Effect of land use differences on pH and available Phospor in Peatland, Kelampangan, Central Kalimantan

By Adi Jaya

WORD COUNT 2280
TIME SUBMITTED 27-JUN-2023 03:20AM
PAPER ID 100815260

Seminar Nasional Agroteknologi 2022
Volume 2023
http://dx.doi.org/10.11594/nstp.2023.3106

NST Proceedings
OPEN ACCESS

Conference Paper

Effect of land use differences on pH and available Phospor in Peatland, Kelampangan, Central Kalimantan

Fitri Wijayanti[1,3]*, Haidar Fari Aditya[1], Adi Jaya[2], Winih Sekaringtyas Ramadhani[4], Raudah Anggraini Tarigan[5]

[1]Universitas Pembangunan Nasional "Veteran" Jawa Timur, Indonesia
[2]University of Palangka Raya, Central Kalimantan
[3]Innovation Center of Appropriate Food Technology for Lowland and Coastal Area, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Surabaya 60294, Indonesia
[4]Department of Soil Science, Faculty of Agriculture, Lampung University, Lampung, 35145 – Indonesia
[5]Agriculture Faculty, Universitas Medan Area, Indonesia

*Corresponding author:
E-mail:
fitri.wijayanti.agro@upnjatim.ac.id

ABSTRACT

This extraordinary peatland area can have various impacts, especially in Indonesia and even globally. In general, in soil classification, peat soil is known as Histosol. Based on the maturity level, there are safric, fabric, and hemic maturity levels. In general, peat soils have a relatively high level of acidity with a pH range of 3-4. Peatland management in the Central Kalimantan region has developed quite rapidly where many peatlands can be used as agricultural lands, such as in the Kalampangan area. Several types of land use analyzed in this study are dragon fruit monoculture, agroforestry with chili as the main crop, burnt forest, and natural peat forest. The analysis was carried out to determine the pH and available P content in the peat soil on each land use. The pH range in each land use is acidic with the highest actual pH range of 4 in the dragon fruit monoculture land use and the lowest in the natural forest landuse of 3,2. Meanwhile, the potential pH has a fairly similar value in the range of 2.1 to 2.5. The highest available P was obtained in chili agroforestry and the lowest was in the burnt forest. The highest available P was obtained in chili agroforestry and the lowest was in the burnt forest. The available pH and p values are strongly influenced by the management carried out by farmers, whereas in some areas the management is carried out quite intensively. An inventory of peat characteristics data is needed for current and future land development.

Keywords: Peatland, landuse, acidic, pH, available phosphor

Introduction

Peat is an organic soil whose formation process takes hundreds of years. Peatlands are characterized by the accumulation of organic matter from dead and decaying plant remains under water-saturated conditions (Jaya et al., 2021). Indonesia has 13.4 million hectares of peatland, most of which are spread over the islands of Sumatra, Kalimantan, and Papua (Ritung *et al*. 2019). Tropical peatlands, which are important reservoirs of water, carbon, and biodiversity, occur mainly along the east coast of Sumatra and in the southern and western coastal areas of Kalimantan (Taufik et al., 2019). In Kalimantan's peatland ecosystems, people generally cultivate crops (ie paddy fields with a shifting cultivation system and rubber agroforestry (Hevea brasiliensis) on mineral soils and shallow peat on a small scale (Medrilzam et. al., 2017, Page et al., 2009). The special characteristics of peat soil that distinguish it from mineral soils in general (Noor et al., 2015), include: (a) easy to experience

