Differences In Nutrient Content In Peat Land And Permanent Production Forest Area In Sei Paham Village, Sei Kepayang District, Asahan District

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Abstract.

Peat soils are classified as marginal soils and are prone to disturbance, so efforts to increase land productivity must be followed by efforts to prevent ecosystem damage. This study aims to analyze differences in nutrient content in peat land and permanent production forest areas in Sei Paham Village, Sei Kepayang District, Asahan District . Taking 5 soil sample points was carried out using a proposive random sampling method . The soil sample is then placed in a sterile plastic bag and immediately taken to the laboratory for analysis. The parameters of the soil analysis carried out included pH , C-total, N, P, K, Ca, Na, Mg, CEC and C/N. The results showed that in permanent production forest, the nutrient content was higher than peatland in all parameters of soil chemical analysis.

Keywords: *Peat , Production Forest and Nutrients.*

I. INTRODUCTION

Peatlands have a very important role, namely as a source of food, habitat, regulator of water management and control of climate change. Peat soils are classified as marginal soils and are prone to disturbance, so efforts to increase land productivity must be followed by efforts to prevent ecosystem damage. Peatland damage mainly occurs due to felling of trees and conversion of forest to other uses which causes drainage, compaction and subsidence, fires and reclamation. In relation to climate change, peatlands have a large carbon content, so that peat plays a very important role as a safeguard against global climate change. If peatlands are burned, or degraded, various types of greenhouse gases will be emitted into the atmosphere which are ready to change the global climate [1].Soil is a relatively weak bond between grains that can be caused by carbonates, organic matter, or oxides precipitating between the particles. The space between the particles can contain water, air, or something else [2]. Peat soil is a type of soil formed from the accumulation of half-decayed plant remains buried in hundreds to thousands of years formed in acidic conditions and anaerobic conditions in wetlands with a composition of more than 50% carbon, silicate sand, sphagnum moss, stems, and grass roots and animal remains. The formation of peat soils is a geogenic process, namely the formation of soil caused by deposition and transport processes, in contrast to the process of forming mineral soils which is generally a pedogenic process [3].

This layer of organic matter consists of piles of dead plants such as leaves, roots, twigs, even complete tree trunks, which have accumulated over thousands of years. The peat layer is formed because dead plants under normal conditions are quickly decomposed by bacteria and other organisms. However, due to the nature of peat soil which is anaerobic and has high acidity, as well as a lack of nutrients, the decomposition process is slow [4]. The specific characteristics of peat soil that distinguish it from mineral soils in general, include: easy to dry irreversibly (irreversible drying), easy subsidence, low bulk density and carrying capacity of the land against pressure, high ability to store water, high content of organic matter and carbon, low nutrient content and fertility, and low pH. Therefore the use of peat for agriculture is generally more problematic than mineral soils, because it requires more inputs and a more complex water management model as well as the possibility of negative impacts on the environment [5]. Peat soils generally have a low pH level, have high cation exchange capacity, low base saturation, low K, Ca, Mg, P content and also low micro element content (such as Cu, Zn, Mn and B) [6].

Conservation forest is a forest area that is protected to preserve the forest and all life in it so that the function of the forest is maintained and running as it should. According to Law Number 41 of 1999 concerning Forestry, conservation forest is a forest area with certain characteristics which has the main function of preserving the diversity of plants and animals and their ecosystems. The forest is located in the village of Sei Paham, District of Kepayang, Asahan Regency, North Sumatra Province. Conditions that have never been cultivated as agricultural land, so it is necessary to conduct research to determine the fertility status of peat soils in secondary forests in Kepayang District, Asahan Regency, North Sumatra Province [7] . Based on the explanation above, the purpose of this study was to determine differences in the quality of nutrients on peat land and permanent production forest areas in Sei Paham Village, Sei Kepayang District, Asahan Regency, in order to determine the dosage of fertilizer application before turning it into agricultural land .

