Abstract

Research Title : Comparison of Biomass and Carbon Sequestration of RRIM 600 Rubber Trees at 6, 10, and 19 Years Old in Moo 7, Thung Kai Subdistrict, Yan Ta Khao District, Trang Province

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This study aims to examine the soil's effect on biomass, carbon sequestration, and carbon dioxide absorption of RRIM 600 rubber trees at 6, 10, and 19 years of age in Moo 7, Thung Kai Subdistrict, Yan Ta Khao District, Trang Province. A 10×10 meter study plot was established, and measurements were taken for soil temperature, pH, moisture content, and soil fertility (N, P, and K levels). Biomass was analyzed using the allometric equation developed by Ogawa et al. (1965) to compare the carbon sequestration of RRIM 600 rubber trees.

The results showed that the 19-year-old RRIM 600 rubber plantation had a total biomass of 130,648.48 kg per rai, a total carbon sequestration of 2,010 kg of carbon per rai, and carbon dioxide absorption of 61,404.96 kg of CO_2 per rai. The 19-year-old plantation had higher values compared to the 10-year-old and 6-year-old plantations. Soil quality was found to have compacted characteristics with loamy, sandy-clay soil. The average temperature ranged from 25.18 to 26.75 °C, and the average pH was between 6 and 6.67, indicating slightly acidic soil. The moisture content varied, with the 19-year-old rubber plantation having the highest moisture content at a soil depth of 10 cm (13.3%) and 20 cm (26.75%). For the 6-year-old rubber plantation, soil fertility was highest, with N at 55.33 mg/L, P at 61.83 mg/L, and K at 153 mg/L. However, soil quality did not correlate with the carbon sequestration of RRIM 600 rubber trees.

Keywords: RRIM 600 rubber tree; carbon sequestration; biomass; carbon storage; carbon credits

Introduction

Thailand is one of the countries where rubber trees are widely cultivated, especially in the southern regions, which have a suitable climate and topography. Rubber trees are not only an important economic crop that generates income for the country, but they also play a significant role in carbon sequestration in the soil and wood, helping to reduce the amount of carbon dioxide in the atmosphere, which is a primary cause of global warming. Rubber trees are medium to large-sized trees with latex in the bark of the trunk. When rubber trees grow to about 6-7 years of age, they can be tapped for latex, which is economically valuable and serves as the main raw material for natural rubber production.

In addition to their economic benefits, rubber trees also play a crucial role in the environment, particularly in terms of absorbing and sequestering carbon dioxide to mitigate global warming. However, an important factor that may affect the carbon sequestration efficiency of rubber trees is the age of the trees. This project aims to study and compare how soil quality at different ages affects the carbon sequestration capacity of rubber trees by comparing the amount of carbon sequestration across different age groups of rubber trees. The goal is to obtain useful data for the management of rubber tree plantations to ensure both economic and environmental sustainability.

Objectives

1. To compare carbon sequestration in RRIM 600 rubber trees aged 6, 10, and 19 years.
2. To analyze soil quality and its impact on carbon storage across different tree ages.

Research Questions

1. How does the carbon sequestration capacity of 19-year-old rubber trees compare to that of 6-year-old and 10-year-old trees?
2. How do soil quality differences across tree ages influence carbon sequestration?

Hypotheses

1. Older trees store more carbon: RRIM 600 rubber trees at 19 years old will sequester more carbon than those aged 6 and 10 years.
2. Soil quality improves with tree age, positively influencing carbon sequestration.

Materials and Research Methodology

1. Florence flask
2. Funnel
3. Filter paper
4. Beaker
5. Glass stirring rod
6. Dropper
7. Aluminum foil
8. Distilled water
9. Digital weighing scale
10. Measuring spoon
11. pH Paper
12. NPK test kit
13. Clinometer
14. . Rapitest Digital 3-Way Soil Analyzer
15. 3-in-1 soil moisture meter

GLOBE Measurement Methods

Soil Measurement Methodology (Pedosphere Soil)

Vegetation Cover Measurement Methodology (Biosphere)

Study Site Selection

The study on carbon sequestration in RRIM 600 rubber trees in the southern region is conducted in Moo 7, Thung Kai Subdistrict, Yan Ta Khao District, Trang Province, at three different ages: 6 years, 10 years, and 19 years. For each age group, a 10 × 10 meter plot is designated. Soil samples are randomly collected at 12 points from each plot by digging to a depth of 10 cm and 20 cm.

Research Methodology

1. Research Preparation Steps

1.) Study of Carbon Sequestration in Rubber Trees in Southern Thailand (RRIM 600 Variety):
The study focuses on rubber trees of the RRIM 600 variety, located in similar planting areas in the southern region of Thailand. Three different age groups were studied: 6, 10, and 19 years old. For each age group, a 10 × 10 meter study plot was selected in Yan Ta Khao District, Trang Province.

