Research Title: A Study on Soil Quality Affecting Carbon Sequestration in Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province

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Abstract

The study on soil quality affecting carbon sequestration in rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province, had the following objectives: 1) To study the growth of rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province, 2) To study the carbon sequestration of rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province, and 3) To study how soil quality affects the carbon sequestration of rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province. The study found that the area where rubber trees and teak trees were planted had sandy loam soil with a granular structure that was compact. The soil's pH was slightly acidic, and the soil temperature was similar across both areas. The soil moisture was high, and the mineral content in the soil around the teak trees was slightly higher than that around the rubber trees. The rubber trees had a greater average circumference and height than the teak trees, indicating better growth and a higher capacity for carbon sequestration.

Keywords: Rubber trees, Teak trees, Soil quality, Carbon sequestration

Introduction

"Currently, Thailand and some countries around the world are facing the problem of global warming or the greenhouse effect, caused by human activities that have increased the amount of carbon dioxide in the atmosphere through the burning of fuel, transportation, shipping, and industrial production. The increased carbon dioxide is damaging the atmospheric layer that protects the Earth's surface, allowing more sunlight to pass through the atmosphere to the Earth's surface, which leads to an increase in global temperatures. Additionally, deforestation to create human infrastructure, build homes, and establish agricultural land has contributed to the problem. Forests, which are crucial in sequestering carbon dioxide through photosynthesis, are being destroyed. As a result, the global capacity for carbon sequestration is decreasing. Carbon sequestration involves transferring carbon dioxide from the atmosphere into natural storage sources, where plants absorb it during photosynthesis and store it in trees and green plants, thus helping to reduce global warming.

Wat Phu Khao Thong is a meditation site with a forest garden, where various species of trees were planted together in 1992. This has made the temple area more shaded, with a variety of plant species, and it serves as a model for natural resource conservation.

Therefore, the project team is interested in studying the soil quality and its impact on the carbon sequestration of rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province, as a basis for selecting suitable tree species in line with current national projects aimed at reducing greenhouse gas emissions and managing natural resources sustainably."

Research Questions

1. "Does the growth of rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province, differ? If so, how?"
2. "Does the carbon sequestration of rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province, differ? If so, how?"
3. "Does soil quality affect the amount of carbon sequestration in rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province? If so, how?"

Research Hypotheses

1. "The growth of rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province, differs."
2. "The carbon sequestration of rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province, differs."
3. "Soil quality affects the amount of carbon sequestration in rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province. Does it differ?"

Related Variables

Hypothesis 1: The growth of rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province, differs.

- **Independent Variable:** Rubber trees and teak trees in the Phu Khao Thong Forest Garden
- **Dependent Variable:** Growth of rubber trees and teak trees
- **Controlled Variables:** Age of rubber trees and teak trees, measurement methods, study area

Hypothesis 2: The carbon sequestration of rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province, differs.

- **Independent Variable:** Rubber trees and teak trees in the Phu Khao Thong Forest Garden
- **Dependent Variable:** Carbon sequestration of rubber trees and teak trees
- **Controlled Variables:** Age of rubber trees and teak trees, measurement methods, study area

Hypothesis 3: Soil quality affects the amount of carbon sequestration in rubber trees and teak trees in the Phu Khao Thong Forest Garden, Trang Province.

- **Independent Variable:** Soil quality in the area where rubber trees and teak trees are planted
- **Dependent Variable:** Carbon sequestration of rubber trees and teak trees
- **Controlled Variables:** Age of rubber trees and teak trees, measurement methods, study area

Materials and Equipment and Research Methodology

Materials and Equipment

1. Measuring tape
2. Clinometer
3. Soil quality testing kit
4. Beaker
5. Randomization table
6. Glass rods
7. Filter paper
8. Distilled water
9. Test tubes
10. Filtration kit
11. Multi-purpose measuring device
12. Soil chart
13. Cu Smart Lens
14. Tree Carbon Sequestration Assessment Website

Research Methodology

Determining the Study Area and Timeframe

1. This study was conducted at the Phu Khao Thong Forest Garden, Nam Phut Sub-district, Mueang District, Trang Province, focusing on two prominent tree species planted in the forest garden, which are Rubber Trees (Hevea brasiliensis) and Teak Trees (Tectona grandis), located at latitude 7.697259° and longitude 99.712189°.
2. The study on soil quality affecting carbon sequestration in Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province, took place from October 2024 to December 2024, studying two prominent tree species, Rubber Trees and Teak Trees.