How to cite:
Wijayanti, F., Aditya, H. F., Jaya, A., Ramadhani, W. S., & Tarigan, R. A. (2023). Effect of land use differences on pH and available Phospor in Peatland, Kelampangan, Central Kalimantan. *Seminar Nasional Agroteknologi 2022*. NST Proceedings. pages 24-27. doi: 10.11594/ nstp.2023.3106

irreversible drainage (b) easy to experience subsidence (c) low bulk density and carrying capacity pressure on the land (d) capacity high for storing water (e) high organic matter and carbon content (f) low nutrient and fertility content (g) low pH. Peatland management in the Central Kalimantan region is developing quite rapidly where a lot of peatlands can already be used as agricultural land, as happened in the Kalampangan area. One of the marginal lands that have the potential to be developed as agricultural land is peatland (Surahman et al, 2017). Local people's activities are farming, hunting, and gathering, and appear to be confined to forest edges and river banks (the river being the main route) (Cole et al., 2022). Regulating land use and plant selection is an important aspect of the principle of sustainability in land reclamation and management (Surahman et al., 2017). This study aims to inventory data on peat characteristics in the Kalampangan area with various land uses, especially for the physical and chemical characteristics of peat, with the hope that this data can be used to determine differences in peatland characteristics. One of the chemical characteristics that often becomes a problem in land with acidic pH is the availability of nutrients, one of which is the availability of nutrient P. Peatlands can be a sink, source, and converter of P, other essential plant nutrients, and contaminants derived from agricultural soils, industrial and municipal wastes. Rewetting of agriculturally affected peatlands increased the concentration of soluble phosphorus, as shown in studies across Europe (Paer, 2009). The purpose of this study was to analyze the availability of P under different pH conditions in various types of land use.

Material and Methods

Research site

This research was conducted in the inland peat area of Kalampangan, Palangkaraya, Central Kalimantan. In the Kalampangan area, the development of peatland management is quite diverse, so that various types of land use can be found. The land uses selected for this study were Agroforestry, Monoculture Gardens, Burnt Land and Natural Forest. Laboratory analysis was carried out at the Land Resources Laboratory, Faculty of Agriculture, Universitas Pembangunan Nasional "Veteran" Jawa Timur.

Table 1. Various Type of Kalampangan, Central Kalimantan

No.	Land Use	Code
1.	Agroforestri with main crop Chili (Ac)	Ac
2.	Agroforestry with main crop corn (Aj)	Aj
3.	OilPalm Plantation (S)	KS
4.	Dragonfruit Plantation (N)	MN
5.	Natural Peatland (H)	HA
6.	Burnt Land (B)	HB

Sampling methods

Sampling was carried out on several types of land, namely Dragon Fruit Monoculture, Oil Palm Plantations, Corn Agroforestry, Chili Agroforestry, Natural Forest and Restoration Forest (as Unprocessed Natural Peat) (Table 1). The first sample was taken during joint research activities. Sampling for burnt land use and natural forest will be carried out in the next period.

Analysis of pH content (Potential and actual) and available P

pH analysis was carried out to obtain the actual pH and potential pH. For actual pH use H_2O as a solvent while for Potential pH use KCl as a solvent. Available P analysis is performed after knowing the pH of the sample. pH is used as an indicator of the method to be used. The results of the pH analysis showed that the pH tends to be acidic, so the extractor used for analysis was Bray's extract.

The results of the analysis are then processed to determine the effect between parameters, namely to analyze the pH conditions in various types of land use and the available P content with pH conditions that tend to be acidic in various types of land use.

Results and Discussion

Potential and actual pH analysis

Sampling of various types of land use in inland peatland (gambut) in Kapampangan, Central Kalimantan, resulted in a variety of pH conditions, all of which were very acidic, both potential and actual pH.

Table 2 shows the potential and actual variations in pH across land use. The potential pH did not show much difference, the potential pH conditions for each land use ranged from 2.1 to 2.5. The actual pH ranges from 3.2 to 4.0. The highest actual pH values were found in land with Dragon Monoculture land use and oil palm plantations. Land processing has an influence on the pH conditions of each land use, especially for the actual pH. Dragon fruit and oil palm monocultures are treated more intensively with periodic liming so that the actual pH on these lands tends to be slightly higher than other land uses. This also applies to agroforestry but not as intensively as oil palm plantations and dragon fruit monoculture.

