A CRITICAL EVALUATION OF THE CARBON SEQUESTRATION CAPACITY OF TREES IN SPECIFIC REGIONS WITHIN KADUNA STATE NIGERIA

ABSTRACT

This research evaluated the capacity of trees to store carbon in two specific locations, namely Gamji Park and Kaduna Polytechnic in Kaduna State. This was done by conducting field measurements, and observations. To facilitate measurement, the research area was partitioned into quadrants. A grand total of 1555 trees were quantified, with 775 trees found in Gamji Park and 780 trees at Kaduna Polytechnic. A non-destructive approach was used, whereby the measurement of tree height and diameter at breast height was conducted without the need for tree felling.The diameter at breast height (DBH) and height of trees with a diameter at breast height of at least 5cm were measured in each plot. The pantropical allometric equations were used to determine the carbon stock and the quantity of carbon dioxide sequestered by the plants. A total of 6875.4 Megatons/ha of carbon dioxide (CO_2) was calculated to be sequestered by trees in the two research locations. The tree species *Eucalyptus tereticornis* and *Magnifera indica* had a much greater capacity for sequestration in comparison to the other trees that were examined. The Pearson correlation coefficient was employed to examine the association between tree parameters and carbon sequestration. The correlation coefficients for height and DBH were 0.934 and 0.979, respectively. These results suggest a positive relationship between tree parameters, specifically tree height and DBH, and carbon sequestration. Notably, DBH exhibited a stronger correlation compared to other parameters. A statistically significant difference in the tree parameters was observed, as shown by a p-value of less than 0.05.

Keywords: Carbon sequestration,Tree height,Carbon dioxide, Diameter at breast height (DBH), *Eucalyptus tereticornis*,*Magnifera indica*.

1. INTRODUCTION

Carbon sequestration via trees and general greenspaces is an economical approach to mitigating global warming and climate change. Estimating the quantity of carbon stored and the fluctuations in carbon stocks in tree biomass, both above and below ground, is crucial for measuring climate change in accordance with the United Nations Framework Convention on Climate Change (Green and Raygorodetsky, 2010). The Kyoto Protocol is a significant international mechanism designed to address the adverse effects of carbon dioxide (CO_2) and other greenhouse gas emissions. The implementation of this global legal framework mandates that developed nations reduce their greenhouse gas emissions between 2008 and 2012, with the aim of promoting sustainable development. The carbon cycle has garnered significant attention from environmental scientists due to the adverse effects of carbon dioxide, a greenhouse gas, on worldwide climate patterns. The extended presence of carbon dioxide in the atmosphere makes it a matter of significant concern. The rising quantity of carbon dioxide in the atmosphere is responsible for over 60% of the observed global climate change (Grace, 2004). Nature has given us natural carbon sinks or sponges, such as the terrestrial biosphere and the seas. The absorption of carbon dioxide by plants occurs via the process of photosynthesis, leading to the efficient removal of carbon from the atmosphere and subsequent storage of carbon within plant tissues, forest litter, and soils (Vashum & Jayakumar, 2012; Soepadmo, 1993). Research findings indicate that plants are responsible for sequestering around 86% of the carbon present above the Earth's surface and 73% of the carbon found in the Earth's soil (Soepadmo, 1993). Tropical forests are widely recognised as significant contributors to the global carbon cycle, including around 46% of the Earth's terrestrial carbon reservoir and 11.55% of the global soil carbon reservoir. According to Bajracharya et al. (2008) estimate, the development of forest wood results in the absorption or removal of about one tonne of carbon from the atmosphere for every 2cm3. According to Banskota et al. (2007), forests have a crucial role in the establishment of a carbon reservoir via the augmentation of above-ground biomass and the improvement of soil organic carbon content. Urban trees provide a range of ecological benefits, including as regulating the temperature of the atmosphere and sequestering atmospheric carbon (Escobedo et al., 2011). Trees have the capacity to absorb carbon dioxide (CO_2) from the atmosphere and sequester it within various components of the tree, including trunks, roots, branches, leaves, and fruits, as well as for prolonged durations under the soil. The aforementioned attribute renders trees very efficient in the process of carbon sequestration. Over time, the carbon contained inside the trunks, branches, and roots of the tree exhibits a reasonably consistent level of stability. According to Chenge and Osho (2018), evaluations carried out in both managed and unmanaged forests located in temperate and tropical climates have shown that forests play a crucial role as a substantial net carbon sink, effectively extracting carbon from the atmosphere.

