

Research Title: Study water, soil and air quality that effects density of *Caulerpa corynephora* in mangrove forest Ban Khok Ok, Trang.

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Abstract

The study of water, soil, and air quality that effects the density of *Caulerpa corynephora* in the Khok Ok Mangrove Forest area, Hat Samran District, Trang Province. The objectives are as follows: 1. to study the water quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran district, Trang province. 2. to study the soil quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang province. 3. to study the air quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran district, Trang province. 4. to study the growth of *Caulerpa corynephora* cultivated under controlled water quality conditions close to natural water in the Khok Ok area. By studying the quality of water, soil, air and the growth of *Caulerpa corynephora* from cultivation. From the study of soil quality, water quality and air quality in both areas is based on the hypothesis that the quality of water, soil and air affect the density of *Caulerpa corynephora* in the Khok Ok mangrove forest, Hat Samran District, Trang Province and *Caulerpa corynephora* grown by controlling the water quality to be close to nature will grow well. It was found that the area with the mixed mangrove forests had more minerals in the soil. The transparency value, the nitrate content and the oxygen content in the water are higher. And the higher light intensity of the air results in a higher density of *Caulerpa corynephora*. And from an experiment in raising *Caulerpa corynephora* using seawater from the Khok Ok mangrove forest, areas where more *Caulerpa corynephora* were found to grow most rapidly in the second week of cultivation.

Keywords: mangrove forest, *Caulerpa corynephora*, water quality, soil quality, air quality

Research Question

1. Does water quality affect the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province?
2. Does soil quality affect the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province?
3. Does air quality affect the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province?
4. Will *Caulerpa corynephora* thrive when cultivated with controlled water quality similar to natural water in the Khok Ok area?

Research Hypothesis

1. Water quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest. Hat Samran District, Trang Province.
2. Soil quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest. Hat Samran District, Trang Province.
3. Air quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest. Hat Samran District, Trang Province.
4. *Caulerpa corynephora* grown by controlling the water quality to be similar to the natural water of Ban Khok Ok will grow well.

Introduction and Review of Literature:

Trang is a province with coastal areas where the majority of residents are engaged in fishing-related occupations, including fishing, collecting and selling seaweed, and processing seafood products. Ban Khok Ok, Hat Samran district, Trang province is one of the community enterprises that promotes eco-tourism in the mangrove forest area and engages in the collection and sale of *Caulerpa corynephora*. This type of algae can be found in abundance in the Ban Khok Ok community that its branches are erected and shaped like feathers. It consists of cylindrical branches that are raised and have pointed tips while the base of the branch is not concave. It can be found on rocky shores, boulders, and sandy bottoms in areas with calm to moderate waves at the lowest tide levels along the coast. *Caulerpa corynephora* have antioxidant properties and contain various vitamins, iodine, and amino acids that are not found in terrestrial plants. Additionally, they can help prevent cancer and provide a wide range of vitamins and minerals that the body needs. In addition, *Caulerpa corynephora* can be used to make cosmetics. They are a type of algae that releases oxygen into the air, absorbs organic matter and minerals in the water for growth, serving as a food source and shelter. Furthermore, they help reduce global warming by absorbing carbon dioxide in the water and converting it into limestone, which accumulates on the stems and leaves. With the many benefits of *Caulerpa corynephora*, they help create jobs and supplement income for villagers in the community of Ban Khok Ok, Hat Samran district, Trang province.

The research team studied the factors influencing the growth of *Caulerpa corynephora* by investigating water quality, soil quality, air quality, and cultivating *Caulerpa corynephora* while controlling water and air quality to be similar to the natural water source in Ban Khok Ok, Hat Samran district. Then, they examined the growth of *Caulerpa corynephora* from cultivation and from natural water sources.

Research Methods and Materials

Related variables

Hypothesis 1. Water quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest. Hat Samran District, Trang Province.

Independent variable: Quality of water in the mangrove forest area.

Dependent variable : Density of *Caulerpa corynephora*.

Control variables : size of the study area, date of survey, instruments used in the survey.

Hypothesis 2. Soil quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest. Hat Samran District, Trang Province.

Independent variable: Quality of soil in the mangrove forest area.

Dependent variable : Density of *Caulerpa corynephora*.

Control variables : size of the study area, date of survey, instruments used in the survey.

Hypothesis 3. Air quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest. Hat Samran District, Trang Province.

