JURNAL PENDIDIKAN LINGKUNGAN DAN PEMBANGUNAN BERKELANJUTAN

Journal of Environmental Education and Sustainable Development

Volume22-Nomor 1,2021
Available at http://journal.unj.ac.id/unj/index.php/plpb
ISSN : 1411-1829 (print), 2580-9199 (online)

Water Pollution Assessment In Bengawan Solo River Using Storet Method

Bagas Aidi[1], Bintang Aji Pangestu[2], Rica Naudita Krisna Setioningrum[2], Roro Azizah[3] [1]Department of Public Health, Faculty of Public Health, PSDKU Airlangga University Banyuwangi, Jl. Wijayakusuma No.113, Kec. Giri, Banyuwangi Regency
[2]Department of Environmental Health, Faculty of Public Health, Airlangga University, Campus C Surabaya, Indonesia
*E-mail: bagas.aidi-2017@fkm.unair.ac.id

Received :16th September 2020
Revised : 15th March 2021
Accepted : 31st March 2021

Keyword:
Water quality, Bengawan Solo STORET Method

ABSTRACT

The Bengawan Solo River stretches from Central Java to East Java, making it the longest river on the island of Java, where Bengawan Solo has become the economic lifeblood for residents, especially in Central and East Java, which traverses densely populated areas, offices, trade, and industry. These various kinds of activities produce waste, which has an impact on water quality pollution. This study aims to determine the status of water quality standards in the Bengawan Solo River. The data used from the Bengawan Solo River Basin Center by using data for the January-March 2020 period through 12 monitoring points were then analyzed using the STORET method. Each parameter is analyzed using Government Regulation number 82 of 2001, and the results are most of the parameters do not meet quality standards, including TDS, TSS, DO. The results of the STORET assessment analysis showed that the Bengawan Solo River was included in class 4 by 41.6% in moderate polluted conditions and the remaining 58.4% in heavily polluted conditions. The results of the calculation of the STORET Method according to classes I, 2, and 3 are 100% in Bad conditions (≥-30), namely, heavily polluted conditions indicate the status of water quality which is not in accordance with the quality standards stipulated in the Decree of the Governor of East Java Number 61 regarding the designation. River in East Java.

https://doi.org/10.21009/PLPB.221.03

How to Cite: Aldi B, Pangestu B A, Setioningrum R N K & Azizah R. (2021). Water Pollution Assessment In Bengawan Solo River Using Storet Method, *22*(01), 26-.42

doi: https://doi.org/10.21009/PLPB.221.03

INTRODUCTION

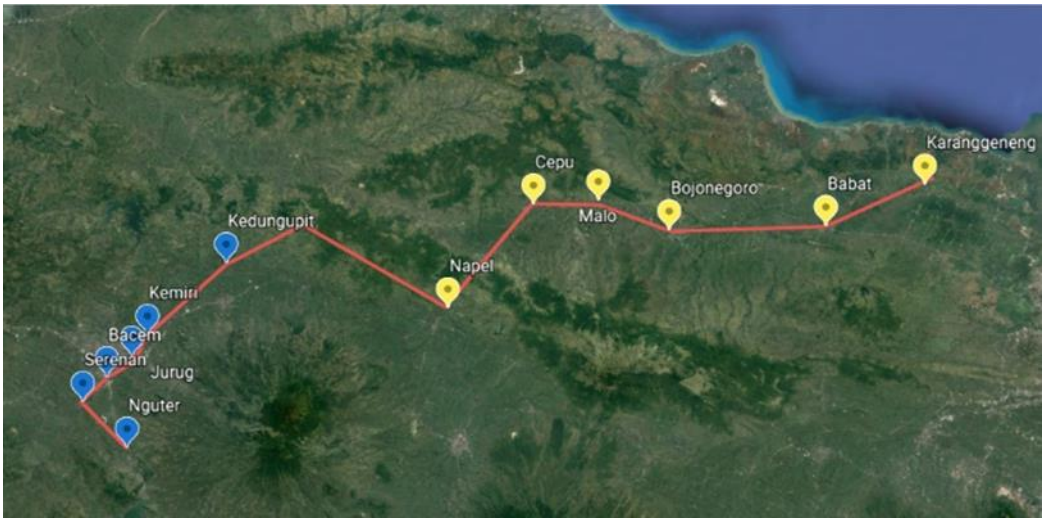
Life cannot exist without water. Because of the importance of water use, water quality is also taken into account for human consumption. The community uses the river to meet their daily needs. The Bengawan Solo River stretches from Central Java to East Java, making it the longest river in Java, where river water is used by the community as the main source of raw material for domestic consumption, electricity generation, recreation, industry, irrigation, industry, and recreation. Bengawan solo has become the economic lifeblood for residents, especially in Central and East Java, which traverse densely populated residential areas, trade, office, and industrial areas. (Pristianto, La Goa and Saputra, 2018). These various kinds of activities produce waste, which has an impact on water quality pollution, both in the Province of Central Java and East Java. Water quality pollution brings many problems that cause harm to society.

