Research Title: The study of Carbon storage of some trees in Thung Khai Botanic Garden, Trang.

Student: Miss Nattika Kaenchan, Miss Thanyaporn Polsung

Teacher: Mrs. Khwanjai Karnchanasrimak, Mrs. Prempitchaya Sriket, Miss Naeriya Tonkrongchan

Scientist: Mr. Kobsak Pennukul

School: Wichienmatu School

Country: Thailand

Date: 21 November 2023 – 20 February 2024

Abstract

The study of Carbon storage of some trees in Thung Khai Botanic Garden, Trang has the objectives 1) to study soil quality that affects the amount of carbon storage of each type of trees in the Thung Khai Botanical Garden, Trang Province, includes Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta 2) to study the air quality that affects the amount of carbon storage of each type of trees in Thung Khai Botanical Garden, Trang Province, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta 3) to study the amount of carbon storage of each type of trees in Thung Khai Botanical Garden, Trang Province, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta by studying the growth of 10 prominent tree species and the quality of the soil in the area of all 10 prominent tree species. From the study of soil quality and the amount of carbon storage of each type of trees was found that soil quality, air quality and growth affected the amount of carbon storage of the 10 prominent tree species, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta in Thung Khai Botanic Garden, Trang. The Alstonia scholaris area had higher temperature values and elements in the soil content than other trees areas. There is less light intensity in the air, resulting in more growth for greater height and circumference values. The Alstonia scholaris are thus able to store the most carbon in all biomass and greenhouse gases.

Keywords: *carbon storage, prominent plant species, soil quality, carbon storage quantity*

Introduction

Currently, Thailand and some countries in the world are experiencing the problem of global warming or the greenhouse effect. This is due to humans increasing the amount of carbon dioxide in the atmosphere by burning fuel Travel, transportation, and industrial production. This causes more carbon dioxide to destruction the atmosphere that protects the earth's surface. As a result, more sunlight can penetrate through the atmosphere to reach the earth. The temperature of the world therefore increases that caused by deforestation. To create various human facilities, forests are an important source of storage. Carbon dioxide in the atmosphere through the process of photosynthesis. This causes the world's efficiency in Carbon storage to decrease for is the transformation of carbon dioxide from the atmosphere to be stored in natural sources. By using the photosynthesis process of plants to absorb carbon dioxide in the atmosphere and store it in trees and green plants.

Thung Khai Botanical Garden, Trang Province, is a natural tourist attraction and learning center about plants in the southern region. It is also a place to preserve wildlife. And with the area being a humid evergreen forest, swamp forest, and low hills, covering an area of approximately 2,600 rai, there are various plants such as fern gardens, insectivorous plants, palm family plants, rubber family plants, and other southern plants that are also interesting many kinds.

Therefore, the research team conducted research on The study of Carbon storage of some trees in Thung Khai Botanic Garden, Trang, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta to study factors affecting carbon storage of tree species. By studying soil quality, air quality in the area of all 10 prominent tree species and the amount of carbon storage of prominent trees species in Thung Khai Botanical Garden, Trang Province.

Research Question and Hypothesis

Research Questions

1. The quality of the soil affects the amount of carbon storage of the 10 outstanding trees, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta. Is it grown in Thung Khai Botanic Garden, Trang Province?
2. The quality of the air affects the amount of carbon storage of the 10 outstanding trees, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta. Is it grown in Thung Khai Botanic Garden, Trang Province?
3. Growth affects the amount of carbon storage of all 10 outstanding trees including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta. Is it grown in Thung Khai Botanic Garden, Trang Province?

Hypothesis

1. The quality of the soil affects the amount of carbon storage of the 10 outstanding trees, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta. Grown in Thung Khai Botanic Garden, Trang Province.
2. The quality of the air affects the amount of carbon storage of the 10 outstanding trees, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta. Grown in Thung Khai Botanic Garden, Trang Province.
3. Growth affects the amount of carbon storage of all 10 outstanding trees, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta. Grown in Thung Khai Botanic Garden, Trang Province.