Independent variable: Quality of air in the mangrove forest area.

Dependent variable : Density of *Caulerpa corynephora*.

Control variables : size of the study area, date of survey, instruments used in the survey.

Hypothesis 4. *Caulerpa corynephora* grown by controlling the water quality to be similar to the natural water of Ban Khok Ok will grow well.

Independent variable : Water quality for *Caulerpa corynephora* cultivation.

Dependent variable : weight of *Caulerpa corynephora*.

Control variables : size of the study area, date of survey, instruments used in the survey.

Materials

- | | |
|---------------------------|---|
| 1. Thermometer | 12. Beaker |
| 2. Quick Soil Test | 13. Erlenmeyer flask |
| 3. Secchi Disk | 14. Stirring Rod |
| 4. Plankton net | 15. Petri Dish |
| 5. Salinity Refractometer | 16. Filter paper |
| 6. Conductivity Meter | 17. CU Smart Lens |
| 7. Plant Color Guide | 18. Google Maps |
| 8. Universal Indicator | 19. Weighing Scale |
| 9. Soil moisture meter | 20. Wire mesh grid |
| 10. Digital hygrometer | 21. <i>Caulerpa corynephora</i> cultivation |

Methods

GLOBE Protocols

Hydrosphere water measurement methods

Pedosphere (soil) soil measurement methods

Atmosphere atmospheric measurement methods

Determine the study location

The mixed mangrove forests and the majority of the mangrove forests are mangroves.



Picture 1 Study area 1, the mixed mangrove forests.



Picture 2 Study area 2, the majority of the mangrove forests are mangroves.

Part 1: To study water quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province.

1.1 Measure the acidity and base values of the water in the mixed mangrove forests and the majority of the mangrove forests are mangroves. Measuring acidity-base values with universal indicator paper. Swish the container with water from the natural waters of the study area 2 times, add 10 milliliters of water and dip a piece of universal indicator paper into it. Compare the color of the paper with the color strip used in the measurement. Measurements were performed 3 times in total.

1.2 Measure the temperature of the water with a thermometer by immersing the thermometer in the water in the study area for approximately 3 - 5 minutes. Read the thermometer value. Immerse the thermometer for another minute for the second and third measurements and read. Record the results.

1.3 Measure the amount of dissolved oxygen in the water in the mixed mangrove forests and the majority of the mangrove forests are mangroves. By washing the water storage bottle with water. The study area 3 times first, then open the cap and drop 2 drops of solution 1, then drop 2 drops of solution 2, then close the cap and shake until a yellow precipitate forms, wait for the sediment to fall to half, then open the cap and drop 5 drops of solution 3 and shake. Mix together until the sediment is completely dissolved. Pour 5 mL of water into a new test tube. Add solution number 4 one drop at a time. Count the number of drops used and see the color of the water that it was faded yellow. Then add 2 drops of solution number 5 and it will turn blue, then drop in solution number 4 and count the number of drops until the water becomes colorless. Then read the value.

1.4 Measure the transparency of the water with the secchi disk by slowly lowering the secchi disk into the water. Until the point where white and black on the secchi disk cannot be seen. Mark the rope at the surface of the water, then slowly pull the rope up. Until the alternating white and black colors are visible on the secchi disk measuring the secchi disk again. Then make a mark on the rope at the surface of the water again. Record the distance between the two measured points. The experiment was repeated 3 times.

1.5 Measure the salinity of water by collecting water samples from the study site and dropping them onto a salinity refractometer. Read the salinity value, record the results and repeat the experiment 3 times.

1.6 Measure the electrical conductivity of water. By pouring water samples into 2 beakers, rinsing the Conductivity meter's electrodes with distilled water, patting it dry, immersing the Conductivity meter into the first beaker to wash the electrodes, lifting the Conductivity meter up from the first beaker. Transfer to the second beaker. Gently stir the second beaker. Wait until the conductivity on the Conductivity meter stabilizes. Record the standard value of the Conductivity meter. Repeat the measurement 3 times.

1.7 Measure Nitrate in water by collecting water samples from the study site, adding substance 1 to change NO_3^- to NO_2^- , then adding substance 2 to react with NO_2^- to change the color of the solution, reading the nitrate amount. By comparing the test colors from the color comparison sheet included in the test kit. Repeat the measurement 3 times.

Part 2: To study soil quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province.

