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Nutrient Content of Water at Different Landuse in Peatland in Central Kalimantan, Indonesia

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Nutrient Content of Water at Different Landuse in Peatland in Central Kalimantan, Indonesia

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Abstract. Research on water in four different landuse in peat swamp area in Kalampangan Central Kalimantan, Indonesia was carried out and water was sampled every one month from May 2018 to April 2019 and analyzed for pH, soil electrical conductivity (EC) and total content of Ca and Mg. Aim of the research is to obtain the different in nutrient concentration in different land use. Methods, six permanent locations in each land use were used to gather water samples. The landuse were established in (a) Peat swamp forest (b) Jelutung forest (c) Agriculture area and (d) Oil Palm. Water samples were taken at 100 cm below the surface at each peatland site. Result show that water in Forest is very acid with average pH (4.24 ±0.48), Jelutung forest (4.68 ±0.33), Agriculture area (4.69 ±0.62), and Oil Palm 4.67 ±0.38). Soil Electrical Conductivity (EC) in Forest is the lowest with average 0.32 ±0.11 mS.cm -1, Jelutung forest (0.56 ±0.36), (c) Agriculture area (0.93 ±0.52), and (d) Oil Palm (0.52 ±0.19), Similary to Soil Electrical Conductivity (EC), Ca content in water in Forest is the lowest with average 8.20 ±4.54 mg.l-1, Jelutung forest (19.72 ±10.42), (c) Agriculture area (23.60 ±11.54), and (d) Oil Palm (17.45 ±8.27). Mg content in water in Forest is the lowest with average 0.51 ±0.40 mg.l-1, Jelutung forest (0.93 ±0.47), (c) Agriculture area (2.77 ±1.57), and (d) Oil Palm 0.82 ±0.59). The highest nutrient cotents of Ca and Mg in water was Agriculture area and the lowest in Forest area. Furthermore, nutrient contents of water at each landuse during dry season was higher than wet.

1. INTRODUCTION

Large areas of peatland occur in Indonesia with estimates ranging from 16 to 27 million hectares [1]. Radjagukguk [2] provides a lower estimate of almost 20 million hectares. In 1990, the peatland in Kalimantan covered an area of about 4,413,000 ha, while after reclamation 3,513,000 ha remained [3], Central Kalimantan covered an area of about 3,010,640 ha [4]. Extensive logging, drainage and the extreme drought of 1997, combine with large fire, have caused great damage to peat lands in Kalimantan [5].

Large-scale drainage networks were built in Indonesian peatlands, including Central Kalimantan, for agricultural uses. Drainage may cause peat domes to collapse, because low water content at the very low density of the peat [3], a low load-bearing capacity, and high total porosity, cannot support the vegetation or maintain the dome-shape [5]. Drainage and logging have caused severe destruction of ombrotrophic peat dome in Palangka Raya, Central Kalimantan.

Chemical properties of peat changes may occur upon oxidation, include peat burning, fertilizer, dolomite added in the peat area. This study evaluates in water chemical properties in peat land in different landuse.

2. RESEARCH AND METHODS

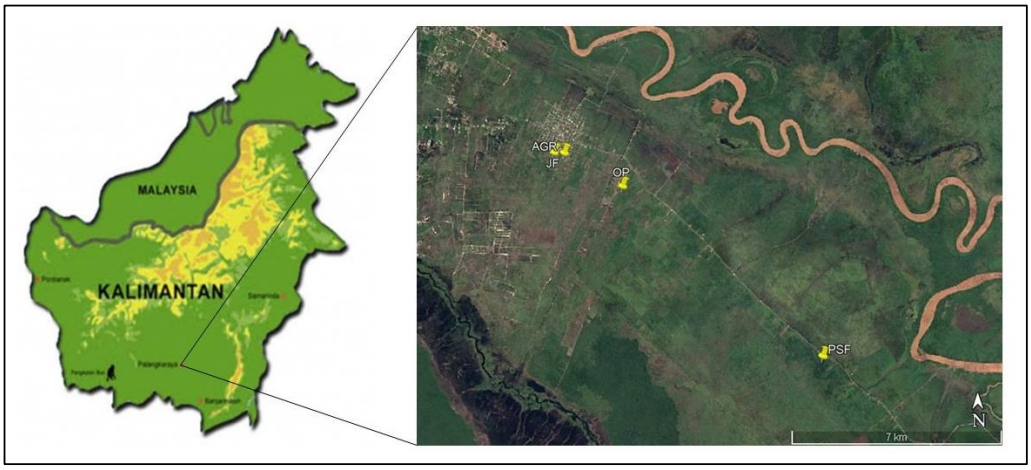

Figure 1. location of Study Plot in Near Kalampangan Vilage in Central Kalimantan Indonesia