Research Methods and Materials

Related variables

Hypothesis 1 The quality of the soil affects the amount of carbon storage of the 10 outstanding trees, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta. Grown in Thung Khai Botanic Garden, Trang Province.

Independent Variable: The quality of the soil in the tree area.

Dependent Variable: The amount of carbon storage of trees.

Control Variables: Size of the study area, date of survey, materials used in the survey.

Hypothesis 2 The quality of the air affects the amount of carbon storage of the 10 outstanding trees, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta. Grown in Thung Khai Botanic Garden, Trang Province.

Independent Variable: The quality of the air in the tree area.

Dependent Variable: The amount of carbon storage of trees.

Control Variables: Size of the study area, date of survey, materials used in the survey.

Hypothesis 3 Growth affects the amount of carbon storage of all 10 outstanding trees, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta. Grown in Thung Khai Botanic Garden, Trang Province.

Independent Variable: Growth of trees.

Dependent Variable: The amount of carbon storage of trees.

Control Variables: Size of the study area, date of survey, materials used in the survey.

Materials

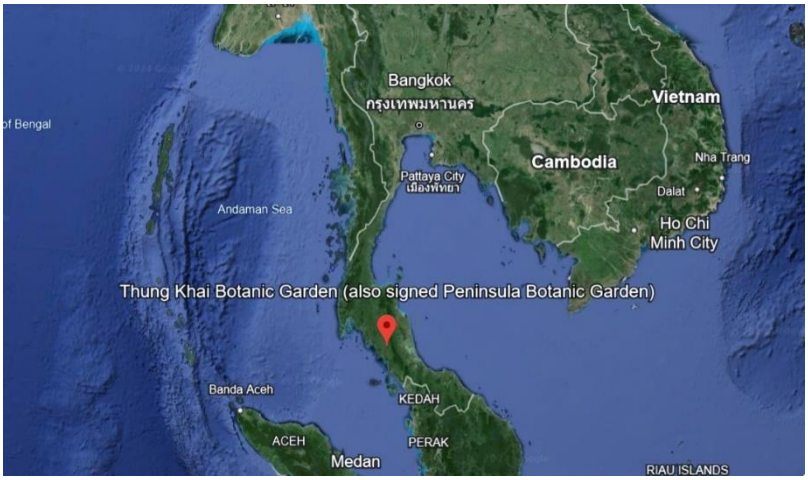
1. Measuring tape
2. Clinometer
3. Beaker
4. Soil quality testing kit
5. Stirring rod
6. Erlenmeyer Flask
7. Filter paper
8. Distilled water
9. Test tube
10. Google Map
11. Air quality meter
12. Website to assess tree carbon storage

GLOBE Protocols

1. Atmosphere Measurement Method
2. Pedosphere (Soil) Measurement Method
3. Biosphere Measurement Method

Determine study points

This research was conducted in Thung Khai Botanical Garden, Thung Khai Subdistrict, Yantakhao District, Trang Province. It is located for the coordinates of latitude 7.4681940 and longitude 99.6383065 and selects the outstanding trees grown in Thung Khai Botanical Garden, Trang Province. Quantity 10 types.



Methods

Part 1 To study the quality of soil that affects the carbon storage of tree species.

1.1 Determine a soil sample collection point in Thung Khai Botanic Garden, Trang Province. By collected from the area where 10 outstanding tree species were to be studied, a total of 10 points.

1.2 Measure soil temperature by using a thermometer for measuring soil temperature at a depth of 10 centimeters, read the temperature in the soil and collect data 3 times.

1.3 Measure soil humidity using a multi-purpose meter. At a depth of 5 centimeters, read soil moisture values. Data were collected 3 times.

