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31 THE REGIONAL OF WATER QUALITY DISTRIBUTION OF PEAT SWAMP LOWLAND IN JAMBI*)

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Abstract. In Jambi province, peat water is distributed in lowland region of West Tanjung Jabung, East Tanjung Jabung, and Muaro Jambi Regencies. Peat water is used for agriculture, rice field, and as a source of clean water for people, while the peat water contains organic matter, Fe, and acids. The purpose of this research was to determine quality peat water scattered in swamps of Jambi. The parameters tested were TDS, color, pH, Fe, Mn, organic matter and nitrate contents. Sampling method used was non probability with purposive sampling technique. The total number of samples was 15, and each region had five sampling points. The samples were collected compositely. The results showed that the parameter values during wet season varied widely, where TDS, Fe, Mn, organic matter, and nitrate values were 0.17-277, 0.382-4.932, <0.003-0.282, 23.00-221, and <0.0006-0.3888 mg/L, respectively, and color and pH values were 17-1065.08 Pt.Co and 3.53-6.90). During dry season, the values of TDS, Fe, Mn, organic matter, and nitrate were 0.29-524, 0.429-5.57, -0.800, 29.29-208.91, and -0.5436 mg/L, respectively, and color and pH values were 15.77 to 205.71 Pt.Co and 3.80 to 7.70. From the research results, it can be concluded that the quality of the swamp peat water of Jambi Province varied widely, however, there were no extremely high and very low values. Peat water quality was relatively different between rainy and dry seasons. The average values of peat water quality in the dry season were better than that in rainy season. The values were good while in the wet season and in dry season, the water was not feasible as a source of clean water for the community because they were still far below the water quality standard.

Keywords: Peat water, clean water, lowland

Abstrak. *Sebaran air gambut di daerah rawa Jambi terdapat di daerah Kabupaten Tanjung Jabung Barat, Tanjung Jabung Timur dan Muaro Jambi. Air gambut di daerah ini digunakan masyarakat untuk pertanian, persawahan dan sumber air bersih sehari hari. Tujuan penelitian ini adalah untuk mengetahui kualitas air gambut yang tersebar di daerah rawa Jambi dengan parameter uji adalah TDS, warna, pH, Fe, Mn, zat organik dan nitrat. Metode sampling yang digunakan non probability dengan teknik purposive sampling. Jumlah total sampel yang ditetapkan 15 titik sampling, dan masing-masing daerah terdiri dari 5 titik sampling. pengumpulan sampel menggunakan metode composit sampling. Hasil penelitian menunjukan bahwa pada musim hujan kandungan parameter air gambut yang tersebar di daerah Jambi sangat bervariasi; TDS 17 – 277 mg/L, Warna 23-1065,08 Pt.Co,pH 3,53 – 6,90, Fe0,382 – 4,932 mg/L, Mn<0,003 – 0,282 mg/L, zat*

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organik23,00 – 221 mg/L dan Nitrat <0,0006 – 0,3888 mg/L, sedangkan pada musim kemarau kandungan TDS 0,29 – 524 mg/L, warna 15,77 – 205,71 mg/L, pH 3,80 – 7,70, Fe 0,429 -5,57 mg/L, Mn 0,00–0,800 mg/L, Zat organik29,29 – 208,9 mg/L dan Nitrat (mg/L) 0,00–0,543 mg/L.Dari hasil telitian dapat disimpulkan bahwa kualitas air gambut di daerah rawa Jambi sangat bervariasi ada yang ekstrim tinggi dan yang sangat rendah. Kualitas air gambut relatif berbeda antara musim hujan dan musim kemarau, rata rata pada musim kemarau kualitas air gambut lebih baik dibanding dengan musim hujan, namun demikian baik pada musim hujan maupun musim kemarau air gambut belum layak untuk dikonsumi sebagai sumber air bersih masyarakat, masih jauh dibawah baku mutu air bersih.

Kata kunci: *Air gambut, air bersih, lahan rawa*

INTRODUCTION

Indonesia is one country in the world that has the largest peat swamp. Peat swamp in Indonesia is approximately 16-27 million hectares (Rieley *et al*. 1997, Sulistiyanto Y. *et al*. 2007). Of the area about 7.2 million hectares or 35% are located on the island of Sumatra, including Jambi region (Susanto 2010).

