JPPIPA 9(Special Issue) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Analysis of Water Quality in The Srigangga River Flow, Central Lombok

Supardiono[1]*, Rachmawati Noviana Rahayu[1], Isrowati, Ernawati[1]

[1]Environmental Science Study Program, Faculty of Mathematics and Natural Sciences, University of Mataram, Mataram, Indonesia.

Received: October 29, 2023
Revised: November 17, 2023
Accepted: December 25, 2023
Published: December 31, 2023

Corresponding Author:
Supardiono
supardiono@staff.unram.ac.id

DOI: 10.29303/jppipa.v9iSpecialIssue.6394

Abstract: The Srigangga River is one of the main rivers flowing into the Batujai Reservoir basin in Central Lombok Regency, West Nusa Tenggara Province. Communities around this area still use river water to fulfill their daily needs. The many activities of residents around this river area affect the decline in river water quality. This research aims to determine river water quality based on physical, chemical, and biological parameters and determine the river water pollution index using the pollution index method. This type of research is a descriptive research method with a laboratory-based approach; sampling locations are carried out in the river's upstream, middle, and downstream parts. The parameters analyzed include pH, TSS, DO, COD, BOD, Phosphorus content, *total coliform*, and *Escherichia coli*. The research results show that of the 8 (eight) parameters tested in the upstream, middle, and downstream parts of the Srigangga River, 4 (four) parameters are above the quality standards determined based on PP RI No.22 of 2021. The water pollution index value shows that the Srigangga River is already polluted in the light category.

Keywords: Pollution Index; Srigangga River; Water Quality

Introduction

A river is an open natural channel on the earth's surface that holds water from upstream to downstream (Kumar et al., 2012). The Srigangga River is one of the main rivers flowing into the Batujai reservoir river basin, located in Central Lombok Regency, West Nusa Tenggara Province. Communities around this river area still use river water to fulfill their daily needs, so this river has a vital role. River conditions cannot be separated from human activities (Effendi., 2016). The large number of activities of residents around the river area who use the river as a disposal area for the remains of human activities, such as the disposal of household waste and trade from upstream to downstream of the river, causes the quality of river water to decline which results in disturbances in the balance of concentrations of physical, chemical and biological factors (Wikurendra et al., 2022).

Water quality shows the quality associated with various specific activities (Halder, J., 2015). The location of the Srigangga River, which empties into the Batujai reservoir upstream, is in Semparu village, dominated by the surrounding environmental conditions consisting of rice fields, plantations, and residential areas. Residential areas along the river dominate the middle part of the river. The downstream part of the river, better known as the Surabaya River, is dominated by residential areas, market areas, stalls, and workshops.

The excess load of dissolved substances in the river results in the river's inability to clean itself and will be disturbed. It can cause problems in polluted waters (Sofiana et al., 2022). This water pollution can harm the life of aquatic biota and the health of residents around the river area who still use the river water (Sandi et al., 2017).

Based on this, it is necessary to carry out an analysis of river water quality based on physical, chemical, and biological environmental test parameters so that it can determine the value of the river water pollution index in the Srigangga River area as well as good management and management of the river environment.

How to Cite:
Supardiono, S., Rahayu, R.N., Isrowati, I., & Ernawati, E. (2023). Analysis of Water Quality in The Srigangga River Flow, Central Lombok. *Jurnal Penelitian Pendidikan IPA*, *9*(SpecialIssue), 254–259. https://doi.org/10.29303/jppipa.v9iSpecialIssue.6394

Method

Research Location and Time

The research location was the Srigangga area, shown in Figure 1. Water samples were taken in three parts of the river: upstream, middle, and downstream. The sampling time was carried out in July 2022.