II. METHODS

This research was carried out from November 2022 to January 2023 on peat land and permanent production forest areas in Sei Paham Village, Sei Kepayang District, Asahan Regency . Then proceed with the analysis of the two peat soil samples at the Socfindo Dolok Masihul Laboratory, Serdang Bedagai North Sumatra . in Figure 1.

Tools and Materials

The tools used are hoes, polybags, stationery, digital cameras, wood, sieves, tape measure, shovels and laboratory analysis tools that support this research. The material used is peat soil taken from peat land and permanent production forest areas in Sei Paham Village, Kec.Sei Kepayang

Research methods

The research was conducted in a quantitative descriptive manner. Taking 5 soil sample points was carried out using a proposive random sampling method . Sampling was carried out by using a drill by driving a drill 30 cm deep cm was then lifted to take soil samples. The soil sample obtained is then put into a poly bag or a certain place/sterile plastic and immediately taken to the laboratory, the soil sample is composited as a sample that is representative of the area. Soil analysis carried out included pH, C-total, N , P, K , CEC , Ca, Na, Mg, and C/N.

III. RESULT AND DISCUSSION

Sei Paham Village, Sei Kepayang Sub-district, Asahan Regency is administratively located on the line 2°03'- 3°26' North Latitude, 99°1'-100°0' East Longitude and is depicted on the map in Figure 1 below. From the map it can be seen that the pink colored area is production forest that can be converted while the yellow colored area is permanent production forest.

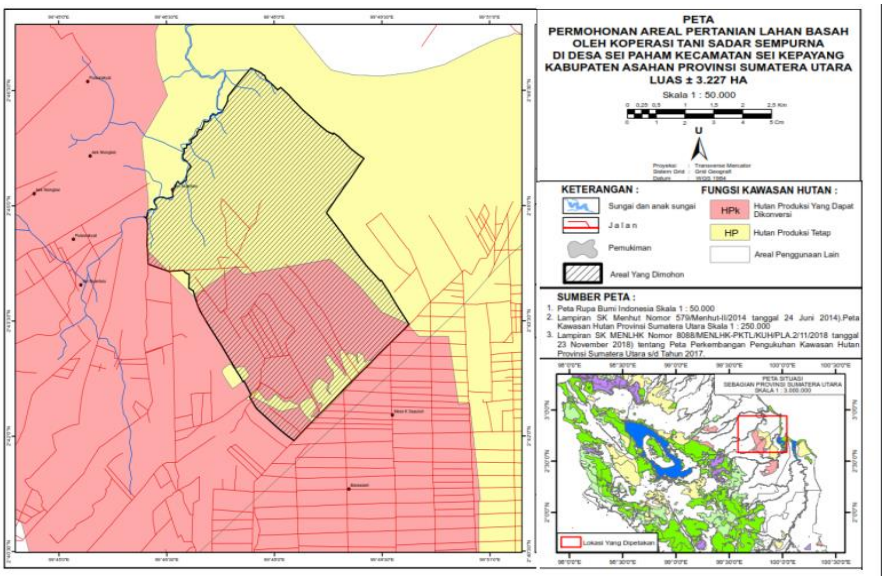

Fig 1. Map of Sei Paham Village

Based on the results of analysis of soil samples that have been taken based on sampling points and then composited, it is known that yields in production forests are still higher than peatlands that can be converted in all parameters of soil chemical analysis. Even though the difference is not too much, the value shows higher in production forests. Soil fertility values in these two samples meet the criteria as peat soil.

Table 1. Results Trait Analysis Soil Chemistry

		Peatlands		Production forest	
No	**Parameter**	**Results**	**Criteria**	**Results**	**Cr i teria**
1	pH	4.89	Low	5,39	Low
2	C-Organic	3.14%	Tall	3.74%	Tall
3	N	1.28%	Very High	1.48%	Very High
4	P	62.4 2 ppm	Very high	63.12 ppm	Very high
5	K	0.58me/100g	Currently	1.28me/100g	Tall
6	Mg	2.42me/100g	Tall	3.22me/100g	Tall
7	Na	0.27me/100g	Low	0.67me/100g	Low
8	Ca	1.15me/100g	Currently	1.45me/100g	Currently
9	CEC	42.15me/100g	Tall	42.68me/100g	Tall
10	C/N	2.45	Low	2.53	Low

