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DISSOLVED ORGANIC CARBON (DOC) IN PEAT WATER SUGGESTS LIMIT TO DECOMPOSITION

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SUMMARY

The majority of Carbon studies on peats focus on soil carbon. It is rare to examine the amounts of carbon in peat water. As a wetland, peat water contains lots of Dissolved Organic Carbon (DOC). This study aims to portray contents of DOC in peat water from agriculture, shrubs and secondary forests. The research site is Rasau Jaya peat dome, which was firstly opened in 1972 for agricultural development. This peat dome is massively drained and disturbed by human activities. A total of 60 peat water samples were analysed. We used Total Organic Carbon (TOC) Analyser. This study showed that DOC concentrations in peat water ranged from 21.18 to 89.78 mg/L. DOC mostly concentrates in the upper part of peat water profile. Further, DOC concentration in agriculture is significantly lower than concentration in secondary forest. This seems to indicate that rates of peat decomposition tend to decrease in most disturbed peats. In other words, limit the peat decomposition.

Keywords: *peat water, dissolved organic carbon, limit to decomposition*

INTRODUCTION

Dissolved Organic Carbon (DOC) is an important component in the carbon cycle of drained peats (Moore *et al.*, 2013; Nuriman, 2015). Drained peats act as DOC discharge, and escalate DOC production as a result of peat decomposition. Deforestation of peatlands usually makes drainage firstly (Hooijer *et al.*, 2006). It will influence DOC concentration in peat pore water, Gandois et al. (2013) result show DOC concentration in the pore water was significantly greater in the deforested site (79.9 ±5.5 mg/l) than the pristine site (62.2 ± 2.2 mg/l).
Only a few DOC studies were conducted in Indonesia. These mostly focus on DOC studies in selected rivers in Sumatra and Central Kalimantan (Ishikawa *et al.*, 2006; Baum *et al.*, 2007; Alkhatib *et al.*, 2007; Moore *et al.*, 2011; Moore et al. 2013), but on the peat pore water in Indonesia not yet. This study aims to find a portray contents of DOC in peat water following different land uses.

METHODS

This study was conducted at the peatland region of Rasau Jaya i.e around the Sub-watershed Kapuas Hilir, West Kalimantan. The location of this research has 53,129 ha of peatland (Anshari *et al.*, 2013). Peat depth in this area ranged from 140 to 525 cm. Sampling locations and GPS coordinates as well as soil taxonomy according to USDA, 2010 are presented in Table 1. Peat pore water samples were collected from secondary forest, open area, bush, agriculture, young rubber plantation and oil palm. A total of 60 pore water samples were collected, using a hand pump, at three depth intervals (See Figures 1). These samples were collected in both rainy and dry seasons of 2013.

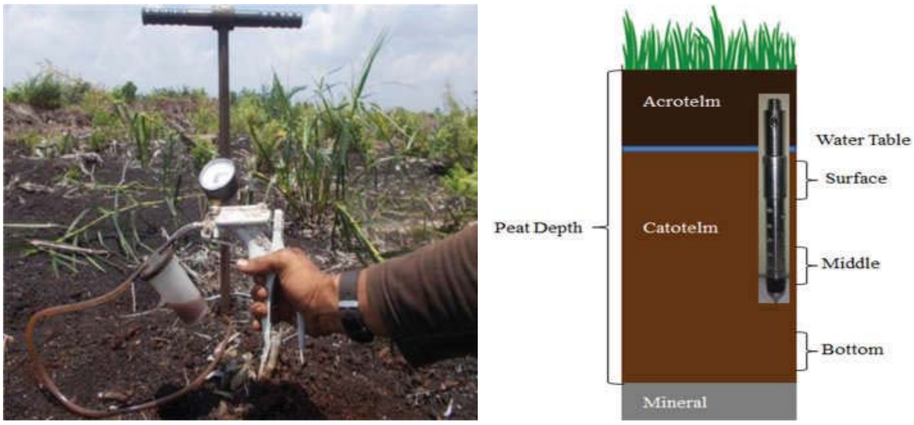
Table 1: Coordinate, land use, soil taxonomy and peat dept on peat pore water sampling.