1.4 Measure the pH of the soil. Take about 1 tablespoon of collected soil and dissolve it with 20 milliliters of distilled water and leave it to settle. Then use universal indicator paper dipped in the solution, soak for about 30 seconds, and compare the color with the standard value on the side of the box.

1.5 Measure the amount of nitrogen, phosphorus, and potassium in the soil by dissolving the collected soil with distilled water with the ratio of soil to water being 1:5. Come filter it with filter paper, check it with a nitrogen, phosphorus and potassium testing kit. By comparing the standard values and then recording the values.

Part 2 To study the quality of air that affects the carbon storage of trees.

2.1 Measure relative humidity in the air and air temperature using a digital hygrometer.

2.2 Measure the light intensity in the air using a light meter (Lux meter)

Part 3 To study the growth of tree species that affect carbon storage.

3.1 Measure the height of all 10 prominent tree species using the Clinometer. Stand 20 meters away from the tree to measure, then aim the Clinometer at the top of the tree, press and hold the button. When you see it, release the button. Read the angle from the Clinometer and record the angle. Then take it to find tan value. Measure the height of the observer from the floor to eye level and calculate the height of the tree.

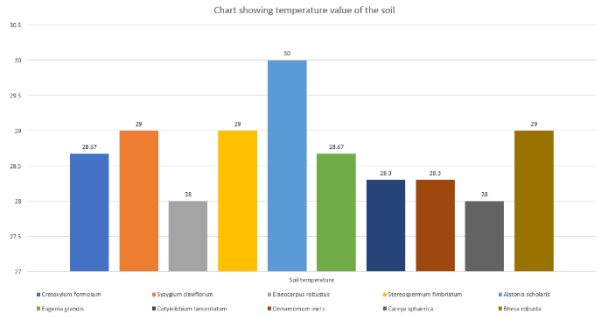
3.2 The trunk circumference of each tree species was measured using a tape measure at chest height, approximately 130 centimeters from the ground. Then save the value.

3.3 Calculate your carbon storage with the Tree Carbon Storage Estimator website by selecting your tree type. Then enter the tree trunk circumference and height of each tree species. The program will calculate and display the biomass and carbon storage information of the trees. Then save the value.

Results

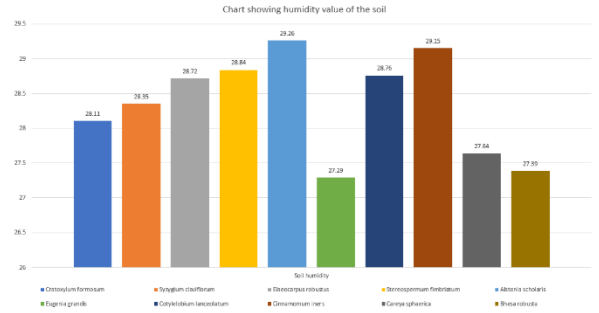
A study on soil quality, air quality, and growth that affect carbon storage of 10 outstanding tree species grown in Thung Khai Botanical Garden, Trang Province. The results are as follows:

Part 1 To study the quality of soil that affects the carbon storage of tree species.



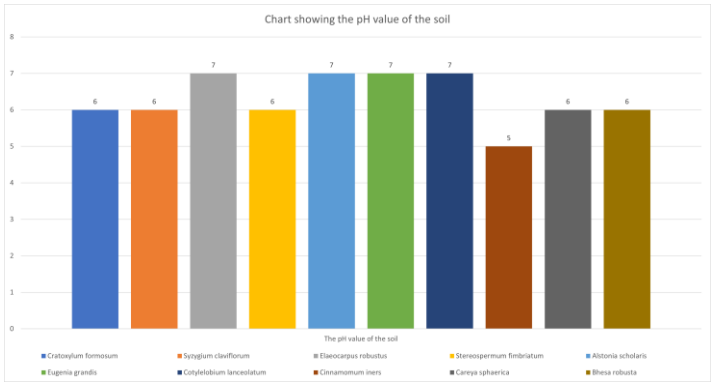
Picture 1: Chart showing soil temperature values around each tree.