The decline in the quality of water resources is a problem from year to year due to the increasing amount of water polluted. Both corporate and domestic waste empties into the Bengawan Solo River, resulting in water pollution from the Solo Bengawan River. Waterrivers that are contaminated with organic and inorganic materials in the form of waste can change the biological properties of the water, and will also affect the chemical composition of these waters. Waters that are polluted with biological pollutants can reduce reduce the dissolved oxygen content. Water pollution from sewage will change the water quality status of the Bengawan Solo River (Ramadhani, Hari, and Yuliani, 2014). The status of water quality is the level of water quality that indicates polluted or good conditions in a water source within a certain time by comparing with the specified water quality standards. Changes in water quality conditions in the Bengawan Solo River, a water quality assessment was carried out using the STORET method.

METHODS

Water quality monitoring is carried out at various locations in the upstream and downstream areas of the Bengawan Solo River, each area having six monitoring points. Figure 1. Monitoring locations of the Bengawan Solo River sample points The location of the Bengawan Solo River water sampling point can be seen in the following table.

Table 1. Location of Sampling Points



No. Point	Place name	Location
	Upstream Region	
1	Kedungupit	Sragen
2	Candlenut	Karanganyar
3	Jurug	Surakarta
4	Bacem	Sukoharjo
5	Serenan	Sukoharjo
6	Nguter	Sukoharjo
	Downstream Region	
7	Karanggeneng	Lamongan
8	Tripe	Lamongan
9	Bojonegoro	Bojonegoro
10	Malo	Bojonegoro
11	Cepu	Bojonegoro
12	Napel	Ngawi

2.1 Data Collection Methods

This study used secondary data obtained from the Central Bengawan Solo Region (BBWSBS) from January-March 2020. Physical parameter tests were directly carried out in the field, while physical, chemical, and biological parameters were tested in-depth at the Test Laboratory of the Central Health Engineering Center. Environment and Disease Control (BBTKLPP) Yogyakarta and Surabaya .. Furthermore, it is calculated using the STORET method, which refers to Government Regulation number 82 of 2001 concerning water quality management and water pollution control.

Table 2. Quality Standard Parameters according to PP 82 of 2001

Parameter	Quality Standards (PP 82 the Year 2001)			
	Class 1	Grade 2	Grade 3	4th grade
Physics				
Temperature	deviation 3	deviation 3	deviation 3	deviation 3
Dissolved Residue	1000	1000	1000	2000
Suspended Residue	50	50	400	400
Chemistry				
PH	6 - 9	6 - 9	6 - 9	5 - 9
DO	6	4	3	0
Nitrate as N	10	10	20	20
Nitrite as N (NO2)	0.06	0.06	0.06	0.06
NH3 - N	0.5	-	-	-
Total Phosphate as P	0.2	0.2	1	1
Iron	0.3	-	-	-
Manganese	0.1	-	-	-
COD	10	25	50	100
BOD	2	3	6	12
Fluoride (F)	0.5	1.5	1.5	-
Lead (Pb)	0.03	0.03	0.03	1
Copper (Cu)	0.02	0.02	0.02	0.2
Detergent	200	200	200	-
Biology				
Total coliform	1000	5000	10000	10000
Stool coliforms	100	1000	2000	2000

