

**Research Name:** The quality of water and soil that affect the carbon storage of the Tenera palm, Napla Subdistrict, Mueang District, Trang Province.

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**School:** Wichienmatu School

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### **Abstract**

The study aims to study the effect of water quality and soil quality on carbon storage of Tenera palm oil in Napla Subdistrict, Mueang District, Trang Province. By comparing areas with  $10 \times 10$  meters of water storage in each area, analysis of soil quality factors such as humidity, pH and main nutrient content (N, P, K) Includes estimates of carbon retention in oil palm trees.

The results showed higher moisture content in soil, pH and nutrients (N, P, K) than in waterless areas. The average moisture content in soil and waterless areas was 1.83% and 1.32%, pH in soil and 6.83%, and 6.83%, respectively. 60 In addition, the average N, P, K nutrients in the soil with water sources were 7.83 mg/L, 7.50 mg/L, 29.97 mg/L respectively, higher than the average 4.11 mg/L, 3.72 mg/L, 11.44 mg/L respectively. In terms of carbon retention, oil palm trees in areas with water sources averaged 756 KgCO<sub>2</sub>eq, higher than 632 KgCO<sub>2</sub>eq, showing that water and soil quality, especially moisture and nutrient content, are directly related to the carbon retention capacity of Tenera palm trees.

**Keywords:** Water quality, Soil quality, Carbon storage volume

## **Introduction**

Thailand is one of the countries where Tenera palm is widely cultivated, especially in the southern region where climate and terrain are suitable. Tenera palm is not only an economic plant for generating income for the country but also plays a role in carbon storage in soil and wood. This reduces the amount of carbon dioxide in the atmosphere that is the main cause of global warming. A comparison study of carbon storage in Tenera palm trees in areas with and without water sources will help understand the impact of water on plant carbon storage. In addition, it will also enhance the efficiency of oil palm cultivation in order to achieve sustainable carbon retention.

The project examines the relationship between water and soil quality with the carbon storage capacity of Tenera palm trees by comparing the carbon storage volume of palm trees in water-based and palm trees in water-free areas to understand the role of environmental factors that affect carbon storage. It also proposed ways to grow oil palm to be efficient in carbon storage, such as selecting suitable soil and water quality areas, improving soil, which will help promote sustainable oil palm cultivation, reduce environmental impact, and increase carbon absorption capacity in agricultural ecosystems.

### **The objectives of the research**

1. To study how water quality affects the carbon sequestration capacity of Tenera oil palm in Napla Subdistrict, Mueang District, Trang Province.
2. To study how soil quality affects the carbon sequestration capacity of Tenera oil palm in Napla Subdistrict, Mueang District, Trang Province.

### **Research questions**

1. Does the area with water sources affect the carbon retention of the Tenera palm better than the area without water sources?
2. Does the quality of soil affect the carbon footprint of the Tenera palm?

## **Research hypotheses**

1. Water quality affects the carbon sequestration capacity of Tenera oil palm.
2. Soil quality affects the carbon sequestration capacity of Tenera oil palm.

## **Materials and equipment and research methodology**

- |                     |                    |
|---------------------|--------------------|
| 1. Flask            | 9. Balance Scale   |
| 2. pH paper         | 10. Spatula        |
| 3. Foil Paper       | 11. Filter Funnel  |
| 4. Beaker           | 12. Moisture Meter |
| 5. Glass Rod        | 13. Thermometer    |
| 6. Distilled Water  | 14. Clinometer     |
| 7. Filter Paper     | 15. NPK Test Kit   |
| 8. Dropping Pipette |                    |

The GLOBE Measurement Protocols

Soil Measurement Protocols (Pedosphere)

Soil Cover Measurement Protocols (Biosphere)

## **Study Area Determination**

To examine carbon sequestration in Tenera oil palm trees within the Napla Subdistrict, Mueang District, Trang Province, the study is divided into two areas: one with a water source and one without a water source. Each study area covers 3 rai of land, and a sample plot of 10 × 10 meters has been designated for data collection in each area. Additionally, soil samples were randomly collected by digging 20 cm deep at 24 points per area for analysis of soil composition that may affect the carbon sequestration of the oil palm trees.

## **Research methodology**

### **1. Research Preparation Phase**

1.) Study carbon storage in two nearby cultivated areas of Tenera palm species using a sample area of  $10 \times 10$  meters in Napla Subdistrict, Mueang District, Trang Province.