From the bar chart, the temperature values in the soil around each some trees are shown that was found in the temperature values each of some trees to be similar. The Alstonia scholaris area has the highest temperature, which is 30 c°, followed by Syzygium claviflorum, Stereospermum fimbriatum, Bhesa robusta, Cratoxylum formosum, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners and the area Elaeocarpus robustus and Careya sphaerica with a minimum temperature, which is 28 c°.



Picture 2: Chart showing soil humidity values for each tree.

From the bar chart shows the soil humidity value of each tree species that was found the humidity value of each tree species to be similar. The Alstonia scholaris area has highest humidity value, which is 29.26, followed by Cinnamomum iners, Stereospermum fimbriatum, Cotylelobium lanceolatum, Elaeocarpus robustus, Syzygium claviflorum, Cratoxylum formosum, Careya sphaerica, Bhesa robusta and area Eugenia grandis has the lowest humidity value, which is 27.29.



Picture 3 : Chart showing the pH in the soil of each tree

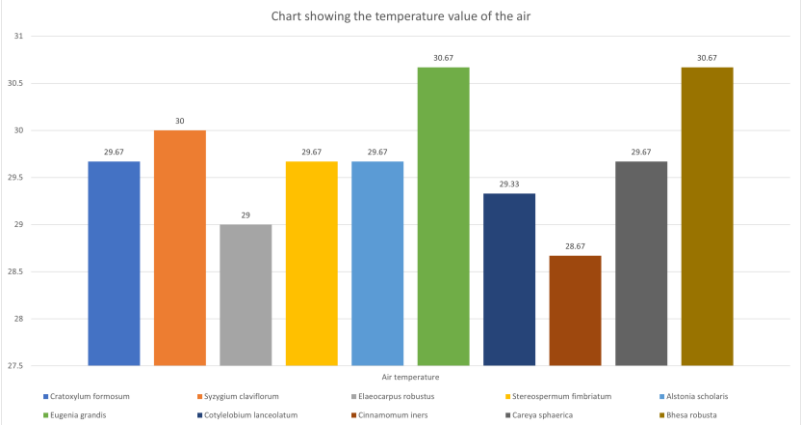
From the bar chart showing the pH in the soil around each tree that was found the pH in each tree area to be similar. The value is between 5 - 7.

Table 1 shows the soil fertility of each tree.

Tree name	Elements in the soil		
	Nitrogen	Phosphorus	Potassium
Cratoxylum formosum	High	Medium	High
Syzygium claviflorum	High	High	High
Elaeocarpus robustus	Medium	Medium	High
Stereospermum fimbriatum	High	High	High
Alstonia scholaris	Very high	Very high	Very high
Eugenia grandis	Medium	Medium	Medium
Cotylelobium lanceolatum	High	Medium	High
Cinnamomum iners	High	Medium	Medium
Careya sphaerica	Medium	Medium	Medium
Bhesa robusta	High	High	High

