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Load Capacity of Water Pollution of Jaing River in Tabalong

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***Abstract*— *Jaing River is part of the 39 km long Barito watershed in South Kalimantan which disembogues into Tabalong River. Jaing River is classified as class I (one) river that is designated as a source of drinking water. The large number of activities in the bank of the river has a potential to reduce the quality of the river. Field observations revealed that some activities created several pollutions and also run off of production waste into the river. Thus, the purpose of this study was to analyze the load capacity of pollution of Jaing River. The study was carried out in Jaing River as far as 39 Km in TabalongRegency and the river water quality was analyzed at 3 sampling points using physical, chemical and biological parameters. The analysis of quality and determination ofload capacity of water pollution used Mass Balance Method. Finally, the results obtained from this study are (1) the BOD pollutant load value of 418.87 kg/day, the value of COD pollution load of 2018.90 kg / day and the value of TSS pollution load of 1698.14 kg/day. (2) The value of pollution load capacity (DTBP) for BOD parameters is 246.07 kg/day, COD parameters are 1154.90 kg/day and for the TSS parameters are 2621.86 kg / day.*

Keywords*— *Jaing River, load capacity of pollution, mass balance method.

I. INTRODUCTION

The rapid development in Tabalong Regency has a significant impact, both positive and negative. The river becomes the media that received this impact as a result of the intense exploration of natural resources.

Sahabuddin et al (2014) stated that the input of waste to the environment from human activities without regarding to the ability of supporting capacity and load capacity of the environment causes a negative influence on the quality of ecosystems either physical, chemical or biological as well as the sustainability of the aquatic environment.

The life of the people of Tabalong Regency cannot be separated from the existence of river; most of them use river water as a source of clean water. JaingRiver is one of the rivers that pass in TabalongRegency with a length of 39 km which *disembogues* into Tabalong River. The Jaing watershed has an area of ± 298 km^{2}as parts of the Barito watershed in South Kalimantan. Jaing River is classified as class I (one) river that is designated as a source of drinking water and other purposes which require the same quality (Tabalong Regency Environmental Agency, 2017).

Transfer of land functions is quite large around Jaing River watersheds, for land clearing of coal mining sector, oil and gas sector, industrial sector, plantation and agriculture sector. The large number of these activities causes theriver potentially experiences a decline in quality. Data from the TabalongRegency Environmental Service stated that the water quality of Jaing River has decreased every year. Field observations show that some activities have the potential to incorporate pollutants into the Jaing River which is likely to dispose of production waste directly or run off of production waste into the river. Sources of run off pollutants tend to be difficult to control because they are scattered.

Pollution is the entry or inclusion of living things, substances, energy, and/or other components into the environment, or it also means changes in the environment by human activities or natural processes so that the quality of the environment drops to a certain level which causes the environment to become less or unable to function anymore in accordance with its designation.Pollutant sources or pollutants are substances or materials that can cause pollution to the environment either pollution of water, air, soil or others. If it is true that there is a decrease in the quality of Jaing River water, of course this will bring many problems that arise for the community around the banks of the Jaing River, both in terms of the level of health and quality of life of the community. Based on this problem, the purpose of this study is to analyze the load capacity of water pollution of Jaing River.

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II. LITERATURE REVIEW

Water Pollution and Pollution Sources

Effendi (2003) said that pollution loads (pollutants) are materials that are foreign to nature or materials that originate from nature itself that enter an ecosystem order that disrupts the designation of the ecosystem. In contrast to Effendi, Suratmo defined water pollution as starting from a certain concentration of pollutants in water for a long time which is able to cause certain influences (SahabuddinHartina, Harisuseno, &Yuliani 2014).

Water pollution is a result of human activities and actions, which are motivated by various things. Because of pollution, the environmental management of the water is disrupted. Water ecosystems become polluted and damaged after receiving the presence of contaminants originating from humans by their actions (Susila, 2011). Water pollution can occur intentionally or unintentionally from human activities in a water that has been clearly designated(Herlambang 2006).

Manan (1977) stated that river water quality problems are mainly caused by sediment content in river water due to erosion in the watershed, especially in the upstream. Water quality is the level of suitability of water for certain uses in meeting the needs of human life, starting from water to meet immediate needs, namely drinking water, bathing and washing, irrigation water or agriculture, livestock, recreation and transportation.

