



RESEARCH ARTICLE

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Evaluation of Peat Nutrient Content in Coconut Plantations: Palm oil (*Elaeis gueneensis* Jacq.) In Paham Labuhanbatu

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Abstract

The use of peatlands for oil palm cultivation involves soil processing techniques, including physical soil improvement and water management, which can alter groundwater levels. These processes can change the peat structure from coarse to very soft and compact, ultimately affecting its chemical properties. This study aims to evaluate the nutrient content of peat at different depths in oil palm plantations. A descriptive method was employed by collecting soil samples from degraded areas at depths of 0-30 cm (top layer) and 30-60 cm (bottom layer). Observations were conducted over several years of oil palm cultivation. The results indicate that at 0-30 cm depth, total nitrogen (N) and potassium oxide (K₂O) content tended to be higher in 2015, whereas phosphorus pentoxide (P₂O₅) content was higher in 2013. In conclusion, variations in planting years suggest an interaction between plant age and nutrient content in peat. This finding underscores the importance of considering soil depth and plant age to maintain peat soil fertility in oil palm plantations. Consequently, fertilization and land management strategies can be implemented more efficiently and sustainably.

Keywords: Nitrogen, Phosphorus, Potassium, Soil Chemistry, Soil Layers

1. Introduction

A peatland is a wetland formed from the accumulation of organic material derived from dead plant remains that have partially decomposed but not fully decayed. The accumulation continues because the decomposition process is hindered. The rate of decomposition influences the maturity of the peat. The maturity level of peat determines its productivity, fertility, and the availability of soil nutrients (Sandra et al., 2022).

Currently, peatlands in Indonesia are extensively used for the cultivation of coconut and oil palm. Indonesia has approximately 20.6 million hectares of peatland, ranking fourth largest in the world (Sanjaya et al., 2023). Over time, increased use of peatlands has led to significant degradation, including peatland fires, canal development, and forest logging (Nusantara et al., 2018). These activities have caused a decline in peat water levels and an increase in CO₂ emissions (Nurzakiah & Nursyamsi, 2016). The conversion of peatlands alters their chemical structure and properties. Human activities such as land clearing, burning, and drainage construction contribute to changes in peat

characteristics (Masganti et al., 2015 in Noor et al., 2014).

Opening peat will lower the surface peat, so that will speed up the decomposition of organic material in peat in the opposite direction. Acceleration decomposition naturally influences the characteristic chemistry of peat, including macro nutrients. The more rapid decomposition also increases the maturity of peat, which affects the availability of nutrients for productivity and fertility of the land (Arifin, 2010).

Mature peat (saprik) generally has a higher nutrient content than raw peat (fibric). Peat saprik has organic C at 60% (Tonks et al., 2017). C- organic land shows the level of material organic content in land (Lestari & Wibowo, 2019). Organic materials are among the sources of N-total in soil (Zhue et al., 2018, in Siregar et al., 2021). However, peat ripe has lower organic C content compared to peat raw. According to Sahputra et al. (2019), low organic C was caused by the decomposition process.

Processing land speeds up the decomposition of peat (Agus et al., 2011), especially in layers, by reducing humidity levels in the peat. The rate decomposition

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increases when humidity increases by 15% because it influences the performance of microorganisms (Suyanto & Irianti, 2015). Microorganisms in peat, such as *Bacillus* and *Pseudomonas* (Alam & Zulaika, 2020), are involved in decomposition. However, under anaerobic conditions, decomposition of organic peat material proceeds slowly (Noor et al., 2014). Research by Tiffara (2023) shows that under anaerobic conditions, the organic carbon content in peat can reach 57.1%, which is classified as very high due to the slow decomposition rate. The age of coconut palm oil plants reflects the duration of land use after processing, leading to changes in peat characteristics, particularly the chemical properties of the top and lower layers. Therefore, it is necessary to study the nutrient content of peat at different depths. This study aims to evaluate the nitrogen

(N), phosphorus (P), and potassium (K) nutrient content in the top and bottom layers of peat soil in coconut palm oil plantations with crops of different ages.

