

Study on Groundwater Quality in Concern to Potent Pollution at Secondary Block P17-5N Delta Telang II (Case Study of Muliasari Village, Tanjung Lago Banyuasin District, South Sumatera Province Indones

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Study on Groundwater Quality in Concern to Potent Pollution at Secondary Block P17-5N Delta Telang II (Case Study of Muliarsi Village, Tanjung Lago Banyuasin District, South Sumatera Province Indonesia)Lilian Novarika¹, Robiyanto Hendro Susanto², M. Faizal³ Poedji Loekitowati Hariani^{4*}¹Student at Environmental Management Program, Graduate Program, Universitas Srinwijaya, Padang Selasa Street 524 Bukit Besar Palembang 30139²Soil Science Department, Faculty of Agriculture Universitas Srinwijaya, Inderalaya, Ogan Ilir, 30662³Chemical Engineering Department, Faculty of Engineering Universitas Srinwijaya, Inderalaya, Ogan Ilir, 30662⁴Chemistry Department, Faculty of Mathematic and Natural Science Universitas Srinwijaya, Inderalaya, Ogan Ilir, 30662*Corresponding Author: pujilukitowati@yahoo.com

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Abstract

Research had been carried out on tidal marshes condition at tertiary channel Muliarsi Village and the effect of land user behavior on water and soils quality. The aimed of research is to evaluate water and soil quality and potent pollution due to fertilizer and pesticide utilization. The research methods are survey and qualitative approach using observation and directed interview with questionnaire aid. Water and soils samples were taken by purposive sampling method. Measurement obtained soils has pH 4.59 and 3.92 for TC4 and TC5 respectively. Cation exchange capacity is 21.65 mg/100 g or TC4 and 20.62 mg/100 g for TC5. C-organic contained in both TC4 and TC5 are very high whereas Total-N is moderate hence ratio C/N has moderate value. P₂O₅ detected as 81.55 ppm at TC4 and 36.06 ppm at TC5. According to Soils Research Centre Bogor, TC4 and TC5 has moderate value of N (35%) while P and K very high (81.55 ppm and 103.32 ppm). Scoring result concluded that soils is in good health and has 76% (TC4) and 73% (TC5). Storet method confirmed score result for soils as B-class or in good condition. According to these result, TC4 and TC5 of Muliarsi Village was lightly polluted and still has good prospect as crops land

Keywords: Tidal zone, Water quality, pollution

Abstrak (Indonesian)

Telah dilakukan penelitian tentang kondisi lahan pasang surut di saluran tersier TC4 dan TC5 Desa Muliarsi dan pengaruh penggunaan lahan oleh petani terhadap kualitas tanah dan air. Penelitian bertujuan mengevaluasi kualitas air dan tanah serta potensi pencemaran karena penggunaan pupuk anorganik dan pestisida. Metode yang digunakan adalah metode survei dan pendekatan kualitatif dengan observasi dan wawancara. Sampel tanah dan air diambil pada dua stasiun dengan metode *purposive sampling*. Hasil pengukuran menunjukkan pH tanah TC4 dan TC5 4,59 dan 3,92. Kapasitas tukar kation 21,65 mg/100 g di TC4 dan 20,62 mg/100 g di TC5. Kandungan C-organik TC4 dan TC5 sangat tinggi dan kandungan N tergolong sedang sehingga C/N tergolong sedang. Kandungan unsur N-total tanah TC4 dan TC5 bernilai sama 0,35%. Kandungan P₂O₅ tersedia 81,55 ppm TC4 dan 36,06 ppm TC5. Berdasarkan kriteria Pusat Penelitian Tanah Bogor, TC4 dan TC5 memiliki kadar N sedang (35%), P dan K sangat tinggi (81,55 ppm dan 103,32 ppm). Hasil skoring menunjukkan tanah tergolong sehat dengan persentase 76% pada TC4 dan 73% pada TC5. Hasil skoring air tanah menurut metode storet bernilai -6 termasuk kelas B atau baik. Desa Muliarsi TC4 dan TC5 disimpulkan tergolong tercemar ringan dan dapat digunakan untuk pertanian.