Capacity of Pollution Load

The terminology of environmental capacity in regulation in Indonesia is usually carried out with environmental supporting capacity. Environmental supporting capacity is the ability of the environment to support human life, other living things, and the balance between the two things. Meanwhile, the capacity of the environment is the ability of the environment to absorb substances, energy, and/or other components that enter or are inserted into it (Abdi et al., 2010).

In terms of load capacity of the pollution refers to the Decree of the Minister of Environment Number 110 of 2003, it is the ability of water in a water source to receive input from pollutant loads without causing the water to become polluted. The pollution load itself is the amount of a pollutant contained in water or waste water (Sahabuddin et al., 2014).

There are 2 (two) calculation methods used in determining the load capacity of water pollution on water sources, namely (1) Mass Balance Method and (2) Streeter-Phelps Method.

III. STUDY METHODS

A. Place and Time of Study

The study area was carried out in JaingRiver as far as 39 Km in Tabalong Regency, South Kalimantan Province by dividing it into 3 (three) segments, namely upstream, middle and downstream. The sampling location can be seen in Table 1 below.

Table 1. Locations of Water Quality Sampling in Jaing River

Segment	Location	Latitude (S)	Longitude (E)
upstream	PangelakVillage, Upau District	02'04"21.1	115'37"25.4
middle	Kasiau Village, MurungPudak District	02'07"41.6	115'27"20.1
downstream	Masukau Village, MurungPudak District	02'07"05.9	115'25"21.7

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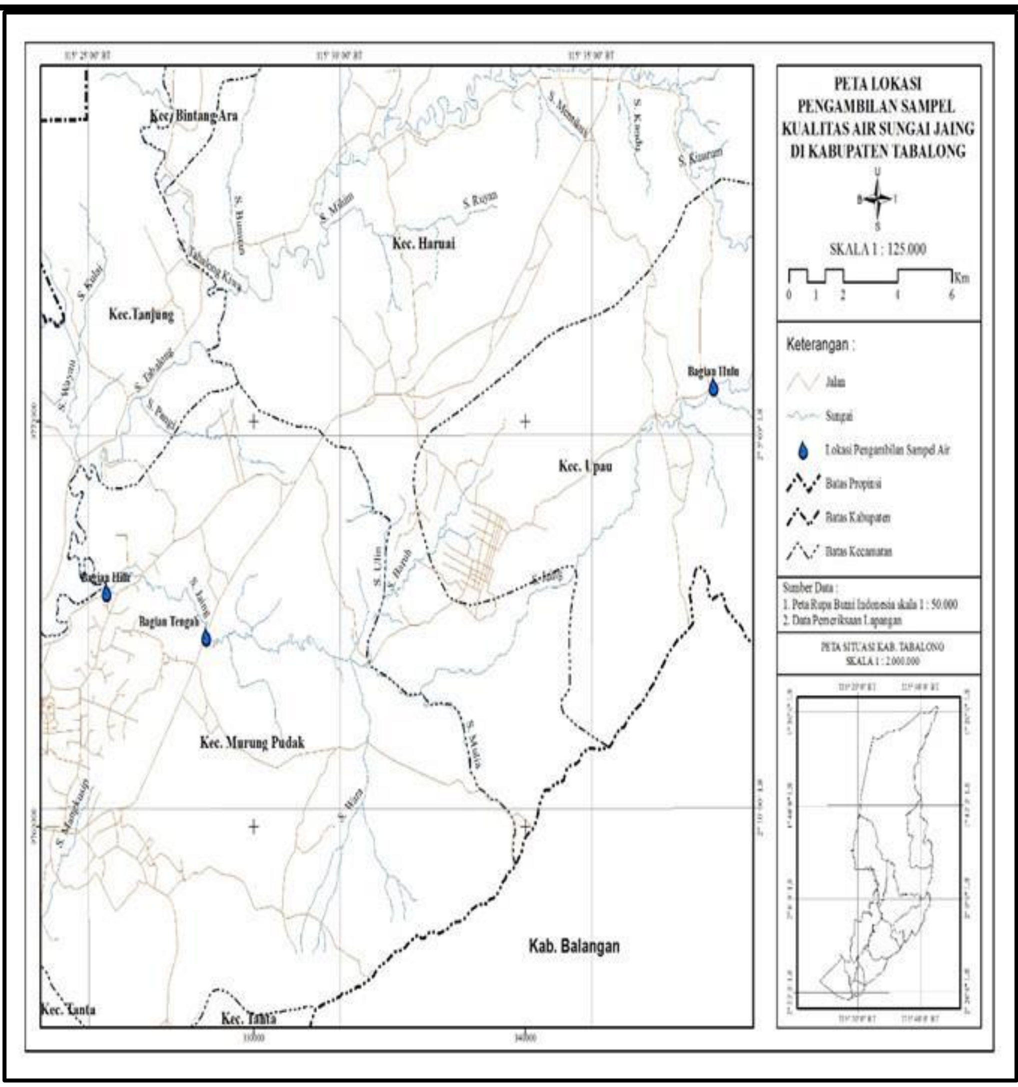