soil pH

The results showed that the peat soil in Sei Paham Village had a low or acidic pH , where the pH of peatland was 4.89 and the area of production forest is 5.39. This is in accordance with statement [8] , namely peatlands generally have a relatively high level of acidity with a pH range of 3–5 . The high level of acidity is caused by drainage conditions and hydrolysis of organic acids [9]. The level of soil acidity correlates with the level of saturation. pH affects the availability of nutrients and solubility in the soil, namely acidic pH causes increased solubility. Soil pH that changes significantly and is classified as strong acid makes it difficult for microorganisms to decompose organic matter [10].

C-organic content

Based on the results of the research that the peat soil in Sei Paham Village has an organic C content of 3.14% and for the Forest Area the C-organic is 3.74% and includes high criteria. [2] stated that peat soils store more carbon than mineral soils. According to [11] the depth of the peat, the maturity and the higher the ash content, the higher the carbon content . Even the organic matter content of peat soils can range from 30 to close to 100% [12].

Nitrogen content _

The nitrogen content found in peatlands is 1.28 % , and in forest areas it is 1.48 %. The N element content in all types of peat soils in this study was in the very high category (>0.75) . Peat as an organic matter has a relatively high N content, so that the presence of peat and organic material on it is a source of N for the soil, the original nature of N in peat soils can have high diversity and can be influenced by many processes such as translocation and volatization, as well as types of vegetation. growing on it, the total N content in peat soils in several regions in Indonesia ranges between 0.3 and 2.1%. Nitrogen in the soil mainly comes from the decomposition process of organic matter, the distribution pattern of the N content that is formed indicates that the total N content is only supplied from the peat layer or organic matter above it, so that the presence of sulfidic materials under the peat layer can be stated to have no effect regarding the possibility of its role as a source of nutrients for the total N content of peat soil [13] .

Phosphate content

The results of the analysis of available P element showed that in peat soil samples it was 62.42 ppm and in production forest areas it was 63.12 ppm . If seen based on the criteria for assessing soil nutrients , it can be categorized as very high. Peat soil contains P mostly in the form of organic P which will then undergo a process of mineralization to become inorganic P (Pi) by micro-organisms. Generally, organic P forms are found in the form of inositol phosphate, especially hexaphosphate (above 60% of total organic P (TPo) organics). Other forms, such as phospholipids, nucleic acids, glucose-1-phosphate, glycerolphosphate, and protein phosphate in soil is only about 2% of total organic P [14] .

Potassium content

Potassium content in peat land is 0.58 _ me/100g (medium) and in forest areas 1.28 me/100g (height) . Potassium is the most quickly lost nutrient. Potassium is a very mobile nutrient in both plants and soil and is easily leached. K nutrient leaching generally occurs in litter that is weathered and is supported by decomposing microbes [4]. So it can be said that The lower potassium K content in peatland areas is caused by the leaching of the K content more easily when compared to production forests where the K content can be bound to plants.

Content of M g

Mg content in soil samples has high criteria . Based on the results of the analysis of nutrient elements in peatland of 2.42 me/100g and in the forest area of 3.22 me/100g . Higher Mg content is thought to affect the low availability of K in peatlands. This is in accordance with [3], which states that the antagonistic properties of K and Mg greatly affect its availability in the soil. The high value of Mg in the soil will affect the availability of K in the soil. [15] stated that overall the condition of peat soil fertility had a fairly high Mg nutrient content.

Its content

Based on the results of laboratory analysis, it was found that the sample had low criteria where the peat had a nutrient content of 0.27 me /100g while on forest land it was 0.67 me/100g. This is due to the thinner nutrient elements of peatlands so that the accumulation of organic matter containing Na in peatlands is also less. According to [16], the low Na content can be due to the absence of the addition of mineral elements which are the main source of Na, the source of Na content is only obtained from the accumulation of organic matter and atmospheric deposition.