2.1 Determine the sampling point in the Khok Ok mangrove forest area, Hat Samran District, Trang Province, 2 areas. Both areas are community feather seaweed collection areas. Area 1 has a variety of mangrove plants. As for the second area, it is a mangrove forest plant area with mangroves as the main plant species. A total of 6 soil samples were collected.

2.2 Study the physical characteristics of the soil by studying soil structure, soil texture and color by comparing with soil charts.

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

2.4 Measure soil moisture at every point. By using a soil moisture meter at a depth of 5 centimeters to read soil moisture values, collecting data 3 times.

2.5 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 and soak for about 30 seconds, then compare the color with the standard value on the side of the box.

2.6 Measure the amount of Nitrogen, Phosphorus, and Potassium in the soil. The soil that was collected was dissolved in distilled water with the ratio of soil: water being 1:5. Then the dissolved soil was dissolved in water and filter it with filter paper. Then have it checked with a Nitrogen, Phosphorus and Potassium testing kit by comparing standard values and record the value.

Part 3: To study air quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province.

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

3.2 Measure light intensity in the air using a lux meter.

Part 4: Measures the density of *Caulerpa corynephora*.

Designate a study area around the mangrove forest area by waiting for low tide. Use a wire mesh grid size 50 x 50 centimeters placed on the study area. Collect *Caulerpa corynephora*, weighed and recorded the results.

Part 5: To study the growth of *Caulerpa corynephora* that is cultivated by controlling the water quality to be similar to the natural water of Ban Khok Ok. Hat Samran District, Trang Province.

5.1 Prepare 3 experimental of 100 centimeters diameter basins, add seawater from the Khok Ok mangrove forest for the cultivation of *Caulerpa corynephora*.

5.2 Measure the acidity, base, temperature, oxygen, salinity and electrical conductivity of the seawater within the 3 experimental basins to be similar to natural seawater.

5.3 Weigh 100 grams of *Caulerpa corynephora* and place it in 3 experimental cultivation basins. Observe and weigh the *Caulerpa corynephora* every 1 week until 4 weeks. Record the *Caulerpa corynephora* growth results.

Results:

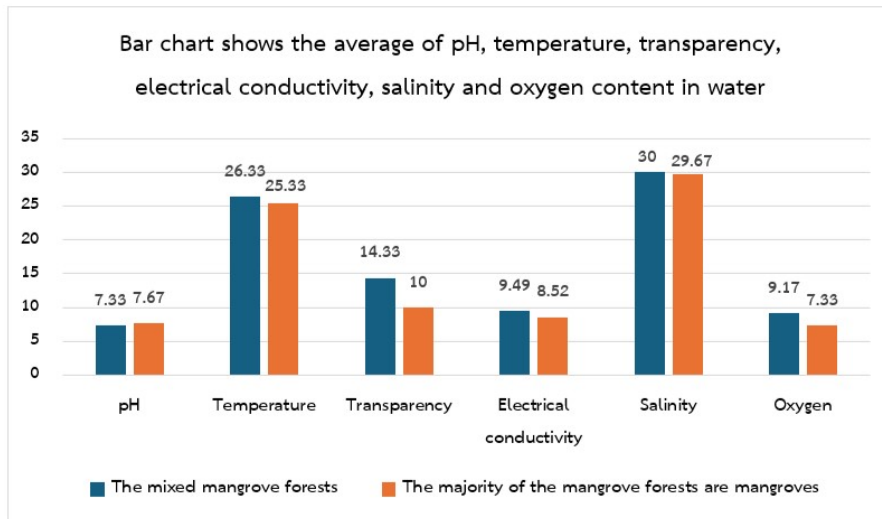
Study of water quality, soil quality, and air quality that affect the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province has the following results as follows:

Geographic coordinates

Table 1 shows the geographic coordinates.

