Research Title: **A Comparative Study of Soil Properties in Oil Palm and Rubber Plantations in Na Yong District, Trang Province**

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Abstract

This research aimed to investigate and compare the physicochemical properties of soil in oil palm and rubber plantations located in Na Yong District, Trang Province. Data collection was conducted at three distinct points within each site, covering morning, midday, and evening intervals. The findings revealed that soil temperatures at both sites were relatively similar, with average temperatures of approximately 28.3 – 28.4°C at a depth of 5 cm and 26.0 – 26.3°C at a depth of 10 cm. Regarding soil acidity-alkalinity (pH), the oil palm plantation exhibited slightly alkaline conditions (mean pH of 8.0), whereas the rubber plantation ranged from neutral to slightly alkaline (mean pH of 7.5); the pH in the oil palm plantation was approximately 0.5 units higher than that of the rubber plantation.

In terms of moisture and light intensity, the rubber plantation showed a significantly higher average relative humidity (1.8) compared to the oil palm plantation (1.5) and received greater average light intensity (783 Lux vs. 644 Lux). Laboratory analysis of primary macronutrients (N, P, K) indicated that nitrogen (N) and phosphorus (P) levels in both areas were at trace amounts. However, potassium (K) levels in the rubber plantation were categorized as medium, which was notably higher than the trace levels found in the oil palm plantation. Consequently, while the physical properties regarding temperature were comparable, distinct differences were observed in pH values and potassium content. The rubber plantation exhibited higher potassium fertility and moisture levels, providing essential data for strategic soil management and optimized fertilization for these two economic crops in the region.

Keywords : Soil Quality Oil Palm Plantation Rubber Plantation

Introduction

Na Yong District in Trang Province represents a significant agricultural hub, where the majority of the population is engaged in the cultivation of oil palm and para rubber. Nevertheless, prolonged and continuous monoculture practices may lead to the degradation of soil resources, exacerbated by the intensive application of chemical fertilizers and herbicides in certain areas. These practices exert a direct impact on the physicochemical quality of the soil.

Consequently, the research team recognized the imperative to investigate and compare the soil properties within oil palm and rubber plantations to elucidate the disparities in soil conditions across these sites. The data derived from this study will serve as a critical guideline for strategic soil restoration, maintenance, and the remediation of soil degradation. Ultimately, this research aims to empower farmers with the knowledge necessary for efficient and sustainable soil resource management.

Research Questions

1. What are the significant differences in the physicochemical properties of soil between oil palm and rubber plantations in Na Yong District, Trang Province?
2. Based on the measured physical and chemical parameters, which plantation site exhibits a higher risk of soil degradation?

Research Hypotheses

1. There are significant disparities in the physicochemical properties of soil between oil palm and rubber plantations, primarily attributed to differences in vegetation cover and plantation management practices.
2. Soil moisture levels in oil palm plantations are hypothesized to be higher than those in rubber plantations, as the denser canopy cover effectively reduces the rate of soil water evaporation.

Research Objectives

1. To investigate and measure the physicochemical parameters of the soil, specifically temperature, moisture content, pH levels, and light intensity at the soil surface within oil palm and rubber plantations.
2. To compare the disparities in soil properties between oil palm and rubber cultivation areas located in Na Yong District, Trang Province.
3. To establish guidelines for farmers in mitigating soil degradation and enhancing soil quality within oil palm and rubber plantations.

Research Methodology

1. **Identification of Study Sites**

Figure 1: Study sites located in Na Yong Nuea Sub-district, Na Yong District, Trang Province.

- **Oil Palm Plantation:** The study was conducted in Na Yong Nuea Sub-district, Na Yong District, Trang Province, situated at the geographic coordinates of **Latitude 7°33'15.0" N** and **Longitude 99°41'51.9" E**.
- **Rubber Plantation:** The study was conducted in Na Yong Nuea Sub-district, Na Yong District, Trang Province, situated at the geographic coordinates of **Latitude 7°33'14.0" N** and **Longitude 99°41'52.0" E**.

