Carbon sequestration in a rubber plantation at Ban Hong Noi, Phak Mai Subdistrict, Huai Thap Than District, Si Sa Ket Province

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Abstract

Carbon Sequestration & Ecosystem Health: Rubber Plantations, Sisaket
Objective: Compare carbon sequestration, canopy cover, and ground vegetation between monoculture vs. mixed cropping across ages.
Methodology:Sampling: Established 30 x 30 m plots in representative plantations.
Biomass: Measured girth/height for calculation via allometric equations.
Ecology: Assessed canopy density (Densitometer) and surveyed ground cover diversity.
Expected Outcomes: Identifying sustainable management to enhance carbon sinks and mitigate climate change.

Introduction

Background & Rationale:
Climate change is driven by rising atmospheric CO_2. Plant-based carbon sequestration is a key mitigation strategy. Beyond economic value, rubber plantations in Sisaket serve as vital carbon sinks. However, sequestration capacity and ecosystem health—indicated by canopy density and ground cover—vary significantly based on tree age and management styles (monoculture vs. mixed cropping).

Research questions

1. Do different ages of rubber trees affect carbon storage and canopy cover?

2. How do different management styles (monoculture vs. mixed) affect cover crop diversity and carbon storage?

Research hypothesis

1. Older rubber plantation have higher biomass, carbon storage, and canopy cover percentages than young mature rubber plantation.

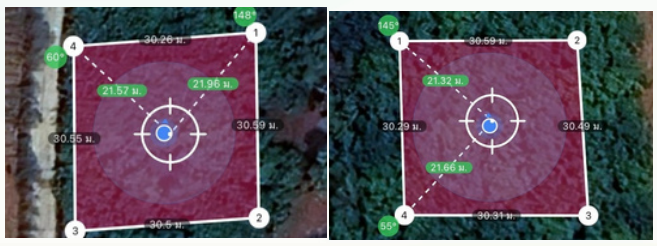
2. Rubber plantations managed using integrated farming practices will have greater diversity of cover crops and a more complete ecosystem than monoculture rubber plantations.

Summary of results and discussion.

Carbon Sequestration: Mature rubber plantations (integrated system) sequestered 16.74 tons/rai, 6.7 times higher than younger plantations (monoculture system).
Age Factor: Older trees accumulate higher biomass in the form of wood over time.
Management Factor: Agroforestry (planting together with Dipterocarpus alatus and coconut trees) increases the complexity of the canopy layer (96.25%), resulting in more efficient carbon absorption than a monoculture system.
Conclusion: Integrated rubber tree cultivation is the most effective approach for carbon sequestration to mitigate global warming.

Research methodology

1. Define the area to be studied.



2. Data collection on rubber trees.

Measure the trunk circumference at a height of 1.35 meters for each tree.
Measure the height of every rubber tree using a height measurement application.

3. Collection of ecological data.

Measure the percentage of canopy cover by using a vertical upward-facing light source at the center of the plot and at all four corners to record the shading values.

Survey and record the types of ground cover plants found within the sample plots.

4. Data analysis.

- Calculate biomass and carbon content using allometry equations.
- Calculate the average percentage of canopy cover.
- Compare results between the two study areas.

Summary of research results.

Sustainable environmental protection is achieved.

Table 1 compares the average growth rates of rubber trees.

Measurement list (Parameters)	Plot 1 (10 years - Single-family home)	Plot 2 (19 years old - mixed)
Number of trees surveyed (trees)	76	83
Average height (meters)	11.39	16.40
Minimum - Maximum height (meters)	8.95 - 11.06	14.00 - 18.70
Average trunk circumference (cm)	38.41	53.64
Minimum - Maximum Circumference (cm)	21 - 58	17 - 105

Table 1 shows that: Rubber trees in older plots have a significantly better growth rate than those in younger plots, with greater average trunk diameter and height, which is consistent with the age of the trees.

Table 2. Ecological characteristics, canopy cover, and plant species data in the plot.

List of temples	Plot 1 (10 years - Single-family home)	Plot 2 (19 years old - mixed)
1. Canopy covering.		
- Number of spots where leaves were found (spots)	74/80	77/80
- Coverage percentage (%)	92.50	96.25
- Density level	dense	Very dense.
2. Cover crops and companion crops.		
- Key features	Common weeds were found covering the ground at only one level.	Other cash crops are planted between the rows of rubber trees.
- Types of plants found.	Common natural grass	Additional plants planted: Dipterocarpus alatus trees, coconut trees, and fodder grasses.

Older rubber plantations exhibit higher soil fertility than younger ones due to integrated farming. By planting crops like Dipterocarpus alatus and coconut trees, farmers create complex ecosystems with larger leaf areas. This enhances carbon absorption and soil moisture retention, outperforming younger plots where weeds grow naturally.

Table 3 compares carbon sequestration.

Carbon data	Plot 1 (10 years - Single-family home)	Plot 2 (19 years old - mixed)
Total biomass including the plot (kg)	3,008.66	20,030.53
Total carbon content of the plot (kg carbon)	1,414.07	9,414.35
Carbon sequestration (tons/rai)	2.51	16.74

Mature rubber plantations with integrated management practices have significantly higher carbon sequestration than younger, monoculture rubber plantations, by approximately 6.7 times (16.74 to 2.51 tons/rai). This is due to two main factors:
1. Age of the rubber trees: Older rubber trees have larger trunks and accumulate more biomass.
2. Integrated management: Intercropping (Dipterocarpus alatus and coconut) increases the overall biomass of the area and enhances the overall ecosystem's carbon absorption capacity.

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REFERENCES

Canopy and ground cover play a crucial role in carbon sequestration in ecosystems. Canopy contributes to above-ground biomass, while ground cover increases organic matter and carbon in the soil, reduces soil erosion, and delays carbon release into the atmosphere. As a result, areas with dense vegetation cover have higher carbon sequestration capacity than open areas.