Part 1: Studying the Growth of Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province

1. Measure the trunk circumference of each Rubber Tree and Teak Tree from October 2024 to December 2024, once a month during the 3rd week of each month, with 10 trees of each species. Use a measuring tape at a height of 130 cm from the ground. Perform measurements 3 times and calculate the average trunk circumference, then record the results.
2. Measure the height of the Rubber Trees and Teak Trees from October 2024 to December 2024, once a month during the 3rd week of each month, with 10 trees of each species. Use a clinometer and the GLOBE measurement guidelines. Perform measurements 3 times and calculate the average height, then record the results.

Part 2: Studying the Carbon Sequestration Capacity of Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province

1. Use the data from the trunk circumference and height measurements of the Rubber Trees and Teak Trees from Part 1 to calculate carbon credits.
2. Calculate the carbon credits using the calculation app from the Greenhouse Gas Management Organization (https://eng.forest.ku.ac.th/project/carbon/).
3. Start by determining the carbon credits for the trees by selecting the appropriate tree species, inputting the trunk circumference and height data for each tree, then clicking to calculate.
4. The app will display the tree biomass and the amount of carbon in the total biomass.

Image showing the calculation of carbon credits using the calculation app from the Greenhouse Gas Management Organization.

Part 3: To Study How Soil Quality Affects Carbon Sequestration in Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province

1. **Sample Collection Location**: Divide the sampling area into two regions, one where rubber trees and teak trees are planted. Collect samples once a month during the 3rd week of the month. Measure the soil temperature using a thermometer and measure soil moisture using a multi-purpose meter, following the GLOBE method. Repeat the measurements 3 times, calculate the average, and record the results.
2. **Soil Sampling**: Collect soil samples from the soil surface by placing a random sampling grid of 50x50 cm. Sample the soil from the surface down to a depth of 5 cm. Mix all the soil before randomly collecting 100-gram soil samples. Study soil

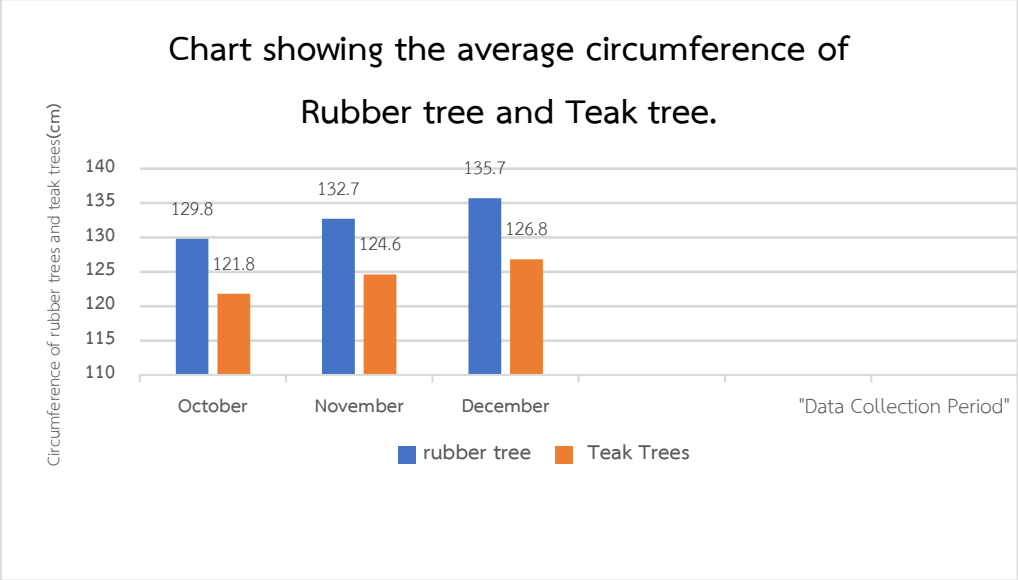
structure, color, and soil aggregation according to the GLOBE method, and record the results.

