

# A Study of Carbon Storage in Perennial Plants and Carbon Neutrality Potential at Kasetsart University Laboratory School Center for Educational Research and Development

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## Abstract

This research aims to study the carbon sequestration capacity of perennial trees and determine the carbon footprint of Kasetsart University Laboratory School (Center for Educational Research and Development), ultimately comparing these figures to assess potential carbon credits. The study was conducted at the Suan Mit Sampan area, where tree species and populations were surveyed. Methodology involved measuring tree circumference at breast height (1.30 meters) and total height during two data collection periods: January 2025 and December 2025. Data analysis included calculating above-ground biomass, carbon sequestration, and the annual carbon increment over a one-year period. Furthermore, the school's carbon footprint was analyzed in accordance with the GHG Protocol. Finally, the carbon sequestration data was compared against the total carbon footprint to evaluate the feasibility of carbon credit valuation.

The study results can be summarized as follows: 1. First Survey (January 2025): The total biomass of perennial trees in the study area was 45,435.64 kg, with a total carbon sequestration of 21,354.75 kg. 2. Second Survey (December 2025): The total biomass increased to 59,183.17 kg, with a total carbon sequestration of 27,816.09 kg. 3. Annual Carbon Footprint (2025): The organizational carbon footprint for Scope 1 and Scope 2 was measured at 2,125,723.94 kgCO<sub>2</sub>e. 4. Carbon Neutrality Analysis: The current carbon sequestration capacity of perennial trees within the Kasetsart University Laboratory School (Center for Educational Research and Development) is insufficient to offset the greenhouse gas emissions generated by school activities.

To achieve the goal of Carbon Neutrality, the research team proposes the following strategic recommendations which are Green Space Expansion: Increase the density of green spaces within the school by prioritizing high-potential carbon-sequestering species identified in this study, namely the Ficus (*Ficus maclellandii*), Bastard Poon Tree (*Sterculia foetida*), and Rain Tree (*Albizia saman*). Carbon Credit Procurement: Explore and study guidelines for acquiring external carbon credits to offset the residual greenhouse gas emissions that cannot be mitigated internally. And Strategic Alignment: These actions will drive the school toward becoming a Low-Carbon Educational Model, aligning with the KU Carbon Neutrality 2035 strategy.

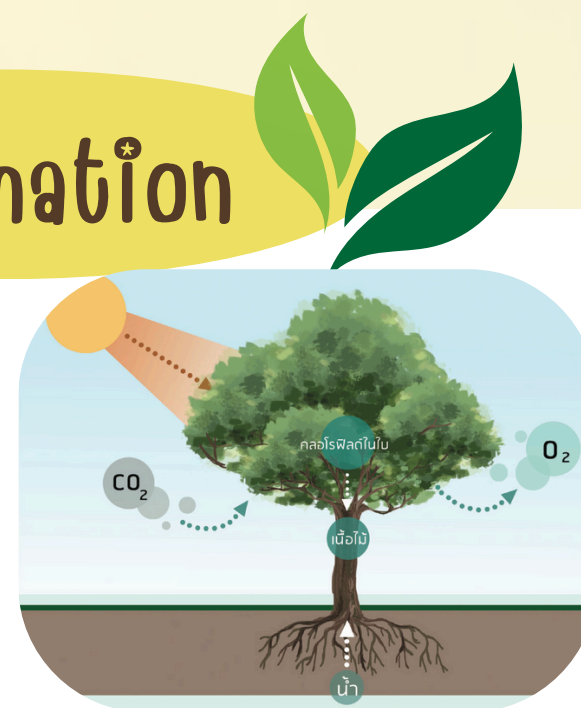
## Background and supporting information



1. To calculate the biomass and carbon sequestration of perennial trees at Kasetsart University Laboratory School.



2. To analyze the organizational carbon footprint within Scope 1 and Scope 2 at Kasetsart University Laboratory School.



3. To compare carbon sequestration capacity against greenhouse gas emissions and evaluate the potential for Kasetsart University Laboratory School to achieve carbon neutrality.

## Research questions

1. What are the values of above-ground biomass and carbon sequestration of perennial trees at Kasetsart University Laboratory School?
2. What is the total organizational carbon footprint for Scope 1 and Scope 2 emissions at Kasetsart University Laboratory School?
3. To what extent can the existing carbon sequestration potential of perennial trees offset greenhouse gas emissions to achieve carbon neutrality, and what are the strategies for enhancing this capacity?