Certain soil properties in the rubber plantations were examined by randomly collecting soil samples at two different depths: 10 cm and 20 cm. Six samples were taken from each depth per plot. The collected samples were then analyzed for soil particle composition, Nitrogen

(N), Phosphorus (P), Potassium (K) levels, soil pH (acidity/alkalinity), and moisture content within the soil.

2.) Literature Review and Collection of Relevant Knowledge and Theories

- Principles of Soil Moisture Measurement
- Principles of Soil NPK Measurement
- Carbon Exchange Processes in Ecosystems
- Carbon Sequestration in Trees
- Principles of Soil Temperature Measurement
- Related Research and Literature
- Principles of Soil pH Measurement
- Tree Circumference Measurement Principles

3.) Objectives of the Study

1. To compare the carbon content in RRIM 600 rubber trees at 6 years, 10 years, and 19 years of age.
2. To compare the physical and chemical soil quality in RRIM 600 rubber trees at 6 years, 10 years, and 19 years of age.

4.) Determining the Sampling Points in the Study Area

- Soil samples will be collected from the rubber plantation in the original area: 6 years (3.5 rai), 10 years (2.5 rai), and 19 years (4 rai). Samples will be randomly collected from each year in 10x10 meter areas at depths of 10 cm and 20 cm, with 6 sampling points at each depth.

2 . Methodology

Soil Physical Quality Study

1.) Soil Temperature Measurement

1.1 Use a spade to dig to a depth of approximately 10-20 centimeters.

1.2 Use the Rapitest Digital 3-Way Analyzer to measure the temperature at 10 cm and 20 cm depths. Insert the device into the prepared soil hole, wait for 1 minute, then read and record the soil temperature in the data log.

Figure 1: Soil Temperature Measurement

2.) Soil Moisture Measurement

2.1 Use a spade to dig to a depth of approximately 10 centimeters and 20 centimeters.

2.2 Use a 3-in-1 soil moisture meter to measure the soil moisture at 10 cm and 20 cm depths. Insert the device into the prepared soil hole, wait for 1 minute, then read and record the soil moisture value in the data log.

Figure 2: Soil Moisture Measurement

3.) Preparation of Surface Soil Samples

3.1 Determine the soil sample collection points.

3.2 Collect soil samples at 6 points, at depths of 10 cm and 20 cm, from a total of 3 areas.

3.3 Collect soil samples along a horizontal line at the designated areas. Use a spade to dig the soil to a depth of approximately 10 cm and 20 cm.

3.4 Place the collected soil into jars and seal them tightly.

4.) Soil Fertility Measurement

4.1 Weigh 20 grams of the collected soil.

4.2 Add 10 milliliters of distilled water.

4.3 Mix the soil with distilled water in a 2:1 soil-to-water ratio.

4.4 Use a nitrogen, phosphorus, and potassium testing kit to analyze the sample. Compare the results with the standard values and then record the measurements.

Figure 3: Soil Fertility Measurement

5.) Measurement of Soil pH (Acidity-Base Level)

5.1 Weigh 20 grams of the collected soil and dissolve it in 20 milliliters of distilled water.

5.2 Filter the soil solution using filter paper.

5.3 Let the solution sit and allow the particles to settle.

Figure 4: Filtration of the Substance for pH Measurement

5.4 Use a Universal Indicator paper,dip it into the solution,and let it sit for approximately 30 seconds.

5.5 Compare the color of the indicator paper with the standard color chart on the side of the box.

Analysis and Conclusion of the Research

1. The collected data will be analyzed and compared to determine relationships. The statistical methods used for data analysis include soil temperature, average pH value of the soil, average soil moisture, and average nitrogen, phosphorus, and potassium content in the soil.
2. Graphs will be created to display and compare the average values of the data.

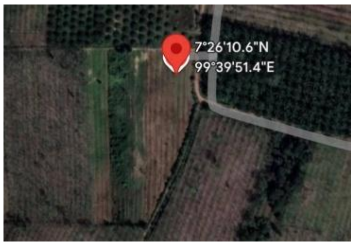
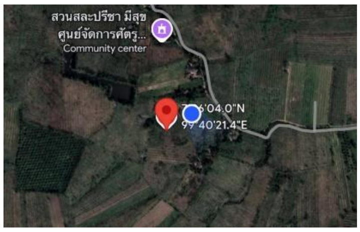
Research Findings

Geographical Coordinates

The study was conducted in the area of RRIM 600 rubber trees, Moo 7, Thung Khai Subdistrict, Yan Ta Khao District, Trang Province. The coordinates are shown in Table 1.