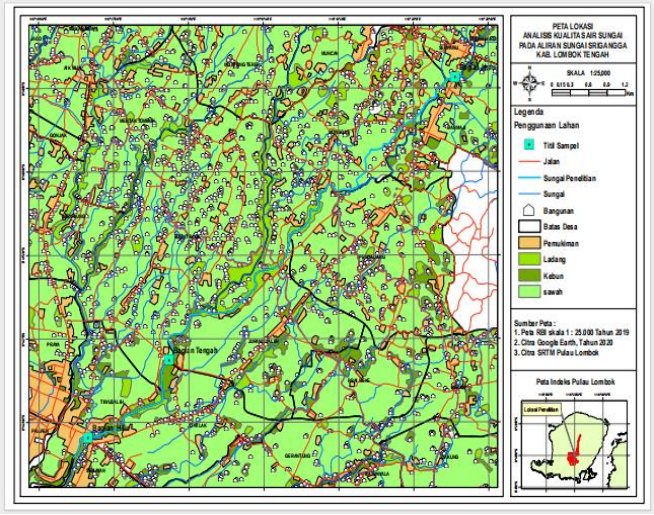

Figure 1. Map of research locations

Materials and Methods

The material used in this research is a sample of Srigangga River water, which will be analyzed to determine its quality. The river water quality parameters tested consisted of three physical, chemical, and biological environmental parameters: pH, DO, TSS, BOD, COD, Phosphate content, Total Coliform, and Escherichia coli. This type of research uses descriptive research methods with a laboratory-based approach. Test analysis was carried out at the Environmental Laboratory, Environmental Service, Central Lombok.

Determination of Sampling Points

The sampling technique uses random probability, based on the research objective of analyzing river water quality in 3 (three) parts of the area, which are expected to represent the research population, namely the upstream, middle, and downstream parts (Wood, 1976).

Table 1. River Water Sampling Points

Location and Point Coordinates	Activities Activities
Point 1 (Upstream)	Rice fields, plantations, settlements
Point 2 (Center)	Settlement
Point 3 (Downstream)	Residential areas, markets, stalls, workshops

Data analysis

Data analysis was carried out descriptively based on river water quality standards in accordance with Government Regulation Number 22 of 2021 concerning the Implementation of Environmental Protection and Management to determine river water class. The Pollution Index method is used to determine the level of river water pollution based on State Minister of Environment Decree No. 115 of 2003 (Wahjono, 2019).

$$PIj = \sqrt{\frac{(\frac{Ci}{Lij})^2_M + (\frac{Ci}{Lij})^2_R}{2}} \quad (1)$$

Information:
Pij=Pollution index
Lij=Concentration water quality parameters based on designated quality standards j
Ci=Concentration water quality parameters based on laboratory test results
M=Maximum value
R=Average value

Result and Discussion

Srigangga River Water Quality

Laboratory test results based on physical, chemical, and biological parameters are shown in Table 2, referring to water quality based on Indonesian Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management.

Total Suspended Solids (TSS)

Total solids suspended shows the condition of sedimentation in a body of water. Generally, total suspended solids contain mud, fine sand, and microorganisms originating from soil erosion processes carried into water bodies (Setyoningrum R N K et al., 2020). Based on an analysis of the water quality of the Srigangga River, it is known that the concentration values in the three parts of the upstream, middle, and downstream areas still show compliance with Government Regulations 22 of 2021 concerning the Implementation of Environmental Protection and Management (Figure 2). The existence of open land around rivers and the river's function as an irrigation channel means that sediment pollution that plants do not absorb will be carried by rainwater and enter water bodies (Sylus K J et al., 2015).

Table 2. Water Quality Laboratory Test Results

Environmental Parameters	Unit	Sampling Location			Class I	Class II	Class III	Class IV
		I	II	III				
Total Suspended Solids (TSS)	mg/L	<2.50	<2.50	<2.50	40	50	100	400
pH	-	7.9	8.5	8.5	6-9	6-9	6-9	6-9
T.PO4	mg/L	0.21	0.20	0.16	0.2	0.2	1	-
Chemical Oxygen Demand (COD)	mg/L	9	8	12	10	25	40	80
DO	mg/L	6.14	7.36	5.74	6	4	3	1
Biological Oxygen Demand (BOD)	mg/L	0.59	0.76	1.23	2	3	6	12
Total Coliform	MPN/100 ml	32,000	8,400	20,000	1000	5000	10,000	10,000
Escherichia coli	MPN/100ml	5,100	1,200	7,400	100	1000	2000	2000

