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by Restu Juniah

Research Article

Study of Chemical Characteristics of the Lambidaro River For Sustainable Environment

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ABSTRACT

Residents, who live along the Lambidaro watershed, generally use river water to meet their daily needs such as bathing, washing and latrines. Around of Lambidaro is a residential and industrial group such as rubber industry, workshop, home industry, and mining. The activities contained along the watershed can lead to an increase in river water pollution load which can be seen from chemical characteristics. Increased pollution loads can cause the river environment to be unsustainable for the community. Sustainable environment means that the environment as a provider of resources for human life is able to maintain its carrying capacity. The purpose of study is to determine the chemical characteristics of river due to sand mining activities for the environment sustainable. This research is using pollution index method with parameter of chemical characteristics measured that is pH, DO, COD, BOD_5, Fe, Mn, NH_4, Nitrate, and Nitrite. The results of analysis of water chemical characteristics of the river indicate that the part close to estuary of the river is in good condition indicating that the location is environmentally sustainable. Meanwhile, the upstream to the middle river body is in mild contamination condition which means that the river environment has been contaminated.

Keywords: chemical characteristics, Water River, pollution index

1. INTRODUCTION

River is defined as fresh water flowing from its source on land to and emptying in the larger seas, lakes or rivers [1]. Another definition of river is a natural or artificial water channel or container in the form of water drainage network along with the water, starting from upstream to estuary, with right and left boundary by line border [2]. Rivers are used as a source of water, for obtaining food, for transportation and defense purposes, as a source of hydropower for driving machinery, for bathing, and as a means of waste-disposal [3].

Palembang city is a riverbank city. One of the rivers in Palembang is Lambidaro river. The Lambidaro river is one of the Musi river basin systems. Along the Lambidaro watershed is a residential area, industrial groups such as rubber industry, workshop, home industry, and mining. The activities contained in the Lambidaro watershed impact on the degradation of river water quality. Waste into the river body such as household waste, mining waste, rubber industry waste, workshop and many others. Meanwhile, Lambidaro river water is used by the community to meet daily needs such as bathing, washing, and latrines. This will certainly have an impact on the people who use the water.

Mining activities is one of the activities that can be a source of pollutants for the Lambidaro River. Sand mining is a practice used to extract sand, such as on a river bed [4]. Mining activities can have an impact on the environment, especially the watershed environment. Environmental problems occur when the rate of extraction of sand, gravel and other materials exceeds the deposition rate. Soerjani et al argues that the taking and utilization of resources with technology or industrialization can degrade the quality of the environment [5]. These problems include the destruction of river ecosystems, degradation of quality of river water, increasing water pollution load, sedimentation, and others. Based on the opinion of Soejarni et al, the sand mining activities

of mining companies have the potential impact on the quality of the Lambidaro river.

Environmental problems caused by the exist various activities along the Lambidaro watershed can make this environment no longer sustainable. Sustainable environment here means environment that can maintain the carrying capacity of the environment as a provider of resources for human life. The one of river environment indicator be sustainable, if the quality of the river water is in a condition below the established water quality standard. The quality standard shall be a measure of the extent of living organisms, substances, energies, or components present or must exist and / or polluted elements present in water [6]. The quality of water quality can be seen from the biological, chemical and physical parameters. This paper will discuss the chemical nature of the Lambidaro river water for a sustainable environment. Water chemical characteristic measured include pH, DO, COD, BOD_5, Iron (Fe), Manganese (Mn), Free Ammonia (NH_4), Nitrate, and Nitrite.

2. EXPERIMENTAL SECTION

This research was conducted at Lambidaro River of Palembang City, South Sumatera. Sampling of river water is carried out at 5 points along the Lambidaro watershed as seen in Figure 1.

The next step after water samples that have been taken is conducted laboratory tests on water chemical characteristics. Chemichal characteristics of Lambidaro river water conducted by laboratory tests are pH, DO, COD, BOD_5, Iron (Fe), Manganese
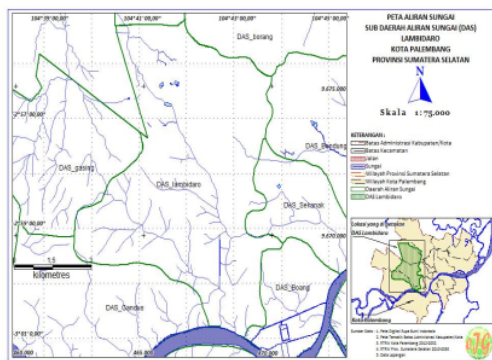
Figure 1. Research Location Lambidaro River [7]

(Mn), Free Ammonia (NH_4), Nitrate, and Nitrite. The next step is to conduct water quality analysis of this river using pollution index method [8].