2. Sample Collection and Preparation

2.1 Determination of Sampling Points and Soil Property Assessment

A **systematic random sampling** approach was employed by selecting three sampling points within each plantation. These points were distributed across the study area using a **zigzag pattern** to ensure that the collected data served as a statistically valid representation of the entire site.

Figure 2: Assessment of soil physicochemical properties in Na Yong Nuea Sub-district, Na Yong District, Trang Province.

- **Light Intensity:** A **3-way Soil Moisture, pH, and Light Meter** was utilized to measure light intensity at the soil surface. Measurements were conducted during three intervals: morning, midday, and evening, by positioning the device **parallel to the ground**.
- **Soil Temperature:** Soil temperature was recorded using a **soil thermometer** inserted at depths of **5 cm and 10 cm**, respectively. The thermometer was left for approximately **2–3 minutes** to allow for thermal stabilization before recording the final values.
- **Soil Moisture:** Moisture levels were assessed using the **Soil Moisture, pH, and Light Meter** at the same depths as the temperature measurements.
- **Soil pH:** The acidity-alkalinity (pH) was determined using a **Soil Moisture and pH Meter**. The probe was inserted into the soil at the same sampling depths used for temperature and moisture. Data from each designated sampling point were systematically recorded.

2.2 Soil Sampling

Figure 3: Soil sampling for macronutrient analysis in Na Yong Nuea Sub-district, Na Yong District, Trang Province.

- **Composite Sampling:** Soil was excavated from the three designated points within each plantation at a depth of **10–15 cm**. The collected samples were then thoroughly mixed in a clean container or plastic bag to obtain a **composite soil sample** representing each specific site.
- **Air-Drying and Processing:** The soil samples were **air-dried** until all moisture was completely removed. Once dried, the soil was ground into fine particles and passed through a **standard sieve**. Only the **fine earth fraction** was retained for subsequent laboratory testing of primary macronutrients (N, P, and K).

Figure 4: Laboratory analysis of soil samples for nutrient content determination.

Research Materials and Equipment

1. **3-way Soil Analyzer (ETP306 / JEDTO):** A multi-functional meter for measuring soil moisture, pH, and light intensity (1 unit).
2. **Steel Probe:** A soil probing rod for site preparation (1 unit).
3. **Soil Thermometer (0–100°C):** For measuring soil temperature at specified depths (1 unit).
4. **Soil Sampling Bags:** Clean plastic bags for sample containment and transportation (2 units).
5. **Hoe / Soil Excavation Tool:** For soil sample extraction at the required depths (1 unit).

Table 1: Soil quality parameters in the oil palm plantation across different sampling points and time intervals.

Plantation Type	Sampling Point	time	Soil Temperature (°C)		Soil (pH)	Moisture	Light Intensity (Lux)
			5cm Depth	10cm Depth			
oil palm plantation	1	Morning	25°C	20°C	8	3.5	900
		Midday	32°C	29°C	8	1	1500
		Evening	31°C	30°C	8	1	300
	2	Morning	24°C	23°C	7.5	1.5	500
		Midday	30°C	28°C	8	1	700
		Evening	32°C	30°C	8	0.5	400
	3	Morning	20°C	19°C	8	3.5	300
		Midday	30°C	28°C	8	1	700
		Evening	31°C	30°C	8	1	500

Table 2: Soil quality parameters in the rubber plantation across different sampling points and time intervals.

Plantation Type	Sampling Point	time	Soil Temperature (°C)		Soil (pH)	Moisture	Light Intensity (Lux)
			5cm Depth	10cm Depth			
Rubber Plantation	1	Morning	23°C	22°C	7.5	1	600
		Midday	30°C	29°C	8	1	850
		Evening	32°C	30°C	8	0	450
	2	Morning	25°C	24°C	7.5	1	600
		Midday	32°C	29°C	7.5	1.5	2000
		Evening	31°C	30°C	7.5	1	600
	3	Morning	23°C	22°C	7.5	2	600
		Midday	31°C	29°C	7.5	3	900
		Evening	29°C	28°C	7	2.5	450

Table 3: Comparison of average soil quality parameters between oil palm and rubber plantations.