The process of determining forest biomass encompasses the use of both remote sensing-GIS techniques and field observations (Vashum & Jayakumar, 2012). Both destructive and non-destructive methods may be used for field measurement. The destructive approach involves the collection of trees and the subsequent measurement of the weight of various tree components after being dried in an oven. On the other hand, the non-destructive approach assesses individual trees by considering their physical attributes such as shape, height, diameter at breast height (DBH), volume, and bulk density. These physical characteristics are then utilised to construct analytical models. The non-destructive method is primarily advantageous in regions where tree removal is impractical or in areas where tree species are protected. Although the destructive approach is known for its higher accuracy, it presents challenges when used for large-scale predictions owing to its demanding nature, substantial financial investment, time-consuming process, and detrimental consequences. As a result, remote sensing provides a comprehensive method for acquiring geospatial data in regions that are inaccessible, hence facilitating the monitoring of changes in vegetation and land use land cover (LULC) (Vashum & Jayakumar, 2012).

Numerous investigations have been conducted using a nondestructive methodology to assess the carbon sequestration capacity of trees. In a study done by Ajayi and Bamidele (2021), the research was carried out at the Adekunle Ajasin University Campus located in Akungba Akoko, Ondo State, Nigeria. The study area exhibits a diverse range of tree species, including both indigenous and non-indigenous species. Notably, *Acacia auriculiformis* stands out as the most abundant, alongside *Terminalia mantily*, *Gmelina arborea*, and *Tectona grandis* among others. Based on the findings of this research, it was determined that Gmelina arborea had the highest carbon sequestration capacity among the tree species examined. The researcher documented a total carbon sequestration of 47.94 kg and a carbon dioxide sequestration of 176.03 kg in the study location. Paul et al. (2019) conducted a study at the Makurdi Zoological Garden in Benue State, Nigeria, to investigate the carbon storage capacity of woody plant species. The total storage of carbon dioxide was calculated to be 3331.05 tons/ha using non-destructive field measurement. A vegetation study of the Ngel Nyaki Forest Reserve was undertaken by Akinsoji (2013). The results indicated that the vegetation inside the Ngel Nyaki forest reserve exhibits self-sustainability and stability. The *Poulteria altissima*, *Polysciasfulva*, *Carapa grandiflora*, and *Entandrophragma angolense* species exhibit higher dominance based on their significant values.

In their research, Makinde et al. (2017) undertook an assessment of the forest's capacity as a natural carbon sink. This study employed geospatial technology to quantify the carbon sequestration capacity of the Oluwa Forest Reserve, presently referred to as the Ondo Afforestation One (OA1), which is part of Ondo State Afforestation Programme (OSAP) series. The reserve is situated in Lisagbede Village, Odigbo Local Government Area (LGA) in Ondo State, specifically in the northwest region of the Oluwa Forest. The forest was found to have stored a total of 358.565 mg/ha of carbon. Ihenyen et al. (2009) conducted an examination of the tree composition inside the Ehor Forest Reserve located in Edo State, situated in southern Nigeria. The research revealed that some tree species inside the reserve face the imminent risk of extinction, a matter of great concern that necessitates the implementation of innovative and sustainable management approaches. Behera et al. (2022) conducted a study on the carbon sequestration potential of tropical tree species for Urban forestry in India. They concluded that species like *T. grandis* can sequester more carbon in very short time frames, which will aid in rapid creation of carbon sinks. Although trees have the capacity to store carbon and reduce climate change, the rate of industrialization and deforestation is causing a significant increase in carbon footprints. This makes it almost impossible for the environment to completely absorb the carbon dioxide that is being emitted. It is essential to conduct an inquiry into the economic and social viability of carbon sequestration, with a specific focus on emerging nations characterized by elevated deforestation rates and reliant on communities for sustenance. Given the aforementioned circumstances, the objective of this study is to evaluate the capacity of trees to store carbon in specific areas within Kaduna State. This study aims to examine various species and their respective abundances, while also evaluating the extent of carbon sequestration. The investigation will also ascertain the correlation between tree factors and carbon sequestration.

2 MATERIALS AND METHODS

2.1 Area of Study

The research was conducted in Kaduna State, located in northern Nigeria at geographical coordinates of roughly 9.2446° N, 7.5232° E (Figure 1). The region under consideration is bordered by six further states, namely Zamfara to the west, Katsina to the northwest, Kano to the northeast, Bauchi to the southeast, Plateau in the south, and Niger in the north. The geographical area under consideration spans around 46,053 square kilometers and has a wide range of physical characteristics. These features consist of rough mountains and valleys, which may be classified into two separate biomes: Guinea savanna in the southern part and Sahel savanna in the northern section. The main irrigation supply in the state is the Kaduna River, which is part of Niger's tributary system. This river provides enough water throughout the year, with periodic variations such as the monsoon or rainy season from May to October, followed by a dry spell from November to April each year. According to Saleh (2015), the state has a number of noteworthy natural resources, including the Kagoro Hills, Kajuru Castle, Matsirga Waterfalls, and Kamuku National Park. Kaduna State Polytechnic and

Gamji Park in Kaduna City were the research locations (Figure 1).