$$PI_j = \sqrt{\dfrac{\left(\dfrac{C_i}{L_{ij}}\right)^2_M + \left(\dfrac{C_i}{L_{ij}}\right)^2_R}{2}} \qquad (1)$$

where:

PI_j = Pollution index for designation (j)

L_{ij} = Concentration of water quality parameters

C_i = Concentration of water quality parameters

$(C_i/L_{ij})_R$ = value (Ci/Lij) on average

$(C_i/L_{ij})_M$ = value (Ci/Lij) on maximum

The pollution index method can directly relate the level of contamination to whether or not a river is used for a particular use and with the value of certain parameters. Determination of status of river water quality can be seen based on pollution index criteria as follows:

$0 \leq PI_j \leq 1.0$ comply quality standard (good condition)

$1.0 < PI_j \leq 5.0$ mild contamination

$5.0 < PI_j \leq 10$ medium contamination

$PI_j > 10$ heavy contamination

3. RESULTS AND DISCUSSION

Lambidaro River is located in Palembang City. Lambidaro River has an area of 50.52 km^2 and width ± 8 m [9]. The Lambidaro river is one of the Musi river flow systems. Activities that exist around these rivers such as the activities of home industries, workshops, mining, agriculture, human settlements, and other activities. The mining activities located around the Lambidaro river are sand mining. This sand mining activity is precisely located near Musi II or ± 1 km from the estuary of the river Lambidaro [10]. Sand mining activities are done by dredging and also suction pumps. If mining activities are open in the water catchment area, it can cause disruption of the water system in a region that may be much wider than the mining area itself [11]. The environment to be affected by mining activities is the river system. Sand mining is expected to have an impact on the Lambidaro River environment. This sand mining activity is expected to contribute to the entry of waste into water bodies that can lead to degradation of river water quality. The decrease of water quality due to sand mining can be caused by the increase of river basin materials resulting from sand mining activities. The basic material of the river that is lifted to the surface of the river is merged with river water. This indicates the burden of pollution that enters the water body and may cause a decrease in river water quality.

The decrease of river water quality can be seen from 3 parameters of water properties, namely biological, chemical and physical. The chemical of the water tested can be an indicator of whether the quality of the water under study is in good or polluted conditions. Comparison between laboratory test results with established water quality standards can indicate in which parameters a high pollution load. Thus it can be estimated the cause of the water bodies. The water quality reduction will certainly affect the sustainability of the environment of region. It mean, the environment is no longer able to provide water with good quality in accordance with predetermined standards or quality standards for the community environment.

The study of chemical characteristics of the Lambidaro river done by taking samples of water at 5 points of measurement. The parameters of chemical characteristics tested were pH, DO, COD, BOD_5, Iron (Fe), Manganese (Mn), Free Ammonia (NH_4), Nitrate, and Nitrite. The following shows the water quality of the Lambidaro river compared to the Class I Water Quality Standard

Table 1. Chemical Characteristics Quality of Lambidaro River Water [7]

No.	Characteristics	Unit	Quality Standard*	L1	L2	L3	L4	L5
1	pH	-	$6-9$	6.87	6.81	6.24	6.38	6.08
2	DO	mg/L	6	3.12	3.26	3.6	3.83	3.12
3	BOD_5	mg/L	2	1.85	1.8	2.51	2.56	3.04
4	COD	mg/L	10	7	7	8	9	12
5	NH_3-N	mg/L	0.5	0.06	0.08	0.08	0.14	0.09
6	Nitrat	mg/L	10	0.15	0.18	0.12	0.08	0.11
7	Nitrit	mg/L	0.06	0.036	0.034	0.039	0.023	0.032
8	Besi	mg/L	0.3	0.08	0.09	0.19	0.09	0.11
9	Mangan	mg/L	0.1	0.03	0.03	0.04	0.05	0.03

* Standard quality based on Governor Regulation South Sumatera Number 16 in 2005

Description:

L1: Estuary Of The Lambidaro

L2: Karang Sari

L3: Canal Irrigation

L4: Canal Bukit Baru

L5: Polygon Retention Pond

Table 2. Water Quality Status of Lambidaro River [7,8]

Location	Pollution Index	Water Quality Status
L1	0.703	Good condition
L2	1.108	medium contamination
L3	0.683	Good condition
L4	1.133	medium contamination
L5	1.4	medium contamination

in Table 1.

Based on Table 1, it can be seen that the pH value of each sampling site point is below the required pH value standard. pH indicates the concentration of hydrogen ions in water [12]. Normal water pH values are approximately neutral, ie between pH 6 and 9, while the polluted water pH, such as wastewater, varies depending on the type of effluent. This indicates that the pH of the Lambidaro river is in normal condition. The point of measurement of L1 and L2 has a high pH value compared to other locations. This is thought to be due to the introduction of alkaline minerals into the water bodies at the site. Alkaline minerals may enter the water bodies of L1 locations as they are within the proximity of sandstone mining activities.