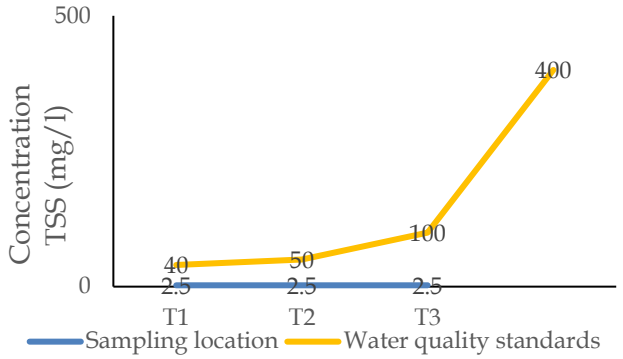

Figure 2. Results of TSS measurement analysis

pH

Based on Indonesian Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management, it is known that the pH content has a quality standard of 6-9 (Figure 3). Analysis of laboratory tests on Srigangga River water shows that the results still follow river water quality standards. The pH value in water is known to indicate the balance between the acid and base content in a solution (Dung et al, 2016).

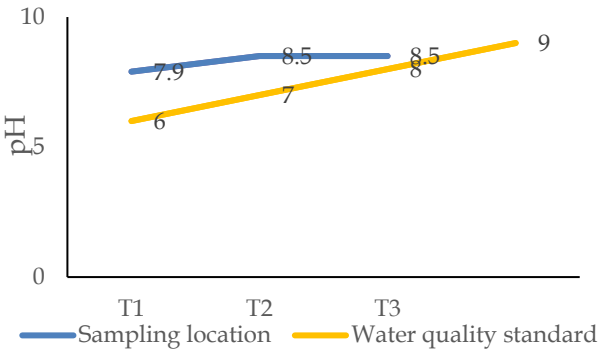

Figure 3. Results of pH measurement analysis

Phosphate content

Based on Government Regulations Number 22 of 2021 concerning the Implementation of Environmental Protection and Management, it is known that the standard limit for river water quality is 0.2 mg/L. The river water quality test analysis results ranged from 0.16-0.21 mg/L (Figure 4). Phosphate content in waters can cause eutrophication. The input of organic materials carried through waste produced by human activities will enter the waters and, under certain conditions, will disrupt existing water processes (Sutamihardja R et al., 2018). Phosphorus is fully oxidized in water to become phosphate (Yulistia et al., 2018)

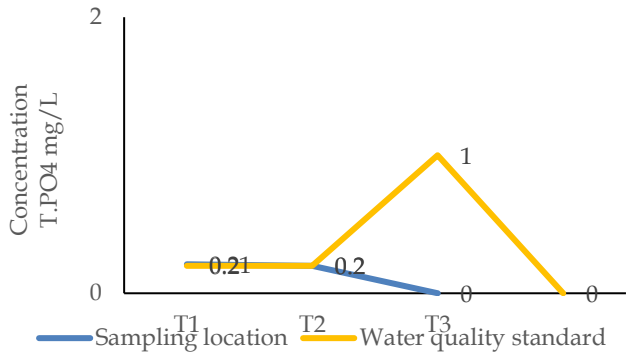

Figure 4. Results of analysis of measurements of total phosphate content

DO

The results of the Srigangga River water quality analysis show that the DO concentration has exceeded the river water quality standards based on Government Regulation 22 of 2021 concerning the Implementation of Environmental Protection and Management. The lowest DO concentration is located in the downstream part of the river at 5.74 mg/L. The low DO value in the downstream section aligns with the increase in organic waste in the waters due to the activity of residential areas, markets, stalls, and workshops. The highest DO concentration is located in the middle at 7.36 mg/L. The high DO concentration value is due to the photosynthesis process of aquatic plants, such as phytoplankton, which produce oxygen in the waters. Dissolved oxygen is very important in the growth and reproduction processes, respiration processes, metabolic

processes by all aquatic living organisms, and the decomposition of organic matter in waters (Firdaus N A 2019).