Some properties of soil in palm orchards are sampled at a depth of 20 centimeters, 12 points in total, 2 areas with and without water sources to analyze soil particles, N, P, K, acidity and moisture content within the soil.

2.) Study, research, collect knowledge and theories related to work.

- Principles of Soil Temperature Measurement
- Principle of determination of NPK values in soil
- the principle of measuring air temperature
- Principles of soil moisture measurement
- Principles of soil pH monitoring
- the carbonation of a palm tree
- Estimation principle of carbon retention of palm trees
- The process of carbon exchange in the ecosystem
- Estimation principle of carbon retention of palm trees
- Related Documents and Research

3.) Establish the purpose of education

1. To compare the carbon footprint of the Tenera palm.
2. To compare the physical and chemical soil quality of the Tenera palm tree.

4.) Determine the sampling point in the area to be studied.

Collect soil samples in a 10-year-old palm garden near the area where the water source is located and where there is no water source. Randomly collect each area in  $10 \times 10$  meters, depth 20 centimeters, 12 points each.

### **2. a process of proceeding**

Physical soil quality study

1) Measurement of soil temperature

- 1.1 Use a shovel to dig about 20 centimeters deep.

1.2 Take the thermometer for measuring the temperature at a depth of 20 centimeters by putting it into a trench of soil prepared. Wait 1 minute to keep the temperature value still. Read the first soil temperature value recorded on the data sheet.

1.3 Read the earth temperature 2 more times, waiting for only 1 minute at a time to read the value.

1.4 If the three readings differ by not more than 1 degree Celsius, it is considered acceptable. Then record the value.

## 2.) Measurement of moisture content in soil

2.1 Use a shovel to dig about 20 centimeters deep.

2.2 Take the soil moisture meter for measuring soil temperature at a depth of 20 centimeters by inserting it into the prepared soil groove. Wait 1 minute to read the temperature value.

## 3) Preparation of soil samples

3.1 Designate a soil sampling point.

3.2 Take a total of 12 soil samples at a depth of 20 centimeters, 2 areas in total.

3.3 Collect soil samples in a designated area along the plane, and use a shovel to dig the soil to a depth of about 20 centimeters.

3.4 Put the soil in a jar. Close the lid tightly.

## 4) Measurement of soil fertility

4.1 Weigh 20 grams of soil

4.2 Take 10mL of distilled water.

4.3 Dissolve the collected soil with distilled water with a soil and water ratio of 2:1.

4.4 Check with a nitrogen, phosphorus and potassium monitoring kit, and compare them with the standard values, and record the values.

## 5.) Acid-base measurement

5.1 Take 20g of collected soil and dissolve it with 20mL of distilled water.

5.2 Apply water-soluble soil to filter by filter paper.

5.3 Set aside for settling

5.4 Use Universal Indicator paper, dip it in a solution, and soak it for about 30 seconds.

5.5 Compare the obtained color with the standard value next to the box.

### Analysis and summary of research results

1. analyze and compare the relationship using the statistics used in the data analysis, including soil temperature, soil pH average, soil humidity average, nitrogen, phosphorus average, and potassium in soil.
2. Graph a mean comparative data

### Research Results

**Geographical coordinates** Study the area of the Tenera palm tree, Na Phi Subdistrict, Mueang District, Trang Province. The coordinates are as shown in Table 1.

**Table 1** Geographical coordinates

Zone	Geographical coordinates	
	Latitude (N)	Longitude (E)
Tenera palm, Watery area.	7.601973	99.668772
Tenera palm, Waterless area.	7.6027675	99.6687620

Zone	Geographical coordinates
Tenera palm, Watery area.	
Tenera palm, Waterless area.	

## 2. Measurement of soil quality

**Table 2** The soil structure of the Tenera palm at Napla Subdistrict, Mueang District, Trang Province, areas with water sources and areas without water sources.

Area	Measured value		
	Adhesion	Soil color	Soil texture.
Watery area	Tighter	7.5 YR 3/3	Silty clay loam
Waterless area	Tighter	7.5 YR 2.5/3	Silty clay loam

According to Table 2, soil adhesion characteristics at a depth of 20 cm were found. It is located in the area with a water source. It has the same adhesion characteristics: tight, soil color has the same value of 7.5YR 3/3 and soil adhesion characteristics at a depth of 20 cm. It is in an area where there is no water source. It has the same characteristics as tight. The soil color has the same value of 7.5 YR 2.5/3.