Table 1: Geographical Coordinates

Zone	Geographical Coordinates	
	Latitude (N)	Longitude (E)
RRIM 600 Rubber Tree at 6 Years of Age	7.4362680	99.6642760
RRIM 600 Rubber Tree at 10 Years of Age	7.4344418	99.6726106
RRIM 600 Rubber Tree at 19 Years of Age	7.4349412	99.6728363

Zone	Geographical Coordinates
RRIM 600 Rubber Tree at 6 Years of Age	
RRIM 600 Rubber Tree at 10 Years of Age	
RRIM 600 Rubber Tree at 19 Years of Age	

Results of the Soil Structure Study of RRIM 600 Rubber Trees at 6 Years of Age

Point	Compaction		Soil Color		Soil Texture	
	10 cm Depth	20 cm. Depth	10 cm Depth	20 cm. Depth	10 cm. Depth	20 cm. Depth
1	Compact	Compact	7.5 YR 3/2	10 YR 4/2	Silty clay	Silty loam
2	Compact	Compact	7.5 YR 3/2	10 YR 4/2	Silty clay	Silty loam
3	Compact	Compact	7.5 YR 3/2	10 YR 4/2	Silty clay	Silty loam
4	Compact	Compact	7.5 YR 3/2	10 YR 4/2	Silty clay	Silty loam
5	Compact	Compact	10 YR 3/2	10 YR 4/2	Silty clay	Silty loam
6	Compact	Compact	10 YR 3/2	10 YR 4/2	Silty clay	Silty loam

From Table 2.1, it was found that the soil consistency at depths of 10 cm and 20 cm had similar characteristics, but with different soil colors. The soil at the 10 cm depth had a color value of 7.5 YR 3/2 and 10 YR 3/2, while the soil at the 20 cm depth showed a color value of 10 YR 4/2. Additionally, the soil texture differed between the two depths. At 10 cm depth, the soil had a texture of clay mixed with silty sand, while at the 20 cm depth, the soil texture was sandy loam mixed with silt.

Results of the Soil Structure Study of RRIM 600 Rubber Trees at 10 Years of Age

Point	Compaction		Soil Color		Soil Texture	
	10 cm Depth	20 cm. Depth	10 cm. Depth	20 cm. Depth	10 cm. Depth	20 cm. Depth
1	Compact	Compact	2.5 YR 6/4	2.5 YR 6/4	Silty clay loam	Silty clay loam
2	Compact	Compact	7.5 YR 3/2	7.5 YR 3/2	Silty clay loam	Silty clay loam
3	Compact	Compact	7.5 YR 3/2	7.5 YR 3/2	Silty clay loam	Silty clay loam
4	Compact	Compact	7.5 YR 3/2	7.5 YR 3/2	Silty clay loam	Silty clay loam
5	Compact	Compact	7.5 YR 3/2	7.5 YR 3/2	Silty clay loam	Silty clay loam
6	Compact	Compact	7.5 YR 3/2	7.5 YR 3/2	Silty clay loam	Silty clay loam

From Table 2.2, it was found that the soil consistency at depths of 10 cm and 20 cm exhibited similar compactness, and the soil color was the same with a color value of 7.5YR 3/3 at both depths. Additionally, the soil texture was similar at both depths, characterized as loamy clay mixed with silty sand.

Results of the Soil Structure Study of RRIM 600 Rubber Trees at 19 Years of Age

Point	Compaction		Soil Color		Soil Texture	
	10 cm Depth	20 cm Depth	10 cm Depth	20 cm Depth	10 cm Depth	20 cm Depth
1	Compact	Compact	7.5 YR 3/3	7.5 YR 3/3	Silty clay loam	Silty clay loam
2	Compact	Compact	7.5 YR 3/3	7.5 YR 3/3	Silty clay loam	Silty clay loam
3	Compact	Compact	7.5 YR 3/3	7.5 YR 3/3	Silty clay loam	Silty clay loam
4	Compact	Compact	7.5 YR 3/3	7.5 YR 3/3	Silty clay loam	Silty clay loam
5	Compact	Compact	7.5 YR 3/3	7.5 YR 3/3	Silty clay loam	Silty clay loam
6	Compact	Compact	7.5 YR 3/3	7.5 YR 3/3	Silty clay loam	Silty clay loam

From Table 2.3, it was found that the soil consistency at depths of 10 cm and 20 cm exhibited similar compactness. The soil color was also the same, with color values of 2.5 YR 6/4 and 7.5 YR 3/2 at both depths. Additionally, the soil texture was consistent at both depths, characterized as loamy clay mixed with silty sand.