According to Nybakken [13], DO or dissolved oxygen in water comes from air diffusion and photosynthesis results of chlorophyllic organisms that live in a waters and are required by the organism to oxidize the nutrients that enter the body. Based on Table 1, the DO score at each point of measurement is below the standard set value.

Meanwhile, the BOD_5 value for the point of measurement of L3, L4, and L5 is above the predefined quality standard. BOD is a test to measure the amount of biodegradable organic matter (materials that can be destroyed or decomposed by living organisms) present in water samples [14]. The high BOD_5 value at the point of measurement of L3 (Canal Irrigation) is estimated to be caused by a pile of garbage around the river. Meanwhile, the high BOD_5 value at the point of measurement of L4 (Canal Bukit Baru) is estimated to be caused by the inclusion of agricultural pesticide residues by the runoff of rainwater and also the covering of the water surface by various plants such as water hyacinth. The measurement point L5 (Polygon Retention Pond) also shows a high BOD_5 value. This is because the entry of organic and inorganic waste into water bodies. Incoming garbage is household waste, such as plastic, food scraps, and also detergent. The causes of high BOD_5 values at these three sites are supported by the opinion that the cause of increasing the BOD_5 value is due to the high factor of domestic waste, in the form of organic and inorganic garbage and detergent, besides organic pollutants can also derive from pesitida residues originating from agriculture carried to the river by runoff rainwate [15].

COD is the amount of oxygen needed to oxidize chemically organic materials. High COD values will result in reduced dissolved oxygen content in river water [16]. The maximum quality standard required COD value is 10 mg/L. Based on Table 1 it can be seen that the COD value at the point of measurement L5 (Polygon Retention Pond) is above the required standard of 12 mg/L. This is allegedly due to the entry of domestic waste into water bodies. The high COD value at this location is in line with the high BOD_5 value of this location as well. This is because BOD and COD are closely related, where BOD is the amount of oxygen required for the degradation of biological incoming water bodies, while COD is the amount of oxygen needed to degrade chemically incoming materials. The value of COD and BOD indicate the existence of interconnection, where the higher the BOD value, the higher the COD value of the waters.

The value of NH_4 (ammonia) along the Lambidaro watershed is in good condition. That is, the value of NH_4 at each location is below the predefined quality standard. However, according to Effendi [17], ammonia levels in natural waters are usually less than 0.1 mg/L. High levels of ammonia can be indicated the presence of contamination of organic materials derived from domestic waste, industrial waste, and agricultural fertilizer runoff. If it refers to Effendi's opinion, it is indicated that the ammonia value exceeding 0.1 mg/L at the L4 site (canal Bukit Baru) comes from domestic waste and also agricultural fertilizer runoff. The high level of nitrates and nitrites in water is determined by the nitrogen and oxygen compounds described by the bacteria. Nitrite in large amounts will bind oxygen in the water resulting in water deprived of oxygen so that dissolved oxygen content becomes low. The content of nitrite can be caused by the degradation of N-containing compounds such as proteins by the activity of micro-organisms. Based on Table 1 shows that the nitrite and nitrate values are still below the established standard.

Fe (iron) and Mn (manganese) high at sand mining sites may be caused by the release of these minerals when sand mining is done [18]. Based on the data shown in Table 1 shows that the high Fe values precisely at the location of L3 and L5 which is the upstream direction of the river. While the Mn values are high at locations L3 and L4. It is possible that the source of Fe and Mn production from this location is not from the impact of sand mining but from other sources. Based on the above sand mining does not contribute significantly as a major contributor to decreased quality of river water chemistry. This may occur because of the mine which was a bit far from the sampling point. In addition, it is estimated that the main sources of pollution from water quality decline are domestic and agricultural waste.

The status of the water quality of the Lambidaro River based on the evaluation of the pollution index value is shown as listed in Table 2.

The results of analysis of water chemical characteristics at 5 points of water quality measurement of the river shows that on the part close to the estuary of the river is in good condition indicating that the location is environmentally sustainable. Meanwhile, the upstream to the middle river body is in mild contaminated condition. This indicates that the river's environment is contaminated. Based on Table 2, it can be seen that the quality status of the Lambidaro river is generally in a mild contaminant condition. If linked to Table 1, the cause of pollution is the high BOD and COD values indicated that the source of the pollutants comes from domestic waste as well as agricultural waste. In general, the Lambidaro River is classified under mildly contaminated conditions.

The condition of the mildly contaminated Lambidaro River if linked to a sustainable environment indicates that the Lambidaro river environment is not in a sustainable condition. It mean, the Lambidaro river is no longer able to maintain the carrying capacity of the environment as a provider of resources for human life. Lambidaro River is not able to provide river water under the conditions specified quality standards. Meanwhile, field studies show that people use river water to meet their daily needs, such as washing, bathing, and latrines. If this condition continues, it will certainly lead to a decrease in the quality of river water, it will also affect the disruption of public health conditions that use water for daily purposes.