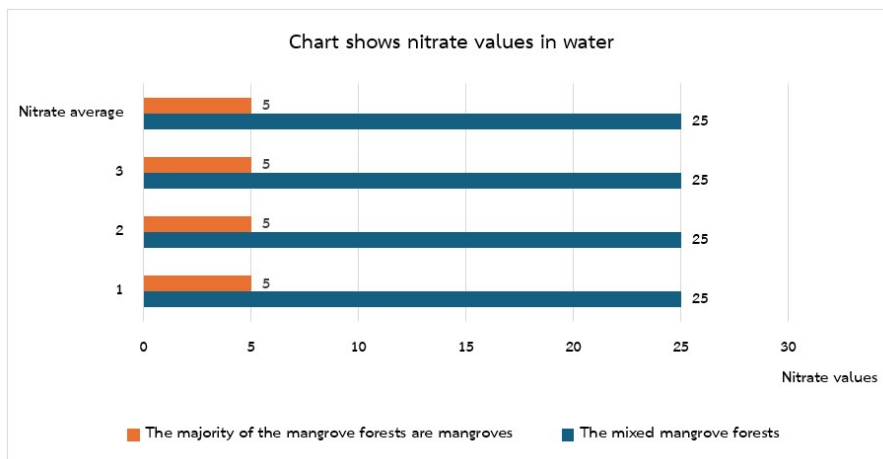
Area	Geographic coordinates	
	Latitude(N)	Longitude(E)
The mixed mangrove forests	7.2198430	99.5940921
The majority of the mangrove forests are mangroves	7.2120181	99.6009873

Part 1: To study water quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province.



Picture 3 Bar chart shows the average of pH, temperature, transparency, electrical conductivity, salinity and oxygen content in water.

From bar chart shows pH, Temperature, Transparency, Electrical conductivity, Salinity and average Oxygen content in water that was found that pH, Temperature, Electrical conductivity and Salinity values of both areas are similar. As for the transparency and oxygen content in the water found in the mixed mangrove forests values that were higher than in the majority of the mangrove forests are mangroves.





Picture 4 Chart shows nitrate values in water.

From Chart shows nitrate values in water, that was found that in the mixed mangrove forests has a higher nitrate value than the majority of the mangrove forests are mangroves.

Part 2: To study soil quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province.

Table 2 shows soil structure, soil cohesion, soil color and soil texture in the Khok Ok mangrove forest area.

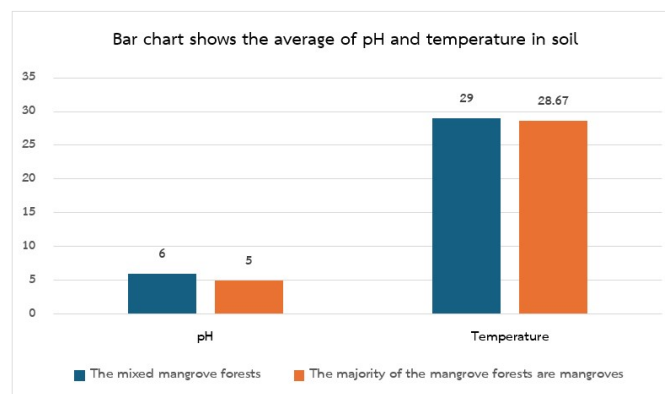
Mangrove forest area	Picture of soil structure	Soil color	Soil cohesion	soil texture
The mixed mangrove forests		7.5YR 2.5/1 Black	Tight soil adhesion	Clay loam
The majority of the mangrove forests are mangroves		7.5YR 2.5/2 V. Dark Brown	Tight soil adhesion	Silty clay

From table 2 shows soil structure, soil cohesion, soil color and soil texture in the Khok Ok mangrove forest area that was found that the mixed mangrove forests have tight soil adhesion, the soil texture is a clay loam type and the color of the soil is 7.5YR 2.5/1Black. The majority of the mangrove forests are mangroves have tight soil adhesion, the soil texture is a silty clay type and the color of the soil is 7.5YR 2.5/2 V. Dark Brown.

Table 3 shows the soil fertility of each zone in the Khok Ok mangrove forest area

Mangrove forest area	Soil fertility		
	Nitrogen	Phosphorus	Potassium
The mixed mangrove forests	Little	Medium	Medium
The majority of the mangrove forests are mangroves	Little	Little	Little

