Research Title : Study and Analysis of the Correlation between Soil Properties and the Quality of Red Sago Palm Starch (*Metroxylon sagu*) in Na Yong District, Trang Province, Thailand

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Abstract

This study aims to investigate the relationship between soil properties and the quality of Sago palm starch (Metroxylon sagu) in Na Yong District, Trang Province. Data collection was conducted from October to January to evaluate the physical and chemical characteristics of the soil and their influence on the growth and starch accumulation within the trunk.

The results regarding physical soil properties in the sago palm forest revealed an average soil temperature of 30–31°C with relative soil moisture levels ranging from 7–10. Light intensity varied across the study sites between 100–450 LM. Chemically, the soil was found to be alkaline, with pH levels ranging from 8.0–9.0. Analysis of primary macronutrients indicated that nitrogen was present in trace amounts, potassium levels were low, and phosphorus levels ranged from low to medium. Regarding the quality and quantity of sago starch extracted from trunks with diameters of 36–45 cm and heights of 65–80 cm, the starch yield percentage ranged between 28–35%. Notably, the third section of the trunk yielded the highest starch content at 35%. Physically, the extracted starch exhibited a brown color, a fine powder texture, and a moisture content of 0%. These findings demonstrate that despite limited macronutrient availability and high soil alkalinity, the sago forest ecosystem in the studied area maintains the potential to produce sago starch with physical characteristics suitable for local utilization.

Keywords:

Sago palm (Metroxylon sagu) Peat swamp forest, Soil properties, Annual rainfall

Introduction

The Red Sago Palm (Metroxylon sagu) is a significant indigenous plant, deeply rooted in both the cultural heritage and the ecological landscape of Na Yong District, Trang Province. The physical environment of sago forests—characterized by wetlands and peatlands—combined with a tropical monsoon climate and consistent rainfall, provides the ideal humidity and conditions for the optimal growth of sago palms. However, soil properties remain a primary factor directly influencing trunk dimensions and starch accumulation, both of which are critical for meeting the production demands of local farmers.

The research team, therefore, focuses on the study and analysis of the physical and chemical characteristics of the soil, including soil temperature, macronutrient content (Nitrogen, Phosphorus, and Potassium), and soil pH levels, conducted between October and January.

This study aims to analyze the relationship between soil property factors and the quality of sago starch. It is hypothesized that optimal macronutrient levels and appropriate pH values within the watershed areas are directly linked to the quality and efficiency of starch accumulation within the trunk of the Red Sago Palm.

Research Question

How do the soil properties in the Sagu forest areas of Nayong District, Trang Province, correlate with and impact the quality of Sagu starch?

Research Hypothesis

Optimal concentrations of primary soil macronutrients (Nitrogen, Phosphorus, and Potassium) and soil pH levels within the watershed ecosystem are directly correlated with the starch accumulation mechanisms and quality within the trunk of the Red Sagu Palm (*Metroxylon sagu*).

2.Research Methodology

2.1 Study Site Selection

This research was conducted in the Sagu forest of Ban Sai Khan, Nayong District, Trang Province, situated at coordinates 7.4912881° N latitude and 99.71247061° E longitude. The geographical characteristics of the study area are defined as wetlands or peat swamp forests, influenced by seasonal monsoons and high annual precipitation. Sampling points were strategically selected from areas where Sagu palms had reached the mature stage (ready for harvest) to ensure consistency with the subsequent starch content analysis.

