis-report [Accessed 3 November 2024].
81. Vroh, B. T. A., Tiébré, M.-S., Ouattara, D., and N'Guessan, K. É., 2014. Forest reserve of Dékpa Agbaou, an example of plant diversity conservation on mine sites in Côte d'Ivoire. *International Journal of Innovation and Applied Studies*, 6(2), pp. 162–171.

82. Vuattoux, R., Konaté, S., Abbadie, L., Barot, S., Gignoux, J. and Lahoreau, G., 2006. History of the Lamto Ecology Station and Ecological Studies at Lamto. In: L. Abbadie, J. Gignoux, X. Le Roux and M. Lepage, eds. *Lamto. Ecological Studies*, vol. 179. Springer, New York, NY, pp.1-15. DOI: 10.1007/0-387-33857-8_1.
83. Whitmore, T. C., 1998. *An Introduction to Tropical Rain Forests.* 2nd ed. Oxford: Oxford University Press. 296 p.
84. World Bank, 2024. *State and Trends of Carbon Pricing 2024*. Washington, DC: World Bank. DOI: 10.1596/978-1-4648-2127-1. License: Creative Commons Attribution CC BY 3.0 IGO.
85. XLSTAT, 2024. Addinsoft, Paris, France.
86. Yangambi, 1956. La classification des végétations d'Afrique. *Nature*, 178(4545), pp. 1273-1274.1274. DOI: 10.1038/1781273a0.
87. Yapo, G. R., Touré, G.-P. T., Guéi, A. M., N'Dri, A. B., Kallo, A., Konan, L. N., Touré, B., Kouadio, H. K. et Koné, A. W., 2023. L'exclusion du feu modifie l'abondance mais pas la diversité des vers de terre dans la savane Guinéenne (Lamto, Côte d'Ivoire). *Étude et Gestion des Sols*, 30, pp. 223-23