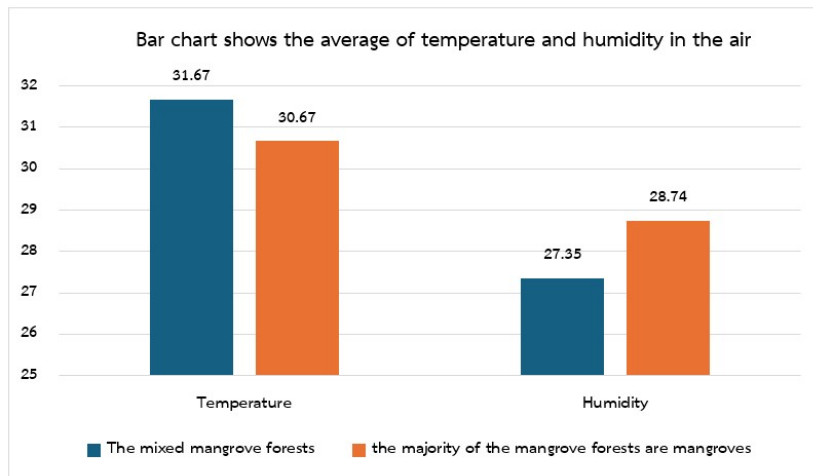
From table 3 shows the soil fertility of each zone in the Khok Ok mangrove forest area that was found that the mixed mangrove forests are more fertile than the majority of the mangrove forests are mangroves. The mixed mangrove forests have little nitrogen and have moderate levels of phosphorus and potassium. The majority of the mangrove forests are mangroves have little nitrogen, phosphorus and potassium.



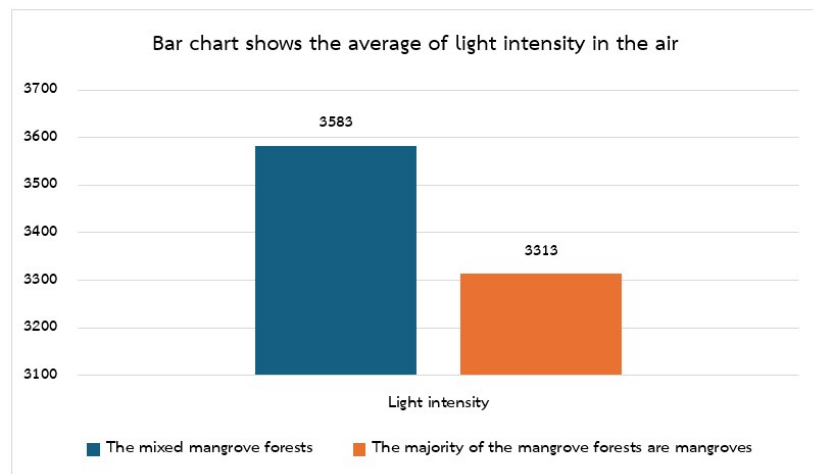
Picture 5 Bar chart shows the average of pH and temperature in soil.

From bar chart shows the average pH and temperature in soil that was found that the temperature of both areas was Similar places However, the mixed mangrove forests are more acidic than the majority of the mangrove forests are mangroves. The mixed mangrove forests have a pH value = 5 and the majority of the mangrove forests are mangroves have a pH value = 6.

Part 3: To study air quality affects the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province.



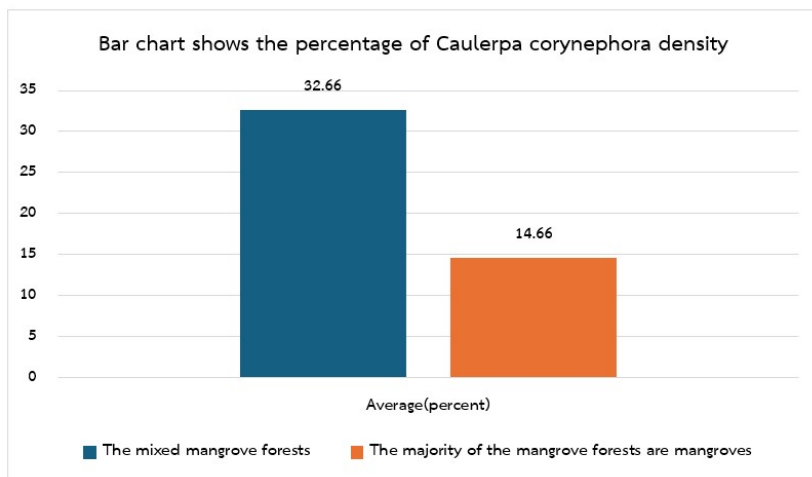
Picture 6 Bar chart shows the average of temperature, humidity in the air.