Jambi Province, one of provinces in Indonesia that located in Sumatra, with an area of 51,000 km^2, equivalent to 5.1 million hectares, is geographically located between 2^0 45 s/d 0^0 45 LS 101^0 0 between the LS and BT s/d 104^0 55 BT or between 0^0 45 2^0 45 LS and 101^0 0-104^0 55 East. The topography of the eastern province of Jambi is generally a swamp (lowland), while the West in general is the mainland (dry land) with topography varying from flat, undulating to hilly. The type of soil potential for agriculture in general dominated by Podsolic Red Yellow (PMK) that is equal to 44.56%. Other soil types are included Regosol Latosol 18.67% 10.74% Humus and Gley. Partly the temperate regions of Jambi B-type climate classification Schmidt and Ferguson with wet months between 8-10 months and 2-4 months dry season. The average monthly rainfall is 179-279 mm Jambi in wet and dry in 68-106 mm (PBS 2000).

Figure 1. Conditions peat water and houses on the edge of the village ditch Peat Gambut Raya in the Muaro Jambi

Three of the ten districts in Jambi provinsi lowland, namely Tanjung Jabung district of West, East and partly Tanjung Jabung the district Muaro Jambi. The total area of peatlands or wetlands contained in Jambi is 684,000 hectares. Of the land area has been successfully opened and developed as agricultural land until it reaches an area 252,983 hectares (Tanjung Jabung western area of 52,052 ha, 149,210 ha Tanjung Jabung East and District area of 10,7000 hectares Muaro Jambi. Land non tidal swamp located in the district covering Muaro jambi 17,900 ha. Batanghari 14,475 ha. Kerinci 1684 ha, ha Sarolangun 4,121. Merangin 436 ha and 2,405 ha Tebo regency (Bambang 2011).

Peat is an organic material that is formed from the incomplete decomposition of plants in wet areas is very moist and anaerobic conditions. Peat water is abundant surface water tidal areas, peat swamp and lowland, brownish red, acidic, having a high content of organic matter, do not meet water quality requirements set by the Ministry of Health through Permenkes No.416 / MENKES/PER/IX/1990 (Iva Rustanti, E. 1990; Yusnimar 2010; Naswir 2003). The acid has acidic character due to carboxylic and phenolic groups. That can be characterized as being generally be yellow-brown color, the acid are the main constituents of the dissolved organic carbon pool in surface waters, water grounds, commonly imparting a yellowish-brown to the water system (Macarty 2011 *in* Andayani 2011).

Organic content in the water is dominated by peat humic compounds which possess aromatic bond complex with functional groups such as-COOH, OH-phenolic and alcoholic OH and is no biodegradable. This trait also causes most of the water Organic peat decomposes naturally difficult. Organic content in the water to form potentially carcinogenic compounds peat include: THM (trihalomethane) in the process of disinfection with chlorine. Humic acid having a molecular weight 2,000-100,000 daltons, have the potential to form organochlorines such as THM and HAA (haloacetic acids) is relatively higher than non humus compounds (Zouboulis 2004).

Water quality peat differ from one region to another, depending on the condition and age of peat soil, such as water quality peat West Kalimantan has a turbidity of 60 NTU, color, 804 Pt.Co, pH 4.8, organic matter 246.8 mg/L (Rustanti 2009), while the water content of the peat area of Jambi has 952 Pt.Co color, pH 3.34 to 5.20, organic matter 332 mg/L (Naswir 2009).

This study aims to determine the water quality of spread peat in Jambi province and is expected to be a material consideration and guidelines to make the process of water treatment peat for water resources community. Data dissemination water quality peat can be used as consideration to provide proper treatment in accordance with such designation for the treatment of water for agriculture, rice and as a source of public water.

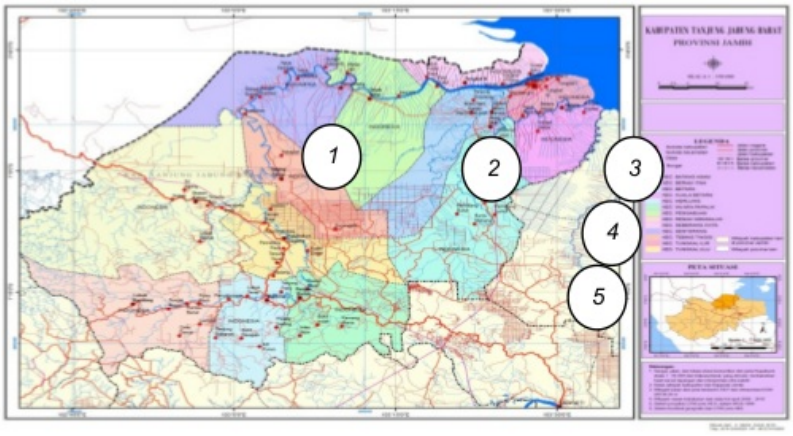
RESEARCH METHODOLOGY

Sampling peat water have taken from 5 points each region (Tanjung Jabung West, Eastern Jabung and Muaro Jambi district), so the total sampling points is 15 pieces. Sampling was carried out based on the theory of finite non probability with purposive sampling techniques, and the collection of composite sampling is done. Sampling locations are centered in the area of human settlements, the village there is a river or a ditch that drained peat water all the time. The sampling locations are presented in Table 1 and figure 1, 2 and 3.