Ca content

The Ca content in peatland is 1.15 me/100g, and the Na content in the forest is 1.45 me/100g . Both samples belong to medium criteria. [17] which states that the soil reaction becomes more acidic, the Ca content decreases and the ash content decreases with the thickness of the peat.[18] states that peat soil is soil composed of organic matter as the parent material. Low levels of cations K + , Ca2+ . Mg2+ and Na2+ are also due to the very acidic pH of peat soils and water-saturated soil conditions due to the shallow high groundwater table.

CEC

From the two soil samples it is known that peatland has a CEC value of 42.15 me /100g and in the production forest sample it is 42.65 me/100g . Both samples are included in the high category. The high value of cation exchange capacity (CEC) at the study site was caused by the high C-Organic value, besides that it was also influenced by the ongoing fertilization treatment and decomposition process, the ongoing decomposition process produces humic compounds that are able to improve cation exchange capacity (CEC) land, [1] stated that the higher the soil organic matter content, the higher the CEC value, the CEC value is influenced by the organic matter content, some organic matter is humus which acts as soil colloid so that the higher the soil organic matter content, the higher the CEC value . [19], explained that peat soils that have high organic matter have a higher cation exchange capacity than soils that have low organic matter content.

C/N

The results of the analysis show that the C/N ratio of the soil at the observation point is included in the low criteria. The results of the analysis showed that the C/N ratio in this study was on peatland (2.45) while on production forest it was (2.53), a low C/N ratio indicated that the decomposition rate had not increased. Based on these results, the peat layer above the groundwater table has a higher decomposition rate compared to the peat layer below the groundwater table. The C/N ratio of organic soil formed by accumulated peat has a lower ratio than production forest. while the average C/N ratio on peatland is (2.45). This shows that microbial traces are less prominent in the stoichiometry of peat soil organic matter compared to organic matter in production forest, directly proportional to the visual appearance of the soil which is often fibrous or hemic [20].

IV. CONCLUSION

The results of the analysis on production forest were higher than peatland in all parameters of soil chemical analysis. Although the difference is not too much, but the value shows more in the production forest tall.

REFERENCES

[1] Noor, 2006 *Penelitian luas Lahan Gambut di Indonesia*.Heryanto, 2005 *Luas Hutan Rawa Gambut di Sumatra*.

[2] [Balittanah] Balai Penelitian Tanah. 2009. *Petunjuk teknis analisis kimia tanah, tanaman, air dan pupuk*. Edisi 2. Bogor (ID): Balai Penelitian Tanah, Balai Besar Litbang Sumber Daya Lahan Pertanian, Badan Penelitian dan Pengembangan Pertanian, Departemen Pertanian. 204 p.

[3] Hardiyatmo, H. . (2017). *Mekanika Tanah* I. Yogyakarta: Gadjah MadaUniversity Press.

[4] Agus, F., Wahyunto, H. Sosiawan, I.G.M. Subiksa, P. Setyanto, A. Dariah, Maswa, N. L. Nurida, Mamat, I. Las, 2014. *Pengelolaan Berkelanjutan Lahan Gambut Terdegradasi: Trade-off Keuntungan Ekonomi dan Aspek Lingkungan*. Dalam Prosiding Seminar Nasional Pengelolaan Berkelanjutan Lahan Gambut Terdegradasi untuk Mitigasi Emisi GRK dan Peningkatan Nilai Ekonomi.BBSDLP. Bogor.

[5] Yamani, A dan S. Bahri.2018. *Kajian Sifat Fisik dan Kimia Tanah Pada Lahan Gambut Pasca Kebakaran*. Universitas Lambung Mangkurat.Banjarmasin.Kalimantan Selatan.

[6] Maftuah, Eni, dan Siti Nurzakiah. 2017. *Pemulihan dan Konservasi Lahan Gambut. Dalam Agroekologi Rawa*, Hal: 470-500. Depok: RajaGrafindo Persada.

[7] Yondra dan N.Wawan. 2017.*Kajian Sifat Kimia Lahan Gambut Pada Berbagai Landuse*. AGRIC 29(2):103-112.