Kaduna State Polytechnic is an esteemed school of higher education situated in Tudun Wada, inside the state of Kaduna, Nigeria. The polytechnic has a campus of over 100 hectares, situated roughly 10 kilometers from the urban core of Kaduna (ksp.edu.ng). Kaduna State Polytechnic is located in the geographic coordinates 10.5843° N, 7.4297° E. A variety of academic and administrative facilities may be found on the polytechnic site, including lecture halls, labs, workshops, libraries, and offices. According to ksp.edu.ng, the institution also offers several student dormitories, staff quarters, and recreational amenities, including a sports complex, a multipurpose hall, and a canteen. Kaduna State Polytechnic has a climate that closely resembles the surrounding region, characterized by a wet season spanning from May to October and a dry season occurring from November to April. The polytechnic may be reached by road, and there are several public transport choices for students and personnel that go from different areas of Kaduna State and its surrounding regions (ksp.edu.ng).

The recreational park known as Gamji Park is situated in Kaduna, specifically inside the core business sector of Kaduna city. It spans an approximate area of 4.4 hectares. Gamji Park is located at around 10.5239° North latitude and 7.4328° East longitude. The park is encompassed by prominent thoroughfares, including Yakubu Gowon Way, Muhammadu Buhari Way, and Independence Way, hence facilitating convenient access via both private vehicles and public transportation. Gamji Park provides a diverse range of amenities for its guests, including a children's playground, a designated picnic space, a miniature zoo, a dining establishment, and a venue dedicated to cultural activities. The park is renowned for its well kept gardens, pathways, and recreational amenities, offering a tranquil setting for unwinding and engaging in leisure pursuits. Gamji Park has a climate similar to that of Kaduna City, characterized by a wet season spanning from May to October and a dry season occurring from November to April. The park is accessible to visitors year-round and is a highly sought-after location for both tourists and local residents (kdsg.gov.ng).

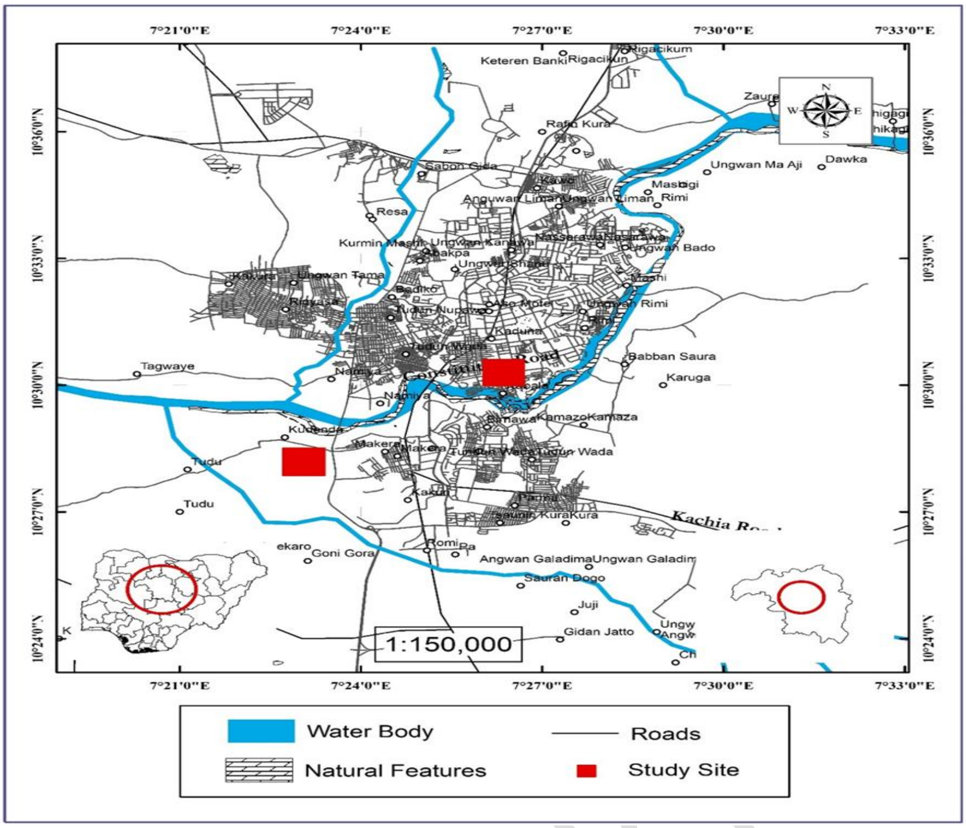

Figure 1: Map of the study area

2.2 Validity/Reliability of Instrument

The calibration of all equipment used in the research adhered to the ISO 9001 quality standard, which mandates that accredited companies provide calibration for their measuring equipment. The research assistants were trained to ensure validity by acquiring a comprehensive understanding of the study's context, the content of the data collecting instrument, and proficiency in data measurement on the site. This mitigates the potential influence of random mistakes, such as imprecise measurements or incorrect instructions.