Results of the Soil Quality Study in Rubber Trees Aged 6, 10, and 19 Years

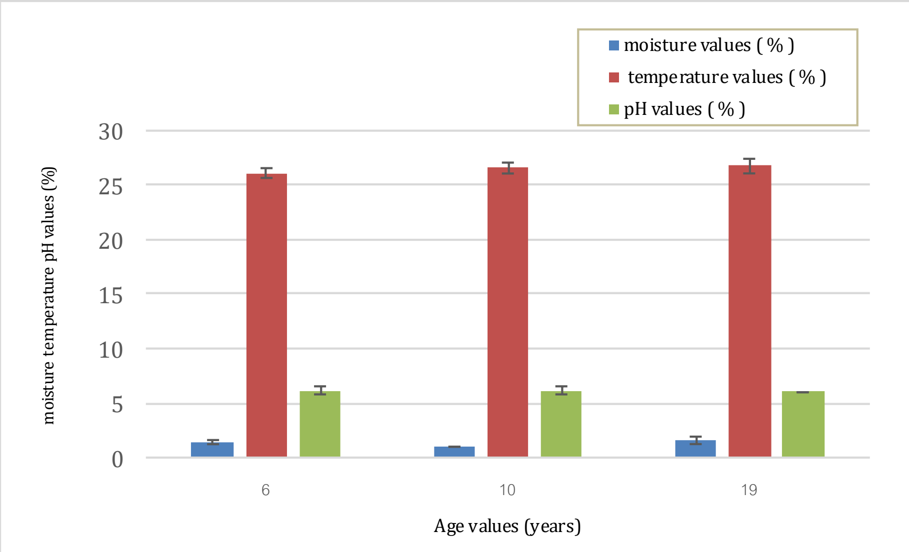


Chart 1 Comparetem moisture temperature pH values of RRIM 600 rubber trees 6,10,19 years.(Soil depth 10 cm)

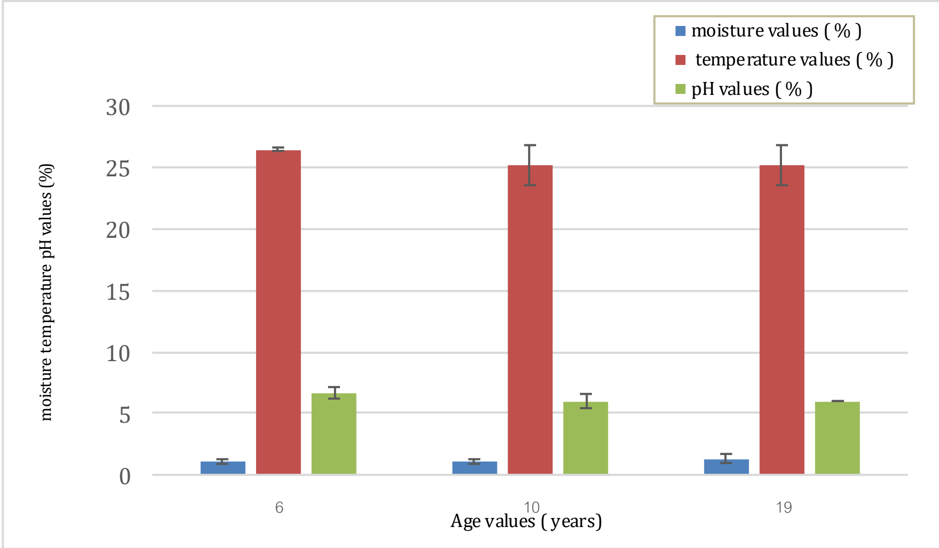


Chart 2 Comparetem moisture temperature pH values of RRIM 600 rubber trees 6,10,19 years.(Soil depth 20 cm)

Charts 1 and 2 show the comparison of average values for soil moisture, temperature, and pH at different age stages and soil depths. The measurements were taken from rubber trees aged 6, 10, and 19 years at soil depths of 10 cm and 20 cm.

The soil moisture differed significantly, with the rubber trees at 19 years of age having the highest moisture content, at 13.3% for 10 cm depth and 26.75% for 20 cm depth. The pH values ranged from 6 to 6.67, indicating slightly acidic soil.

Results of the Soil Structure Study of RRIM 600 Rubber Trees at 6, 10, and 19 Years of Age

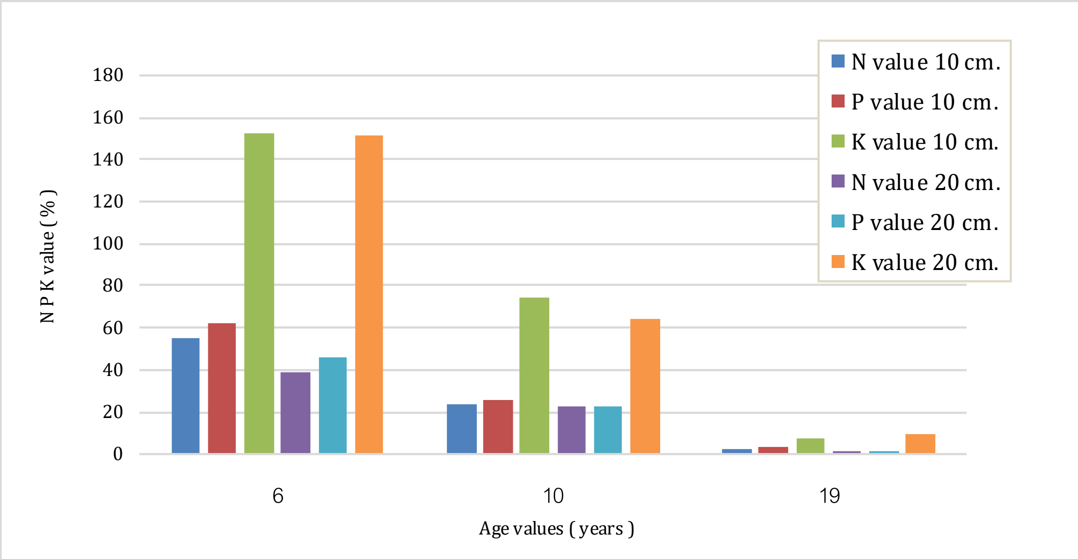


Chart 3 Comparetem N P K values of RRIM 600 rubber trees 6,10,19 years.