The study was carried out is in the northern part of Block C of ex Mega Rice project near Kalampangan village in Central Kalimantan, Indonesia. Water samples were collected at six permanent sites in each different landuse. The latter were established in (a) Peat swamp forest (b) Jelutung forest (c) Agriculture area and (d) Oil Palm. Water samples were taken at 100 cm depths below the surface at each peatland site. At each sites, there was 1 (one) polyethilane pipe. The total of pipe was 24 pipes. Water sample was taken by hand pump.

From May 2018 to April 2019, one month's worth of water samples were taken. Following collection, samples were kept in a refrigerator at 4^{o}C at the laboratory at Palangka Raya University. Water samples were filtered the following day. The filtered materials were subjected to chemical analysis using AAS spectra 30 for Ca and Mg. pH of water sample was using pH meter Hanna pH 211. Soil electrical conductivity were analyzed by Conductivity meter (Hanna HI 8633).

3. RESULTS AND DISCUSSION

3.1 Forest

Throughout the study period, the pH of the water in the forest area varied, ranging from 3.66 to 5.17, with a mean of 4.24 ± 0.48 throughout a one-year period. In the dry season, September 2018 had the highest value (pH = 5.17), followed by August 2018 (pH 4.83). On the other hand, the lowest value occurred in April 2019 (pH =3.66) in the end of wet season.

Table 1. pH, EC (mS. cm^{-1}) and nutrient concentration (mg.l^{-1}) in water sample in different landuse during 1 year study period.

Landuse	pH	EC(mS.cm^{-1})	Ca(mg.l^{-1})	Mg (mg.l^{-1})
Forest	4.24±0.48	0.32±0.11	8.20±4.54	0.51±0.40
Jelutung	4.68±0.33	0.56±0.36	19.72±10.42	0.93±0.47
Agriculture	4.69±0.62	0.93±0.52	23.60±11.54	2.77±1.57
Oil palm	4.67±0.38	0.52±0.19	17.45±8.27	0.82±0.59

Similarly to the pH of water, the Soil electrical conductivity (EC) of water in forest was also varied throughout the study period. The soil EC value of water in forest ranging from 0.25 to 0.63 $mS.cm^{-1}$ and the mean during the study period was 0.32 ± 0.11 $mS.cm^{-1}$. The highest value obtained was in September 2018 (0.63 $mS.cm^{-1}$) in the dry season, followed by August 2018 (0.44 $mS.cm^{-1}$) in dry season. On the other hand, the rainy season's lowest value, recorded in February 2019, was 0.25 $mS.cm^{-1}$.

Majority of nutrient in water are Ca. The calcium of water varied during the study period ranging from 1.10 to 16.23 mg. l^{-1} and the mean during the study period was 8.20 ± 4.54 mg. l^{-1}. The highest value obtained was in September 2018 (16.23 $mg.l^{-1}$) in the dry season, followed by October 2018 (12.16 $mg.l^{-1}$) in dry season. On the other hand, during the wet season in April 2019, the lowest value was 1.10 $mg.l^{-1}$.

Similarly to Ca, Mg of Forest water varied throughout the study period ranging from 0.14 to 1.60 $mg.l^{-1}$ and the mean during the study period was 0.51 ± 0.40 $mg.l^{-1}$. The highest value obtained was in September 2018 (1.60 $mg.l^{-1}$) in the dry season, followed by November 2018 (0.89 $mg.l^{-1}$) in dry season. On the other hand, during the wet season in April 2019, the lowest amount was recorded at 0.14 mg/l.

3.2 Jelutung Forest

Similarly to the pH of water in forest area, the pH of water in Jelutung area varied throughout the study period ranging from pH 4.14 to 5.15 and the mean during the study period was 4.68 ± 0.33. The highest value obtained was in September 2018 (pH = 5.15) in the dry season, followed by August 2018 (pH 5.08) in dry season. On the other hand, April 2019 had the lowest value (pH = 4.14) toward the conclusion of the wet season.