Good environmental management must be done, that the quality of the river water is below the established standard, so it is feasible to be used in everyday life. The things that can be done is to start by reducing the waste that can enter the water body. Management of domestic waste can be done by no longer dispose of waste into water bodies. Meanwhile, to overcome agricultural waste is to reduce the use of chemicals. Good environmental management will certainly have an impact on the achievement of a sustainable environment.

4. CONCLUSION

The study of the chemical characteristics of the Lambidaro River shows that in general the quality of the water is mildly contaminated. The BOD and COD parameters at some point of measurement indicate a value that is above the required water quality standard. Indication of the high value of BOD and COD comes from domestic waste and agricultural waste. This suggests that sand mining is not a major factor in pollution of the Lambidaro river because it is located quite far from the estuary of river. However, it is undeniable that continuous mining will be one of the causes of river pollution.

Based on the analysis obtained that environmental conditions are polluted, then the management of the environment must be done. This is so that the water quality of the river is below the water quality standard intended. If environmental management has been done, it is expected to achieve a sustainable river environment. Thus the community along the Lambidaro watershed as a water user can use it because the water condition is in good condition (not polluted).

REFERENCES

[1]   Pangestu, H. and Haki, H. 2013. The Analysis Of Total Sediment Transport On The Dawas River District Of Musi Banyuasin. *Journal of Civil and Environmental Engineering.*1(1). pp 103-109.

[2]   Government Regulation About the river. Number 38. 2011

[3]   Galunder, B.K. and Kolar. M. 2010. Chemical Analysis and the River Mura water Quality. *International Journal of Sanitary Engineering Research.* 4(2). pp 4–17.

[4]   Pitchaiah, P.S. 2017. Impacts of Sand Mining on Environment–A Review. *SSRG International Journal of Geo informatics and Geological Science.* 4(1). pp 1–6.

[5]   Anggraini, 2013. The Effect of Sand Mining on Environment Quality in Regency Of Tasikmalaya District. *Antology of Geography Education.* 3(1). pp 1-13.

[6]   Government Regulation about Management of water quality and control of water pollution. Number 82 in 2001.

[7]   Environmental agency of Palembang city. Strategic Environmental Assessment Power Support and Capacity of Lambidaro River. Palembang. 2016.

[8]   The decision of the Minister of the environment about the determination of the Status of Water Quality Guidelines. Number 115. 2003.

[9]   Endah Praptiani. Report of Palembang City River. 2012. (https://www.academia.edu/9773539/Laporan_Sungai_Anak_sungai_Kota_Palembang_2012) accessed on 04 August 2012.

[10] Documents Feasibility Study Sand Mining of Panji Mahakarya company.

[11] Suhartini. The phenomenon of sand mining and development and its environmental impact (Case Study around Merapi and Bantul District). pp 228-238. Presented at the National Seminar of Mathematics and Natural Sciences UNY, Yogyakarta on August 1, 2006

[12] Prasad, K., Hari, C., Anjali, M., Reddy. S. 2016. Study of Physico-Chemical Characteristics of Penna River at Chennur, Cuddapah Basin, India. *Indian Journal of Advances in Chemical Science.* 4(1). pp 20-24.

[13] Simajuntak, M. 2007. Dissolved Oxygen and Apparent Oxygen Utilization in Bay of Klabat Waters, Bangka Island. *MARINE SCIENCE.* 12(2). pp 59-66.

[14] Chandra, S. 2011. Evaluation of Physicochemical Characteristics of Various River Water in India. *CODEN ECJHAO E-Journal of Chemistry.* 8(4). pp 1546-1555.

[15] Penn, M.R., Pauer, J.J., and Mihelcic. J.R. Biochemical Oxygen Demand, Environmental And Ecological Chemistry. Vol. II. (https://www.eolss.net/Sample-Chapters/.../E6-13-04-03.pdf).

[16] Aziz, T. 2013. The Influence of Addition of Tawas $Al_2(SO_4)_3$ and Chlorine $Ca(OCl)_2$ to the Characteristics of Physical and Chemistry of water Lambidaro River. *Journal Chemical Engineering.* 3(19). pp 55–65.

[17] Mahyudin, S. and Prayogo, T.B. 2015. Water Quality Analysis and Water Pollution Control Strategy of Metro River in Kepanjen City, Malang Regency. *J-PAL*, 6(2). pp 15–114.

[18] Rizqan, A. 2016. Quality Status of River Water Around Sand Mining Areas in Batang Alai River Wawai Village South Kalimantan. *EnviroScienteae.* 12(1). pp 1-6.

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