Chart 3 shows the comparison of nitrogen (N), phosphorus (P), and potassium (K) content in the soil at different tree ages. The findings are as follows: At 6 years of age, at a depth of 10 cm, the average nitrogen (N) content was 55.33 mg/L, the highest value. The phosphorus (P) content was 61.83 mg/L, and the potassium (K) content was 153 mg/L. At 19 years of age, at a depth of 20 cm, the average nitrogen (N) content was 1.50 mg/L, the lowest value. The phosphorus (P) content was 1.83 mg/L, and the potassium (K) content was 7.17 mg/L. The study shows that the age of the soil and its depth significantly influence the levels of N, P, and K. Soils that are younger and shallower have higher nutrient content compared to older, deeper soils.

Table 5: Comparison of Carbon Sequestration in Rubber Trees at 6, 10, and 19 Years of Age

Age value (years)	Carbon sequestration per rai ($KgCO_2$ / Rai)	Total biomass per rai (Kg / Rai)	The carbon dioxide absorption capacity of perennial trees ($KgCO_2$ / Rai)
6	330	30,639.84	14,400.8
10	1428.8	106,135.84	49,883.84
19	2010	130,648.48	61,404.96

From Table 5, which shows the comparison of total carbon sequestration, total biomass, and carbon dioxide absorption of the RRIM 600 rubber trees at different ages, the findings are as follows: At 19 years of age, the total carbon sequestration was the highest, at 2,010 kg of carbon per rai. The total biomass was 130,648.48 kg per rai. The total carbon dioxide absorption by the trees was 61,404.96 kg of CO_2 per rai.

Summary and Discussion of Experimental Results

1.Total Carbon Sequestration

The 19-year-old RRIM 600 rubber trees have a higher carbon sequestration capacity compared to the 10-year-old and 6-year-old RRIM 600 rubber trees, which have the lowest carbon sequestration. This is consistent with the study by Jintana Bangjan and Suntree Yingchatchawal, 2006, which found that rubber trees accumulate biomass as they age, with the highest accumulation occurring in the trunk and branches across different age stages (2, 5, 12, 16, and 26 years). Typically, RRIM 600 rubber trees can accumulate up to 80-90% of their total biomass in the trunk and branches.The results of the analysis of certain soil properties in rubber plantations at depths of 0-10 cm and 10-20 cm revealed that the soil in the 6, 10, and 19-year-old rubber plantations had a compact consistency. The soil texture was loamy clay mixed with silty sand, with no significant differences among the different age groups.

The 19-year-old RRIM 600 rubber trees had a carbon sequestration value of **201 $KgCO_2$ per rai**, which differs from the carbon estimation based on the biomass of rubber trees over a 25-year period. According to Supawan Petsri and Amnat Chidthaisong (2010), the carbon sequestration was estimated to be 30.99 $KgCO_2$ per rai.

2. Soil Properties in Rubber Plantations: Random Soil Sample Analysis at Depths of 0-10 cm and 10-25 cm

The results of the analysis of soil properties in rubber plantations at depths of 0-10 cm and 10-20 cm showed that the soil in the 6, 10, and 19-year-old rubber plantations had a compact consistency. The soil texture was a loamy clay mixed with silty sand, with no significant differences across the different age groups. Soil moisture content varied, with the 19-year-old rubber trees having the highest moisture content, recorded at 13.3% at 0-10 cm depth and 26.75% at 10-20 cm depth. The pH of the soil ranged from 6.0 to 6.67, indicating slightly acidic conditions.

Acknowledgements

This research comparing the carbon sequestration capacity of RRIM 600 rubber trees at the ages of 6, 10, and 19 years in Moo 7, Thung Khaai Subdistrict, Yan Ta Khao District, Trang Province, has been successfully completed with the support from the budget of the Special Classroom Program, Wichianmat School. I would like to express my gratitude to the principal of Wichianmat School for recognizing the importance of research work and the development of students' potential.