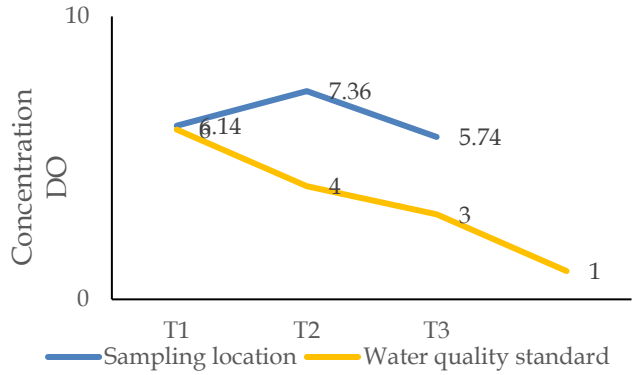

Figure 5. Results of DO measurement analysis

Chemical Oxygen Demand (COD)

Based on the river water quality analysis results, it is known that the COD concentration in 3 parts of the Srigangga River area is still below the river water quality standards, ranging from 8-12 mg/L. The COD value in unpolluted waters is usually less than 20 mg/L (Wicheisa et al., 2018).

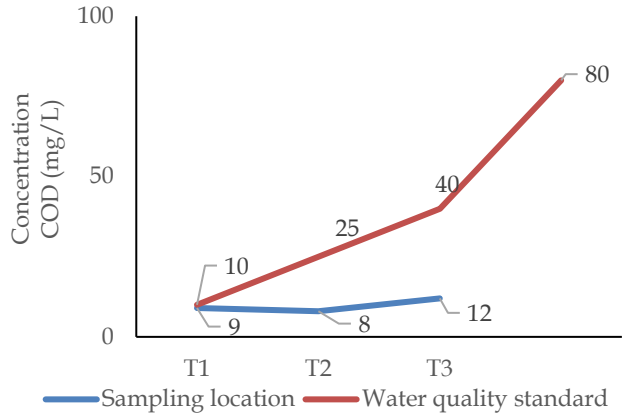

Figure 6. COD measurement analysis results

Biological Oxygen Demand (BOD)

Based on the results of river water quality analysis, it is known that the BOD concentration in 3 parts of the Srigangga river area is still below river water quality standards. The lowest concentration value is located in the upstream area at 0.59, and the highest is in the downstream area at 1.23. The increase in BOD concentration values from upstream to downstream areas is due, in part, to residential activities around the Srigangga river, which receives waste during its journey (Figure 4). The greater the BOD concentration in a body of water indicates that the concentration of organic matter in that water is also high (Ali et al., 2013). Organic waste materials are generally in the form of waste or materials that microorganisms can degrade. If they are thrown into river flows, they can increase the BOD concentration value (Suprayogi et al., D. 2014).