[8] Zhang L, Gałka M, Kumar A, Liu M, Knorr KH, Yu ZG. 2021. *Plant succession and geochemical indices in immature peatlands in the Changbai Mountains, northeastern region of China: implications for climate change and peatland development*. Sci Total Environ. 773. https://dx.doi.org/10.1016/j.scitotenv.2020.143776.

[9] Qadafi M, Notodarmojo S, Zevi Y. 2021. *Performance of microbubble ozonation on treated tropical peat water*: Effects on THM4 and HAA5 precursor formation based on DOM hydrophobicity fractions. Chemosphere. 279:130642. https://doi.org/10.1016/j.chemosphere.2021.130642.

[10] Zhou C, Li C, Siva S, Cui H, Lin L. 2021. *Chemical composition, antibacterial activity and study of the interaction mechanisms of the main compounds present in the Alpinia galanga rhizomes essential oil*. Ind Crops Prod. 165:113441. https://dx.doi.org/10.1016/j.indcrop.2021.113441.

[11] Waraningtyas, I. 2017. Ketebalan Gambut Berdasarkan Jarak Dari Sungai Indragiri Serta Hubunganya Dengan Sifat Kimia Tanah. Departemen Ilmu Tanah Dan Sunberdaya Lahan. Fakultas Pertanian.IPB. Bogor.

[12] Noor M, Masganti, Agus F. 2014. *Pembentukan dan karakteristik gambut tropika Indonesia*. In: Agus F, Anda M, Jamil A, Masganti, editors. Lahan gambut Indonesia: pembentukan, karakteristik, dan potensi mendukung ketahanan pangan. Edisi revisi, cetakan II 2016. Bogor (ID): IAARD Press, Badan Penelitian dan Pengembangan.

[13] Fahmi, A. 2012.*Saling tindak tanah gambut dan substratum bahan sulfidik serta pengaruhnya terhadap sifat kimia tanah.Disertasi*.Program Pascasarjana. Universitas Gadjah Mada. Yogyakarta. 2012.

[14] Hartatik et al., 2005. Laporan Akhir Penelitian Teknologi Pengolahan Hara pada Budidaya Pertanian Organik. Laporan Bagaian Proyek Penelitian Sumber Daya Tanah dan Proyek Pengkajian Teknologi Pertanian Partisipatif.

[15] Agus, F., Markus, A., Ali, J. dan Masganti.2016. *Lahan Gambut Indonesia*.G Conservation Cervice.FAO Land and Water Development Division. FAO, Rome.

[16] Malau, R.S. & Utomo, W.H. (2017).*Kajian Sifat Fisik Tanah Pada Berbagai Umur Tanaman Kayu Putih (Melaleuca Cajuputi) Di Lahan Bekas Tambang BatubaraPT Bukit Asam (Persero)*.***Jurnal Tanah dan Sumberdaya Lahan*** 4 (2): 525-531.

[17] Fahmi, A. 2012.*Saling tindak tanah gambut dan substratum bahan sulfidik serta pengaruhnya terhadap sifat kimia tanah.Disertasi*.Program Pascasarjana. Universitas Gadjah Mada. Yogyakarta. 2012.

[18] Wawan, W., Ariani, E., dan Lubis, H. R. (2019).*Sifat kimia tanah dan produktivitas kelapa sawit*. ***Jurnal Agroteknologi***, 9(2), 27–34.

[19] Hardjowigeno, S. 2010. *Ilmu Tanah*. Edisi ketiga.PT. Mediyatama Sarana Perkasa. Jakarta.

[20] Siregar, A., Walida, H., Sitanggang, K. D., Harahap, F. S., & Triyanto, Y. (2021). Karakteristik Sifat Kimia Tanah Lahan Gambut di Perkebunan Kencur Desa Sei Baru Kecamatan Panai Hilir Kabupaten Labuhanbatu. ***Agrotechnology Research Journal***, *5*(1), 56. https://doi.org/10.20961/agrotechresj.v5i1.48434