Keywords: pasang surut, kualitas air, pencemaran

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INTRODUCTION

Areas consider as wetlands in Indonesia was estimated to be 20.6 million hectares or approximately 10.8% of Indonesia's land [1]. Tidal marshes one kind of wetlands are defined as wetlands commonly or constantly flooded with water, characterized by growing soft-stemmed vegetation amended to saturated soil conditions [2]. Wetlands generally is used as crops land or plantation. Plantation in this area includes palm, rubber whereas crops are usually paddy, corn, fruit and other horticultures [3]. In order to increase the productivity of land in tidal zone, water management plays important role. Productivity of paddy field can be increase by several factors one of them is better management of water supply. The main obstacle found in tidal zone is low pH of soil due to formation of oxidized pyrite layer. Acidity higher than allowed threshold limit the availability of trace elements such as P, K, Ca and Mg. On the other hand, high level of salt concentration in the soils came from intrusion of salt water can covered large area due to flat land topography. High concentration of salt in the soils not only can disturbed rooting system performance of the plant but also responsible for cell plasmolysis which in turn cause plant death [4].

Paddy field and other crops land developed in Muliarsi village are considered to contribute to environmental pollution due to excessive use of inorganic fertilizer and pesticides. Calaris with active ingredient atrazine is one of herbicide used to exterminate weed especially on corn field. Chlorantranilipole containing insecticide namely Prevathon 50 SC is used to control rod borer of paddy. To increase land fertility of paddy, corn and water melon, inorganic fertilizer is widely used in the area concern such as NPK type (Nitrogen-Phosphor-Potassium).

In addition to herbicide and insecticide, farmer also used pesticide to protect crops from plant disturbing organism (PDO). The pesticide utilization by farmer generally conducted without proper control and higher than dosage allowed as instructed [5]. The negative impact of pesticide to sensitively plant is irregular and early maturation symptoms, biomass lost and plant death [6]. Highly dose of pesticide and inorganic fertilizer used on crops, as a matter of fact does not correlate to higher productivity of the land. According to farmer perception on crops production process, organic system prefers to maintaining land quality and fertility, biodiversity of paddy field and also reduced environmental pollution of the area [7]. To evaluate damage caused by utilization of fertilizer and pesticide, study on ground water quality in concern to

potent pollution derived by pesticides and fertilizer was conducted. The environmental impact on crops especially paddy, corn and water melon are also outlined.

EXPERIMENTAL SECTION

Research was conducted using survey method and qualitative approach. Observation strategy combined with questionnaire aid on directional interview were applied to gather primary data. Sampling location were carried out at 2 (two) stations, each station was divided into 3 plots. Samples were taken from each plots at three sample points and consist of water and soil. Water sampling method was performed according to procedures on SNI 06-689.11-2004; SNI 06-2480.1991; SNI 06-6989.9:2004; SNI 6989.4:2009; SNI 6989.5:2009. Soil samples was taken by using purposive sampling method i.e. extraction points were chosen at 0-20 cm in depth. The samples were treatment further and made in form of composite. Data analysis was carried out using descriptive technique. Evaluation of water quality data was conducted by Storet method. Measurement result was compared with standard quality threshold according to Governor of South Sumatera provision no. 16/2005 on Water Allotment and River Quality Threshold. Soil analysis result was evaluated by referring to criteria formulated by institution of concerned [8,9]. Methods conducted to gather data required in this research were filling questionnaire and directed interview. Respondent were residents in the area and invited to be interviewed at night.

Research location is one secondary block depicted on Figure 1, whereas water sampling location is depicted on Figure 2. Point of sampling for water at TC4 and TC5 are display on Figure 3. The water sample was subjected to analysis for several chemical parameters including pH, Fe, Mn, NO_3 and NO_2 .

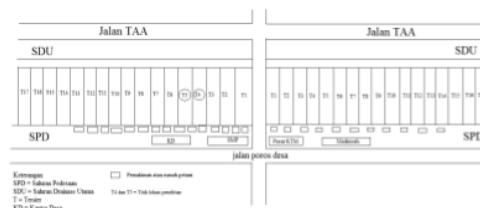


Figure 1 Secondary block of Muliarsi Village

RESULT AND DISCUSSION

Ground Water Quality at Muliarsi Village

Water quality in location research was affected by tide. The quality was concerned with compatibility on its amount, duration time and availability frequency. Its

quality and availability will influence the utilization on crops and daily use. In addition to tide as water resources, residents also used rain water as alternative resources. Climate condition obviously is major influence on rain water availability. Rainfall data from 2015 to 2016 at Muliasari Village Tanjung Lago district was taken from Climatology station located at Kenten Palembang (Figure 4).