I would like to express my sincere gratitude to my advisor, Teacher Jiraphon Sirirat, for her valuable feedback and guidance, which have greatly contributed to my understanding of the methods for assessing carbon sequestration and the carbon exchange process of trees, leading to the successful completion of this research in line with the set objectives. I would also like to thank Mr. Sakda Phaisomboon, the Director of Wichianmat School, for approving the budget for this educational research project. My sincere thanks go to Wichianmat School for providing the necessary equipment to carry out various experiments. I would like to extend my gratitude to my friends and colleagues who offered their assistance or advice during this project. Special thanks to my parents for their sacrifices, support, and guidance throughout this research process. Lastly, I would like to thank the entire research team for their collective effort in ensuring the successful completion of this study.

Research Team

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References

Jintana Bangjan, and Suntree Yingchatchawal. (2006). Biomass of RRIM 600 Rubber Trees. Agricultural Science Journal, 37(4), 341-351.

Asman Limskul, Suntorn Ngodngam, Nantheera Sriburin, Pharitda Suwannee, Ratchaneekorn Paisan. Final Research Report on the Development of Carbon Storage and Exchange Process Assessment Methods under the Carbon Storage and Exchange Process Assessment Tool/Method Development Project [Online]. https://eservice.dcce.go.th/storage/Media/C201912236906.pdf

Yupyao Tokiri, Chuanphit Jarat, Duangta Novachek, and Nongnuch Sarapee. Research Report on Carbon Storage in the Biomass of Trees in the Saengthawan Community Forest, Surin Province [Online]. Department of Environmental Science, Faculty of Science and Technology, Surin Rajabhat University. Department of Biology, Faculty of Science and Technology, Surin Rajabhat University.

https://ph01.tci-thaijo.org/index.php/Scipsru/article/download/240748/165511/847313

Somsak Sukwong and colleagues (March 2016). Measurement of Carbon Storage in Trees within the Landscape of Khon Na Le [Online].

file:///C:/Users/HP/Downloads/Carbon-Measurement-Training.pdf

Supawan Petsiri and Amnat Chidthaisong. (2010). Carbon Storage Potential in Rubber Plantations of Thailand. In the Proceedings of the 1st National Academic Conference on Thailand and Global Climate: Risks and Opportunities in Global Climate Management Mechanisms. (pp. 439-447). August 19-21, 2010, Nonthaburi Province.

Rungphet Panyawuthi, Uairat Kanjanakhundee, Sophiranya Thongmak, and Khatha Watkij. Biomass Assessment and Carbon Storage of Trees at the Plant Genetic Conservation Area (PGA), OP. NSTDA-Khlong Phai, Nakhon Ratchasima Province [Online]. file:///C:/Users/HP/Downloads/25695-Article_20Text-73022-1-10-20220914.pdf

Ogawa, H., Yoda, K., Ogino, K., and Kira, T. (1965). Comparative ecological studies on three main types of forest vegetation in Thailand II. Plant biomass. Nature and Life in Southeast Asia (4): 49–80.

1. I AM A DATA SCIENTIST

The project was carried out using a process based on data collection principles, analysis, and conclusion to ensure accuracy and reliability. The approach included problem formulation, systematic scientific data collection (e.g., random sampling), and data analysis using statistics to compare the means of different variables. The data was processed using Excel to calculate the averages and standard deviations (S.D.) to enhance the reliability of the results for comparison. Graphs and charts were used to visualize trends and differences in the data. A bar chart was used to display the relationship between the age of rubber trees and the results, which were presented in the form of a bar graph for comparison.

2. I AM A COLLABORATOR

This work was the result of collaboration among several parties, including the research team, the advising professor, and relevant organizations. It highlights the importance of being a good collaborator and working as a team. The research team, composed of three students, collectively planned, designed the experiments, collected data, analyzed the results, and drew conclusions. The advising professor played a key role in providing guidance on the research process, sample collection methods, and data analysis. Collaboration with other organizations, such as the support from the school, which provided the budget, equipment, and academic assistance, as well as the cooperation of farmers and the community who provided information on the rubber tree plantation area and allowed the research to take place, was crucial to the success of this project.

3. I MAKE AN IMPACT

The current issue of rubber cultivation faces declining prices from latex production. Studies on other roles of rubber trees have shown that they play an important role in reducing the amount of carbon dioxide in the atmosphere, which is a major cause of global warming. Additionally, local communities can generate income from rubber trees by assessing the amount of carbon dioxide absorbed and calculating the revenue from carbon offset credits. Rubber plantations can be developed into voluntary carbon credit trading projects, similar to other forestry sectors, as they are effective carbon sinks both in the trees and in the soil. Moreover, the management practices in rubber plantations help reduce carbon loss throughout the lifespan of the trees, which is long enough to support carbon trading contracts.

Raw data

: RRIM 600 rubber tree, 6 years old.