## Expected outcomes

To obtain comprehensive data on the carbon sequestration capacity of perennial trees and the total carbon footprint of Kasetsart University Laboratory School.

## Research Instruments



Measuring tape



Laser rangefinders



1.30. meter level measuring stick

## Research Results

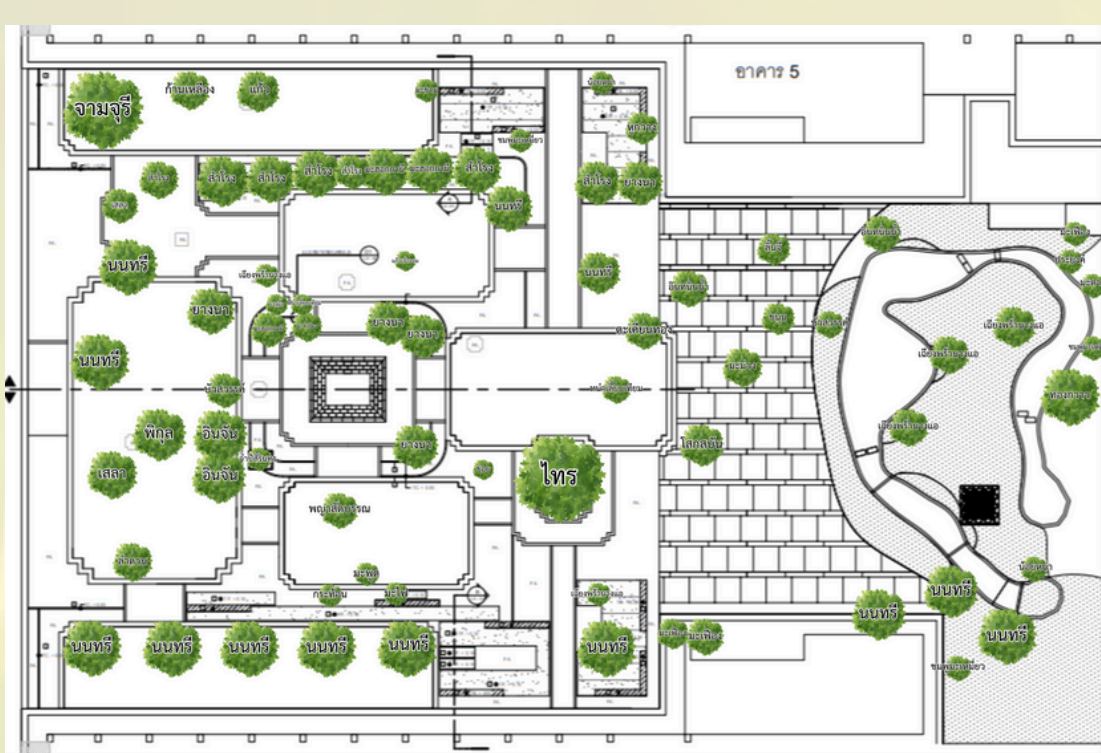
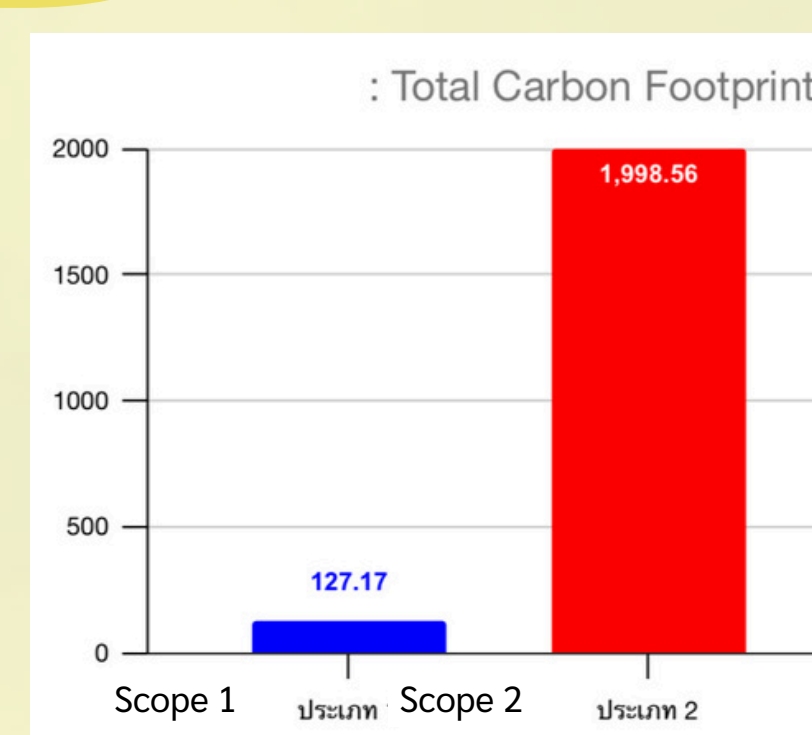