Table 1. Location of sampling points

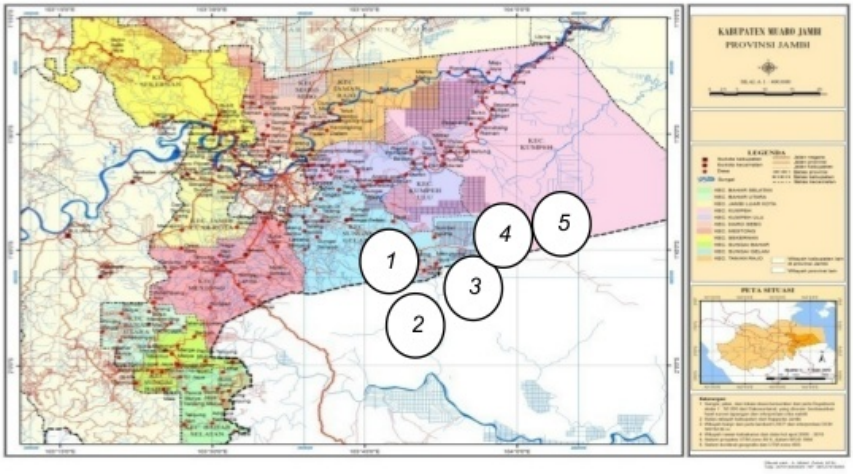
Area	No	Location of Sample	Coordinate	Remark
West Tanjung Jabung District	1	Bramitam/Bramitam Kiri	S 00º 52'.883" E 103º21'.925"	Tidal
	2	Sinyerang/Lumahan	S 00º 49'.667'' E 103º21'.764''	Pengabuan River and Tidal
	3	Teluk Nilau/Pengabuan	S 00º 55'.765'' E 103º21'.873''	pengabuan River and Tidal
	4	Betara/Mekar sari	S 00º52'.871'' E 103º21'.903''	Tidal
	5	Betara/Serdang jaya	S 00º 58'.805'' E 103º22'.795''	Batara River and Tidal
District Eastern Tanjung Jabung	1	Garagai/Pandan Lagan	S 01º24'.205'' E 103º42.106''	Peat Swamp
	2	Sabak Barat/Parit Culum	S 01º16.664'' E 103º45'.157''	Swamp Peat
	3	Dendang/Sido Mukti	S 01º13'.883'' E 103º53'.649''	Batanghari River
	4	Mendahara/Desa lagan Tengah	S 01º05'.877'' E 103º43'.168''	Swamp Peat
	5	Rantau Rasau/Rantau Rasau II	S 01º16'.445'' E 103º30'. 245''	Batanghari River and Tidal
District Muaro Jambi	1	Sungai Gelam/Tangkit Baru	S 01º 37'.765'' E 103º42'.128''	Peat
	2	Sungai Gelam/Gambut Raya Petaling	S 01º43'.117'' E 103º52'.406''	Peat
	3	Kumpeh/Arang Arang	S 01º 36'.796'' E 103º47'.951''	Batanghari River
	4	Kumpeh/Arang-Arang PKS	S 01º36'.165'' E 103º47'.470''	Batanghari River
	5	Teluk raya/Pematang Raman	E 01º045'.261'' S 101º22'.637''	Batanghari River