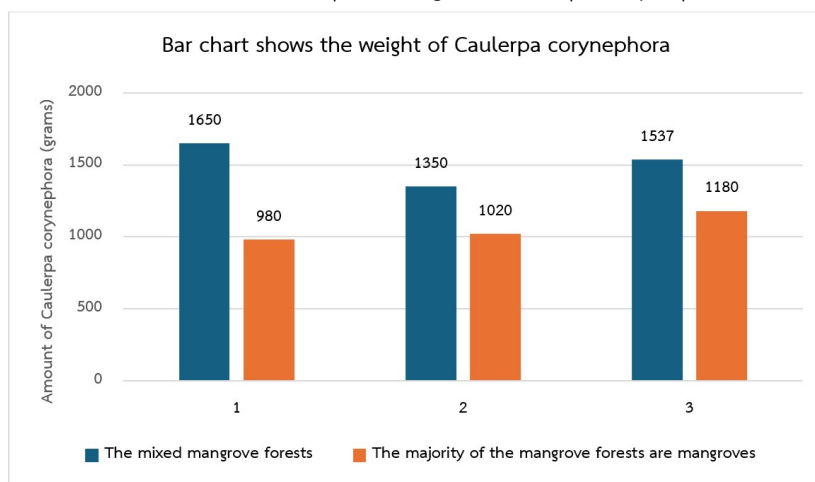
Picture 7 Bar chart shows the average of light intensity in the air.

From bar chart shows the average of temperature, humidity, and light intensity in the air that was found that both areas had similar temperature and humidity values. But in the mixed mangrove forests, the light intensity was higher than in the majority of the mangrove forests are mangroves.

Part 4: Measures the appearance and density of *Caulerpa corynephora*.



Picture 8 Bar chart shows the percentage of *Caulerpa corynephora* density.



Picture 9 Bar chart shows the weight of *Caulerpa corynephora*.

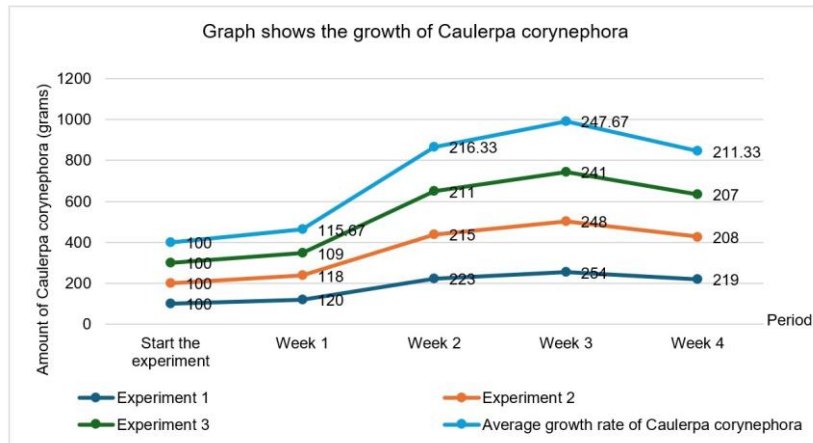
From bar chart shows the percentage of *Caulerpa corynephora* density and the weight of *Caulerpa corynephora* that was found that *Caulerpa corynephora* in the mixed mangrove forests were dense than the majority of the mangrove forests are mangroves.

Table 4 shows the color of *Caulerpa corynephora* in the Khok Ok mangrove forest.

Mangrove forest area	Color of <i>Caulerpa corynephora</i>		
	1	2	3
The mixed mangrove forests	5GY5/10 Green	5GY5/10 Green	5GY5/10 Green
The majority of the mangrove forests are mangroves	5GY6/10 Light green	5GY6/10 Light green	5GY6/10 Light green

From table 4 shows the color of *Caulerpa corynephora* in the Khok Ok mangrove forest that was found that the mixed mangrove forests have a darker color of *Caulerpa corynephora* than the majority of the mangrove forests are mangroves. The mixed mangrove forests have green *Caulerpa corynephora* color 5GY5/10. The majority of the mangrove forests are mangroves have light green *Caulerpa corynephora* color 5GY6/10.

Part 5: To study the growth of *Caulerpa corynephora* that is cultivated by controlling the water quality to be similar to the natural water of Ban Khok Ok. Hat Samran District, Trang Province.



Picture 10 Graph shows the growth of *Caulerpa corynephora*.

From graph shows the growth of *Caulerpa corynephora* that was found that *Caulerpa corynephora* in all 3 experimental sets showed the same growth trend. During the first week, the *Caulerpa corynephora* will gradually adapt and grow slowly. In the 2nd week, the *Caulerpa corynephora* will grow rapidly and gradually decrease during the 3rd week. And during the 4th week, the *Caulerpa corynephora* will begin to decompose.