Plantation Type		oil palm plantation	rubber plantation	difference
Soil temperature (°C)	5 (cm)	28.3	28.4	- 0.1
	10 (cm)	26.3	26.0	0.3
Soil (pH)		8	7.5	0.5
moisture		1.5	1.8	- 0.3
light		644	783	-139

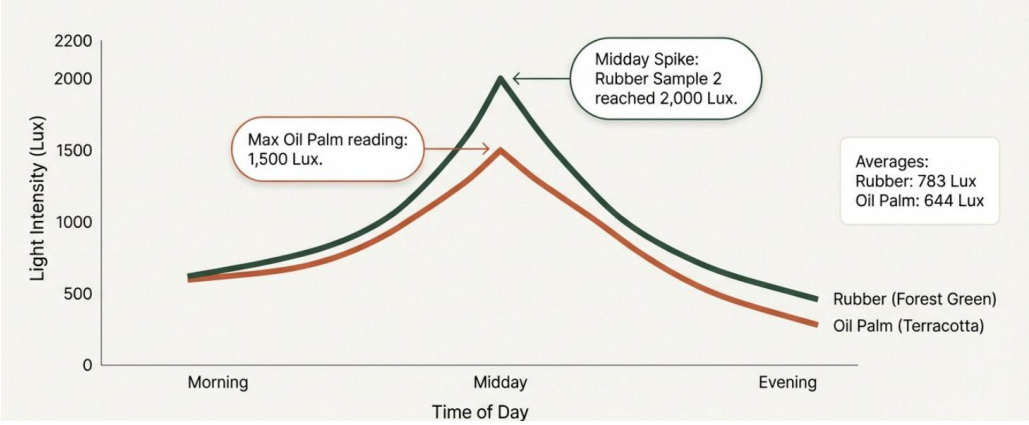

Figure 5: Comparison of ground-level light intensity at depths of 5 cm and 10 cm within oil palm and rubber plantation environments.

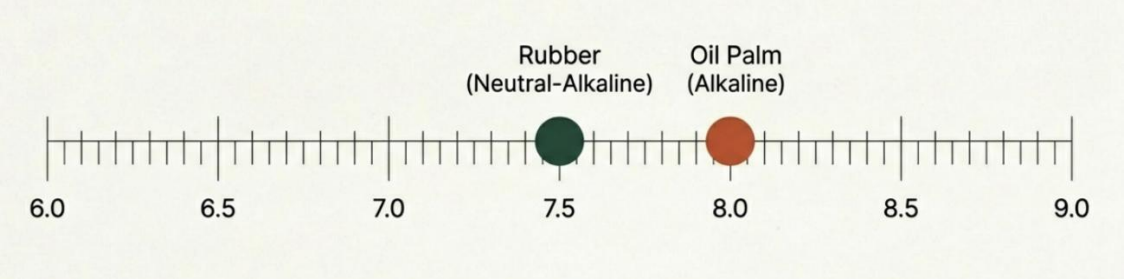

Figure 6: Comparison of soil pH levels at 5 cm and 10 cm depths within oil palm and rubber plantations.

Table 4: Laboratory analysis of primary soil macronutrients in oil palm and rubber plantations.

Plantation Type	Macronutrients		
	N	P	K
oil palm plantation	trace	trace	trace
Rubber Plantation	trace	trace	Medium

Conclusion

The comparative study of soil properties in oil palm and rubber plantations in Na Yong District, Trang Province, yields the following conclusions based on the surveyed factors:

1. **Light Intensity, Soil Temperature, and Moisture:** The **rubber plantation** exhibited a higher average light intensity reaching the soil surface compared to the oil palm plantation. However, the **oil palm plantation** showed higher soil temperatures at both 5 cm and 10 cm depths. In terms of moisture, the **rubber plantation** maintained a higher average soil moisture content than the oil palm plantation.

2. **Soil pH and Macronutrients:** Soil in both study areas was found to be **alkaline (pH > 7.0)**. Regarding nutrient content, the **oil palm plantation** contained Nitrogen (N), Phosphorus (P), and Potassium (K) only at **trace levels**. Similarly, the **rubber plantation** showed trace levels of N and P but contained a **medium level** of Potassium (K).