Map of sampling locations of West Jabung



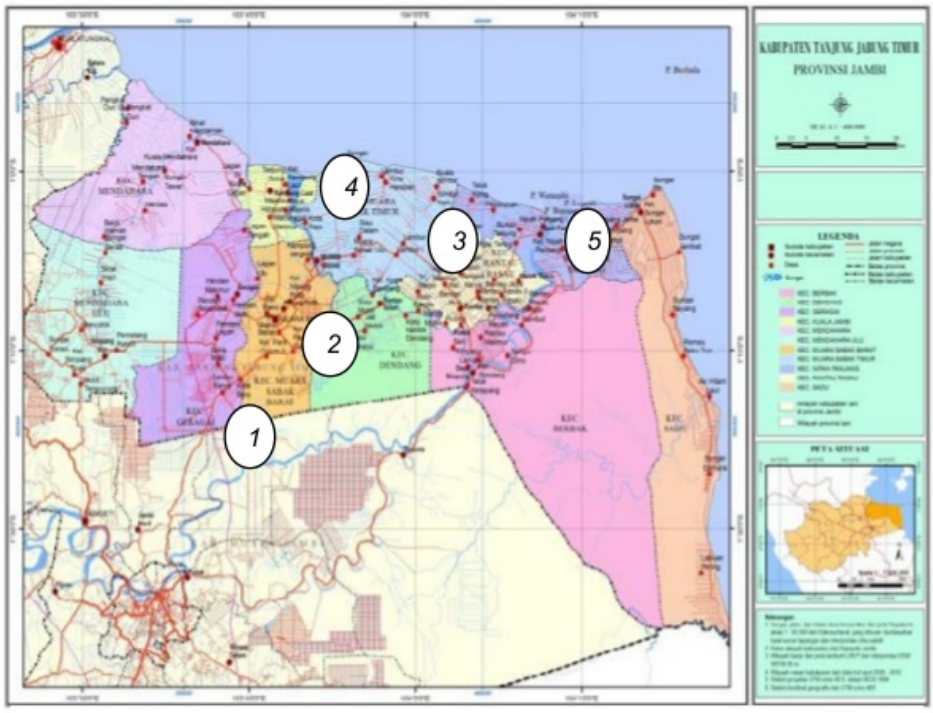
Note: 1 Senyerang village, 2. Sirindit village, 3. Bramitam village, 4. Mekar Sari village and 5.Serdang village

Map of sampling points at Muaro Jambi district



Note: 1 Tangkit Baru village, 2. Gambut Raya Petaling village, 3. Arang Arang village, 4. Arang-arang PT.Makin and 5. Teluk Raya/Pematang Raman village

Map of peat water sampling points at East Tanjung Jabung



Note: 1. Pandan Lagan village, 2. parit Culum village, 3. Sido Mukti village, 4. Lagan tangah village and 5. Rantau Rasau II village

Test parameters were used as indicator in this study is the content of TDS, color, pH, Fe, Mn, organic matter and nitrate. Test parameter measurements performed using PH meter instrument, gravimteri, UV-V is spectrophotometer and AAS. All examination conducted water quality peat refers to the Standard Methods for Examination of Water and Waswater.

RESULTS AND DISCUSSION

Based on laboratory tests on the parameters TDS, pH, Color, Fe, Mn, organic matter in peat water spread area of Jambi obtained results are very diverse and varied. Water quality peat between one location to another quite different, and each region has different characteristics from each other. Although peat water in the same area or the district but the content of the material has a striking content of each others. Data detailed measurement results are listed in table 2 and 3.

Table 2. The results of measurements of water parameters Jambi rainy season turf areas

Area	No	Parameters Location of sample	TDS mg/L	Color Pt.Co	pH	Fe mg/L	Mn mg/L	matter organic mg/L	Nitrat mg/L
District	A	Bramitam/Bramitam Kiri	40	326.7	4.03	4,932	0.282	221.86	0.1824
Tanjung	B	Sinyerang/lumahan	69	23.43	3.60	0.473	<0.03	74.31	0.0188
Jabung	C	Teluk nilau/ pengabuan	46	186.26	3.80	0.473	<0.03	93.02	0.1009
West	D	Betara/Mekar Sari	193	400.27	3.70	4,816	<0.03	196.62	0.1469
	E	Betara/Serdang jaya	23	38.40	4.50	1,939	<0.03	102.84	0.0383
District	F	Garagai/Pandan Lagan	32	908.23	4.00	1,237	<0.03	80.01	0.1886
Tanjung	G	Sabak Barat/Parit Culum	60	30.46	3.60	0.382	<0.03	96.72	0.0885
Jabung	H	Dendang/Sido Mukti	35	29.29	4.10	3,759	<0.03	102.07	0.0779
Eastern	I	Mendahara/ lagan Tengah	75	801.22	3.53	0.671	<0.03	67.80	0.2161
	J	Rantau Rasau/R. Rasau II	94	0.277	3.82	0.765	<0.03	23.00	<0.0006
District	K	Sungai Gelam/Tangkit Baru	29	29.39	6.10	0.645	<0,03	167.56	0.0370
Muaro	L	Sungai Gelam/Gambut Raya	277	1065.08	6.90	0.725	<0,03	77.57	0.3888
Jambi	M	Kumpeh/Arang Arang	18	41.311	5.9	1.751	<0,03	102.07	0.0442
	N	Kumpeh/Arang Arang	17	605.23	5.4	1.359	<0,03	65.36	0.1349
	O	Kumpeh/Teluk Raya	21	309	5.4	1.877	<0,03	125.20	<0.0006

Table 3. The results of measurements of water parameters Jambi season turf areas.