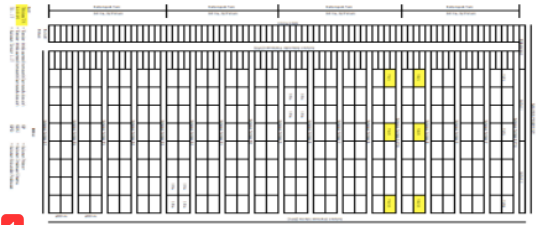


Figure 2 Water sampling location at TC4 and TC5



Figure 3 Research location (a) TC4 and (b) TC5

In 2016, Tanjung Lago experienced rain season for 4 months (rainfall > 200 mm per month) and dry season for 5 months (rainfall < 100 mm per month). Data obtained concluded the minimum rainfall at 1,00 mm on February and maximum rainfall at 251.30 mm on September. In 2015, rain season was lasted only for 3 months whereas dry season happened for 9 months. Months without rain (0 mm per month) was happened on September and October but reach maximum at 304.20 mm per month on April. Figure 4 shows monthly uneven rainfall throughout the year which caused difficulty on water availability and utility for land watering. Highly rainfall might create a water pool which bad for several plants but lowly rainfall made plants more severe and hinder its growth.

Provided that water supply from rain and irrigation is limited, Plants are absorbed water optimally through capillary motion if the water source located less than 100 cm in depth [10]. Ground water depth observe can be tolerance if it located no deeper than 110 cm. Capillary motion of water is able to afford water supply for almost all plants. In dry condition where ground water depth observe is down to 150 cm, the

contribution of ground water to supply water approximately 65% of potential evapotranspiration need [11].

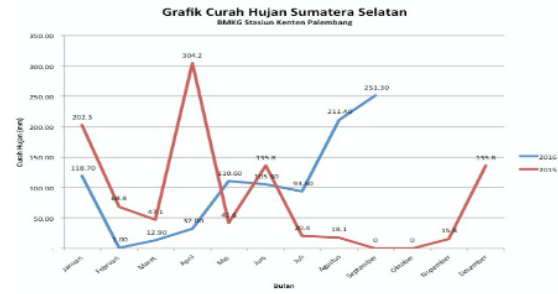


Figure 4 Rainfall data at Tanjung Lago district year 2015 and 2016

Chemical analysis on water was carried out to determine whether the water fulfill the requirement stated on Governor's provision or not. Result displays on Table 1 is scored and confirmed to be polluted or clean.

According to Table 1, water sample has low pH, high content of Fe, Mn, NO₃ and NO₂. Other researcher [12] reported the same result of high content on Fe. Fe has roles in electron transport, it is also important component on formation of ferredoxin protein, involved in protein synthesis and development of root apical meristem. Scoring index for chemical analysis result was referred to Storet system. By using this system, we are able to assess how polluted environment by comparing it with quality threshold provisioned by the government.

Result shows water at TC4 and TC 5 has score -6 (range from -1 to -10) which categorized as class B. The score indicates TC4 and TC5 has lightly polluted water and still available for farming land but with caution. In order to be used in proper and sustainable amount, farmer has to give attention on water inlet and tertiary channel condition from excessive use of inorganic fertilizer and pesticide.

Soil Fertility Indicator

Effort on creating crops land at tidal zone to produce paddy and horticultures need to be maintained it continuity by regularly evaluate land healthy and recovery. Soil healthy indicator in this research includes chemical properties of land; pH H₂O, CEC, C-organic, Total-N, availability of P₂O₅ and K₂O. Table 2 and 3 show these parameters for soil sample obtained.