No	Code	Coordinate (UTM 49M) X	Coordinate (UTM 49M) Y	Land Use	Soil Taxonomy (USDA 2010)	Peat Dept (cm)
1	AT1	332460	9964326	Secondary Forest	Fibric Haplohemists	360
2	AT2	330269	9965149	Secondary Forest	Hemic Haplosaprists	240
3	AT3	330667	9968380	Open	Hemic Haplosaprists	287
4	AT4	324243	9966844	Open	Hemic Haplofibrists	375
5	AT5	324809	9972593	Bush	Hemic Haplofibrists	184
6	AT6	321387	9977190	Agriculture	Typic Haplofibrists	525
7	AT7	312578	9972549	Young Rubber	Typic Haplofibrists	224
8	AT8	308643	9972775	Oil Palm	Typic Haplofibrists	210
9	AT9	306833	9973601	Oil Palm	Sapric Haplohemists	140
10	AT10	305618	9974373	Oil Palm	Sapric Haplohemists	177

Source: Field inventory, 2013

Peat pore water was carried out using the modified pore water sampling tools which plugged into the peat soil at a depth of 0.2 (surface); 0.5 (middle) and 0.8 (bottom) of peat depth below the water table. At this depth, the water inside of peat soil (pore water) was sucked using the manual hand pump (mityvac) which had been connected by the hose in pore water sampling.

The determination formulation of the depth of the peat soil pores water sampling were as follows:
Surface: 0.2 (PD-WT) + WT
Middle: 0.5 (PD-WT) + WT
Bottom: 0.8 (PD-WT) + WT; where:
PD: Peat Depth (cm)
WT: Water Table (cm)



A B

Figure 1: Peat pore water sampling using modified pore water sampling. A: Peat pore water sampling. B: The depth of the peat pores water sampling.

We used TOC-VCPH (SHIMADZU) to measure DOC concentration. All pore water samples were filtered with pre-combusted Glass Microfiber Filters Whatman GF/G 47 mm Ø with pore size of 0.7 µm. We also measured rubbed fiber contents (Andriesse, 1988). We used T-test and oneway ANOVA to analyze differences of DOC concentration according to corresponding land uses. Correlation of fiber content to DOC was analyzed by simple linear regression.

RESULTS AND DISCUSSION

Average DOC concentrations in dry and rainy seasons were 58.4±15.65 mg/l, and 54.63±14.77 mg/l. T-test result shows indifferent between DOC concentrations in dry and rainy seasons (See Figure 2).

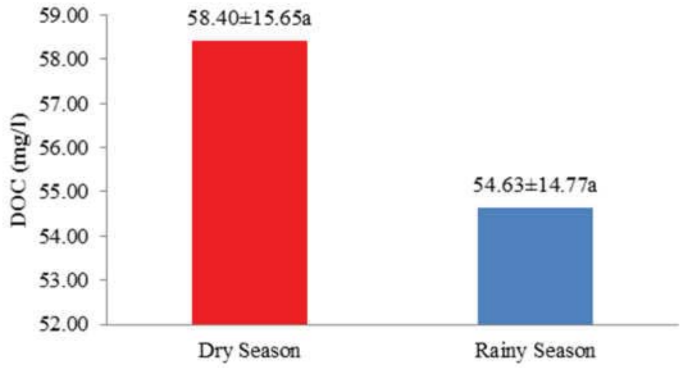


Figure 2: A record of average DOC concentrations.

Profiles of DOC concentrations in dry and rainy seasons showed a descending pattern from surface to bottom layers. These were 66.62 mg/l, 56.69 mg/l, and 51.89 mg/l in dry season, and these were 61.58 mg/l, 53.27 mg/l, and 49.04 mg/l in rainy season (See Figure 3). Result of Anova on these DOC profiles was not significantly different. A decline of DOC in bottom layer suggests different rates of peat decomposition from surface to bottom. Decomposition is more active in the surface than in the bottom.