Table 2. the actual pH, potential pH and availability of P

Landuse	pH H_2O	pH KCl	Available P (ppm)
Dragon Fruit Monoculture	4,0	2,2	93,9
Oil Palm Plantation	4,0	2,4	83,9
Agroforestry Jelutung & Corn	3,4	2,5	252,1
Agroforestry Jelutung & Chili	3,6	2,4	287,5
Natural Peat/Natural Forest	3,6	2,1	24,9
Burnt Land	3,2	2,1	36,3

One of the research results is the pH conditions in various land use and the available P content in various land uses. The highest available P content was in agroforestry land. Meanwhile, in some other lands, it is quite high but not as high as in agroforestry lands. In general, the available P is related to the pH in a field, where if the pH is low, the available P is also low. However, this did not occur in the research area where the available P was quite high even though the pH was low. This happens because agroforestry land and monoculture land are treated intensively. Provision of dolomite and the addition of some fertilizer input from outside which is given periodically. Apart from land management, the peatland in the study location is peat with a fairly good level of maturity, so the top layer of peat is well-decomposed and able to add nutrients.

Figure 1, shows the relationship between pH and Available P in every land use in Kalampangan. this shows that the condition of potential pH and availability of P is directly proportional. However, the actual pH and availability of P are irregular, this is due to the various and quite intensive land management. Near-neutral pH values are generally considered optimal for phosphate uptake (Barrow, 2016). Soil pH greatly affects the solubility and proportion of various phosphate compounds absorbed by plants (Waheed et al., 2017). Peat soils have a low ability to adsorb P fertilizers. This is because peat soils are rich in low molecular weight reactive functional groups such as citric acid, malic acid, and oxalic acid, and high molecular weight humic and fulvic acid functional groups (Maftu'ah et al., 2014).

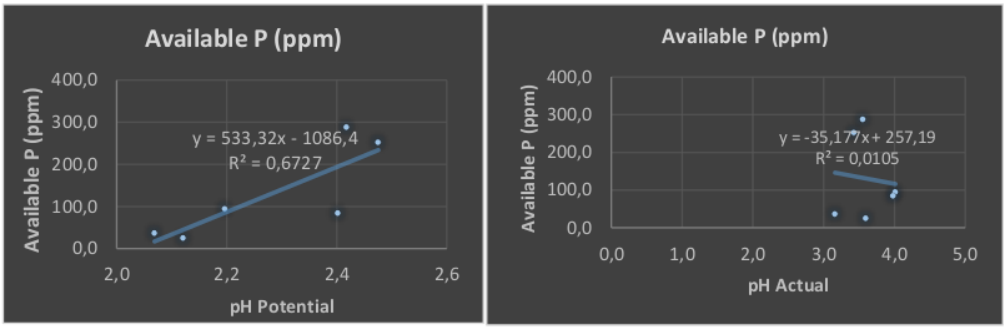

Figure 1. pH actual, pH potential and Available P

Conclusion

The pH conditions on peatlands tend to be low and classified as acidic. Low pH will affect the availability of Phosphorus. Peatlands in the Kalampangan area are developing quite rapidly. Land management is quite intensive with a variety of different land uses. This affects the actual pH in this area so that the actual pH varies quite a bit. These conditions affect the availability of P. Availability varies greatly due to differences in pH and various treatments.

References

Barrow, N. J. (2016). *The effects of pH on phosphate uptake from the soil*. Springer International Publishing Switzerland 2016.

Cole L. E. S., Åkesson, C. M., Hapsari, K. A., Hawthorne, D., Roucoux, K. H., Girkin, N. T., Cooper, H. V., Ledger, M. J., O'Reilly, P., & Thornton, S. A. (2022). Tropical peatlands in the anthropocene: Lessons from the past. *Anthropocene, 37*(2022), 100324. https://doi.org/10.1016/j.ancene.2022.100324

Jaya A., Sosilawati, Antang, E. U., Djaya, A. A., & Gunawan, H. (2021). Agroforestry farming system as peatland restoration efforts in Central Kalimantan, Indonesia. *IOP Conf. Series: Earth and Environmental Science, 694* (2021), 012016