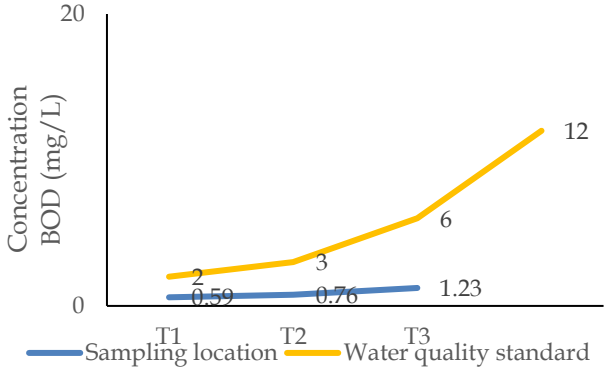

Figure 7. Results of BOD measurement analysis

Total Coliform

Coliform bacteria are found in soil and water environments affected by surface water and human and animal waste disposal (Nurdiana F, Julyantoro PGS, and Suryaningtyas EW 2019). Based on the results of the analysis of the water quality of the Srigangga River, the results show that the results are above the quality standards that have been determined based on Government RegulationsNumber 22 of 2021 concerning the Implementation of Environmental Protection and Management ranges from 8,400-32,000 MPN/100 ml (Figure 7). The high value of Total Coliform concentration in the Srigangga River flow is due to the discharge of organic waste that is discarded in the river flow, as well as from the river's function as an irrigation channel for organic materials (Aqielatunnisa, A. 2015).

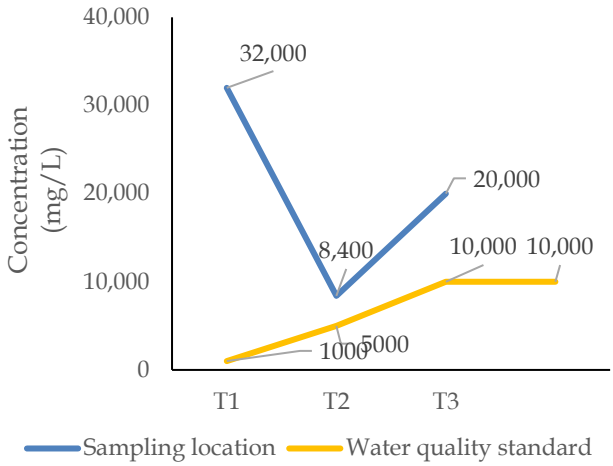

Figure 8. Results of analysis of Total Coliform measurements

Escherichia coli

The results of the Srigangga River water quality analysis test compared to river water quality standards show that the results are above the quality standards set

based on Government Regulations. Number 22 of 2021 concerning the Implementation of Environmental Protection and Management ranges from 1,200 - 7,400 MPN/100 ml. The content of pollution loads in the form of feces has increased from upstream to downstream because livestock activities and domestic waste enter the river body, and some communities still use the river directly for washing and toilets.

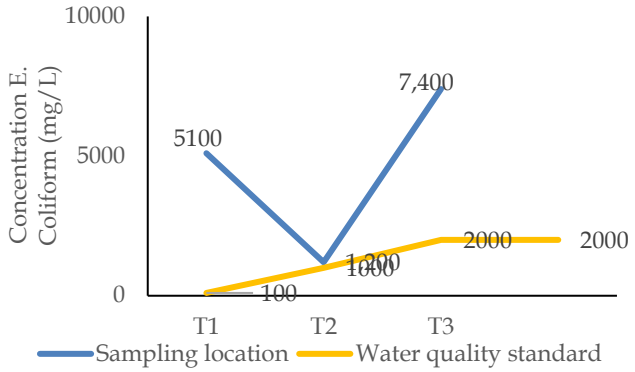

Figure 9. Results of Escherichia coli measurement analysis

Srigangga River Pollution Index

The pollution index is one of the methods of determining water quality status (Yohannes et al., 2019). Water quality status shows the level of comparison of source water quality conditions with water quality standards determined based on government regulations, Number 22 of 2021, concerning environmental protection and management implementation.

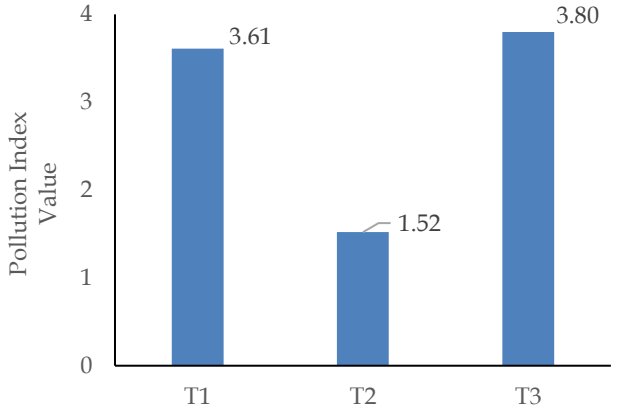

Figure 10. Pollution Index Value

The pollution index value in the Srigangga River flow in the upstream area is 3.61, in the middle area is 1.52, and in the downstream area, it is 3.80. Variations in river water quality status in three river areas indicate that the Srigangga River is lightly polluted. Pollutants originating from human activities around the river basin, such as activities originating from settlements, agriculture, services, and trade, have affected the water quality of the Srigangga River.