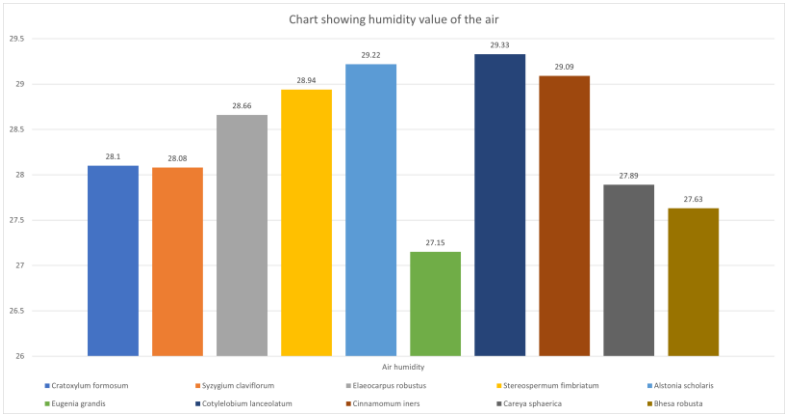
The table shows the fertility of the soil in each tree that was found the area Alstonia scholaris to have more soil fertility than other tree areas with area Alstonia scholaris having very high levels of nitrogen, phosphorus and potassium. Area Cratoxylum formosum has high levels of nitrogen, potassium, and medium levels of phosphorus. Area Syzygium claviflorum has high levels of nitrogen, phosphorus and potassium. Area Elaeocarpus robustus has medium levels of nitrogen, phosphorus and high levels of potassium. Area Stereospermum fimbriatum has high levels of nitrogen, phosphorus and potassium. Eugenia grandis tree area has medium levels of nitrogen, phosphorus and potassium. Area Cotylelobium lanceolatum has high levels of nitrogen, potassium, and medium levels of phosphorus. Area Cinnamomum iners has high levels of nitrogen, phosphorus and medium levels of potassium. Area Careya sphaerica has medium levels of nitrogen, phosphorus, and potassium, and area Bhesa robusta has high levels of nitrogen, phosphorus, and potassium.

Part 2 To study the quality of air that affects the carbon storage of trees.



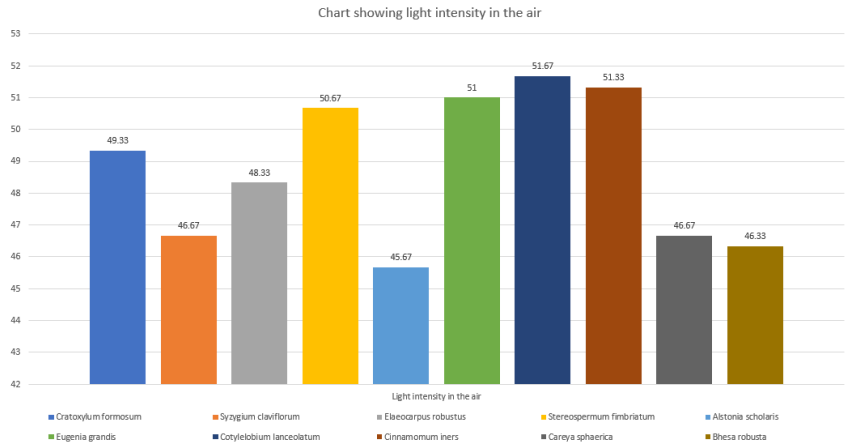
Picture 4: Bar chart showing the temperature in the air around each tree

From the bar chart shows the air temperature values around each tree that was found the temperature values of each of tree species to be similar. Area Alstonia scholaris and Bhesa robusta have the highest temperature, which is 30.67 c°, followed by Syzygium claviflorum, Cratoxylum formosum, Elaeocarpus robustus, Stereospermum fimbriatum, Careya sphaerica, Cotylelobium lanceolatum, Elaeocarpus robustus and area Cinnamomum iners has the lowest temperature, which is 28.67 c°.



Picture 5: Chart showing the air humidity value of each tree

From the bar chart shows the air humidity values around each tree that was found the air humidity values in each tree to be similar. Area Cotylelobium lanceolatum has the highest air humidity, which is 29.33, followed by Alstonia scholaris, Cinnamomum iners, Stereospermum fimbriatum, Elaeocarpus robustus, Cratoxylum formosum, Syzygium claviflorum, Careya sphaerica, Bhesa robusta and area Eugenia grandis has the lowest air humidity, which is 27.15



Picture 6: Bar chart showing the light intensity of each tree.

From the bar chart shows the light intensity of each tree that was found the light intensity in the Cotylelobium lanceolatum to the highest light intensity, which was 51.67 and the Alstonia scholaris area for the least light intensity, which was 45.67.