2.3 Data Collection

The data used in this research was obtained by conducting a sample procedure on the trees located inside the premises of Kaduna Polytechnic and Gamji Park. Data on tree height and diameter at breast height (DBH) were obtained from the trees of the polytechnic campus and the park using a random selection of quadrants. Kaduna Polytechnic and Gamji Park were partitioned into quadrants for the study area. Inorder to determine the coordinates of each quadrant of the research sites, several tools including a measuring tape, range poles, a clinometer, and a Global Positioning System (GPS) receiver were used. An analysis was conducted on vegetation to determine the regions with high species diversity and those with low species diversity. A non-invasive approach to biomass assessment was used, whereby the measurement of tree height and diameter at breast height was conducted without the need for tree felling. Therefore, the measurements of tree height and diameter at breast height (DBH) were conducted for each individual tree within the designated research sites. The height of the tree was measured using a clinometer, while its girth was measured using a measuring tape. Data collected in the field were documented in spreadsheets. Trees were identified at the species level by visually seeing and being identified by a taxonomist. The presence of shrubs and plants was not documented.

2.4 Above Ground Biomass (AGB) Estimation

Various ways have been devised to compute AGB, including allometric equations as well as remote sensing methods. The allometric equation proposed by Chave et al. (2014) was used to evaluate the above-ground biomass of trees.

$$\mathrm{AGB} = 0.0673 \times (\rho D^2 H)^{0.976} \quad (1)$$

Where D is the diameter at breast height, H is the overall height, and ρ is the wood density (wood specific gravity), which is estimated to be 0.7 g/cm^3 (Aabeyir, et al., 2020).

2.5 Below GroundBiomassEstimation

The calculation of below-ground biomass was derived from above-ground biomass. A non-invasive technique utilizes the subterranean biomass of plants, which constitutes 20% of the vegetation's aerial biomass.

Below ground biomass = 20% × above ground biomass that is:

$$\mathrm{BGB} = 20\% \times \mathrm{AGB} \quad (2)$$

2.6 Carbon StockEstimation

Numerous methodologies have been devised to evaluate the carbon store within diverse ecological systems. Allometric equations are often used in forest dynamics as a method for estimating above-ground biomass (AGB), which may then be transformed into carbon stock by using carbon content data.

To calculate the above-ground carbon (AGC), the above-ground biomass (AGB) will be multiplied by 50%, resulting in Equation 3.

$$\mathrm{AGC} = \text{total AGB} \times 0.50 \quad (3)$$

To evaluate the Below Ground Carbon (BGC), the Below Ground Biomass (BGB) will be multiplied by 50% which gives Equation 4.

$$\mathrm{BGC} = \text{total BGB} \times 0.50 \quad (4)$$

2.7 Estimated Total Carbon Stock (TCS)

The concept of "total carbon stock" pertains to the approximate aggregate quantity of carbon present in the natural surroundings, including both carbon deposited above and carbon stored below the Earth's surface. Equation 5 calculates the total carbon store by considering the carbon stock in a standing tree.

$$\text{Total carbon stock} = \text{AG carbon stock} + \text{BG carbon stock} = \text{AG carbon stock} + \text{carbon below ground biomass} \quad (5)$$

2.8 Biomass CarbonDioxide Sequestered

The aboveground carbon was multiplied by 3.67, which is the ratio of the molecular weights of carbon and carbon dioxide, in order to estimate the quantity of carbon dioxide (CO_2) sequestered in the above ground biomass. This is seen as Equation 6.

$$CO_2 = \text{aboveground carbon stock} \times 3.67 \quad (6)$$

The below-ground carbon was multiplied by 3.67, which is the ratio of the molecular weights of carbon and carbon dioxide, in order to calculate the quantity of carbon dioxide (CO_2) sequestered in the below-ground biomass. This is shown as Equation 7.

$$CO_2 = \text{belowground carbon stock} \times 3.67 \quad (7)$$

2.9 Total Sequestered Carbon Dioxide (CO_2)

The entire stock of carbon was transformed into CO_2 by multiplying it by 3.67, the molecular weight difference between carbon and CO_2. This is given by Equation 8:

$$CO_2 = \text{Total carbon stock} \times 3.67. \quad (8)$$

2.10 Analytical Statistics

After the completion of data collection from the field, variables such as diameter at breast height (DBH) and height of each sampled tree were systematically organized and documented on an Excel data sheet. The data analysis was conducted using Microsoft Excel 2016. Correlation analysis was conducted using the Statistical Package for the Social Sciences (SPSS) to investigate the association between tree metrics, namely tree heights and diameter at breast height (DBH), and the quantity of carbon stored. The hypothesis was tested using the p-value at a 95% confidence level.