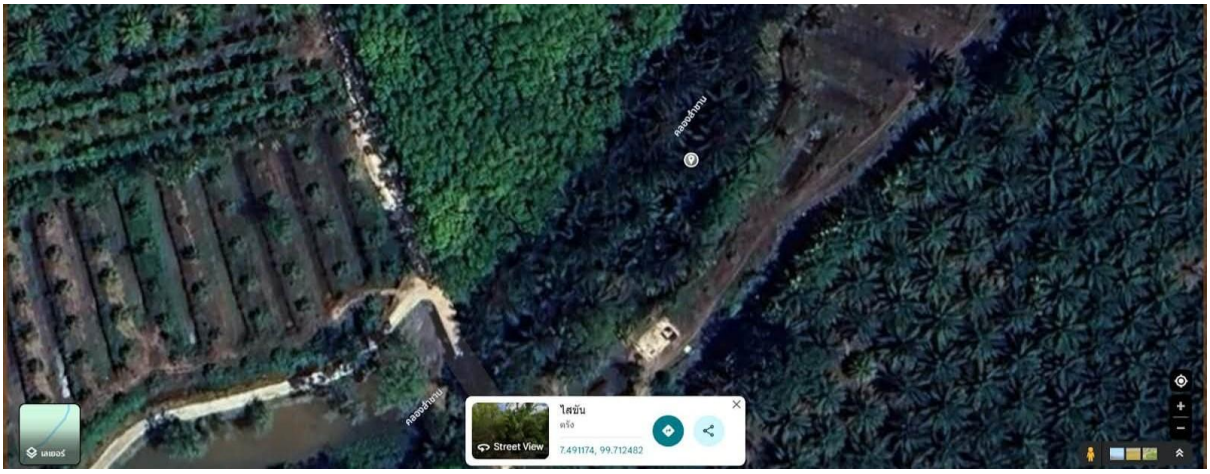

Figure 1: Geographical location of the study site within the Sagu palm forest, Lamo Sub-district, Nayong District, Trang Province (Source: Google Maps).

2.2 Soil Sampling and Preparation

Soil samples were collected from the Sagu palm forest in Nayong District, Trang Province, between October and January. A composite sampling method was employed, in which sub-samples were randomly collected from multiple locations across the study area and thoroughly mixed in plastic bags to ensure a representative soil sample.

The sampling was conducted at a depth of 15 cm. Following collection, the soil samples were air-dried under direct sunlight for a duration of three days. To prepare the samples for analysis, the

dried soil was pulverized using a mortar and pestle. Extraneous organic matter, such as wood fragments and grass debris, was manually removed. Subsequently, the soil was passed through a 2.0 mm mesh sieve to obtain a uniform particle size suitable for further physical and chemical characterization.

Figure 2: Three-point composite soil sampling method, with samples pooled in plastic bags to represent the study area (Source: Google Maps).

2.2 Soil Physical Property Analysis

2.2.1 Determination of Soil Moisture, Light Intensity, and pH

Soil moisture, light intensity, and pH were measured using a Richmoto analog soil meter. The probe was inserted into the soil at a depth of 15 cm. Measurements were recorded after a single insertion for each sampling point.

2.2.2 Soil Temperature Measurement

Following the Pedosphere (Soil) measurement protocols, soil temperature was recorded at two distinct depths:

Measurement at a depth of 5 cm.

Measurement at a depth of 10 cm.

Extractant Solution was added to 2.5 mL of the soil extract, followed by colorimetric interpretation.

2.3 Soil Chemical Property Analysis

Soil Sample Preparation

Dried soil samples were sieved through a No. 40 mesh (0.425 mm aperture) to ensure a uniform soil texture. A soil-to-distilled water ratio of 1:2 was prepared. The mixture was stirred thoroughly for 30 seconds and allowed to sediment for 3 minutes. This process was repeated three times before the supernatant was used for further analysis.

Analysis of Soil Macronutrients (NPK) and pH

Chemical properties were analyzed using the HANNA Soil Test Kit:

2.3.1 Nitrogen (N) Analysis: One packet of AmmoniaNitrogen Activator was added to 2.5 mL of the soil extract. Results were determined via colorimetric comparison.

2.3.2 Phosphorus (P) Analysis: One packet of Phosphorus

2.3.3 Potassium (K) Analysis: Potassium Extractant Solution was added to 0.5 mL of the soil extract, diluted with 2.5 mL of distilled water, and evaluated by color change.

2.3.4 pH Analysis: pH Test Solution was added to 2.55 mL of the soil extract to determine the acidity or alkalinity level.