**Table 3** compares the mean, humidity, pH temperature of the area with the water source and the area without the water source.

Area	Average moisture values (%)	Average temperature values (° C)	Average pH values	Average N P K values (mg/L)		
				N	P	K
Watery area	1.83	25.58	6.83	7.83	7.50	29.97
Waterless area.	1.32	26.39	6.60	4.11	3.72	11.44

Table 3 shows the mean soil moisture, the mean soil temperature, the pH of soil, and the average soil temperature. The NPK of soil in each area was found to have the following values:

3.1) The area with water sources has an average soil humidity of 1.83% with an average soil temperature of 25.58%, a pH of 6.83%, an NPK average of 7.83 mg/L, 7.50 mg/L, 29.97 mg/L, respectively.

3.2) Areas without water sources have an average soil humidity of 1.32% with an average soil temperature of 26.39% with a pH of 6.60 with an NPK average of 4.11 mg/L 3.72 mg/L 11.44 mg/L, respectively.3.2) Areas without water sources have an average soil humidity of 1.32% with an average soil temperature of 26.39% with a pH of 6.60 with an NPK average of 4.11 mg/L 3.72 mg/L 11.44 mg/L, respectively.

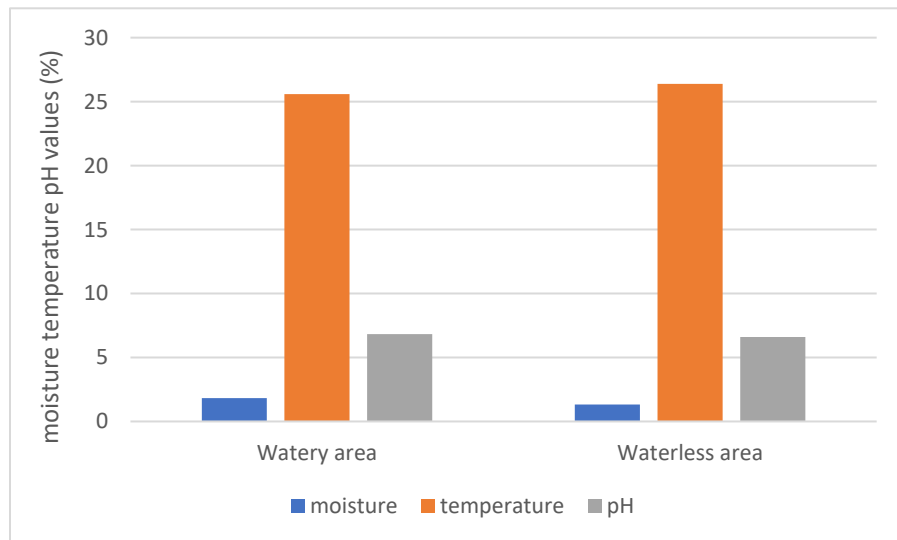


Chart 1 Comparison moisture values of Tenera palm Watery area and Waterless area

shows a comparison from bar chart 1 where the average soil moisture content in each area was found to have the following values:

1.1 The area with water has an average humidity of 1.83% with an average temperature of 25.58 and a pH of 6.83.

1.2 The area without water has an average humidity of 1.32%, a temperature average of 26.39 and a pH average of 6.60.



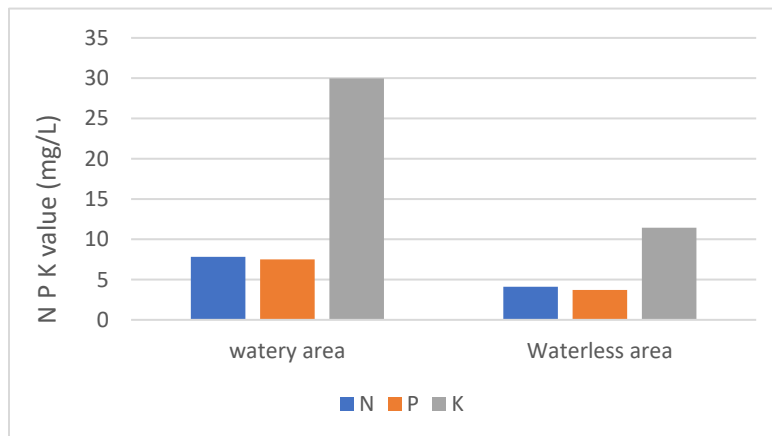


Chart 2 Comparison temperature values of Tenera palm Watery area and Waterless area

From the 2nd bar chart graph showing the comparison of NPK values in soil in each area, it was found to have the following values: The average NPK was 7.83 mg/L 7.50 mg/L 29.97 mg/L, respectively, and the average NPK was 4.11 mg/L 3.72 mg/L 11.44 mg/L, respectively.