Part 3 To study the growth of tree species that affect carbon storage.

Table 2 shows the height and circumference of each tree.

Tree name	Height (m)	Circumference (cm)	Distance to tree (m)	Angle
Cratoxylum formosum	22.2	113	20	48
Syzygium claviflorum	32	216	20	58
Elaeocarpus robustus	18.6	72	20	43
Stereospermum fimbriatum	19.4	159	20	44
Alstonia scholaris	29.6	256	20	56
Eugenia grandis	14.6	56	20	36
Cotylelobium lanceolatum	17.4	158	20	41
Cinnamomum iners	18	79	20	42
Careya sphaerica	14	75	20	35
Bhesa robusta	28.6	256	20	55

From the table shows the height and circumference of each tree species that was found Alstonia scholaris for the greatest height and circumference, followed by Bhesa robusta, Syzygium claviflorum, Stereospermum fimbriatum, Cotylelobium lanceolatum, Cratoxylum formosum, Cinnamomum iners, Careya sphaerica, Elaeocarpus robustus and Eugenia grandis respectively.

Table 3 shows soil biomass both aboveground and underground and an overview of each tree.

Tree name	Aboveground biomass (kg.)	Underground biomass (kg.)	Total biomass (kg.)
Cratoxylum formosum	723.08	195.23	918.32
Syzygium claviflorum	3476.66	938.70	4415.36
Elaeocarpus robustus	261.16	70.51	331.68
Stereospermum fimbriatum	1213.14	327.55	1540.69
Alstonia scholaris	4456.88	1203.36	5660.23
Eugenia grandis	129.13	34.96	163.99
Cotylelobium lanceolatum	1081.76	292.07	1373.83
Cinnamomum iners	301.73	81.47	383.19
Careya sphaerica	215.6	58.23	273.90
Bhesa robusta	4313.84	1164.74	5478.58

From the table showing soil biomass both above ground and underground and an overview of each some tree was found that aboveground, underground and an overview biomass Alstonia scholaris had the highest mass, which was 5660.23 kg, followed by Bhesa robusta, Syzygium claviflorum, respectively, Stereospermum fimbriatum, Cotylelobium lanceolatum, Cratoxylum formosum, Cinnamomum iners, Elaeocarpus robustus and Eugenia grandis had the lowest mass, which was 163.99 kg.

Table 4 shows the carbon content in the total biomass and the amount of greenhouse gases sequestered by each tree species.

Tree name	Carbon content in total biomass (kgC)	Amount of greenhouse gases sequestered ($kgCO_2e$)
Cratoxylum formosum	431.61	1582.56
Syzygium claviflorum	2075.22	7609.14
Elaeocarpus robustus	155.89	571.59
Stereospermum fimbriatum	724.13	2655.13
Alstonia scholaris	2660.31	9754.47
Eugenia grandis	77.08	282.61
Cotylelobium lanceolatum	645.70	2367.57
Cinnamomum iners	180.10	660.37
Careya sphaerica	128.73	472.02
Bhesa robusta	2574.93	9441.42

From the table shows the carbon content in the total biomass and the amount of greenhouse gases sequestered by each tree species that was found that Alstonia scholaris to be able to store the largest amount of carbon in total biomass, which was 2660.31 kgC, followed by Bhesa robusta, Syzygium claviflorum, Stereospermum fimbriatum, Cotylelobium lanceolatum, Cratoxylum formosum, Cinnamomum iners, Elaeocarpus robustus, Careya sphaerica respectively, and Eugenia grandis was able to store the least amount of carbon in total biomass, which was 77.08 kgC And from the amount of greenhouse gases sequestered. It was found that Alstonia scholaris was able to store the largest amount of greenhouse gases, which was 9754.47 $kgCO_2e$, followed by Bhesa robusta, Syzygium claviflorum, Stereospermum fimbriatum, Cotylelobium lanceolatum, Cratoxylum formosum, Cinnamomum iners, Elaeocarpus robustus, Careya sphaerica respectively, and Eugenia grandis was able to store the least amount of greenhouse gases, which was 282.61 $kgCO_2e$

Discussion

A study on soil quality, air quality, and growth that affect carbon storage of 10 outstanding tree species grown in Thung Khai Botanical Garden, Trang Province. The results of operations can be summarized and discussion as follows.