Fig.1: Location of Water Sampling

The time for conducting this studywas 4 (four) months, namely from January to April 2019 and the river water sampling period took place 3 (three) times starting from February to March.

The parameters analyzed include physics, chemistry and microbiology parameters with the analytical method adjusted for the parameters studied as shown in the following table.

Table 2. Physical, chemical, water biology parameters and their analytical methods

No.	Parameter	Unit	Analysis Method
	Site		
1	Temperature	0C	SNI 06-6989.23-2005
2	pH	-	SNI 06-6989.11-2004
3	DHL	μ mhos/cm	SNI 06-6989.1-2004
4	Dissoved Oxygen (DO)	mg/L	SNI 06-6989.14-2004
	Laboratory		
5	Suspended Solid	mg/L	SNI 06-6989.3.2004
6	BOD	mg/L	SNI 6989.72-2009
7	COD	mg/L	SNI 6989.2-2009
8	Phospate	mg/L	SNI 06-6989.31-2005
9	Fecal Coliorm	mg/L	MP N
10	Total Coliform	mg/L	MP N

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B. Determination Analysis of Load Capacity of JaingRiver Pollution

Analysis of capacity determination is carried out by the *Mass Balance* method.

$$C_R = \frac{\Sigma CiQi}{\Sigma Qi} = \frac{\Sigma Mi}{\Sigma Qi} \text{..............................(1)}$$

Where :

C_R = The average concentration of constituents for the combined flow

C_i = Concentration of constituents in the i- flow

Q_i = i-flow rate

M_i = Constituent mass in the i- flow

To determine the load capacity using the Mass Balance Method, the steps that must be taken are as follows:

1. Measuring the concentration of each constituent and the flow rate in the stream before mixing with pollutant sources,
2. Measuring the concentration of each constituent and the flow rate in each pollutant source stream,
3. Determine the average concentration in the final flow after the flow mixes with the pollutant source by calculating:

$$C_R = \frac{\Sigma CiQi}{\Sigma Qi} = \frac{\Sigma Mi}{\Sigma Qi} \text{.............................. (2)}$$

In another source, the method for calculating pollution load was based on measurements of river water flow and river waste concentration based on the equations of Mitsch and Goesselink (1993) in Appendix II of the Regulation of the Minister of Environment No. 1 of 2010.

BPs = Qs x Cs (j) x f .... (3)

Information :

BPs = River Pollution Load (kg/day)

Qs = River Water Debit (m^3/sec)

Cs (j) = Pollution Element Concentration (j) (mg/l)

F = FaktorKonversi =

$$\frac{1\ kg}{1.000.000\ mg} x \frac{1000\ liter}{1\ m3} x \frac{84.600\ detik}{1\ hari} = 86,4 \frac{kg.liter.detik}{mg.m3.hari}$$

Pollution load capacity (DTBP) can be determined using the following equation:

DTBP = Pollution Load According to Quality Standards - Measured Load Pollution

IV. RESULTS AND DISCUSSION

The analysis of the calculation of pollution load capacity (DTBP) of river water is carried out on 3 (three) parameters, namely BOD (Biological Oxygen Requirement), COD (Chemical Oxygen Requirement) and TSS (Total Suspended Solids). The selection of pollution load capacity parameters (DTBP) is based on the key parameters for the representativeness of JaingRiver water quality conditions while also representing the dominant source in Jaing watershed.

Calculation of pollution load capacity (DTBP) of river water shows the amount of existing or actual pollutant load currently entering the river flow. In addition, it is also showed the amount of pollution load allowed to enter as well as the amount of pollution load that needs to be lowered or the allocation of pollution loads so that the improvement of the quality of the water for these parameters can be achieved.