Source: Government Regulation 82 the Year 2001

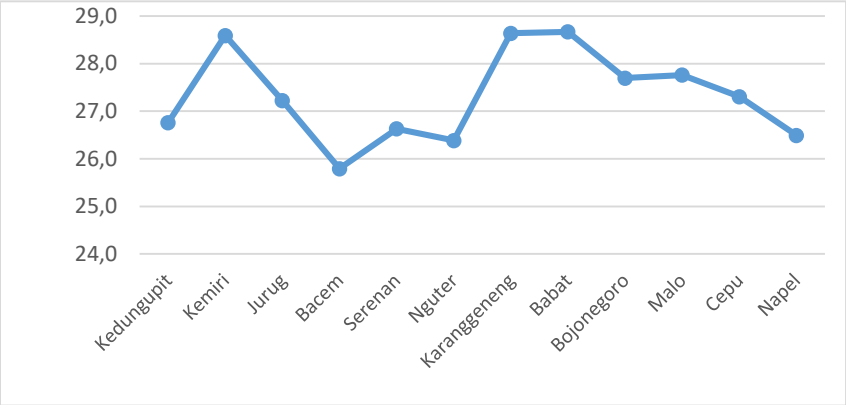
RESULTS AND DISCUSSION

Research result

The results of the research on the water quality of the Bengawan Solo River were carried out in January, February, and March as well as the location of the collection point using 19 parameters which refer to Government Regulation Number 82 of 2001 concerning Water Quality Management and Water Pollution Control. The results of the water sample analysis are presented in the following figure:

Temperature

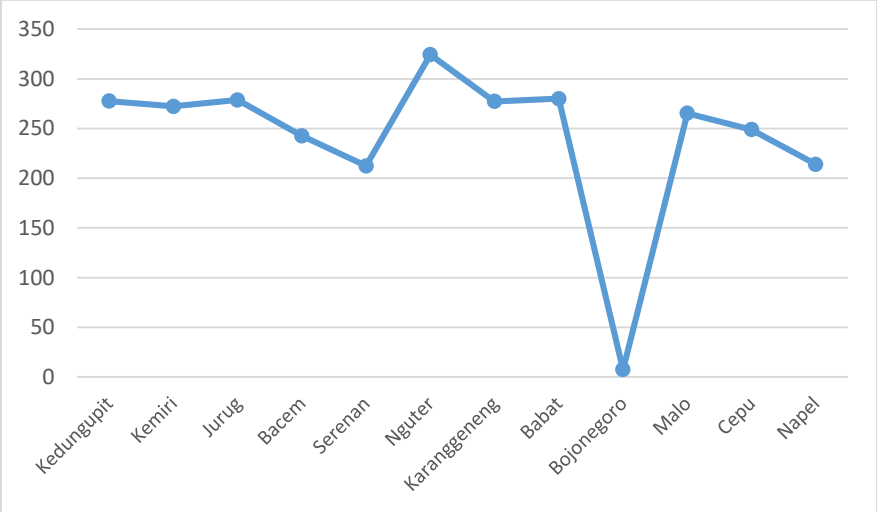
Figure 2.Temperature measurement results



In the image, the average temperature measurement at 12 measurement points tends to be stable with the highest temperature of 28.7 at the point of Babat and the lowest of 25.8 at the point of Bassem. All points meet the quality standards in all classes of water quality standards.

TDS

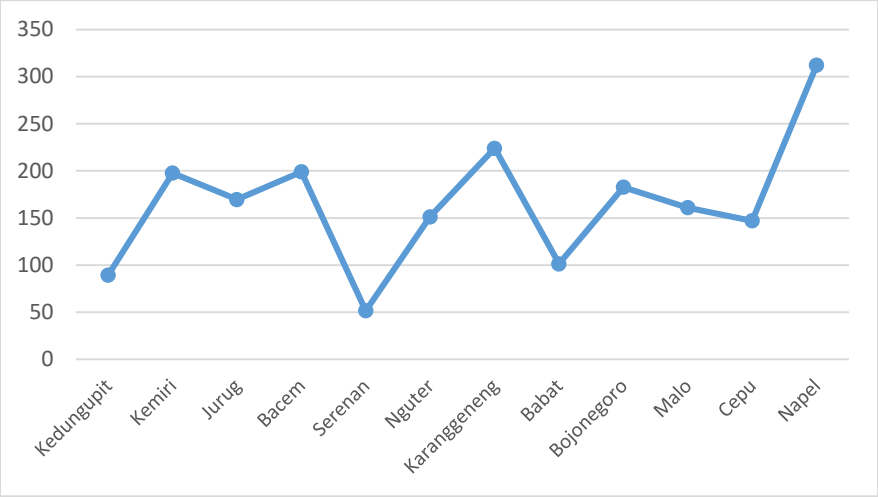
Figure 3. TDS measurement results



In the image, the average Dissolved Residue (TDS) measurement at 12 measurement points tends to be stable with the highest concentration of 324 and the lowest 7. All points meet the quality standards in all classes of water quality standards.