Part 1 from the study of temperature, humidity and pH in the soil were found that the humidity value and pH in the soil of all 10 types of trees were similar values. As for the temperature values, it was found that the Alstonia scholaris area had the highest soil temperature, and soil fertility studies showed that the Alstonia scholaris area had very high levels of nitrogen, phosphorus and potassium in the soil.

Part 2 from the study of temperature, humidity and light intensity in the air were found that the temperature and air humidity values in all 10 types of trees were similar. As for the light intensity in the air, it was found that the Alstonia scholaris area has a lower light intensity in the air than other tree areas.

Part 3 from studying height and circumference were found that Alstonia scholaris has a higher height and circumference than other tree species. The study of aboveground, underground soil biomass and overview of each tree species found that the soil biomass both above ground, underground and overall Alstonia scholaris had the highest mass.

Conclusion

From the study of soil quality, air quality, and growth affect carbon storage of 10 prominent tree species grown in Thung Khai Botanical Garden, Trang Province that is based on the hypothesis that soil quality, air quality, and growth to affect the carbon storage of 10 prominent tree species, including Cratoxylum formosum, Syzygium claviflorum, Elaeocarpus robustus, Stereospermum fimbriatum, Alstonia scholaris, Eugenia grandis, Cotylelobium lanceolatum, Cinnamomum iners, Careya sphaerica and Bhesa robusta grown in Thung Khai Botanical Garden, Trang Province. It was found that the Alstonia scholaris area had higher temperature and elements in the soil than other tree areas. It has a lower light intensity in the air, results in more growth to a higher height and circumference than Alstonia scholaris, so it can store the most carbon storage in the total biomass and the amount of greenhouse gases.

Suggestion

1. Conduct further studies of other dominant tree species.
2. Conduct a study on how to calculate carbon sequestration from all parts of the tree.

Citations

Chakrit N. (2021). *Evaluate tree carbon sequestration*. Retrieved on December 18th, 2023. From https://eng.forest.ku.ac.th/project/carbon/

The Institute for the Promotion of Teaching Science and Technology. (2020). *Measurement of organisms and soil cover.* Retrieved on December 18th, 2023. From https://globefamily.ipst.ac.th/home/globe-channel/globe-protocols/

The Institute for the Promotion of Teaching Science and Technology. (2020). *Air measurement.* Retrieved on December 25th, 2023. From https://globefamily.ipst.ac.th/globe-protocols/atmosphere

nukkpidet. (2020). *Southern Botanical Garden Thung Khai Trang Attractions*. Retrieved on December 25th, 2023. From https://travel.trueid.net/detail/X6BKDGbY7qLo

Optional Badge

I am a Collaborator

Our team consists of 2 members. We work together every step of the way. From planning, surveying, collecting data, analyzing, making reports on the following topics: Abstract, Research Question and Hypothesis, Introduction and Review of Literature, Research Methods and Materials, Results, Discussion and Conclusion until this research was successfully completed.

I make an Impact

Currently, Thailand and some countries in the world are experiencing the problem of global warming or the greenhouse effect. Therefore, we study the amount of carbon storage of tree species that will help reduce global warming by studying soil quality, air quality and the growth of trees.

I am a Problem Solver

From this research study this allows us to know that trees store a very high amount of carbon. Which helps reduce global warming that is currently occurring. We therefore spread knowledge to people and help conserve existing trees.