Similarly to the pH of water, the soil EC of water in Jelutung forest was also varied throughout the study period. The soil EC value of water in Jelutung ranging from 0.33 to 1.39 $mS.cm^{-1}$ and the mean during the study period was 0.56 ± 0.36 $mS.cm^{-1}$. The highest value obtained was in September 2018 (1.39 $mS.cm^{-1}$) in the dry season, followed by July 2018 (1.12 $mS.cm^{-1}$) in dry season. In contrast, the wet season's lowest value (0.33 $mS.cm^{-1}$) was in December 2018 and March 2019.

Majority of nutrient in water are Ca. The calcium of water in Jelutung varied throughout the study period ranging from 6.94 to 34.69 $mg.l^{-1}$ and the mean during the study period was 19.72 ± 10.42 $mg.l^{-1}$. The highest value obtained was in September 2018 (34.69 $mg.l^{-1}$) in the dry season, followed by July 2018 (39.89 $mg.l^{-1}$) in dry season. On the other hand, during the wet season in March 2019, the lowest value was 6.94 $mg.l^{-1}$.

Similarly to Ca, Mg of Jelutung forest water varied throughout the study period ranging from 0.43 to 1.93 $mg.l^{-1}$ and the mean during the study period was 0.93 ± 0.47 $mg.l^{-1}$. The highest value obtained was in September 2018 (1.93 $mg.l^{-1}$) in the dry season, followed by August 2018 (1.67 $mg.l^{-1}$) in dry season. On the other hand, the wet season's lowest value of 0.43 $mg.l^{-1}$ was recorded in March 2019.

3.3 *Agriculture area*

The pH of water in Agriculture area varied throughout the study period ranging from pH 3.98 to 5.97 and the mean during the study period was 4.69 ± 0.62. The highest value obtained was in September 2018 (pH = 5.97) in the dry season, followed by August 2018 (pH 5.41) in dry season. Conversely, the lowest measurement (pH = 3.98) was in April 2019 at the end of the wet season.

Similarly to the pH of water, the soil EC of water in Agriculture area was also varied throughout the study period. The soil EC value of water in Agriculture ranging from 0.54 to 2.10 $mS.cm^{-1}$ and the mean during the study period was 0.93 ± 0.52 $mS.cm^{-1}$. The highest value obtained was in September 2018 (2.10 $mS.cm^{-1}$) in the dry season, followed by August 2018 (1.65 $mS.cm^{-1}$) in dry season. In comparison, the wet season's lowest value (0.54 $mS.cm^{-1}$) happened in February 2019.

Majority of nutrient in water are Ca. The calcium of water in Agriculture area varied throughout the study period ranging from 3.60 to 44.17 $mg.l^{-1}$ and the mean during the study period was 23.60 ± 11.54 $mg.l^{-1}$. The highest value obtained was in September 2018 (44.17 $mg.l^{-1}$) in the dry season, followed by August 2018 (37.39 $mg.l^{-1}$) in dry season. On the other hand, during the wet season in March 2019, the lowest value was 3.60 $mg.l^{-1}$.

Similarly to Ca, Mg of Agriculture water varied throughout the study period ranging from 0.41 to 6.96 $mg.l^{-1}$ and the mean during the study period was 2.77 ± 1.57 $mg.l^{-1}$. The highest value obtained was in September 2018 (6.96 $mg.l^{-1}$) in the dry season, followed by July 2018 (3.51 $mg.l^{-1}$) in dry season. On the other hand, during the wet season in November 2018, the lowest value was recorded at 0.41 mg/l.

3.4 Oil palm

The pH of water in Oil Palm area varied throughout the study period ranging from pH 4.13 to 5.32 and the mean during the study period was 4.67 ± 0.38. The highest value obtained was in October 2018 (pH = 5.32) in the dry season, followed by September 2018 (pH = 5.09) in dry season. Conversely, April 2019 saw the lowest reading (pH = 4.13) toward the end of the wet season.

Similarly to the pH of water, the soil EC of water in Oil Palm was also varied throughout the study period. The soil EC value of water in Oil Palm ranging from 0.31 to 0.88 mS.cm-1 and the mean during the study period was 0.52 ± 0.19 $mS.cm^{-1}$. The highest value obtained was in August 2018 (0.88 $mS.cm^{-1}$) in the dry season, followed by July 2018 (0.87 $mS.cm^{-1}$) in dry season. In comparison, the wet season's lowest value (0.31 $mS.cm^{-1}$) happened in February 2019.