3. **pH Measurement**: Measure the soil's pH according to the GLOBE method, performing 3 measurements, calculate the average, and record the results.
4. **Soil Nutrient Measurement**: Measure the nitrogen, phosphorus, and potassium levels in the soil using a Kisd Test kit according to the GLOBE method, performing 3 measurements, calculate the average, and record the results.
5. **Analysis**: Analyze the soil quality data and assess its relationship with carbon sequestration. Record the results.

Research Results

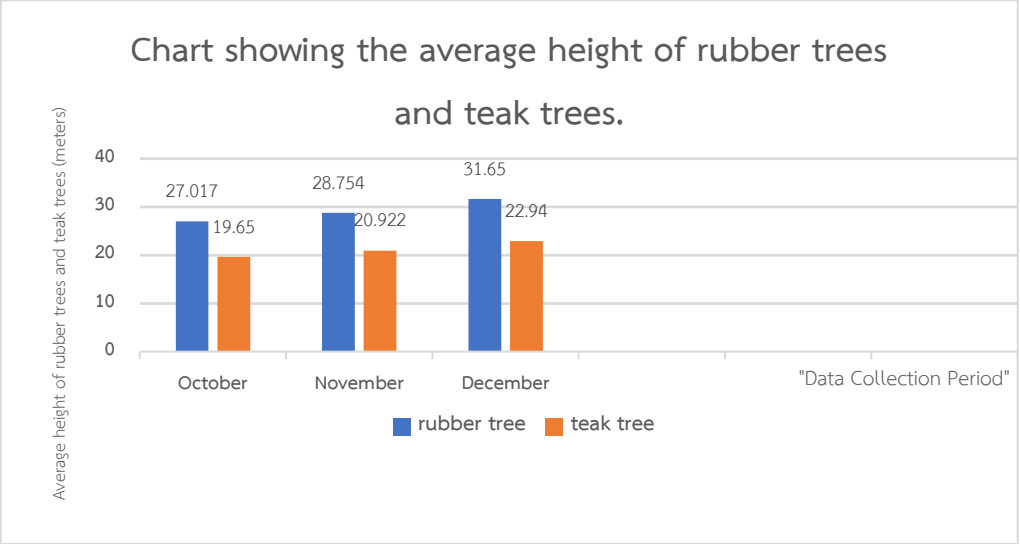
Part 1: Study of the Growth of Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province

Figure 1 shows the average circumference of the rubber trees and teak trees in the Phu Khao Thong Forest Garden.



From the graph, it can be seen that the average circumference of the rubber trees is greater than that of the teak trees. The highest average circumference for both rubber trees and teak trees occurred in December, followed by November, while the lowest average was recorded in October. The rubber trees had a larger trunk circumference compared to the teak trees.

Figure 2 shows the average height of the rubber trees and teak trees in the Phu Khao Thong Forest Garden.



From the graph, it can be observed that the average height of the rubber trees is greater than that of the teak trees. The highest average height for both rubber trees and teak trees occurred in December, followed by November, while the lowest average height was recorded in October. The average height of the rubber trees was greater than that of the teak trees.