Discussion

The results indicate that the **rubber plantation** exhibited a higher light intensity (**783 Lux**) compared to the **oil palm plantation** (**644 Lux**). This is primarily due to the physical state of the rubber trees during the **defoliation (leaf-shedding) period**, which allows more sunlight to penetrate the canopy and reach the ground. Interestingly, despite this increased light exposure, the rubber plantation maintained a higher **moisture content (1.8)** and a surface soil temperature (at 5 cm) comparable to that of the oil palm plantation. This phenomenon can be attributed to the **accumulation of leaf litter** on the soil surface in the rubber plantation, which acts as a **natural mulch**. This organic layer effectively retains soil moisture and serves as a thermal insulator, preventing the surface temperature from rising excessively in response to light intensity.

In contrast, the oil palm plantation, despite receiving less light, showed a higher soil temperature at a depth of **10 cm (26.3°C)**. This suggests that the specific sampling points lacked sufficient **ground cover**, leading to greater heat penetration into the deeper soil layers.

Regarding the chemical properties, the **soil pH** in the oil palm plantation was more alkaline than in the rubber plantation, likely due to more frequent **fertilization cycles**. The analysis of **primary macronutrients (N, P, K)** highlighted that the rubber plantation possesses higher fertility in terms of **Potassium (K)**. Conversely, the oil palm plantation showed only **trace levels** for all three essential nutrients, signaling a state of **severe nutrient depletion**.

In conclusion, this study demonstrates that the type of crop and land management practices directly influence the physicochemical properties of the soil. The rubber plantation showed a superior ability to balance temperature and moisture through natural processes, whereas the oil palm plantation appeared more vulnerable to surface moisture loss. These findings provide valuable data for farmers in Na Yong District to improve **irrigation planning**, select appropriate **cover crops**, and manage **pH adjustment** to mitigate long-term soil degradation.

Recommendations

Based on the findings of this study, the following recommendations are proposed for future research:

1. **Seasonal Comparative Analysis:** Future studies should conduct comparative soil property assessments across different seasons, specifically the **rainy and dry seasons**. This would provide a more comprehensive understanding of the annual fluctuations in soil moisture and temperature, allowing for more precise agricultural planning.
2. **Biological Soil Diversity:** It is recommended to expand the scope of research to include the **diversity of soil microorganisms and macrofauna** (such as earthworms). Investigating these biological indicators would help clarify the relationship between physical soil factors and **biological soil fertility**, providing a more holistic view of the soil ecosystem in both oil palm and rubber plantations.

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References

Kaewmanee, J. (2018). *Soil management in rubber plantations and its impact on physical soil quality indicators*. Songkhla: Department of Earth Sciences, Faculty of Natural Resources, Prince of Songkla University.

Sukchan, S. (2017). *Impacts of rubber plantation management on soil physicochemical properties*. Bangkok: Land Development Department, Ministry of Agriculture and Cooperatives.

Taludma, C., Suttakorn, P., & Phruksanan, J. (2019). A comparative study of physical and chemical soil properties in oil palm and rubber plantations in Nong Khai Province. *Ubon Ratchathani University Journal of Science and Technology*.

Appendix

1. Field Investigation and Soil Sampling (Morning Session)

Figure 1: Soil parameters and light intensity data collection at an oil palm plantation site in Na Yong Nuea, Na Yong District, Trang.

Figure 2: Data collection of soil parameters and light intensity in a rubber plantation located in Na Yong District, Trang.

2. Field investigation and soil sampling (Midday session).

Figure 3: Soil parameters and light intensity data collection at an oil palm plantation site in Na Yong Nuea, Na Yong District, Trang.

Figure 4: Data collection of soil parameters and light intensity in a rubber plantation located in Na Yong District, Trang.

3. Field investigation and soil sampling (Evening session).

Figure 5: Soil parameters and light intensity data collection at an oil palm plantation site in Na Yong Nuea, Na Yong District, Trang.

Figure 6: Data collection of soil parameters and light intensity in a rubber plantation located in Na Yong District, Trang.

4. Laboratory determination of soil macronutrient content (N, P, K) across different study areas.

Figure 7: Measurement of soil primary macronutrients (Nitrogen, Phosphorus, and Potassium).