A. Inventory and Identification of Pollution Loads in Jaing River

Output from the process of inventory and identification of pollutant sources is the amount of pollutant load estimated to be produced by pollutant sources entering into the river flow that potentially enters and pollutes. The results of the inventory and identification of pollution loads entering JaingRiver are shown in the following table 3.

Table 3. Pollution Sources in Jaing River

No.	Sector	Existing BOD (kg/day)	Existing COD (kg/day)	Existing TSS (kg/day)
1	Mining	-	-	4868.51
2	Oil and Gas	1.665	2.978	-
3	Rubber Industry	6.915	15.543	15.543
4	Agriculture	263.12	-	0.35
5	Farm	56.84	137.76	-
6	Fishery	0.136	0.203	-
7	Waste	28.731	43.096	-
8	Household	930.656	1279.652	884.123

Table 3 shows the value of pollution load from pollutant sources that enter Jaing River flow is a cumulative pollution load from 2 (two) Districts crossed by Jaing River namely MurungPudak District and Upau District. The results of the calculation of the pollution load above shows for the BOD parameter that household activities are the highest contributors to pollutants than other types of activities, then agricultural and livestock activities generally contribute to the second and third pollutant loads. Meanwhile, the waste sector makes a fourth contribution. The smallest contributor is fishery activities, for the exception of mining activities because the data obtained by mining activities do not produce types of waste with BOD parameters.

The results of the calculation of pollution load for COD parameters indicate that household activities are the highest contributors to pollutants than other types of activities, and then livestock activities and general waste contribute to the second and third pollutant loads. Meanwhile, the rubber and oil and gas industry sector contribute the fourth and fifth. The smallest contributor is fishery activities, for the exception of mining activities because the data obtained by mining activities do not produce types of waste with COD parameters.

TSS parameters from the calculation of pollution load shows that there are only 4 (four) sectors that contributed to pollution costs, the highest pollutant contributor is mining activities, then household activities and the rubber industry generally contribute the second and third pollutant loads. Meanwhile, the smallest contributor is agricultural activities.

B. Determination of Load Capacity of Water Pollution of JaingRiver

Determination of load capacity of water pollution (DTBP) of Jaing Riveruses the Mass Balance method. Jaing River is divided into 3 (three) parts, namely upstream, middle and downstream parts. The section describes the existing of points and conditions of Jaing River. The data used for this method uses water quality results for BOD, COD and TSS parameters. In addition to water sampling for water quality, river flow measurements are also carried out in 3 (three) sampling points.

Table 4. Calculation of Load Capacity of Pollution (DTBP) in Jaing River with Mass Balance Method

Jaing River	BOD	COD	TSS
Pollutant Load (kg/day)	418.87	2018.90	1698.14
Quality Standard (Class 1) mg/L	2	10	50
Quality Standard (Class 1) (kg/day)	172.8	864	4320
DTBP (kg/day)	-246.07	-1154.90	2621.86

Table 4 shows that the BOD and COD concentrations in all sampling points in Jaing River have passed the class I (one) water quality standard, so it can be said that the Load Capacity of Pollution (DTBP) ofJaing River has passed BOD and COD parameters. The results of calculations using the mass balance method show that the total BOD pollutant load that has entered the Jaing River from upstream to downstream is estimated at 418.87 kg/day which is distributed almost evenly in 3 (three) segments. Furthermore, the total COD pollution load that has entered the Jaing River from upstream to downstream is estimated at 2018.90 kg/day and the total TSS pollution load that has also entered Jaing River from upstream to downstream is estimated at 1698.14 kg/day.

Based on the South Kalimantan Governor's Regulation No. 5 of 2007 concerning Allotment and Quality Standards of River Water shows the load capacity of pollution (DTBP) of Jaing River water at three monitoring points for BOD and COD parameters (Table 29) has exceeded Class I Water Quality Standards (one) even it has no more capacity. The exceeded value of load capacity of pollution (DTBP) of the river for BOD parameters is 246.07 kg/day and the COD parameter is 1154.90 kg/day. For TSS parameters in JaingRiver it still has capacity or is still within the limits of Class I (one) Water Quality Standards which are permitted according to established regulations which are equal to 2621.86 kg/day.