Section 2: Study on Carbon Sequestration of Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province

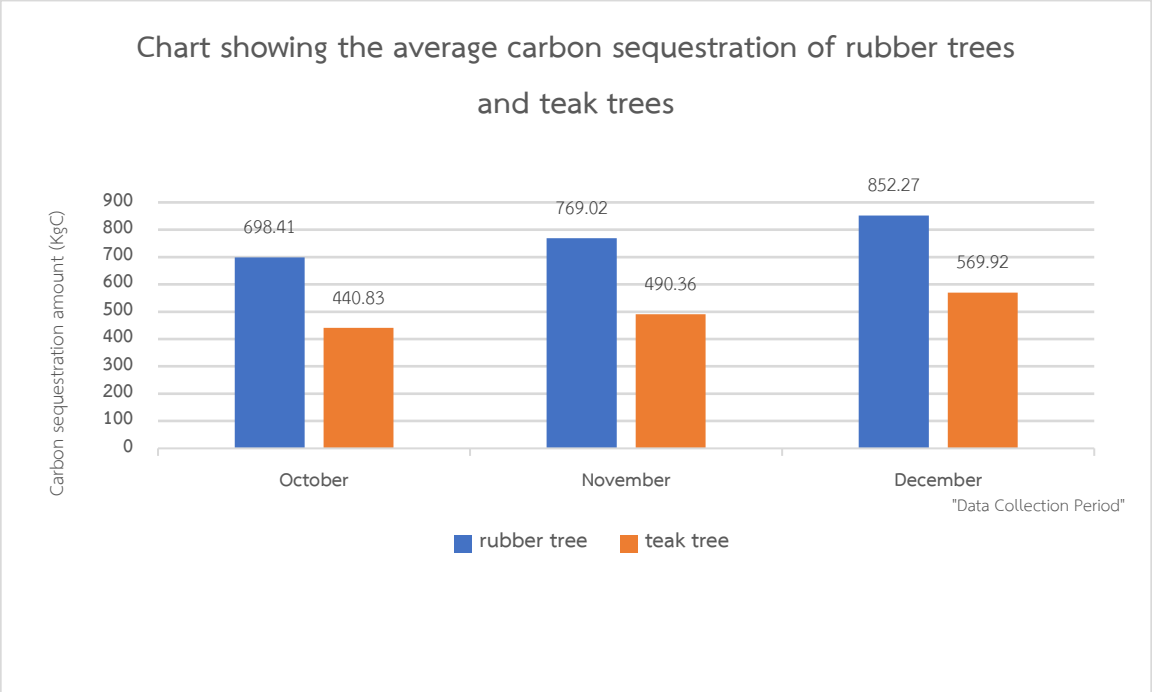


Figure 3 shows the average carbon sequestration of rubber trees and teak trees in the Phu Khao Thong Forest Garden.

From the graph, it can be observed that rubber trees can sequester more carbon in their biomass than teak trees. The average carbon sequestration of both rubber trees and teak trees was highest in December, followed by November, and the lowest average was recorded in October. Rubber trees were able to sequester more carbon than teak trees.

Section 3: Study on the Impact of Soil Quality on Carbon Sequestration of Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province

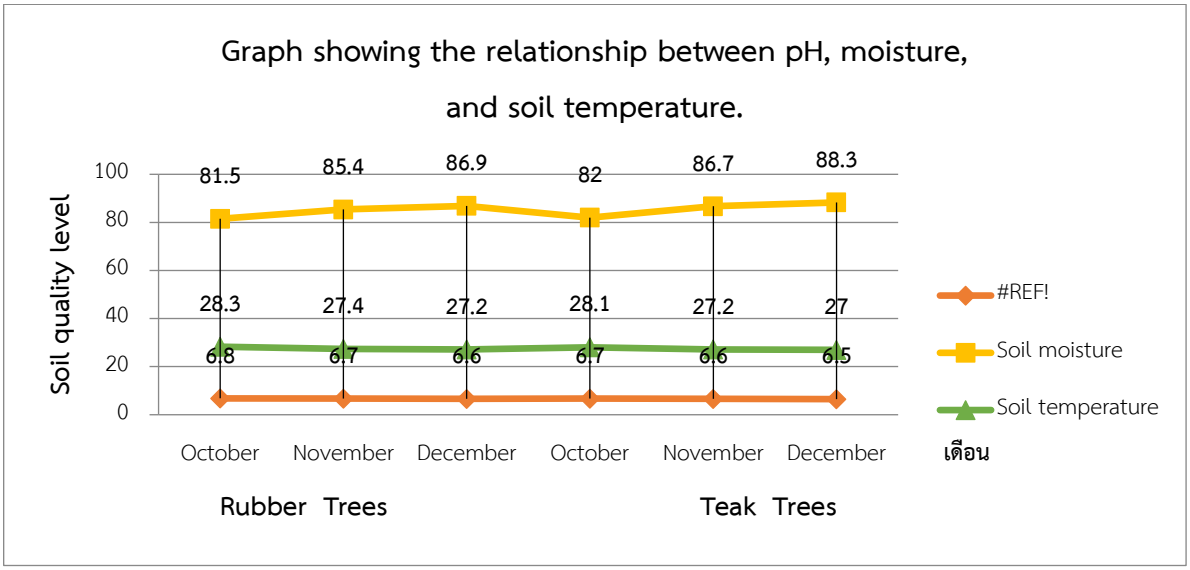
Table showing the physical characteristics of the soil.