Research Materials and Equipment

1.Beakers

2.Thermometer

3.Richmoto analog soil meter

4.HANNA Soil Test Kit (for pH and NPK analysis)

5.Test tubes

6.Glass stirring rods

7.Measuring cylinder (100 mL)

8.No. 40 sieve (0.425 mm mesh size)

9.High-precision digital balance

3.1 Analysis of Soil Physical Properties

Table 1: Analysis of Physical Characteristics of Soil in Sago Palm Forests, Na Yong District, Trang Province (October – January)

Date of Observation	Soil Moisture (level)	Light Intensity (Lm)	Temperature (°C)	pH Level
October 20, 2025	10	200	31	8
November 10, 2025	10	300	30	8
December 5, 2025	10	450	30	8
January 20, 2026	7	100	31	8

3.2 Chemical Property Analysis

According to the chemical property analysis of the soil in Sago palm forests from October to January, conducted in Na Yong District, Trang Province

Table 2: Chemical Properties of Soil in Sago Palm Forests, Na Yong District, Trang Province, Analyzed Using Hanna Soil Test Kits for pH and NPK Levels.

Sampling Date	Soil-to-Water Ratio	Nitrogen (N) Content	Phosphorus (P) Content	Potassium (K) Content	pH Level
October 20, 2025	1:2	Trace	Medium	Low	9
November 10, 2025	1:2	Trace	Medium	Low	9
December 5, 2025	1:2	Trace	Medium	Low	9
January 20, 2026	1:2	Trace	Low	Low	9

3.3 Analysis of Starch Quality

Based on the quality analysis of sago starch samples collected from Na Yong District, Trang Province

Table 3: Analysis of Physical Dimensions and Starch Yield of Sago Palms (Metroxylon sagu) Derived from Randomly Sampled Trunks (n=3) Following the Removal of External Bark.

Segment No.	Diameter (cm)	Height (cm)	Pre-extraction Mass (kg)	Extracted Starch Mass (kg)	Starch Yield (%)
1	45	65	81.00	14.18	17.50
2	36	80	87.22	17.44	20.01
3	42	65	90.00	16.69	18.52

Table 4: Physical properties and characteristics of Sago starch.

Segment No.	Color	Moisture Characteristics	Texture / Form
1	Brown	Dry appearance	Fine powder
2	Brown	Dry appearance	Fine powder
3	Brown	Dry appearance	Fine powder

Research Conclusion

The study conducted in the Sago palm forest of Ban Sai Khan, Na Yong District, Trang Province, yields the following conclusions:

1. Effects of Soil Physicochemical Properties on Plant Growth

- **Soil Properties:** The soil in the study area is characterized as **alkaline**, with pH levels ranging from **8.0 to 9.0**. Environmental conditions remained relatively stable, with temperatures between **30–31°C** and moisture levels at **7–10%**. Regarding nutrient content, primary macronutrients (**N-P-K**) were generally low; notably, Nitrogen was found only in **trace** amounts.
- **Plant Dimensions:** Despite high alkalinity and low nutrient availability, the Sago palms exhibited robust growth, with trunk diameters ranging from **36–45 cm** and heights between **65–80 cm**.
- **Synthesis:** The findings suggest that stable soil temperature, consistent moisture, and adequate light intensity (**100–450 lm**) provided by the canopy density are key factors. These environmental conditions enable Sago palms to achieve sufficient maturity for starch accumulation despite the nutrient-limited and alkaline soil profile.

2. Quality and Characteristics of Sago Starch

- **Physical Characteristics:** The extracted and processed Sago starch presented as a **fine powder** with a distinct **brown** coloration. Post-drying analysis indicated a moisture content of **0%**.
- **Starch Yield and Accumulation:**
    - Laboratory analysis of three random samples showed a **starch yield** (by mass) ranging from **17.50% to 20.01%**. The data indicates a positive correlation between height and yield, as the tallest segment (**80 cm**) produced the highest yield.

- Furthermore, the research identified **starch accumulation** levels between **28% and 35%**. Segment 3 demonstrated the highest efficiency, reaching a peak accumulation of **35%**.

Recommendations

1. Soil Amendment and Management

Based on the chemical analysis, the soil exhibits high alkalinity (pH 8.0–9.0) and deficient levels of essential macronutrients (N, P, and K). It is recommended that farmers or forest managers apply **organic matter** or **manure** to mitigate the soil pH toward a neutral range. This amendment will enhance nutrient bioavailability, allowing Sago palms to more effectively absorb essential elements for growth.

2. Light and Canopy Management

Given the high variability in light intensity (100–450 LM) caused by dense canopy cover, strategic **canopy thinning** or pruning of neighboring vegetation is advised. Optimizing light penetration will improve the photosynthetic efficiency of the Sago palms, which may subsequently increase the rate of starch accumulation within the trunks.

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