ลำดับ	ชนิดไม้	ประเภทพรรณไม้	ความสูงของต้นไม้ H	ความโต (เส้นรอบวงที่ระดับเพียงอก) GBH	เส้นผ่านศูนย์กลางที่ระดับสูงเพียงอก DBH	มวลชีวภาพเหนือพื้นดินในส่วนลำต้น WS	มวลชีวภาพเหนือพื้นดินในส่วนกิ่ง WB	มวลชีวภาพเหนือพื้นดินในส่วนใบ WL	มวลชีวภาพเหนือพื้นดินทั้งหมด WT	มวลชีวภาพใต้ดิน	มวลชีวภาพรวม	ปริมาณคาร์บอน carbon content	ปริมาณก๊าซเรือนกระจกที่กักเก็บได้	
			(m)	(cm)	(cm)	(kg)	(kg)	(kg)	(kg)	ratio	(kg)	(kgC)	(kgCO2e)	(tCO2e)
1	ต้นยางพารา	พรรณไม้ทั่วไป	7	64	20.20	67.28	12.85	2.67	82.80	22.36	105.15	49.42	181.22	0.181
2	ต้นยางพารา	พรรณไม้ทั่วไป	7	97	30.71	140.62	28.99	5.26	174.87	47.22	222.09	104.38	382.73	0.383
3	ต้นยางพารา	พรรณไม้ทั่วไป	6	84	26.67	89.90	17.69	3.51	111.09	30.00	141.09	66.31	243.14	0.243
4	ต้นยางพารา	พรรณไม้ทั่วไป	12	86	27.48	188.87	40.15	6.79	235.81	63.67	299.48	140.76	516.11	0.516
5	ต้นยางพารา	พรรณไม้ทั่วไป	11	86	27.48	176.19	37.19	6.40	219.78	59.34	279.12	131.19	481.01	0.481
6	ต้นยางพารา	พรรณไม้ทั่วไป	7	89	28.29	118.88	24.09	4.53	147.49	39.82	187.31	88.04	322.80	0.323
7	ต้นยางพารา	พรรณไม้ทั่วไป	9	81	25.86	138.95	28.61	5.21	172.77	46.65	219.41	103.12	378.12	0.378
8	ต้นยางพารา	พรรณไม้ทั่วไป	8	74	23.44	102.91	20.54	3.97	127.42	34.40	161.83	76.06	278.88	0.279
9	ต้นยางพารา	พรรณไม้ทั่วไป	8	76	24.25	100.22	19.95	3.88	124.05	33.49	157.54	74.04	271.50	0.271
10	ต้นยางพารา	พรรณไม้ทั่วไป	9	66	21.01	90.45	17.81	3.53	111.78	30.18	141.96	66.72	244.65	0.245

: RRIM 600 rubber tree, 6 years old .

ลำดับ	ชนิดไม้	ประเภทพรรณไม้	ความสูงของต้นไม้ H	ความโต (เส้นรอบวงที่ระดับเพียงอก) GBH	เส้นผ่านศูนย์กลางที่ระดับสูงเพียงอก DBH	มวลชีวภาพเหนือพื้นดินในส่วนลำต้น WS	มวลชีวภาพเหนือพื้นดินในส่วนกิ่ง WB	มวลชีวภาพเหนือพื้นดินในส่วนใบ WL	มวลชีวภาพเหนือพื้นดินทั้งหมด WT	มวลชีวภาพใต้ดิน	มวลชีวภาพรวม	ปริมาณคาร์บอน carbon content	ปริมาณก๊าซเรือนกระจกที่กักเก็บได้	
			(m)	(cm)	(cm)	(kg)	(kg)	(kg)	(kg)	ratio	(kg)	(kgC)	(kgCO2e)	(tCO2e)
1	ต้นยางพารา	พรรณไม้ทั่วไป	33	109	34.75	773.82	190.49	18.51	982.82	265.36	1,248.19	586.65	2,151.04	2.151
2	ต้นยางพารา	พรรณไม้ทั่วไป	20	112	35.56	514.13	121.30	14.48	649.91	175.47	825.38	387.93	1,422.41	1.422
3	ต้นยางพารา	พรรณไม้ทั่วไป	17	160	50.92	829.35	205.64	19.21	1,054.20	284.63	1,338.83	629.25	2,307.25	2.307
4	ต้นยางพารา	พรรณไม้ทั่วไป	14	91	29.09	257.52	56.54	8.76	322.83	87.16	409.99	192.70	706.55	0.707
5	ต้นยางพารา	พรรณไม้ทั่วไป	10	104	33.14	237.25	51.65	8.20	297.10	80.22	377.32	177.34	650.24	0.650
6	ต้นยางพารา	พรรณไม้ทั่วไป	11	127	40.41	360.68	82.02	11.33	454.03	122.59	576.62	271.01	993.70	0.994
7	ต้นยางพารา	พรรณไม้ทั่วไป	12	168	53.34	689.69	167.76	17.34	874.79	236.19	1,110.99	522.16	1,914.60	1.915
8	ต้นยางพารา	พรรณไม้ทั่วไป	17	116	37.01	465.33	108.65	13.55	587.54	158.63	746.17	350.70	1,285.90	1.286

RRIM 600 rubber tree, 6 years old.