Area	No	Parameters Location of sample	TDS mg/L	Color Pt.Co	pH	Fe mg/L	Mn mg/L	Matter organik mg/L	Nitrat mg/L
West	A	Bramitam/Bramitam Kiri	524	16,77	6,64	3,88	ttd	126,85	0,0651
Tanjung	B	Sinyerang/lumahan	63	191,76	4,52	1,42	ttd	33,23	Ttd
Jabung	C	Teluk Nilau/ pengabuan	67	96,27	6,02	3,12	ttd	78,84	0,0507
District	D	Betara/Mekar Sari	345	45,23	5,25	2,25	0,80	116,0	0,0417
	E	Betara/Serdang jaya	85	24,26	5,13	3,04	ttd	85,04	0,1182
Eastt	F	Garagai/Pandan Lagan	183	15,17	3,80	1,56	0,58	29,29	0,0301
Tanjung	G	Sabak Barat/Parit Culum	36	112,21	6,45	3,65	Ttd	52,52	0,1080
Jabung	H	Dendang/Sido Mukti	382	117,23	4,66	2,04	0,75	150,07	0,0917
Distric	I	Mendahara/Lagan Tengah	289	196,77	4,71	4,23	0,53	63,42	0,1531
	J	Rantau Rasau/R. Rasau II	28	205,71	5,24	5,57	ttd	80,45	0,2714
Muaro Jambi District	K	Sungai Gelam/Tangkit Baru	46	121,28	3,80	0,493	ttd	208,91	0,0969
	L	Sungai Gelam/Gambut Raya	59	69,502	3,87	0,429	ttd	68,69	0,2537
	M	Kumpeh/Arang Arang	30	200,209	7,52	1,946	ttd	70,58	0,0558
	N	Kumpeh/Arang Arang Ujung	36	180,21	7,32	4,73	ttd	55,24	0,5436
	O	Teluk raya/Pematang Raman	34	142,33	7,70	3,71	ttd	92,78	0,0597

Water quality peat in each region are very varied and unique, both season and dry season. The rainy season usually occurs from October to early June, and the dry season which usually occurs in mid-June to late September, but because climate change is happening is that the world today is no longer stable.

The results showed that the content of the wet season parameters; TDS (mg/L) 17 to 277, Color (Pt.Co) 0.277 to 1065.08, pH 3.53 to 6.90, Fe (mg/L) 0.382-4.932, Mn (mg/L) <0.003 to 0.282, organic matter (mg/L) 23.00 to 221 and Nitrate (mg/L) <0.0006 to 0.3888, while in the dry season TDS content (mg/L) 29 to 524, color (Pt.Co) 15.77 to 205.71, pH 3.80 to 7.70, Fe (mg/L) 0.429 -5.57, Mn (mg/L) Signed-0.800, Organic matter (mg/L) 29.29 to 208.91 and Nitrate (mg/L) Signed -0,5436 mg/L

Content of suspended substances and extreme colors of the region, the village of Gambut Raya Petaling District of Muara Jambi River District Gelam has a TDS content of 277 mg/L and the color of 1065 mg/L, and the peat water from the village of Tanjung Jabung Mekar Sari West has a TDS content of 193 mg/L and the color of 400.27 mg/L, and the peat water village Bramitam TDS 40 mg/L, while the TDS content in other villages under the average of 0.90 mg/L. Judging from the physical properties of high TDS content was positively correlated with peat water color, the more concentrated the higher TDS water peat 326.7 mg/L. However, TDS is not always correlated with color, water color is more brown peat but small TDS, the water in the peat charcoal is charcoal color 605.23 mg/L, while TDS 0.17, then the village of Middle Lagan 801.22 Pt content of color . Co. while TDS 0.32 mg/L, and the village of Pandan Lagan peat water content Garagai color and TDS Pt.Co 908.23 0.32 mg/L.