Majority of nutrient in water are Ca. The calcium of water in Oil Palm area varied throughout the study period ranging from 7.59 to 30.30 $mg.l^{-1}$ and the mean during the study period was 17.45 ± 8.27 mg.l-1. The highest value obtained was in July 2018 (30.30 $mg.l^{-1}$) in the dry season, followed by Juni 2018 (27.98 mg.l-1) in dry season. On the other hand, the wet season's lowest value (7.59 $mg.l^{-1}$) happened in December 2018.

Similarly to Ca, Mg of water in Agriculture area varied throughout the study period ranging from 0.27 to 2.43 $mg.l^{-1}$ and the mean during the study period was 0.82 ± 0.59 $mg.l^{-1}$. The highest value obtained was in July 2018 (2.43 $mg.l^{-1}$) in the dry season, followed by June 2018 (1.41 $mg.l^{-1}$) in dry season. In comparison, the wet season's lowest value of 0.27 $mg.l^{-1}$ was recorded in March 2019.

3.5 pH

pH value of water in Agriculture area was the highest with 4.69 ± 0.62, followed by Jelutung area (4.68 ± 0.33), Oil Palm (4.67 ± 0.38) and the lowest was forest area (4.24 ± 0.48), repectively. The result above indicated that peat water was more acid in forest than other landuse, especially in Agriculture. One of possible reason for this is more frequent dolomite, catle manure, ash etc added in Agriculture, Oil palm and Jelutung than Forest area. Furthermore, Prasad et al [6] suggestion that the pH in deforested forest are higher than forest area. The higher pH value in deforested area could be result of present ash and basic cations such as Ca, Mg, and K from peat burned in that area.

3.6 Soil electrical conductivity (EC)

Similarly to pH value in Agriculture area, the soil EC in Agriculture area was the highest with (0.93 ±0.52) mS.cm -1, followed by Jelutung area (0.56 ±0.36), Oil Palm (0.52 ±0.19), and the lowest was forest area 0.32 ±0.11 mS.cm -1, repectively.

The result above indicated that water in Agriculture has higher soil EC than other landuse. One of possible reason for this is that more frequent dolomite, catle manure and ash added in Agriculture compare to other landuse. Similarly to Gong [7] suggestion that the soil EC is affected by fertilizer, manure, compuound fertilizer application. The higher concentration of soluble salt ions in the solution, indicated the higher EC. Furthermore, Othaman et al [8] suggestion that soil EC reflect the soil salinity (salt concentration) where, the higher the EC value, the higher the salt concentration in the soil and vice versa. Result of the study shown that the highest soil EC is in Agriculture area (0.93 ±0.52) $mS.cm^{-1}$,

and agreed with Mirzakhaninafchi et al [9] a number of fertilizers applied to the soil also affect its EC value.

3.7 Nutrients

In general, calcium and magnesium concentration in Agriculture show higher values during the dry season than the wet season. It seems that these results agree with other workers who also found that the concentration of certain elements in water was higher in the dry than the wet season, for example, magnesium and potassium [10].

Several reasons have been suggested to explain why nutrient concentrations in water are higher in dry than wet periods, presence in the atmosphere of dust during the dry season originating from peat burning may contain base cations (e.g. Ca, Mg, K) [11] then go down to the water. Moreover, biomass burning, especially in the end of dry season, may contribute several cations to water [12]. Furthermore, in the end of dry season, farmers added dolomite, ash, and fertilizer on their land, such as Agriculture and Oil Palm.

The findings of this present study seem to accord with the conclusions of Sulistiyanto [11] who suggest that the majority of elements in water result from biomass burning carried out by farmers near to the study areas every year at the beginning of crop cultivation, mainly during the dry season. Furthermore, in the end of dry season (beginning of crop cultivation), farmers added dolomite, ash, and fertilizer on their peat land, especialy in Agriculture and Oil Palm.

Various reasons have been suggested to explain the differences in the chemical composition of water in Forest, Jelutung, Agriculture and Oil Palm. Higher nutrient contents (Ca and Mg) in Jelutung, Agriculture and Oil Palm may result from dolomite, fertilizer, ash, and catle manure added in that area.

4. CONCLUSION

This study provides information on the variation of pH, soil electrical conductivity (EC), and nutrient content of peat water in different landuse during the 1-year study period were all of nutrient concentration in forest area was lower than others landuses. Moreover, the results of this study highlight those nutrient concentrations in peat water was nearly the same between Jelutung, Agriculture, and Oil Palm area.

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