**Table 4** compares the carbon footprint of areas with water sources and areas without water sources.

Area	Carbon sequestration per rai ( KgCO <sub>2</sub> eq / Rai )	Total biomass per rai ( Kg / Rai )	The carbon dioxide absorption capacity of perennial trees ( KgC / Rai )
Watery area	756	124.94	51.61
Waterless area.	623	104.40	43.12

Table 4 shows the average carbon retention for each area. It was found to have the following values:

The average carbon footprint of the water area was 756 KgCO<sub>2</sub>eq and the average carbon footprint was 623 KgCO<sub>2</sub>eq, the average total carbon footprint was 124.94 kg, and the average total carbon footprint was 104.40 kg. The average carbon footprint was 51. 61 kgC and non-aqueous area,the average carbon content is 43.12 kgC.

## **Summary and discussion of experimental results**

Based on the study of carbon retention in Tenera palm trees, the comparison between areas near or far from water sources has improved carbon retention efficiency, which is for both purposes:

1) To study the effect of water quality on carbon storage of Tenera palm, Napla Subdistrict, Mueang District, Trang Province. The results showed that the average carbon storage area was 756 KgCO<sub>2</sub>eq and the average carbon storage area was 632 KgCO<sub>2</sub>eq. This is consistent with the objective because the area where the water source is located affects the amount of carbon storage, resulting in higher carbon retention than the area without water source.

2. ) to study the quality of soil affecting the carbon retention of Tenera palm, Napla Subdistrict, Mueang District, Trang Province. The survey was conducted on the basis that soil in the area has higher mineral value than soil in the area. The analysis results were as follows: The area with water sources averaged 756 KgCO<sub>2</sub>eq and the area without water, the average carbon storage at 632 biosphere above total ground was 74.04 kg, the area with total biological mass was 124.94 kg, and the area without total biological mass was 104.40 kg The average carbon content of water is 51.61 kgC and the average carbon content of non-aqueous area is 43.12 kgC.

### **Acknowledgements**

The research "Water and soil quality that affects carbon retention of Tenera palm in Napla Subdistrict, Mueang District, Trang Province" was successfully completed with support from the Wichienmatu School Special Classroom Department. I would like to express my appreciation to the Wichienmatu School Director for the importance of research. And promote the development of students' potential in the academic field.

I would like to thank my advisor, Mr. Jiraporn Sirirat, who gave us useful advice and opinions throughout the project and gave us knowledge on the process of carbonation assessment and exchange of trees. That supports and approves the budget for the implementation of this research project.

Thanks to Wichienmatu School for its support in experimental equipment and facilities, and to all of its friends and related parties for their assistance and consultation throughout the field collection process.

Finally, I would like to thank all the researchers for their cooperation in this study, their knowledge, their ability, and their determination.

Project Team

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### **Reference Document**

Somsak Sukwong and colleagues (March 2016) Measurement of the carbon storage volume of trees in the Nondanale landscape [online]

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

Rungphet Panyawut, Urairat Kanchanakundee, Sophiraya Thongmak and Kravatkit assess the biological mass and carbon storage of trees in the Plant Genetic Conservation Center area, P.O. OBEC - Khlong Phai, Nakhon Ratchasima Province [online]

<file:///C:/Users/HP/Downloads/25695-Article%20Text-73022-1-10-20220914.pdf>

Yupayao Tokiri, Chuanpit Charat, Taeng Nova Sheikh and Nong Nuchasaraphi, Faculty of Science and Technology, Surin Rajabhat University's Faculty of Science and Technology, Surin Rajabhat University's Research Report on Carbon Storage in the Biosphere of Ban Saeng Sun Community Forest [Online]

<http://phol.tci-thaijo.org/index.php/Scipsru/article/download/240748/165511/847313>

Mr. Asamon Limsakul, Mr. Sunthorn Ngam, Ms. Nantheera Sriburin, Ms. Paritda Suwanee, Ms. Ratchanikorn Paisan, presented a complete research report on the development of carbon-exchange methods and equipment.