This means that water peat and brown colors are not necessarily concentrated solute contained therein is higher, because the substance dissolved in water is influenced by the presence of particles derived from organic matter, soil erosion, rainfall, etc., as well as the level of acidity (pH) iron content and other parameters. Peat water pH is influenced by the amount of pyrite and organic substances contained in the soil, the higher the organic matter and pyrite the rate the higher the acidity. Peat that has been processed and will have good drainage resulted in increased acidity of the peat water, as much pyrite are silent on the surface will rise up and out, up there on the surface of pyrite oxidation, and produces hydronium ions and sulphate ions as one indication of the acidity of peat water. The quality of water color cast Jambi peat areas can be described as follows:

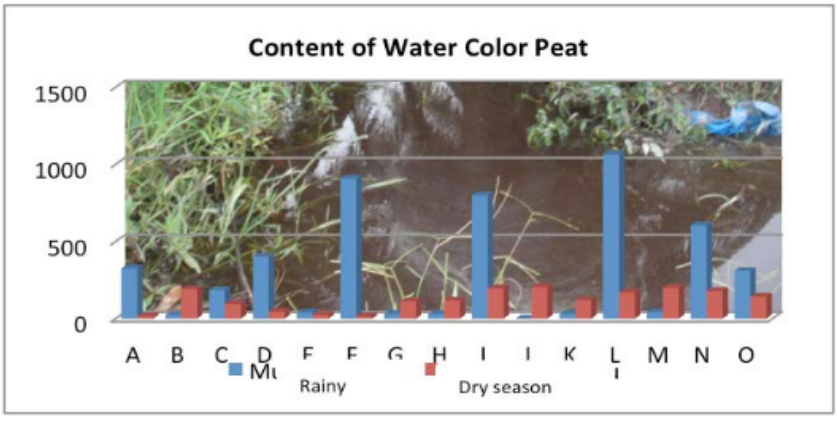


Figure 2. The distribution of the color content of peat water area of Jambi

Peat acidity (pH) in the rainy season varies, the average is acidic with a pH of 5.9 to 3.53, except in Tangkit baru and Gambut Raya village to Gelam River district near neutral pH content of the pH 6.1 and 6.9 . In the dry season the average peat water quality

is relatively better than the dry season, the level of acidity (pH) TDS, organic matter and other parameters tends improved, pH peat water in the dry season is quite good even relatively neutral pH values above 7.0 (peat water from village Gambut Raya pH 7.9).

Figure 3. Water conditions in the residential community Gambut Raya village and New Tangkit village In Muaro Jambi District

The improvement in water quality in the dry season turf caused by the absence of organic substances seepage and other materials that are dissolved from the peat soil around the trench or the forest peat drift and go ke badan river in peat areas, while in the rainy season, organic substances and materials dissolved in peat and peat forest much carried away or seeps into streams and ditches around it.

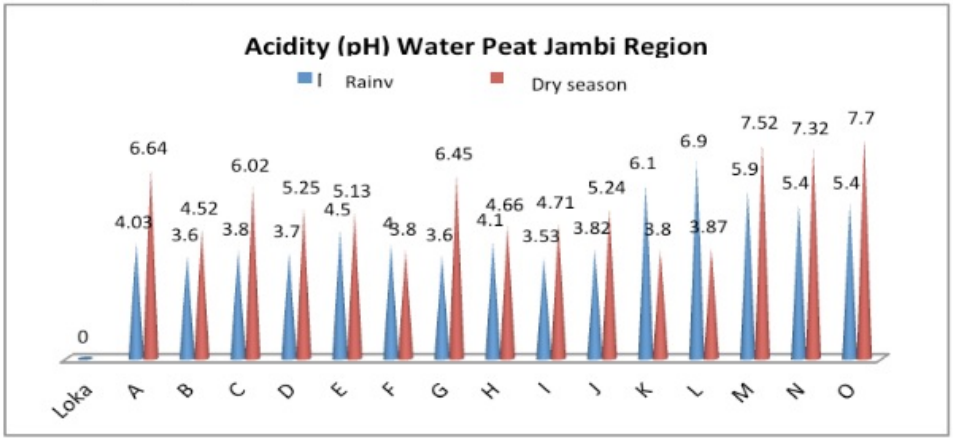


Figure 4. Distribution of water acidity of peat area of Jambi

According Sulistiyanto *et al*. (2007), that the pH in forested areas is higher than the pH of the water in the peat, because pristine forests its soil still contains many cations cations such as Ca, Mg, and K which can increased alkalinity of soil and water properties (Veneklaas *et al*. 1990 in Sulistiyanto 2007)