Based on this, efforts and strategies are needed to control and reduce pollution in the Srigangga River by improving management and better management of the river environment by involving the participation of community members in its management by carrying out routine monitoring so that the water quality of the Srigangga river is following water quality standards based on Government regulationsNumber 22 of 2021 concerning Implementation of Environmental Protection and Management.

Conclusion

The results of water quality analysis with physical, chemical, and biological parameters, namely Total Suspended Solid (TSS), pH, Total Phosphate, BOD, COD, Dissolved Oxygen (DO), Total coliform, and fecal Coliform show that TSS, Total Phosphate, Total Coliform, and Fecal Coliform has polluted the upstream, middle and downstream areas of the Srigangga river. It is caused by household activities around the Srigangga River, which produce waste from bathrooms, toilets, kitchens, laundry, agriculture, and livestock. Based on the Pollution Index (IP) calculation, the Srigangga River is classified as lightly polluted with a Pollution Index value of 1.52 – 3.80.

Acknowledgements

The authors wish to thank Dinas Lingkungan Hidup (DLH) of Central Lombok for facilitating this research.

Author Contributions

Conceptualization, S., E., I., R.N.R.; methodology, S., E., ; validation, S., E., I., R.N.R. ; formal analysis, E., and I.,; investigation, , S., E., I., R.N.R.; resources, E., I., R.N.R. ; data curation, S., E., I., R.N.R.; writing-original draft preparation, S. and E. ; writing-review and editing, I. and E.; visualization, S., I.; supervision, S., and E. ; project administration, S., E., I., R.N.R. ; All authors have read and agreed to the published version of the manuscript.

Funding

This research was funded by the researcher's independent funding.

Conflicts of Interest

The authors declare no conflict of interest.

References

Ali, A., Soemarno, P. M., & Purnomo, M. (2013). Kajian kualitas air dan status mutu air sungai Metro di Kecamatan Sukun kota Malang. *Jurnal Bumi Lestari*, *13*(2), 265-274.

Aqielatunnisa, A. (2015). *Analisis Bakteri Coliform (Fekal*

dan Non-Fekal) Sebagai Indikator Kualitas Perairan Sungai Gajah Wong, Daerah Istimewa Yogyakarta. Skripsi. UIN Sunan Kalijaga. http://digilib.uin-suka.ac.id/id/eprint/15732

Dung, D. Q., & Duc, P. A. (2015). Influence of water temperature and salinity on pH during dry season in lower Dong Nai River system, Vietnam. *GeoScience Engineering*, *61*(4), 29. https://doi.org/10.1515/gse-2015-0028

Effendi, H. (2016). River Water Quality Preliminary Rapid Assessment Using Pollution Index. Procedia Environmental Sciences. https://doi.org/10.1016/j.proenv.2016.03.108

Firdaus, N. A. (2019). Analisis Kualitas MAnalisis Kualitas Air (Studi Kasus Mata Air Citrosono Di Kecamatan Grabag Kabupaten Magelang) ata Air Citrosono Di Kecamatan Grabag Kabupaten Magelang. *Jurnal Georafflesia: Artikel Ilmiah Pendidikan Geografi*, *4*(2), 147-152. https://doi.org/10.32663/georaf.v4i2.1141

Halder, J., & Islam, N. (2015). Water Pollution and its Impact on the Human Health. *Journal of Environment and Human*. https://doi.org/10.15764/eh.2015.01005. https://doi.org/10.15764/EH.2015.01005