3. RESULTS AND DISCUSSIONS

3.1 Composition of Various Species of Treesin Gamji Park

A total of 12 species and nine (9) families were discovered in Gamji Park, and their respective frequencies of occurrence are shown in Table 1. The Magnifera indica species exhibited the highest number of trees, at 248, accounting for 32% of the total. The species Elaeis guinensis exhibited the second-highest count of tree stands, with a total of 124 trees. The frequency range of other known tree species within the region varied from 4% to 8%. The species that were found showed similarities to those that were identified by Ajayi and Bamidele (2021) on the Adekunle Ajasin University campus in Ondo state. Nevertheless, *Gmelina arborea* was the most prevalent species in that survey. The study area at Kaduna Polytechnic mostly consists of a uniform planting of *Eucalyptus tereticornis*. Table 2 presents the identification of five unique tree species belonging to four different families. The *Eucalyptus tereticornis* species had the greatest number of tree stands, totaling 520 trees and accounting for 66.67% of the composition (Table 2). Additional tree species that have been identified in the region include *Azadirachta indica*, often known as the umbrella tree, *Magnifera indica*, commonly referred to as the mango tree, *Acacia senegalensis*, well known as the Acacia tree, and *Psidium guajava*.

Table 1: Frequency of occurrence of tree species in each sample quadrants in Gamji Park

Trees	**Total**	**% Frequency**
Magnifera indica	248	32
Elaeis guinensis	124	16
Newbouldia laevis	31	4
Carica papaya	62	8
Termanalia mantaly	31	4
Pakia biglobosa	31	4
Acacia senegalensis	31	4
Azadirachta indica	31	4
Psidium guajava	31	4
Eucalyptus tereticornis	62	8
Gmelina arborea	31	4
Tectona grandis	62	8
TOTAL TREES	775	100.00

Table 2: Frequency of occurrence of tree species in each sample quadrants in kaduna Polytechnic (CASSS)

Trees	**Total**	**% Frequency**
Magnifera indica	52	6.67
Acacia senegalensis	52	6.67
Azadirachta indica	104	13.33
Psidium guajava	52	6.67
Eucalyptus tereticornis	520	66.67
TOTAL TREES	780	100

In the Gamji park, it was noted that *E. tereticornis* exhibited the highest average height of 34.6 m, but *P. guajava* had the lowest mean height of 4.6 m. In contrast, *T. grandis* had the highest average diameter at breast height (DBH) of 55 cm, and *P. guajava* displayed the lowest DBH of 5.5 cm. At Kaduna Polytechnic, a same pattern was seen, with *E. tereticornis* exhibiting the highest average height and DBH of 36.7 m and 50.2 cm respectively, whilst *P. guajava* had the lowest average height of 5.7 m. The minimum mean DBH of 18.6 cm was observed by *A. indica*.