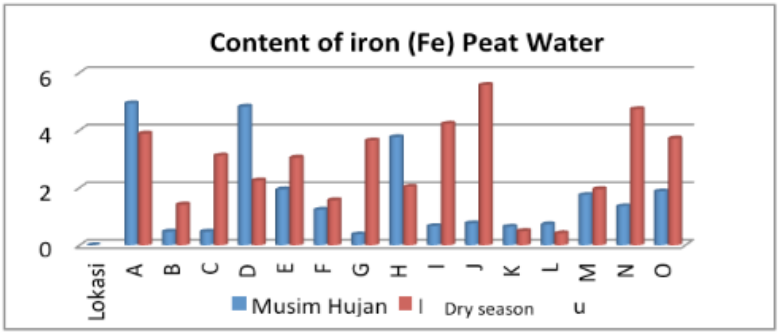


Figure 5. Distribution of iron (Fe) content in the peat water area of Jambi

Content of iron (Fe) in the area of Jambi peat water well in the wet season and the dry season are relatively high average and far above the water quality standard set, even in the seacoast village of Rasau its Fe concentration up to 5.50 mg/L and in the village of Tanjung Jabung Bramitam its western Fe 4.93 mg/L.

Increased acidity of peat water alongside the elevated levels of iron. Acidity and increased Fe ions on peat water are the result of compound pyrite (FeS_2) is oxidized in an aerobic atmosphere. Oxidation of pyrite produces sulfate ions (SO_4^{-2}) and a hydronium ion (H^+), the two ions to form sulfuric acid. In the peat soil drainage does not exist, or peat, which has not been processed, yet reclaimed its pirit not oxidized, so did not form sulfuric acid, generally near neutral pH water. Oxidation of pyrite and the formation of sulfuric acid in the peat water (Achmad, 2004).

$$FeS_2 + 2O_2 + 3{,}5\ H_2O \longrightarrow Fe(OH)_3 + 2(SO_4^{-2}) + 4H^+$$

Pirit oksigen water — Feroi (III) sulfation hidronium (acid)

In addition to sulfuric acid, there is also another type of acid that may exist in the peat water is carbonic acid ($2HCO_3^-$). Carbonic acid in water from exposed soils containing $CaCO_3$ fogginess then reacts with CO_2 gas from the reaction of photosynthesis in aquatic biota to form H_2CO_3, and can cause acidity in the peat water. And the difference in the acidity of peat water also caused by the structure of the soil, calcareous soil acidity is usually lower than the calcareous soils

Content of organic matter in peat water spread area of Jambi differ from one location to the other location, there are extreme high organic matter content of the rainy season as the village Bramitam with organic substances 221.86 mg/L and in the dry season in the village Tangkit the new organic substances 208.90 mg/L.

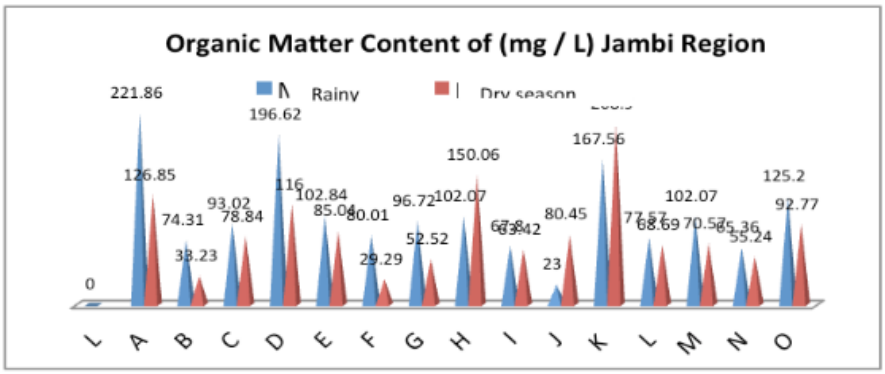


Figure 6. Distribution of organic matter content of peat water area of Jambi

Peat is an accumulation remnant vegetation that has died and then broken down by anaerobic and aerobic bacteria into components that are more stable. In addition to organic matter that forms peat are also inorganic substances in small quantities. In the environment of deposition of peat more than 90% under water-saturated conditions (Sukandarrumidi, 1995). Conditions peat water used by the people in the Jambi quite alarming, Figure 2 shows the peat water used for domestic needs and places of worship/musholla Tangkit area Muaro Jambi regency. Water quality is also affected by peat rainfall, heavy rainfall led to many matter to dissolved organic matter in the soil and washed away to river, so the water is brown and peat over the higher acidity. Lots of organic matter and peat water acidity is a picture of many organic acids or acid content of peat water, the humic acid and fulvic.