<https://eservice.dcce.go.th/storage/Media/C201912236906.pdf>

Measurement of carbon retention of trees in landscape, Nodesak Sukwong and faculty 1-2 March 2016.

<https://shorturl.asia/G4AJ8>

## **I AM A DATA SCIENTIST**

We conducted this project using the principles of scientists studying the relationship between soil quality and carbon capture capabilities of Tenera palm trees using quantitative research processes focusing on field data and statistical analysis. To analyze chemical and physical properties, the data were recorded and processed using statistical methods to compare soil quality differences. The results are presented in tabular and chart form to show the relationship between soil quality and carbon retention potential, which is beneficial to soil resource management and palm forest conservation. To improve carbon capture efficiency and reduce the impact of climate change, and then use the information to further develop.

## **I AM A COLLABORATOR**

We've been working effectively on a multi-party collaboration, whether it's a dedicated research team planning, designing experiments, collecting data, analyzing results and summarizing findings systematically, and sharing our responsibilities for accurate and complete information. The project also received support and cooperation from external agencies. Wichienmatu School supported the necessary budget, equipment, and technical support. Farmers and communities in the Tenera palm plantation area provided information about the experimental area and allowed full research. These demonstrate that sharing of knowledge and collaboration not only improves research efficiency, but also helps to analyze and solve problems creatively, making our project successful and highly reliable at every stage of the project.

## **I MAKE AN IMPACT**

We conducted a study on water and soil quality that affects the carbonation of Tenera palm trees to assess the water and soil quality that affects the carbonation of Tenera palm trees. The study found that water and soil quality influenced the carbon retention of Tenera palm trees and that the results of the study could be disseminated to palm growers that cultivating palm trees would increase carbon retention, resulting in strong, sustainable and fruitful palm trees.

Raw data: Tenera palm trees, areas with water sources

ลำดับ	ชนิดไม้	ประเภทพรรณไม้	ความสูงของ	ความโต (เส้น	เส้นผ่าน	มวลชีวภาพ	มวลชีวภาพ	มวลชีวภาพ	มวลชีวภาพ	มวลชีวภาพได้	มวลชีวภาพรวม	ปริมาณคาร์บอน	ปริมาณก๊าซเรือนกระจกที่กักเก็บ	
			ต้นไม้	รอบวงที่ระดับ	ศูนย์กลางที่	เหนือพื้นดินใน	เหนือพื้นดินใน	เหนือพื้นดินใน	เหนือพื้นดินใน					
			H	เพียงอก)	ระดับสูงเพียงอก	ส่วนลำต้น	ส่วนกิ่ง	ส่วนใบ	ทั้งหมด					
			(m)	(cm)	(cm)	(kg)	(kg)	(kg)	(kg)	ratio	(kg)	(kgC)	(kgCO <sub>2</sub> e)	(tCO <sub>2</sub> e)
1	ปาล์ม	กลุ่มปาล์ม	12.304	279	88.77	ไม่มี	ไม่มี	ไม่มี	119.59	49.03	168.62	69.64	255.34	0.255
2	ปาล์ม	กลุ่มปาล์ม	11.237	270	85.91	ไม่มี	ไม่มี	ไม่มี	110.68	45.38	156.06	64.45	236.32	0.236
3	ปาล์ม	กลุ่มปาล์ม	9.971	259	82.41	ไม่มี	ไม่มี	ไม่มี	99.80	40.92	140.72	58.12	213.10	0.213
4	ปาล์ม	กลุ่มปาล์ม	15.344	298	94.82	ไม่มี	ไม่มี	ไม่มี	143.86	58.98	202.84	83.77	307.17	0.307
5	ปาล์ม	กลุ่มปาล์ม	11.237	250	79.55	ไม่มี	ไม่มี	ไม่มี	110.68	45.38	156.06	64.45	236.32	0.236
6	ปาล์ม	กลุ่มปาล์ม	11.58	312	99.27	ไม่มี	ไม่มี	ไม่มี	113.57	46.56	160.13	66.13	242.49	0.242
7	ปาล์ม	กลุ่มปาล์ม	11.237	250	79.55	ไม่มี	ไม่มี	ไม่มี	110.68	45.38	156.06	64.45	236.32	0.236
8	ปาล์ม	กลุ่มปาล์ม	13.498	246	78.27	ไม่มี	ไม่มี	ไม่มี	129.30	53.01	182.32	75.30	276.09	0.276
9	ปาล์ม	กลุ่มปาล์ม	11.237	289	91.95	ไม่มี	ไม่มี	ไม่มี	110.68	45.38	156.06	64.45	236.32	0.236
10	ปาล์ม	กลุ่มปาล์ม	12.686	280	89.09	ไม่มี	ไม่มี	ไม่มี	122.72	50.32	173.04	71.47	262.04	0.262
11	ปาล์ม	กลุ่มปาล์ม	11.58	295	93.86	ไม่มี	ไม่มี	ไม่มี	113.57	46.56	160.13	66.13	242.49	0.242
12	ปาล์ม	กลุ่มปาล์ม	13.929	313	99.59	ไม่มี	ไม่มี	ไม่มี	132.75	54.43	187.18	77.30	283.45	0.283