types of plants	Rubber Trees		Teak Trees	
soil quality	October	November	October	November
Soil structure	Granular structure	Granular	Round clumps	Round clumps
Soil texture	Loamy sand	Loamy sand	Loamy sand soil	Loamy sand soil
Soil color	Brownish-black color	Brownish-black	Brownish-black color	Brownish-black color
Soil aggregation	Compact	Firm	Firm	Firm

From the table, it can be observed that the area where rubber trees and teak trees are planted has loamy sand soil, with a round clump soil structure that is tightly bound.

The table shows the amount of minerals in the soil.

types of plants	Rubber Trees			Teak Trees		
soil quality	**ต.ค**	**พ.ย**	**ธ.ค.**	**ต.ค**	**พ.ย**	**ธ.ค.**
Nitrogen	None	None	None	Low	Low	Low
Phosphorus	Low	Low	Low	Low	Low	Low
Potassium	Low	Low	Low	Moderate	Moderate	Moderate



Graph showing the relationship between pH, moisture, and soil temperature.

From the graph, it can be seen that the soil's pH level in the areas around the rubber trees and teak trees is mildly acidic, with the soil temperature being similar. The moisture content in the soil around the teak trees is higher.

Summary and Discussion of Research Results

Part 1: Study of the Growth of Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province

It was found that the average circumference and height of the rubber trees were higher than those of the teak trees. The highest average circumference and height of both rubber trees and teak trees were recorded in December, while the lowest averages were in October. This shows that the growth of both tree species increased over time, with rubber trees showing better growth.

Part 2: Study of the Carbon Sequestration in Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province

It was found that rubber trees were able to sequester more carbon in their biomass than teak trees. The highest average carbon sequestration for both species occurred in December, while the lowest average was in October. This shows that the carbon sequestration of both rubber and teak trees increased, with rubber trees being able to sequester more carbon due to their better growth.

Part 3: Study of Soil Quality Affecting Carbon Sequestration in Rubber Trees and Teak Trees in the Phu Khao Thong Forest Garden, Trang Province

It was found that in the areas where rubber trees and teak trees were planted, the soil was sandy loam with a spherical structure and compacted. The soil had a mildly acidic pH, with similar soil temperatures and high moisture content. The mineral content in the soil around the teak trees was slightly higher than in the soil around the rubber trees. This is consistent with the findings of the Botanical Garden Organization (2019), which states that deciduous trees like teak contribute to the decomposition of leaves and add organic matter to the soil. Furthermore, the research found that rubber trees had a larger circumference and height than teak trees, indicating better growth and higher carbon sequestration, which aligns with the research by Prachya and Setthiran (2018), which demonstrated that larger trees with greater height are able to sequester more carbon. This also corresponds with the study by Parinya Phusaksae, Sapidilok Sampanthavivat,

Rungreung Poolsiri, and Chanitha Jantachoti (2018), which found that the highest biomass and carbon sequestration were found in the neem tree, which showed the best growth.

Recommendations

1. Conduct further studies on other prominent tree species.
2. Study the methods for calculating carbon sequestration from all parts of plants.

Acknowledgements

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