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Tabel 1. Water quality status at Muliarsari Village (TC4 and TC5)

Chemical parameter	Class IV quality threshold	unit	Average result			
			TC4	Score	TC5	Score
pH	5-9	4 -	3,73	-6	3,76	1
Fe	-	mg/L	0,10	0	0,63	0
Mn	-	mg/L	0,02	0	0,03	0
NO ₃	20	mg/L	0,09	0	0,09	0
NO ₂	-	mg/L	0,03	0	0,04	0
Sum				-6		-6

Table 2. Analysis result of soil samples from TC4 and TC5 Muliarsari Village

Lokasi Penelitian	pH	Nilai	KTK (me/100gr)	Nilai	C-Org (%)	Nilai	N-Total (%)	Nilai	P ₂ O ₅ (ppm)	Nilai	K ₂ O (ppm)	Nilai	Total Nilai	%	Kelas
TC4	4,59	2	21,65	3	25,37	5	0,35	3	81,55	5	103,32	5	23	76%	Sehat
TC5	3,92	1	20,62	3	38,37	5	0,35	3	36,06	5	80,82	5	22	73%	Sehat

Keterangan: Sangat Sehat (SS)= >80%; Sehat (S)= 80-60%; Cukup Sehat (C)=60-40%; Kurang Sehat dan Tidak Sehat (TS)=<20%.

Table 3. Fertility evaluation criteria of soil at Muliarsari Village (TC4 and TC5)

Parameter	Titik Sampel Lokasi Penelitian			Rata-rata (TC4)	Titik Sampel Lokasi Penelitian			Rata-rata (TC5)
	TC4L1	TC4L9	TC4L15		TC5L1	TC5L9	TC5L15	
pH H ₂ O	4,43 (SM)	4,63 (M)	4,73 (M)	4,59 (M)	3,62 (SM)	3,97 (SM)	4,17 (SM)	3,92 (SM)
KTK (mg/100g)	20,45 (S)	23,85 (S)	20,65 (S)	21,65 (S)	20,35 (S)	21,25 (S)	20,25 (S)	20,62 (S)
C-Organik (%)	25,84 (ST)	25,28 (ST)	25,00 (ST)	25,37 (ST)	64,98 (ST)	6,22 (ST)	43,92 (ST)	38,37 (ST)
N-Total (%)	0,42 (S)	0,47 (S)	0,18 (R)	0,35 (S)	0,35 (S)	0,23 (S)	0,48 (S)	0,35 (S)
P ₂ O ₅ tersedia (ppm)	147,69 (ST)	63,29 (ST)	33,69 (9T)	81,55 (ST)	49,97 (ST)	27,58 (T)	30,61 (T)	36,06 (ST)
K ₂ O tersedia (ppm)	114,70 (ST)	112,27 (ST)	83,00 (ST)	103,32 (ST)	101,38 (ST)	74,28 (ST)	66,78 (ST)	80,82 (ST)

Sumber: Laboratorium Bioteknologi Lingkungan, Bogor (2016)

Keterangan : Sangat Rendah (SR); Rendah (R); Sedang (S); Tinggi (T); Sangat Tinggi (ST); Sangat Masam (SM); Masam (M).

According to table 2, soil pH at TC4 and TC5 are 4.59 and 3.92 respectively. This value confirmed that soil at the location is relatively acid. Acidity condition affect the chemical reaction occurred in soils hence the availability of nutrient. Average cation exchange capacity (CEC) shows medium value 21.65 mg/100 g at TC4 and 20.62 mg/100 g at TC5. CEC value according to previous report [13] has correlation to pH, if the pH relatively low (acid) than CEC will also has low value.

C-organic content at TC4 and TC5 of Muliarsari Village is relatively high whereas Total-N content is moderate. C/N ratio base on value above is calculated medium. TC4 has C-organic value 25.37% whilst TC5 has 38.37% indicate decomposing level still in progress or moderate. C-organic content in each soil horizon specify on how extent organic accumulation in the soils. C-organic is increase as the soil horizon located deeper. The existence of pyrite can interfere analysis result of C-organic due to advance oxidation of pyrite after C-organic run out by excess potassium dichromate. This

event could cause C-organic obtained higher than actual value.

Total-N of soils at TC4 and TC5 has moderate value 0.35%. Nitrogen mainly came from organic matters and fertilization residue. Decrease on Nitrogen content in soils generally due to land cultivation, microorganism activities or being washed-up by stream. In case of high Nitrogen content in the soil which generate acidity, lime addition can be considered to neutralize the effects [14]. Organic acids in large amount may cause poisoning and disturbed plant growth.