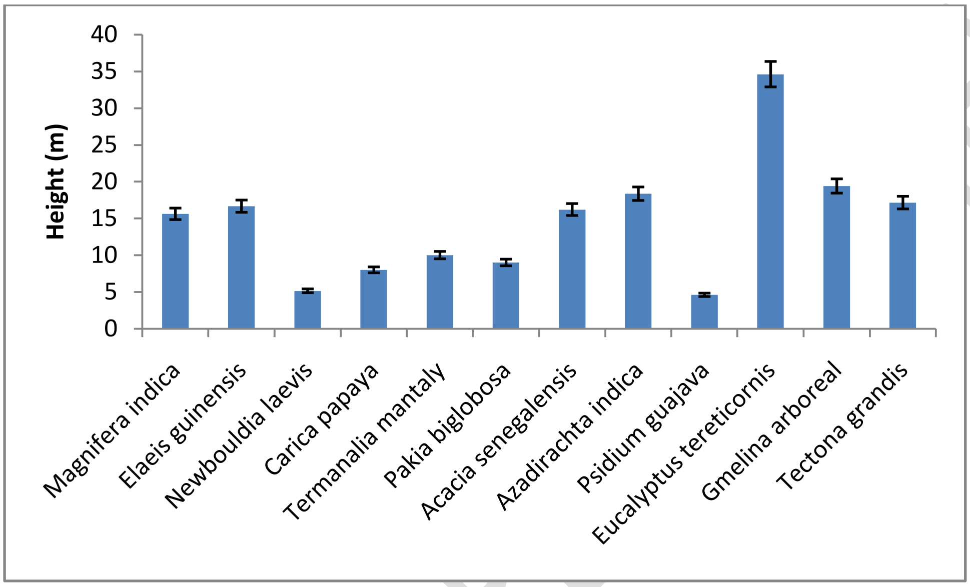

Figure 2. Mean height of tree stands in Gamji Park.

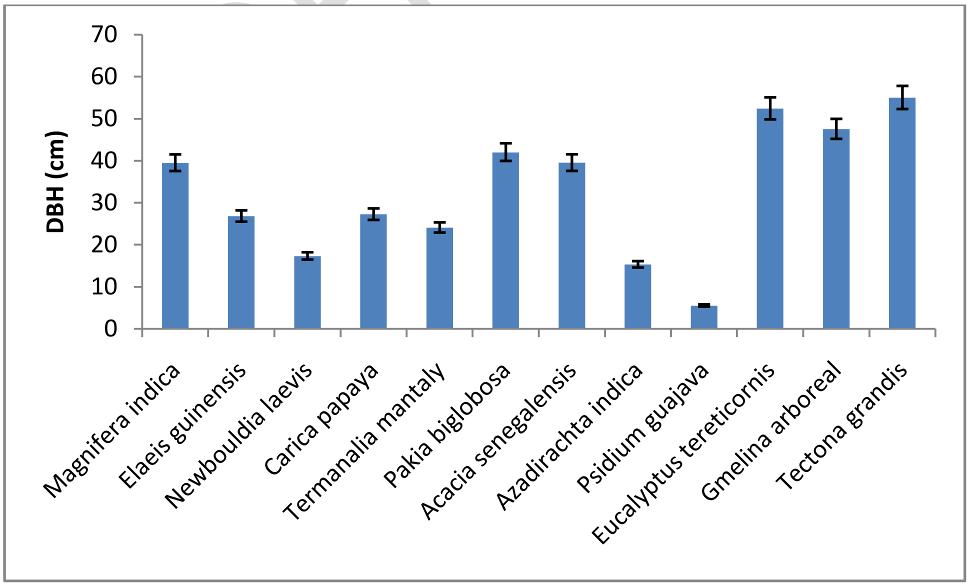

Figure 3. Mean DBH of tree stands in Gamji Park.

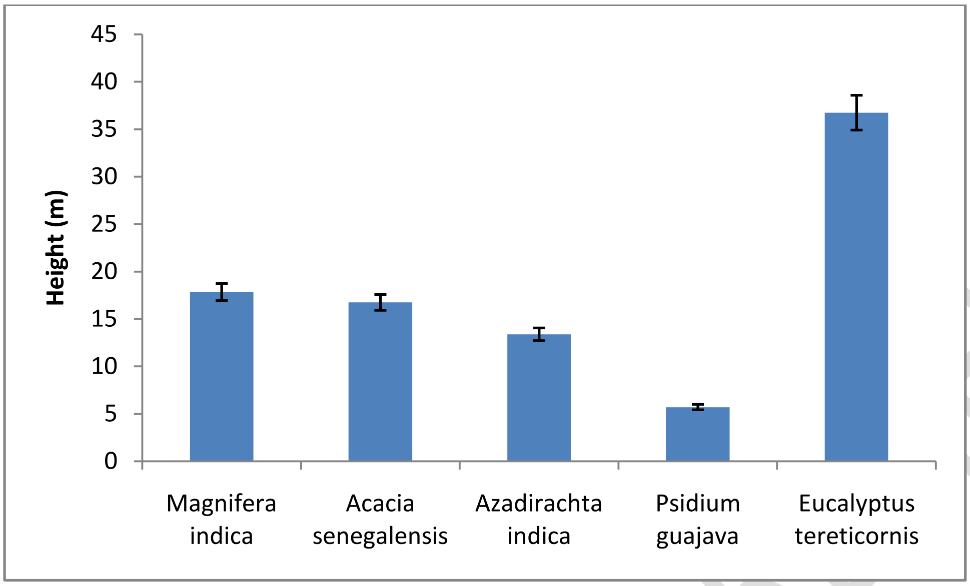

Figure 4. Mean height of tree stands in Kaduna Polytechnic.