Raw data: Tenera palm trees, areas without water sources

ลำดับ	ชนิดไม้	ประเภทพรรณไม้	ความสูงของ	ความโต (เส้น	เส้นผ่าน	มวลชีวภาพ	มวลชีวภาพ	มวลชีวภาพ	มวลชีวภาพ	มวลชีวภาพได้	มวลชีวภาพรวม	ปริมาณคาร์บอน	ปริมาณก๊าซเรือนกระจกที่กักเก็บ	
			ต้นไม้	รอบวงที่ระดับ	ศูนย์กลางที่	เหนือพื้นดินใน	เหนือพื้นดินใน	เหนือพื้นดินใน	เหนือพื้นดินใน					
			H	เพียงอก)	ระดับสูงเพียงอก	ส่วนลำต้น	ส่วนกิ่ง	ส่วนใบ	ทั้งหมด					
			(m)	(cm)	(cm)	(kg)	(kg)	(kg)	(kg)	ratio	(kg)	(kgC)	(kgCO <sub>2</sub> e)	(tCO <sub>2</sub> e)
1	ปาล์ม	กลุ่มปาล์ม	11.237	240	76.36	ไม่มี	ไม่มี	ไม่มี	110.68	45.38	156.06	64.45	236.32	0.236
2	ปาล์ม	กลุ่มปาล์ม	13.929	270	85.91	ไม่มี	ไม่มี	ไม่มี	132.75	54.43	187.18	77.30	283.45	0.283
3	ปาล์ม	กลุ่มปาล์ม	10.584	260	82.73	ไม่มี	ไม่มี	ไม่มี	105.11	43.10	148.21	61.21	224.44	0.224
4	ปาล์ม	กลุ่มปาล์ม	10.904	300	95.45	ไม่มี	ไม่มี	ไม่มี	107.85	44.22	152.07	62.81	230.29	0.230
5	ปาล์ม	กลุ่มปาล์ม	9.393	260	82.73	ไม่มี	ไม่มี	ไม่มี	94.72	38.83	133.55	55.16	202.24	0.202
6	ปาล์ม	กลุ่มปาล์ม	9.971	295	93.86	ไม่มี	ไม่มี	ไม่มี	99.80	40.92	140.72	58.12	213.10	0.213
7	ปาล์ม	กลุ่มปาล์ม	8.582	272	86.55	ไม่มี	ไม่มี	ไม่มี	87.44	35.85	123.29	50.92	186.70	0.187
8	ปาล์ม	กลุ่มปาล์ม	11.237	248	78.91	ไม่มี	ไม่มี	ไม่มี	110.68	45.38	156.06	64.45	236.32	0.236
9	ปาล์ม	กลุ่มปาล์ม	9.393	249	79.23	ไม่มี	ไม่มี	ไม่มี	94.72	38.83	133.55	55.16	202.24	0.202
10	ปาล์ม	กลุ่มปาล์ม	7.354	258	82.09	ไม่มี	ไม่มี	ไม่มี	76.06	31.19	107.25	44.29	162.41	0.162
11	ปาล์ม	กลุ่มปาล์ม	8.074	230	73.18	ไม่มี	ไม่มี	ไม่มี	82.79	33.94	116.73	48.21	176.77	0.177
12	ปาล์ม	กลุ่มปาล์ม	8	246	78.27	ไม่มี	ไม่มี	ไม่มี	82.10	33.66	115.76	47.81	175.31	0.175

# Appendix



Collect soil samples in the area  
where water is supplied



Collect soil samples in areas where  
there is no water supply



Measure the height of a palm



Measure the girth of a tree



weigh 20 grams of soil



Measure water to get 10mL of it.



Measure the NPK value  
in the soil.



Measure the pH in the soil.