2. Material and Methods

This study was carried out at PT Perkebunan Nusantara IV Kebun Meranti Paham, located in the District Panai Hulu, Regency Labuhanbatu, North Sumatra, at coordinates 02°11'18"02"21'24" N and 100°09'13"-100°12'02" E, at an altitude of 9 meters above sea level. Observation done at 3 ages: planting coconut palm oil in 2011, planting in division II in 2013, planting in division IV in 2015, and planting in Afdeling III. The study's framework is presented in Figure 1.

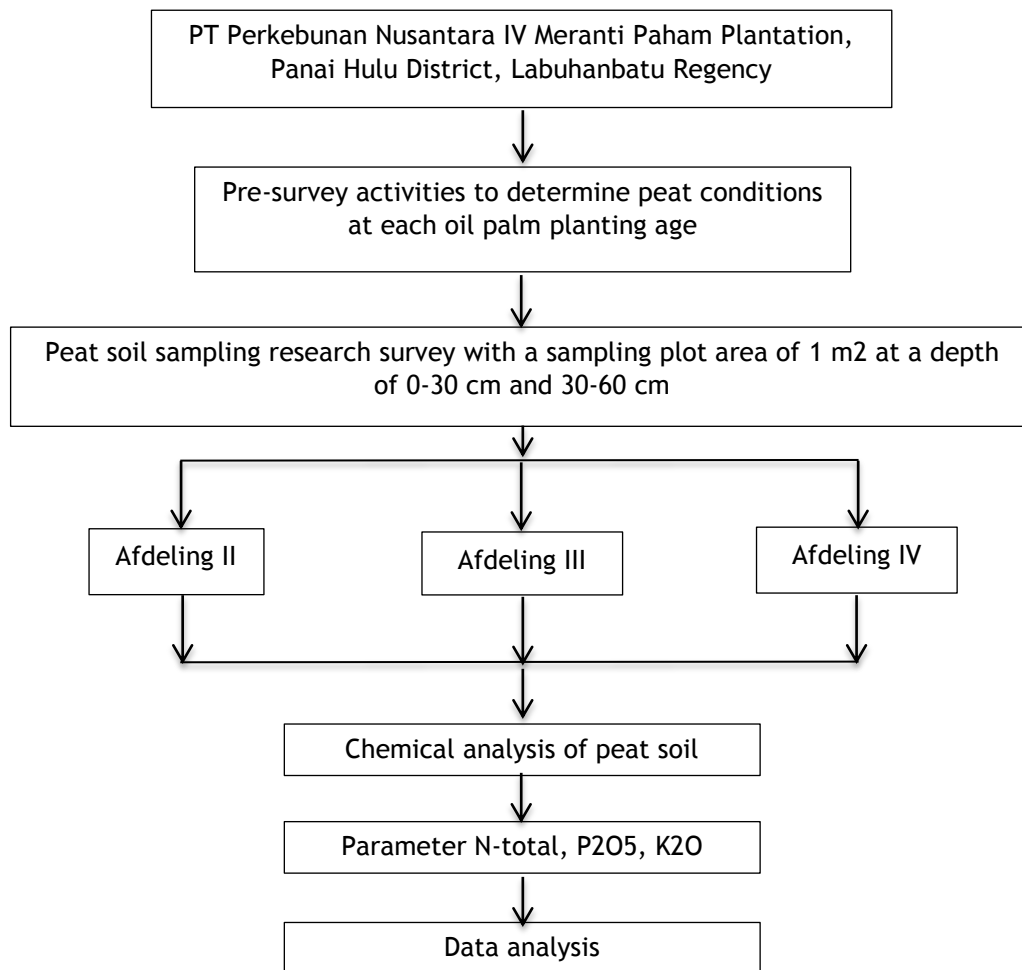


Figure 1. Framework conceptual research

Retrieval sample land use drill peat at a depth of 0-30 cm and a depth of 30-60 cm, which is located on the fence. This method is used to obtain a relatively small sample from a large number of chemists. Method: random sampling of 3 parallel points at each plot with different crops. The third point represents the horizontal distribution and is taken at a uniform distance to avoid location bias. The next third sample land was composited for every depth.

Before taking the sample, the pot was cleaned of plant material clinging to the land area of 1 m². Method: This is used because the characteristics of land are relatively homogeneous at the aspect level, maturity, peat type, land closure, and plant age, so the number of point samples is already sufficient. Then, the analysis was conducted in the Research and Technology Laboratory, Faculty of Agriculture, University of North Sumatra, to determine the

total N, P₂O₅, and K₂O content in the composited peat sample.