V. CONCLUSION

Based on the results of study and analysis, it can be concluded that the Load Capacity of Pollution (DTBP) of JaingRiver Water for BOD and COD has exceeded Class I parameters (one) Water Quality Standard and even it has no more capacity. The exceeded value of the load capacity of pollution (DTBP) of Jaing River for BOD parameters is 246.07 kg/day and the COD parameter is 1154.90 kg/day. The TSS parameters that are permitted according to established regulations are equal to 2621.86 kg/day.

VI. SUGGESTION

For the Government of TabalongRegency, the results of this study can be used for programs and activities for Jaing River pollution control asthe development of integrated sanitation system, animal manure processing system, and waste infrastructure.

REFERENCES

[1] Abdi, Z., Pramono H, and M. Widyastuti. 2010. Assessment of Load Capacity of Pollution of Batanghari River in PenggalGasiang- LangkokRiver West Sumatra.

[2] Agustiningsih, D., S. B Sasongko, and Sudarno. 2012. Analysis of Water Quality and Control Strategy for Water Pollution of Blukar River in Kendal Regency. Journal of Precipitation Vol.9 No.2 September 2012 ISSN 1907-187X

[3] Agustini, L., M.A Rifa'i and Baharuddin. 2017. Mapping and Determination of the Status of Water Quality Based on the Storet Method in Barito Luar Watershed of South Kalimantan Province. MCSIJ - Marine Journal Vol. 1 No. 2 of 2017

[4] Arisanty, D., S. Adyatma and N. Huda. 2017. Analysis of Fecal Coliform Bacteria on Kuin River in Banjarmasin City. Indonesian Geography Magazine Vol. 31 No. September 2, 2017 (51-60) ISSN 0125-1790 (print) DOSN 2540-945X (Online) DOI: https: //doi.org/10.22146/mgi.25493,web: https: //jurnal.ugm.ac. id / mgi: Banjarmasin

[5] Basmi, J. 1999. Planktonology (Bioecology of Plankton Algae). Faculty of Fisheries and Marine Sciences, Bogor Agricultural University. Bogor

[6] Djoharam, Veybi, EttyRiani, and Mohamad Yani. 2018. "Analysis of Water Quality and Load Capacity of Pollution in the Pesanggrahan River in the Province of Jakarta, Jakarta." Journal of Natural Resources and Environmental Management 8 (1): 127–33. https://doi.org/10.29244/jpsl.8.1.127-133: Jakarta

[7] Effendi, H. 2003. Review of water quality for the management of aquatic environmental resources. Kanisius Publisher. Yogyakarta

[8] Hadi, Anwar. 2015. Environmental Sampling. Erlangga Publisher: Jakarta

[9] Herlambang, Arie. 2006. "Water Pollution and its Repetition Strategy." Jai 2 (1): 16–29.

[10] Jumaidi, Ahmad. 2016. "The Effect of Water Debit on Improving Water Quality in the Recirculation System and Its Relationship with the Synthesis and Growth of Gurame Fish Seeds (*OshpronemusGouramy*)." E - Journal of Fisheries Cultivation Engineering and Technology 5 No. 1 ok.

[11] Kadir, S. 2014. Management of Watersheds for Flood Control in the Catchment of JaingArea of South Kalimantan Province Sub-watershed. Dissertation. Agricultural Science Doctoral Program Interest in Natural Resource Management and Environment for the Postgraduate Program in the Faculty of Agriculture, Brawijaya University Malang: Malang

[12] Ministry of Environment. 2003. Decree of the Minister of Environment Number 110 of 2003 concerning Guidelines for Determining the Capacity of Water Pollution at Water Sources. Ministry of Environment of Republic of Indonesia: Jakarta

[13] Ministry of Environment. 2009. Law Number 32 of 2009 concerning Environmental Protection and Management. Ministry of Environment of Republic of Indonesia: Jakarta

[14] Ministry of Environment. 2010. Regulation of the Minister of Environment Number 01 of 2010 concerning Management of Water Pollution Control. Ministry of Environment. Ministry of Environment of Republic of Indonesia: Jakarta

[15] Ministry of Environment. 2013. Exposure Calculation of Load Capacity of Barito River Pollution. https://www.menlh.go.id/ekspose-perh Calculation-daya-tampung-beban-pencemaran-sungai-barito/

[16] Ministry of Environment. 2014. Guidelines for Determining Supporting Capacity and Environmental Capacity. Ministry of Environment of Republic of Indonesia: Jakarta

[17] Maryono, A., 2003. River Development Impact and River Restorations (Development of River Impacts and River Restoration). Master of Engineering Systems, Postgraduate Program UGM: Yogyakarta

[18] Noprianti, R. 2013. Status of Water Quality Using the Pollutant Index Method in Lemo River, North Barito Regency, Central Kalimantan Province. Special Issues. LambungMangkurat University: Banjarbaru

[19] Neno, Abd Kamal, Herman Harijanto, Students of Forestry Faculty, University, Teaching Staff, Faculty of Forestry, and Tadulako University. 2016. "Relationship between Water Debit and Water Levels in Lambagu River, Tawaeli District, Palu City." News of the Jungle, Vol. 4 Number 2 December 2016 4: 1–8.