Nurdiana, F., Julyantoro, P. G. S., & Suryaningtyas, E. W. (2019). Kelimpahan bakteri coliform pada musim kemarau di Perairan Laut Celukanbawang, Provinsi Bali. *Jurnal Current Trends in Aquatic Science*, *2*(1), 101-107. https://simdos.unud.ac.id/uploads/file_penelitian_1_dir/917a87a6596f811537e5304ebb86e556.pdf

Sandi, M. A., Arthana, W., & Sari A. H. W. (2017). Bioasessment dan Kualitas Air Daerah Aliran Sungai Legundi Probolinggo Jawa Timur. *Journal of Marine and Aquatic Sciences*, 3(2): 233-241. https://doi.org/10.24843/jmas.2017.v3.i02.233-241

Sofiana, M., Kadarsah, A., & Sofarini, D. (2022). Kualitas Air Terdampak Limbah sebagai Indikator Pembangunan Berkelanjutan di Sub DAS Martapura Kabupaten Banjar. *Jukung (Jurnal Teknik Lingkungan)*, *8*(1): 18–31. https://doi.org/10.20527/jukung.v8i1.12966

Suprayogi, S., Purnama, S., & Darmanto, D. (2014). Pengelolaan Daerah Aliran Sungai. Yogyakarta: UGM Press

Sutamihardja, R. T. M., Azizah, M., & Hardini, Y. (2018). Studi dinamika senyawa fosfat dalam kualitas air sungai ciliwung hulu kota bogor. *Jurnal Sains Natural*, *8*(1), 43-49. https://doi.org/10.31938/jsn.v8i1.114

Sylus, K. J., & Ramesh, H. (2015). The study of sea water intrusion in coastal aquifer by electrical conductivity and total dissolved solid method in Gurpur and Netravathi River basin. *Aquatic Procedia*, *4*, 57-64. https://doi.org/10.1016/j.aqpro.2015.02.009

Wahjono, H. D. (2019). Pengembangan Sistem Sampling Air untuk Mengatasi Gangguan Lumpur pada Sistem Online Monitoring Kualitas Air Sungai Development of Water Sampling System to Overcome Mud Disruption in The Application of Online Monitoring of River Water Quality. *Jurnal Teknologi Lingkungan Vol*, *20*(1): 113- 122. https://doi.org/10.29122/jtl.v20i1.3078

Wicheisa, F. V., Hanani, Y., & Astorina, N. (2018). Penurunan Kadar Chemical Oxygen Demand (COD) Pada Limbah Cair Laundry Orens Tembalang dengan Berbagai Variasi Dosis Karbon Aktif Tempurung Kelapa. *Jurnal Kesehatan Masyarakat*, 6 (6): 135-142. https://doi.org/10.14710/jkm.v6i6.22168

Wikurendra, E. A., Syafiuddin, A., Nurika, G., & Elisanti, A. D. (2022). Water quality analysis of pucang river, sidoarjo regency to control water pollution. *Environmental Quality Management*, *32*(1), 133-144. https://doi.org/10.1002/tqem.21855

Wood, W. (1976). Guidelines for collection and field analysis of groundwater samples for selected unstable constituents. https://bibliotecadigital.ciren.cl/bitstream/handle/20.500.13082/24195/twri_1-D2_a.pdf?sequence=2

Yulistia, E., Fauziyah, F., & Hermansyah, H. (2018). Assessment of Ogan River Water Quality Kabupaten OKU South Sumatera by NSFWQI Method. *IJFAC (Indonesian Journal of Fundamental and Applied Chemistry)*, *3*(2), 54-58. https://doi.org/10.24845/ijfac.v3.i2.54

Yohannes, B. Y., Utomo, S. W., & Agustina, H. (2019). Kajian Kualitas Air Sungai dan Upaya Pengendalian Pencemaran Air. *IJEEM-Indonesian Journal of Environmental Education and Management*, *4*(2), 136-155.. https://doi.org/10.21009/IJEEM.042.05