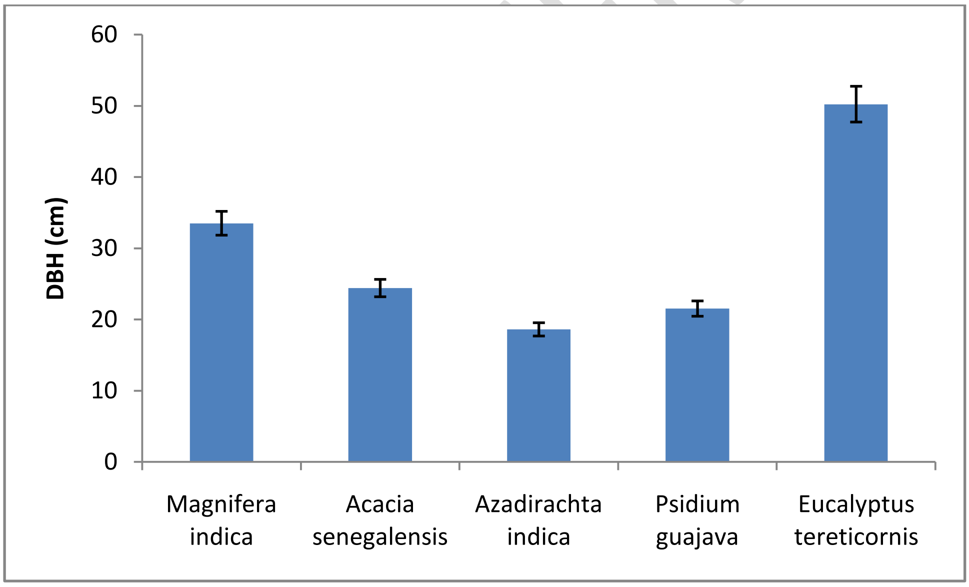

Figure 5. Mean DBH of tree stands in Kaduna Polytechnic.

3.2 Estimation of Carbon Sequestered

According to the data presented in Tables 3 and 4, a total of 1555 trees were measured in the field, with 780 trees measured in Kaduna Polytechnic and 775 trees measured in Gamji Park. The purpose of these measurements was to estimate the aboveground biomass (AGB) and belowground biomass (BGB) in the study areas, as well as to determine the total carbon content and evaluate the sequestered carbon dioxide (CO_2).

Table 3: Result of height and diameter-at-breast height field measurements in Gamji Park

Species	Total Height (m)	Total DBH (cm)	No. of Trees
Magnifera indica	3872.11	9789.39	248
Elaeis guinensis	2065.01	3321.55	124
Newbouldia laevis	159.65	536.30	31
Carica papaya	496.00	1688.47	62
Termanalia mantaly	310.00	746.07	31
Pakia biglobosa	279.00	1302.00	31
Acacia senegalensis	502.20	1224.50	31
Azadirachta indica	568.85	474.30	31
Psidium guajava	142.60	170.50	31
Eucalyptus tereticornis	2145.20	3248.80	62
Gmelina arborea	601.40	1473.53	31
Tectona grandis	1062.68	3410.00	62
TOTAL			775

Table 4: Result of height and diameter-at-breast height field measurements in Kaduna Polytechnic

Species	Total height (m)	Total DBH (cm)	No. of Trees
Magnifera indica	927.33	1742	52
Acacia senegalensis	870.48	1268.8	52
Azadirachta indica	1391	1934.4	104
Psidium guajava	296.4	1119.04	52
Eucalyptus tereticornis	19101.03	26116.55	520
TOTAL			780

The pantropic allometric equation developed by Chave et al. (2014) was used to determine the AGB. According to the data shown in Table 5, it can be noticed that *E. tereticornis* had the highest AGB value of 2,997,611.59 mg/ha in both sites. This was due to its exceptional overall height and diameter at breast height (DBH), as well as its status as the most prevalent tree species in both areas when considered together. The assessment of AGB necessitates the inclusion of these factors in the pantropic allometric equation. The study conducted by Rajput et al. (2017) revealed that biomass output is influenced by a range of ecological parameters, such as germiplasm and individual stand attributes. The highest observed value of BGB, calculated from the AGB, was found in *E. tereticornis*, with a value of 599,522.32 mg/ha. The process of BGB accumulation is consistently influenced by the dynamics of AGB. BGB has a crucial role as a carbon reservoir for the structure of urban land use and makes up around 20% to 26% of the overall biomass (Cairns et al., 1997; Santantonio et al., 1997). Therefore, the *E. tereticornis* tree stands were assessed to have a maximum carbon sequestration capacity of 6600 megatons/ha. The species *N. laevis* had the lowest carbon sequestration capability, measuring 0.02 megatons per hectare. The one-way ANOVA revealed statistically significant differences ($p<0.05$) across all detected species. *Magnifera indica* and *Eucalyptus tereticornis* were identified as the two trees that exhibited the highest carbon sequestration rates, with a combined total of 249 megatons/ha of carbon sequestered. The findings of this research align with the results reported by Adiaha et al. (2022), which demonstrated that *Mangifera indica* had a significant capacity for carbon sequestration. In a study conducted by Alhassan et al. (2014), the authors investigated the use of remote sensing and geographic information system (GIS) methods for the evaluation of forest degradation and carbon sequestration in the Effan forest reserve located in Kwara State. The results suggest that the forest reserve effectively captures a significant amount of carbon, and this capacity increases proportionally with the expansion of forest areas. The research proposed the use of *Gmelina aborea* tree species in reforestation initiatives as a means to mitigate global warming.