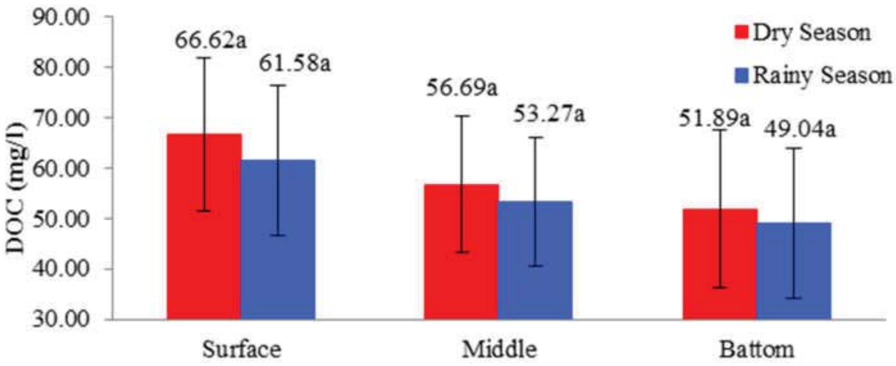


Figure 3: Profiles of DOC concentration.

Figure 4 presents total DOC concentrations of dry and rainy seasons on land uses. Higher DOC values were recorded at young rubber plantation and secondary forest than at other sites, but palm oil is quite as well. This suggests that DOC concentrations tend to decrease due to intensive land cultivation (Kalbitz *et al.*, 2000). Young rubber plantation is freshly disturbed peat, so releases the most DOC from the peat solid due to oxic conditions and microbial activity.

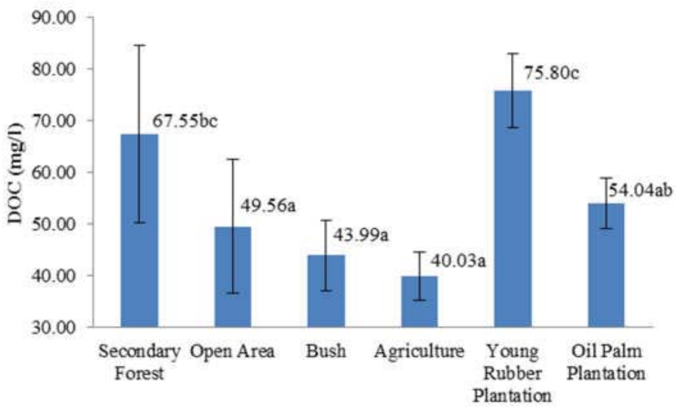


Figure 4: The Average DOC concentrations depending on land use.

Ranges of DOC concentration and fiber content on this research were 24.10-87.74 mg/l and 15.28-85.71 %. Average of DOC concentration was 56.51 mg/l and average of fiber content was 48.64 %. The fiber content is illustration from degree of peat decomposition (Andriesse, 1988), and the degree of peat decomposition is a genetic differentiation of Histosols or peat soil (Soil Survey Staff, 2010). Pearson correlation between DOC concentration and rubbed fibers is negatively significant, with an correlatiion value -0.49 or $R^2 = 0.236$. A simple linear regression suggests that high rubbed fibers produce low DOC, and vice versa (See Figure 5). Gandois et al. (2012) also reported DOC production is correlated with degrees of peat decomposition.

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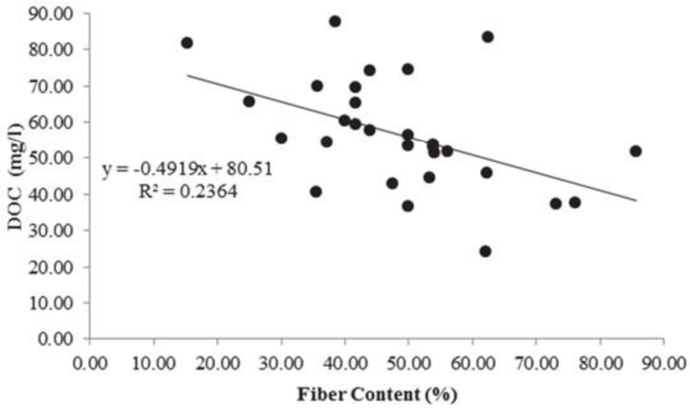

Figure 5: A simple linear regression between rubbed fiber content and DOC concentration.

CONCLUSIONS

This research shows that DOC production has a moderately negative correlation with rates of peat decomposition. Degrees of peat decomposition, however, are very complex because of limit to peat growths. Therefore, DOC is more produced in recently disturbed peats than old disturbed peats. This also implies that peat decomposition is constrained by internal factors of peats, as organic compounds in peats have different degrees of resistance to disturbances.

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