Diagram showing the diversity and location of trees in the area of Kasetsart University Laboratory School Center for educational and Development



The chart illustrates the total Carbon Footprint in two different types of Scope

## Acknowledgement

The research team would like to express our sincere gratitude to **Global Learning and Observations to Benefit the Environment (GLOBE)** for providing the opportunity to engage in environmental science activities. We extend our heartfelt thanks to **Dr. Narinthorn Jumwong**, Secretary of the Coordination Center for Research Stations and Demonstration Forests, Faculty of Forestry, Kasetsart University, and **Ms. Papitchaya Hongkarnjanakul**, Doctoral Student at the Faculty of Engineering, Chulalongkorn University, for their invaluable guidance and expertise. Finally, we would like to thank **Kasetsart University Laboratory School (Center for Educational Research and Development)** for their continuous support, which was instrumental in the successful completion of this research

## Methodology

1. Study Site: Botanical Garden in Kasetsart University Laboratory School Center for educational and Development which covers a total area of **4,400 square meters**, with dimensions of **55 by 80 meters**

2. Use the GLOBE Protocol procedures



2.1 Data was collected in January 2025 and December 2025 using the strict GLOBE Protocol:

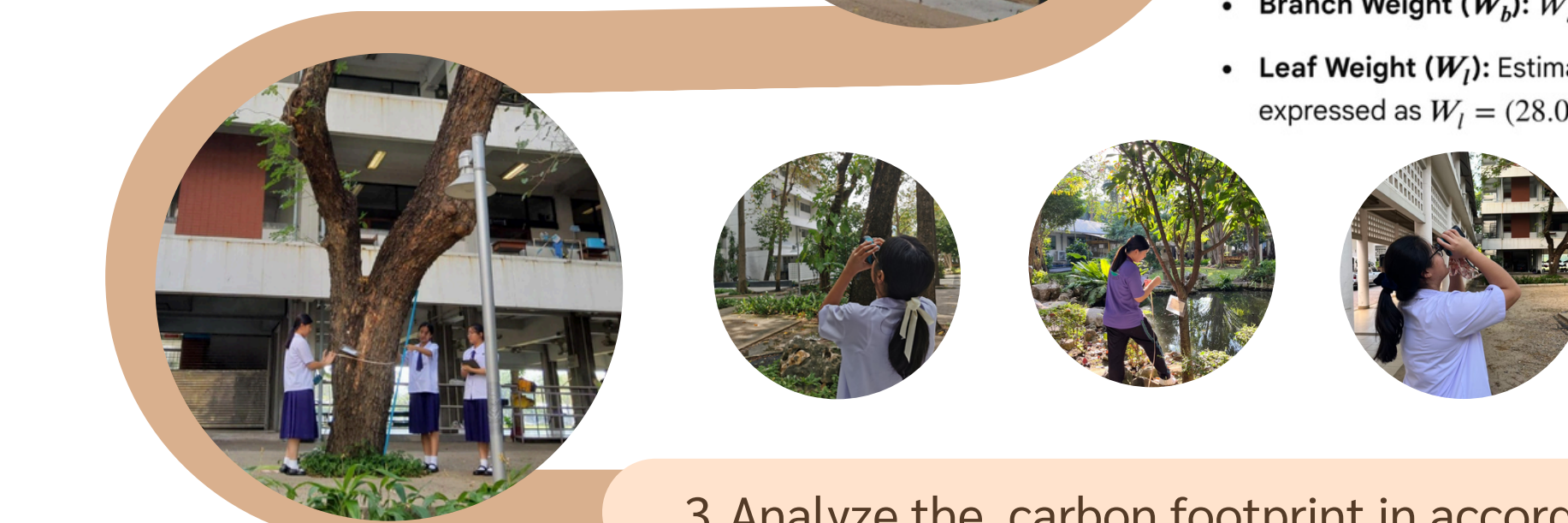
- **Tree Dimensional Measurement:** The circumference (at Breast Height, 1.30 m) and height (using a Laser Range Finder) of every perennial tree were measured.
- **Data Recording:** All collected data (tree name, location, circumference, and height) were meticulously documented, and a site map was prepared.