The data obtained are primary data from the results analysis laboratory, including N-total, P₂O₅, and K₂O. The data were analyzed using descriptive methods in Microsoft Excel software, Version 2010, and presented in a descriptive table form.

3. Results and Discussion

3.1. Upper Layer Nutrient Content

Research results show that the nutrient content in the layer at a depth of 0-30 cm varies greatly (Table 1). The total N content in the 0-30 cm layer was highest in 2015, with an average planting rate of 2.08%. This result shows higher organic matter content and greater N loss in the year 2015 planting compared to the years 2011 and 2013. The N-total height value indicates that the land peat is not

degraded (Ngajito et al., 2018).

P₂O₅ content in layers 0-30 cm with an average highest in the year 2013 planting of 0.25%. The P content in peat is greatly influenced by pH; a study found that the pH conditions in the top layer of the year's planting in 2011 and 2015 were more acidic than those in 2013. Meanwhile, K content in the 0-30 cm layer was highest in 2015, with an average of 0.53%. The K content value in the soil layer decreases with increasing age of coconut palm oil plants. This finding is caused by activity on the surface land, Good coconut palm oil, and plant closing soil. Plants can absorb K from the soil layer; K absorption is greatest during the vegetative period, reaching 85% and 15% in the generative period (Setianingsih, 2017). Research by Wibianto et al. (2023) states that coconut oil palms that are >7 years old can absorb 2.12 kg of K, 1.94 kg of P, and 3.6 kg of N from in-land peat.

Table 1. Average Total N, P₂O₅, and K₂O nutrient content at a depth of 0-30 cm

No	Year Plant Coconut Palm oil	N-total (%)	P ₂ O ₅ (%)	K ₂ O (%)
1	2011	1.76	0.17	0.46
2	2013	1.11	0.25	0.39
3	2015	2.08	0.23	0.53

3.2. Bottom Layer Nutrient Content

Research results show that the nutrient content in the layer at a depth of 30-60 cm varies greatly (Table 2). The total N content in the 30-60 cm layer was highest in 2015, with an average of 1.66%. Decrease the content in the lower layer. The high peat water content causes this bias. So N, on the lower layer, can be lost through washing. The depth of the peat layer influences the amount of water that can be absorbed and stored (Susandi et al., 2015). Study Suparto (2018) states that on the land peat, there is a loss of N due to washing of 5.62 kg N/ha, or around 7.15%, and a loss of other predicted N due to evaporation of 9.78 kg N/ha, or around 12.45%.

P₂O₅ content in layers 30-60 cm with an average highest in the year of planting 2011 and year 2013 planting

of 0.21%. The P content value in the soil layer is generally lower because the level increases with depth. In the soil level, decomposition is lower. Availability of P in land peat compared with depth peat. Research by Masganti (2003) has shown that land peat is increasingly affected by declining P levels. Research by Kamaliah et al. (2022) states P₂O₅ content in peat in Mixswam of 2.38 ppm and includes very low criteria. Whereas K content in the 30-60 cm layer was highest in 2011, with an average of 0.95%. Increasingly higher K content in the lower layer is caused by K leaching up and settling in the layered coating below. Research by Pulunggono et al. (2020) stated that the total K value in peat at a depth of 60-90 was 95.5 mg/kg and at a depth of 30-60 was 86.3 mg/kg.

Table 2. Average Total N, P₂O₅, and K₂O nutrient content at a depth of 30-60 cm

No	Year Plant Coconut Palm oil	N-total (%)	P ₂ O ₅ (%)	K ₂ O (%)
1	2011	1.42	0.21	0.95
2	2013	1.52	0.21	0.57
3	2015	1.66	0.15	0.64



Figure 2. Documentation study taking sample land peat at a depth of 0-30 cm and 30-60 cm



Figure 3. Documentation analysis of a sample of land peat in the laboratory

4. Conclusion

Research results show that macronutrient content in peat varies based on peat depth and the age of coconut palm oil plantations. The variation observed over the years indicates an interaction between plant age and nutrient content in the peat. This result confirms that maintaining soil fertility in peatlands under coconut palm oil plantations requires specific consideration of both soil depth and plant age. Consequently, fertilization and land management

strategies can be implemented more efficiently and sustainably.

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