ลำดับ	ชนิดไม้	ประเภทพรรณไม้	ความสูงของต้นไม้ H	ความโต (เส้นรอบวงที่ระดับเพียงอก) GBH	เส้นผ่านศูนย์กลางที่ระดับสูงเพียงอก DBH	มวลชีวภาพเหนือพื้นดินในส่วนลำต้น WS	มวลชีวภาพเหนือพื้นดินในส่วนกิ่ง WB	มวลชีวภาพเหนือพื้นดินในส่วนใบ WL	มวลชีวภาพเหนือพื้นดินทั้งหมด WT	มวลชีวภาพใต้ดิน	มวลชีวภาพรวม	ปริมาณคาร์บอน carbon content	ปริมาณก๊าซเรือนกระจกที่กักเก็บได้	
			(m)	(cm)	(cm)	(kg)	(kg)	(kg)	(kg)	ratio	(kg)	(kgC)	(kgCO2e)	(tCO2e)
1	ต้นยางพารา	พรรณไม้ทั่วไป	11	208	66.27	917.26	229.83	20.24	1,167.33	315.18	1,482.51	696.78	2,554.86	2.555
2	ต้นยางพารา	พรรณไม้ทั่วไป	13	118	37.50	377.10	86.15	11.70	474.95	128.24	603.18	283.50	1,039.49	1.039
3	ต้นยางพารา	พรรณไม้ทั่วไป	16	122	38.79	488.26	114.58	14.00	616.84	166.55	783.38	368.19	1,350.03	1.350
4	ต้นยางพารา	พรรณไม้ทั่วไป	13	163	51.72	704.14	171.65	17.55	893.34	241.20	1,134.54	533.24	1,955.20	1.955
5	ต้นยางพารา	พรรณไม้ทั่วไป	12	147	46.87	532.24	126.02	14.81	673.07	181.73	854.80	401.76	1,473.11	1.473
6	ต้นยางพารา	พรรณไม้ทั่วไป	14	254	80.82	1,694.52	452.56	26.29	2,173.37	586.81	2,760.18	1,297.28	4,756.71	4.757
7	ต้นยางพารา	พรรณไม้ทั่วไป	7	155	49.30	342.34	77.42	10.90	430.66	116.28	546.94	257.06	942.57	0.943

Raw data table of soil in RRIM 600 rubber plantation, 6 years old.

6 ปี	Soil depth 10 cm						Soil depth 20 cm					
Spot	Moisture content	Temperature value	N value	P value	K value	pH value	Moisture content	Temperature value	N value	P value	K value	pH value
1	1	27.22	103	115	150	7	1.5	26.66	58	67	257	6
2	1	26.66	27	28	59	7	1.5	25.55	42	46	152	6
3	1	26.11	62	71	197	6	1.5	26.11	17	21	56	6
4	1	26.11	56	59	209	7	1	26.11	14	22	47	6
5	1.5	26.66	4	4	5	6	1.5	25.55	43	50	140	7
6	1	26.11	80	94	298	7	1.5	26.66	58	67	257	6

Raw data table of soil in RRIM 600 rubber plantation, 10 years old.

10ปี	Soil depth 10 cm						Soil depth 20 cm					
Spot	Moisture content	Temperature value	N value	P value	K value	pH value	Moisture content	Temperature value	N value	P value	K value	pH value
1	1	26.66	27	30	85	6	1	27.22	21	27	64	7
2	1	21.66	26	28	89	6	1	26.11	12	13	53	6
3	1	25.55	18	22	60	7	1	27.22	25	27	56	6
4	1	26.11	22	26	91	6	1	26.66	15	18	62	6
5	1.5	25.55	28	24	74	5	1	26.11	44	23	63	6
6	1	25.55	22	22	46	6	1	26.11	18	30	86	6

Raw data table of soil in RRIM 600 rubber plantation, 19 years old.

19 ปี	Soil depth 10 cm						Soil depth 20 cm					
Spot	Moisture content	Temperature value	N value	P value	K value	pH value	Moisture content	Temperature value	N value	P value	K value	pH value
1	1	26.66	1	5	1	6	1	27.77	1	2	4	6
2	1	21.66	9	7	23	6	2	26.66	2	2	6	6
3	1.5	25.55	1	1	3	6	1.5	26.66	1	1	4	6
4	1	26.11	2	2	6	6	1.5	25.55	1	1	4	6
5	1.5	25.55	0	0	1	6	2	27.22	0	0	2	6
6	2	25.55	3	3	9	6	1.5	26.66	4	5	35	6

Appendix

Figure 1: Measuring the height of

Figure 2: Measuring the distance between the tree and the

Figure 3: Measuring the circumference

Figure 4: Mixing the sample for N, P, and K analysis.

Figure 5: Mixing the sample for pH.

Figure 6: Filtering the sample for pH analysis.

Figure 7: Filtering the sample for pH analysis.

Figure 8: Measuring N, P, and K values