Table 5: Total Carbon sequestered by each tree species

Trees	Total Height (m)	Total DBH(cm)	AGB (Mg/ha)	BGB (Mg/ha)	AGC (Mg/ha)	BGC (Mg/ha)	TCS (Mg/ha)	CO_2 (Megatons/ha)
Magnifera indica	4799.44	11531.39	113,179.69	22,635.92	56,589.85	11,318.01	67,907.85	249.22
Elaeis guinensis	2065.01	3321.55	4,376.82	875.38	2,188.41	437.64	2,626.05	9.64
Newbouldia laevis	159.65	536.30	10.25	2.01	5.08	1.05	6.13	0.02
Carica papaya	496.00	1688.47	290.42	58.05	145.21	29.02	174.23	0.64
Termanalia mantaly	310.00	746.07	37.26	7.47	18.68	3.74	22.32	0.09
Pakia biglobosa	279.00	1302.00	99.71	19.92	49.90	9.96	59.87	0.22
Acacia senegalensis	1372.68	2493.30	1,678.45	335.73	839.18	167.82	1,007.09	3.70
Azadirachta indica	1959.85	2408.70	2,221.17	444.25	1,110.63	222.13	1,332.66	4.89
Psidium guajava	439.00	1289.54	152.30	30.46	76.15	15.23	91.38	0.34
Eucalyptus tereticornis	21246.23	29365.35	2,997,611.59	599,522.32	1,498,805.75	299,761.11	1,798,566.95	6,600.74
Gmelina arborea	601.40	1473.53	268.68	53.74	134.39	26.92	161.21	0.59
Tectona grandis	1062.68	3410.00	2,409.00	481.80	1,204.50	240.90	1,445.40	5.31

The expected population of Kaduna State in 2020, as reported by kdsg.gov.ng, was 9.48 million. This indicates that the tested tree was unable to sequester more than 1% of the per capita carbon footprint. Considering that some of these trees were planted more than a decade ago, it is evident that the significance of trees in carbon sequestration relies heavily on the presence of more trees and green areas to effectively carry out this ecological role.

3.3 Relationship between Tree Parameters and Carbon Sequestration

The Pearson correlation analysis reveals a favourable link between tree height and diameter at breast height with carbon stored, as shown by correlation coefficients of 0.934 and 0.979, respectively. While there is a significant link between both parameters and carbon sequestration, it is seen that the diameter at breast height (DBH) has a greater association with carbon sequestration. This observation aligns with the outcomes of prior research, including the study conducted by Makinde et al. (2017) on the geospatial modelling of carbon sequestration in Oluwa Forest in Ondo State, Nigeria, as well as the research conducted by Odiwe et al. (2012) in Ile-Ife, Southwestern Nigeria, and the work of Chave et al. (2005, 2014) on tree allometry and the enhanced estimation of carbon stocks and balance in tropical forests.

4. CONCLUSION

The results of this research suggest that the chosen study locations have a significant ability to store carbon in the presence of trees. A comprehensive inventory of 1555 tree stands, representing 12 distinct species, was conducted on both campuses. These tree stands had a carbon storage capacity of 6875.4 megatons per hectare. The identification of tree species composition and density has been recognized as crucial determinants that significantly impact carbon sequestration. *Eucalyptus tereticornis* and *Magnifera indica* tree species have shown significant capacity for sequestration, underscoring their crucial role in mitigating climate change and preserving ecological equilibrium in Kaduna State due to their abundant presence. Although trees serve as carbon reservoirs, the ecological impact of this function is not substantial unless there is a conscious endeavor to cultivate and preserve trees in order to preserve and sustain the natural environment. The integration of trees into urban environments, agricultural fields, and other appropriate landscapes is crucial in order to contribute to endeavors aimed at reducing carbon emissions, enhancing air quality, and offering other ecological advantages.

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