Humic acid is formed from the decomposition of organic material by aerobic organisms. This acid has a molecular weight of 10,000 to 100,000 g/mol (Toshiyuki *et al.* 2004). Humic acid is an organic compound that is very complex aromatic macromolecules, have a variety of colors ranging from brown black to gray. has aromatic bond length and no biodegradable (can not be degraded by microorganisms), which is the result of oxidation of lignin compounds (phenolic group). This acid is not soluble in water under conditions pH <2 but soluble in the higher pH. Figure 1 shows the model structure of humic acid.

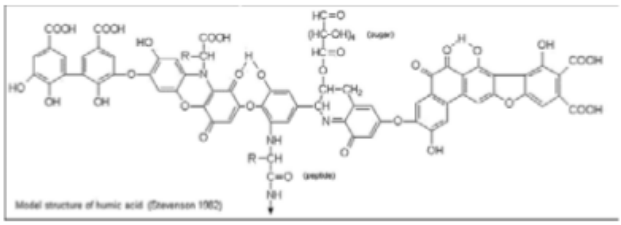


Figure 7. Humic Acid Structure Model (Stevenson 1982)

Fulvic acid is an organic acid naturally occurring compounds derived from humus, insoluble in water, often found in surface water with low molecular weight that is between the range of 1,000 to 10,000 (Toshiyuki, *et al.* 2004 and Sarah D *et al.* 2004). It is soluble in water at all pH conditions and will be in the solution after the removal of humic acid by acidification process. Its color varies from yellow to brownish yellow. Fulvic acid model structure can be seen in Figure 8.

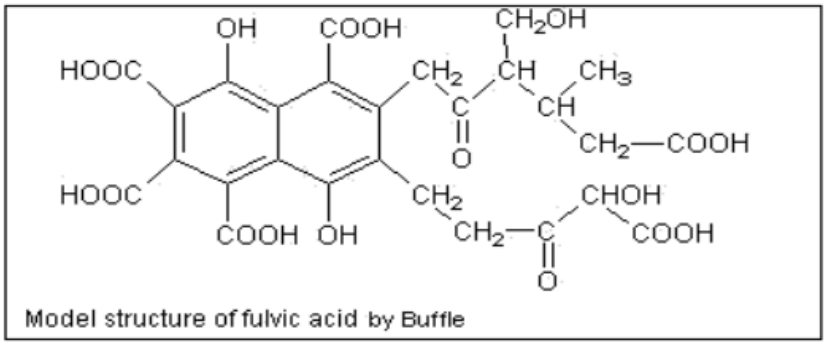


Figure 8. Model structure of fulvic acid by buffle

Acid water is formed in the environment from carbon dioxide (CO_2) derived from the degradation of organic compounds by bacteria and of algae, CO_2 produced by the process of photosynthesis with the help of sunlight. Humic acid and fulvic acid into the peat water is through rain water that flows into the pores of the peat soil. With the inclusion of peatland water inundation occurs and water-saturated peat, peat long submerged will experience the process of weathering and leaching of organic materials. Humus humus that exist in plants and organic materials in long enough to form humic acid and amino fulfat that ended up being the component that causes the water acidic peat. Fulvic acid is more complex plays an important role as a chelating agent. Cluster of phenolic and carboxylic fulvic acid forming a claw that has a very strong affinity for trivalent metal ions such as Al^{3+} and Fe^{3+}. Solid compounds and solutions of fulvic acid with Al^{3+} or Fe^{2+} form chelates can reduce environmental pollution caused by the solubility of the ions. Bourbonniere and Creed (2006), states that humic and fulvic acids that exist in water peat soil can donate a negative charge and acts as an organic colloids.

CONCLUSION

From the research it can be concluded that the peat water quality of the swamps spreaded in Jambi Province varied widely and no value was extremely high and very low. Contents of TDS, color, pH, Fe, Mn, organic matter, and nitrate of the peat water in Jambi region were relatively different between the rainy and dry seasons. The wet season values were

17-277 mg/L TDS, 17-065.08 Pt.Co color,, pH of 3.53-6.90, 0.382- 4.932 mg/L Fe , <0.003-0.282 mg/L Mn), and 23.00-221 mg/L organic matter. While in the dry season TDS content (mg/L) 0.29 to 524, color (Pt.Co) 15.77 to 205.71, pH 3.80 to 7.70, Fe (mg/L) 0.429 -5.57, Mn (mg/L) Signed - 0.800 and Organic matter is 29.29 to 208.91 mg/L. the average water quality in the dry season turf better than the rainy season. The water qualities were good in the wet season and it was not feasible as a source of clean water for the community in the dry season. The values were still far below the water quality standard.

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