2.2 Calculate tree biomass and carbon sequestration using the allometric equations of Ogawa et al. (1965).

- **Stem Weight ( $W_s$ ):**  $W_s = 0.0396 \times (D^2 H)^{0.9326}$
- **Branch Weight ( $W_b$ ):**  $W_b = 0.003487 \times (D^2 H)^{1.0270}$
- **Leaf Weight ( $W_l$ ):** Estimated using a formula involving total crown biomass ( $W_c$  or  $W_{lc}$ ), expressed as  $W_l = (28.0W_c + 0.025)^{-1}$ .

• **Total Aboveground Biomass ( $W_T$ ):**  
 $W_T = W_s + W_b + W_l$



3. Analyze the carbon footprint in accordance with the GHG Protocol



Research Scope	GHG	Unit	%
Scope 1	145.30	tCO <sub>2</sub> e	7
Scope 2	1,832.01	tCO <sub>2</sub> e	93
Scope 3	0.00	tCO <sub>2</sub> e	0
Total	1,977.31	tCO <sub>2</sub> e	100

## Research Results

Table 1, which displays tree circumference, diameter at breast height (DBH), height, biomass, and above-ground carbon sequestration from the first survey in January 2025 (the top three tree), the total biomass of all perennial trees was 45,435.63652 kilograms., with a total carbon sequestration of 21,354.74917 kilograms.

No.	Botanical Name	Scientific Name	Circumference (cm)	Diameter (m)	Height (m)	Total Above-ground Biomass	Above-ground Carbon Storage
1	Banyan Tree	<i>Ficus maclellandii</i> King	304	96.765979	20	4260.2464	2002.315847
2	Banyan Tree	<i>Ficus maclellandii</i> King	291	92.627960	20	3921.1926	1842.960562
3	Bastard Poon Tree	<i>Sterculia foetida</i> L.	256.5	81.646294	19.5	3013.6437	1416.41255

Table 2, which presents the data for tree circumference, diameter at breast height (DBH), height, biomass, and above-ground carbon sequestration from the second survey in December 2025 (the top three), the total biomass of the perennial trees was 59,183.17 kilograms, with a total carbon sequestration of 27,816.09 kilograms.

No.	Botanical Name	Scientific Name	Circumference (cm)	Diameter (m)	Height (m)	Total Above-ground Biomass	Above-ground Carbon Storage
1	Banyan Tree	<i>Ficus maclellandii</i> King	664.00	211.36	20	18867.88	8867.90
2	Rain Tree	<i>Albizia saman</i> (Jacq.) Merr.	238.00	75.76	21.4	2855.96	1342.30
3	Bastard Poon Tree	<i>Sterculia foetida</i> L.	47.00	14.96	12.2	78.25	36.78

## Summary

1. First Survey (January 2025): The total biomass of perennial trees in the study area was 45,435.64 kg, with a total carbon sequestration of 21,354.75 kg
2. Organizational Carbon Footprint: The analysis of Scope 1 and Scope 2 greenhouse gas emissions for the year 2025 revealed a total emission of 1,959,177.52 kgCO<sub>2</sub>e. The primary source of emissions is electricity consumption (Scope 2), accounting for 1,832,010.52 kgCO<sub>2</sub>e, or 93.51% of total emissions.
3. Carbon Neutrality Potential: Comparative evaluation shows that the total accumulated carbon stored in all perennial trees (approximately 2,125,723.94 kgCO<sub>2</sub>e) is currently insufficient to fully offset the school's annual greenhouse gas emissions. The cumulative offset capacity represents 0.3% of the annual emissions.

## Citations

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