Discussion:

The study of water quality, soil quality, and air quality affecting the density of *Caulerpa corynephora* in the Khok Ok mangrove forest area, Hat Samran District, Trang Province, can be discussed as follows

Part 1: From the study, it was found that the pH value, temperature, transparency, electrical conductivity, salinity, and average oxygen content in the water were examined. It was found that the pH value, temperature, electrical conductivity, and salinity in both areas were similar. However, the turbidity and oxygen content in the water in the mixed mangrove forests and value area were higher than those in the majority of the mangrove forests are mangroves. As for the nitrate level in the water, it was found that the mixed mangrove forests had a higher nitrate level in the water than the majority of the mangrove forests are mangroves.

Part 2: From the study of soil structure, soil aggregation, soil color, and soil texture, it was found that the mixed mangrove forests had dense soil aggregation. clay loam, and the soil color was black. 7.5YR2.5/1Black. In the majority of the mangrove forests are mangroves, the soil has dense aggregation, silty clay, and the soil color is dark brown. 7.5YR2.5/2 V.Dark Brown The temperature of the soil in both areas is nearby values, but the mixed mangrove forests is more acidic than the majority of the mangrove forests are mangroves. In the mixed mangrove forests, the pH value is 5, while in the majority of the mangrove forests are mangroves, the pH value is 6. Part 3: From the bar graph shows temperature, humidity, and average light intensity in the air, it was found that both areas have similar temperature and humidity values. However, in the mixed mangrove forests, the average light intensity is higher than in the majority of the mangrove forests are mangroves.

Part 4: From the density study was found that the density and weight of the *Caulerpa corynephora* were higher the mixed mangrove forests than the majority of the mangrove forests are mangroves.

Part 5: From the study of the growth of *Caulerpa corynephora* cultivated under controlled water quality conditions similar to natural water in Khok Ok Village, Hat Samran District, Trang Province, it was

found that during the first week, the ferns gradually adapted and grew slowly. In the second week, the ferns exhibited rapid growth, which gradually decreased in the third week. By the fourth week, the ferns began to decompose.

Conclusion:

From the study of soil quality, water quality and air quality in both areas is based on the hypothesis that the quality of water, soil and air affect the density of *Caulerpa corynephora* in the Khok Ok mangrove forest, Hat Samran District, Trang Province and *Caulerpa corynephora* grown by controlling the water quality to be close to nature will grow well. It was found that the area with the mixed mangrove forests had more minerals in the soil. The transparency value, the nitrate content and the oxygen content in the water are higher. And the higher light intensity of the air results in a higher density of *Caulerpa corynephora*. And from an experiment in raising *Caulerpa corynephora* using seawater from the Khok Ok mangrove forest, areas where more *Caulerpa corynephora* were found to grow most rapidly in the second week of cultivation.

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OPTIONAL BADGES

I AM A COLLABORATOR

Our group has 2 members. We work as a group at all stages, planning, surveying, collecting data, analyzing and reporting on the following topics: Abstract, Introduction, Research Objectives, Research Questions, Research Hypotheses, Materials Methods, Results and Discussion, and this Conclusion was accomplished.

I MAKE AN IMPACT

Ban Khok Ok, Hat Samran District, Trang Province is one of the community enterprises that promotes eco-tourism in the mangrove forest area and engages in the collection and sale of *Caulerpa corynephora*. This type of algae can be found in abundance in the Ban Koak Out community, From the differences in the mangrove ecosystem: in the mixed mangrove forests and the majority of the mangrove forests are mangroves. Therefore, we need to study the water quality, soil quality, and air quality that affected the density of the *Caulerpa corynephora* and cultivated it to study its growth, while controlling the water quality to be close to the natural water of the Khok Ok, Hat Samran District, Trang Province.

I AM A DATA SCIENTIST

From the study of water quality, we have examined the pH, temperature, transparency, electrical conductivity, salinity, oxygen content, and amount of nitrate in the water. The study of soil quality has examined soil structure, soil color, soil texture, mineral content, pH, and temperature in the soil. The study of air quality has examined the humidity, light intensity, and temperature in the air, which affect the density and weight of the *Caulerpa corynephora* and cultivate it while controlling the water quality to be close to the natural water of the Khok Ok, Hat Samran District, Trang Province to study its growth, to study growth patterns, as shown in the average data presented in the table, chart, and graph.