[20] Nurjanah, Putri. n.d. 2018 "Analysis of the Effect of Rainfall on Water Quality Microbiological Parameters and Status of Water Quality on the River Code, Yogyakarta The Analysis of Rainfall Impact on Water Quality of Microbiological Parameters and Water Quality Status in Code River, Yogyakarta," no. 20. https://doi.org/10.14710/IK.IJMS.12.2.59-66.

[21] Reid, G.K. 1961. Ecology of inland waters and estuaries. Reinhold Book Corporation. New York, Amsterdam, London. 375 p.

[22] Sahabuddin H, D. Harisuseno and E. Yuliani. 2014. Analysis of Status of Water Quality and Capacity of

Pollution of Wanggu River in Kendari City. Journal of Aquatic Engineering Volume 5, Number 1, May 2014, pp. 19-28

[23] Sanjaya, R.E and R. Iriani. 2018. River Water Quality in Tanipah Village (Coastal Peat) in South Kalimantan. Biolink Vol. 5 (1): Pg. 1-10: Banjarmasin

[24] Saraswati, S.P., Sunyoto, Bambang A. KdanS. Hadisusanto. 2014. Study of the Form and Sensitivity of the Formulas for the Index of Pi, Storet, Ccme for Determining the Status of Tropical River Water Quality in Indonesia (Assessment of PI Index Formula, Storet, CCME for The Determination of Water Quality Status of ATropical Stream in Indonesia). Humans and the Environment, Vol. 21, No.2, July 2014: 129-142

[25] Simanjuntak, Marojahan. 2012. "Dissolved Oxygen and Apparent Oxygen Utilization in the Waters of TelukKlabat, Bangka Island." MARINE SCIENCE: Indonesian Journal of Marine Sciences 12 (2): 59–66. https://doi.org/10.14710/IK.IJMS.12.2.59-66.

[26] Sinaga, Eva Lia Risky, Ahmad Muhtadi, and DarmaBakti. 2017. "Temperature Profile, Dissolved Oxygen, and PH Vertically for 24 Hours in KelapaGading Lake,Asahan Regency, North Sumatra." Omni-Akuatika 12 (2). https://doi.org/10.20884/1.oa.2016.12.2.107.

[27] Sofarini, D., A. Rahman and I. Ridwan. 2010. Analysis of Testing of Heavy Metal Tests on Water, Biota and Sediment Bodies in the Waters of Barito Watershed. Bumi Lestari Journal Volume 10 Number 1 February 2010 p. 28-37https: //www.researchgate.net/publication/277842199: Banjarmasin

[28] Suripin, 2001. *Preservation of Land and Water Resources*. Andi Publisher, Yogyakarta

[29] Sutiknowati, Lies Indah. 2016. *"Bioindicator of Pollutants, Bacteria."* Oseana XLI: 63–71.

[30] Trilaksono, Ginanjar, IngSudarno, IrDwi, and SiwiHandayani. 2001. *"QUALITY AND MASS BALANCE METHODS (Case Study: Garang River, Central Java),"* no. 82.

[31] Warlina, L. 2004. *Water Pollution: Sources, Impacts and Countermeasures*. Bogor Agricultural Institute: Bogor

[32] Widodo, Aminuddin and M.U.A Gani. 2012. *Efforts to Reduce Pollution of Wastewater Due to Diamond Sediment Mining*. Bulletin of Environmental Geology Vol. 22 No. 2 August 2012: 101-114: Banjarmasin

[33] Woelansari, Emmy, Mahmiah and Supriyatno W. 2017. *"Forfat Distribution and Oxygen Dissolved in East Coast Waters of Surabaya."* Marine National Seminar XII Faculty of Technical and Marine Sciences, Hang Tuah University: Surabaya., B-98.