TC4 and TC5 have average P₂O₅ availability respectively 81.55 ppm and 36.06 ppm. Phosphor as well as Nitrogen originated from organic matters and fertilizer residue. Low content of Phosphor in soils might cause by Al and Fe fixation at low pH. To prevent such occurrence, farmer should carry out calcification prior fertilization on the land. Assessment on chemical properties and land fertility status was conducted by PPT Bogor according to parameters determined pH,

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soils CEC, C-organic, Total-N and availability of Phosphor. The assessment result was scored to classify land healthy and obtain 76% for TC4 and 73% for TC5. Land at TC4 and TC5 base on this score was concluded in good health. Maintaining land condition must be carried out by land users in order to preserved land capacity to grow plants.

Environmental Potential Pollution at Muliarsari Village (TC4 and TC5): Use of Inorganic Fertilizer

One of specific characteristic of tidal zone is high level of diversity on land fertility even in the same slot [15]. Analysis result of land nutrients content at Muliarsari Village is displayed on Table 4.

Table 4. Data Analysis result of N, P and K at Muliarsari Village (TC4 and TC5)

Location	Nutrients		
	Total-N (%)	P ₂ O ₅ (ppm)	K ₂ O (ppm)
TC4	0,35 (M)	81,55 (VH)	103,32 (VH)
TC5	0,35 (M)	36,06 (VH)	80,82 (VH)

Source: Laboratory of Environmental Biotechnology, Bogor (2016) (Criteria according to PPT, 1983) very low (VL); low (L); moderate (M); high (H); very high (VH);

Laboratory analysis result on Table 4 was interpreted using criteria formulated by Soils Research Centre Bogor (1983). Location area of research TC4 and TC5 has same Total-N content 35% and considered as moderate. P and K content measured as P₂O₅ and K₂O has very high value 81.55 ppm and 103.32 ppm for TC4 and 36.06 ppm and 80.82 ppm for TC5. High concentration of P₂O₅ in addition to lignocellulosic material decomposition also affected by soil acidity, flooded land and wetland. Phosphor availability is higher in wetland compare to dry land [16]. Soil acidity enhanced Al, Fe and Mn content in the land which can potentially bind Phosphor and make it harder for plant to absorb.

Results on Table 4 confirmed an optional effort at TC4 and TC5 of Muliarsari Village for fertilization according to Soils Research Centre Bogor. Both location (TC4 and TC5) need urea fertilizer to be added. Fertilizer SP36 also need to be added at TC5 while TC4 is not necessary. K₂O available in enough amount at both TC4 and TC5 so it won't need fertilizer addition.

Pesticides Utilization on Land

Pesticides is well known as chemicals used by farmer to exterminate bugs and enhance farm products. Despite its benefit, pesticides can also harmful to human being due to toxic properties if contained in fruit and vegetables. Residual threshold quantity of pesticide in crops land has been regulated by joined decree between

ministry of health and ministry of agriculture (No. 881/Menkes/SKB/VIII/1996; 711/Kpts/P.20/8/1996). Samples analysis of soils for pesticides Prevathon® contain active ingredient Chlorantranilipole and Calaris® contain active ingredient Atrazine is displays in Table 5.

Table 5. Analysis result of soils sample on pesticides

No	Test Sample	Aktive ingredient	(mg/Kg)	
			threshold	result
1	Prevathon®	Chlorantranilipole	0.01	0.02
2	Calaris®	Atrazine	0.01	0.04

Pesticide residue contained in soils at TC4 and TC5 apparently higher than allowed threshold. Chlorantranilipole has contents 0.02 mg/Kg and Atrazine has contents 0.04 mg/Kg all of above threshold 0.01 mg/Kg. Pesticides residue has polluted soils at TC4 and TC5 according to data above. Interview conducted to residents confirmed that farmer had used pesticides without dose recommended by user guide. To prevent negative impact of pesticides application, farmer should be trained on how to use pesticides safely and properly. Using natural pesticides such as bio pesticide should take into consideration for pest extermination purpose.

CONCLUSION

Score result for water quality at Muliarsari Village shows that TC4 and TC5 has -6 and categorized as B class. The area concluded as suffer from light pollution. Chemicals properties of soils indicate the soils is still in healthy condition and has 73% and 76% score for TC4 and TC5 respectively. Effort on maintaining and recovering land condition is needed in order to gain optimum productivity of land. Pesticides containing Chlorantranilipole and Atrazine was detected above allowed threshold i.e. 0.02 mg/Kg for Chlorantranilipole and 0.04 mg/Kg for Atrazine. The residual pesticide detected was above residual threshold quantity assigned by join decree of ministry of health and ministry of agriculture.

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