Maftu'ah E., Ma'as, A., & Purwanto, B. H. (2014). N, P and K storage efficiency on degraded peat soil through ameliorant Application. *Journal of Degraded and Mining Lands Management, 1*(4), 187-196. https://doi.org/10.15243/jdmlm.2014.014.187

Medrilzam M., Smith, C., Aziz, A. A., Herbohn, J., & Dargusch, P. (2017). Smallholder farmers and the dynamics of degradation of peatland ecosystems in Central Kalimantan, Indonesia. *Ecological Economics, 136*(2017), 101–113.

Noor M., Masganti, & Agus, F. (2015). *Formation and characteristics of Indonesian tropical peat*. Swampland Agriculture Research Institute, Riau Agricultural Technology Study Center, Soil Research Institute.

Page, S., Hoscilo, A., Langner, A., Tansey, K., Siegert, F., Limin, S., & Rieley, J. (2009). *Tropical peatland fires in Southeast Asia.* In: Cochrane, M.A. (Ed.), Tropical Fire Ecology: Climate Change, Land Use, And Ecosystem Dynamics. Springer and Praxis Publishing Ltd., Chicester, UK., p. 263.

Paer, H. W. (2009). Controlling eutrophication along the freshwater–marine continuum: Dual nutrient (N and P) reductions are essential. *Estuar. Coast., 32*, 593–601.

Ritung, S., Suryani, E., Yatno, E., Nughroho, K., et al. (2019). *Peatland Map Scale 1:50.000 (In Indonesian)*. Bogor: The Center for Agricultural Land Resource Research and Development.

Surahman A., Shivakoti, G., & Soni, P. (2017). *Prospect of sustainable peatland agriculture for supporting food security and mitigating greenhouse gas emission in Central Kalimantan, Indonesia*. Redefining Diversity and Dynamics of Natural Resources Management in Asia volume 1 2017 Elsevier Inc.

Taufik M., Veldhuizen, A. A., Wösten, J. H. M., van Lanen, H. A. J. (2019). Exploration of the importance of physical properties of Indonesian peatlands to assess critical groundwater table depths, associated drought and fire hazard. *Geoderma, 347*(2019), 160–169

Waheed K. N., Ijaz, N., Khatoon, Z., Hayat, S., & Nuzhat, U. (2017). Effects of pH on release of phosphorus from rock phosphate at different temperatures against the various time intervals involved. *International Journal of Biosciences, 10*(1), 202-209.

Effect of land use differences on pH and available Phospor in Peatland, Kelampangan, Central Kalimantan

ORIGINALITY REPORT

7%
SIMILARITY INDEX

PRIMARY SOURCES

1	library.wur.nl Internet	28 words — 2%
2	A Jaya, Sosilawaty, E U Antang, A A Djaya, H Gunawan. "Agroforestry farming system as peatland restoration efforts in Central Kalimantan, Indonesia", IOP Conference Series: Earth and Environmental Science, 2021 Crossref	18 words — 1%
3	journal.ipb.ac.id Internet	18 words — 1%
4	mafiadoc.com Internet	17 words — 1%
5	A. Surahman, G. Shivakoti, P. Soni. "Prospect of Sustainable Peatland Agriculture for Supporting Food Security and Mitigating Green House Gas Emission in Central Kalimantan, Indonesia", Elsevier BV, 2017 Crossref	14 words — 1%
6	www.adscientificindex.com Internet	14 words — 1%
7	Jariyah, J., Simon Bambang Widjanarko, Yunianta, and Teti Estiasih. "Quality Evaluation of Wheat-	12 words — 1%

Pedada Fruit Flour (PFF) Biscuit with Different Emulsifiers",
Agriculture and Agricultural Science Procedia, 2016.
Crossref

EXCLUDE QUOTES	ON	EXCLUDE SOURCES	< 10 WORDS
EXCLUDE BIBLIOGRAPHY	ON	EXCLUDE MATCHES	< 10 WORDS