TSS

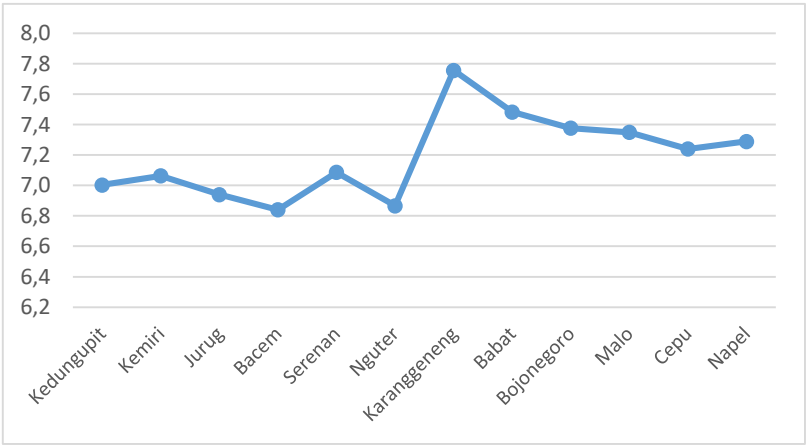
Figure 4. TSS measurement results



In the image, the average Suspended Residue (TSS) at 12 measurement points tends to be stable with the highest concentration of 324 at the Napel point and the lowest 51 at the Serenan point. All points meet the quality standards in class 3 & 4 of water quality standards.

PH

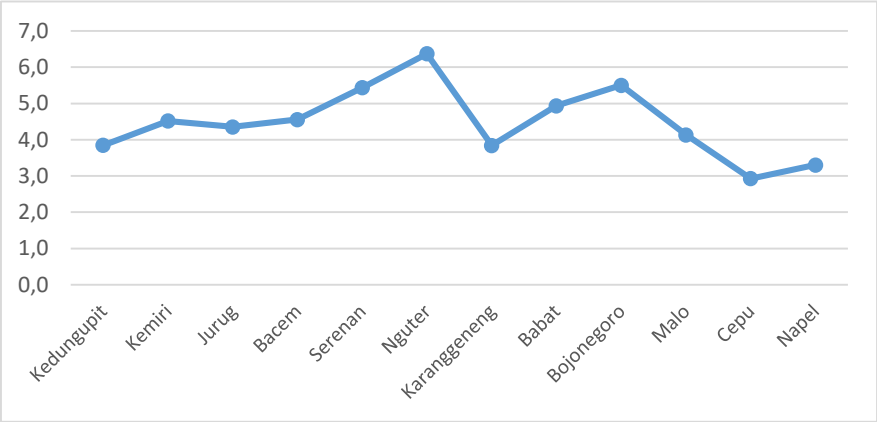
Figure 5. pH measurement results



In the picture, the average pH measurement at 12 measurement points tends to be stable with the highest pH being 7.8 at the Karanggeneng point and the lowest being 6.8 at the Bacem point. All points meet the quality standards in all water quality standard classes.

DO

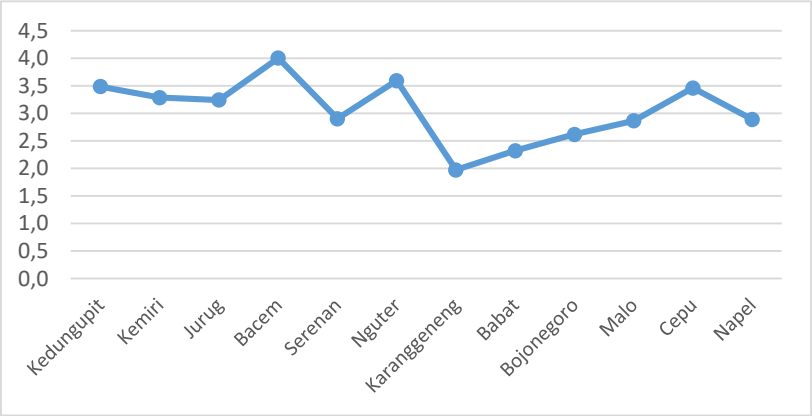
Figure 6.DO measurement results



In the picture, the average Dissolved Oxygen (DO) measurement at 12 measurement points tends to be stable with the highest concentration of 6.4 at the Nguter point and the lowest 2.9 at the Cepu point. Only 1 point fulfills the quality standard in class 1 water quality standard, 8 points meet the class 2 quality standard and the rest meet the class 3 and 4 quality standards.

Nitrate

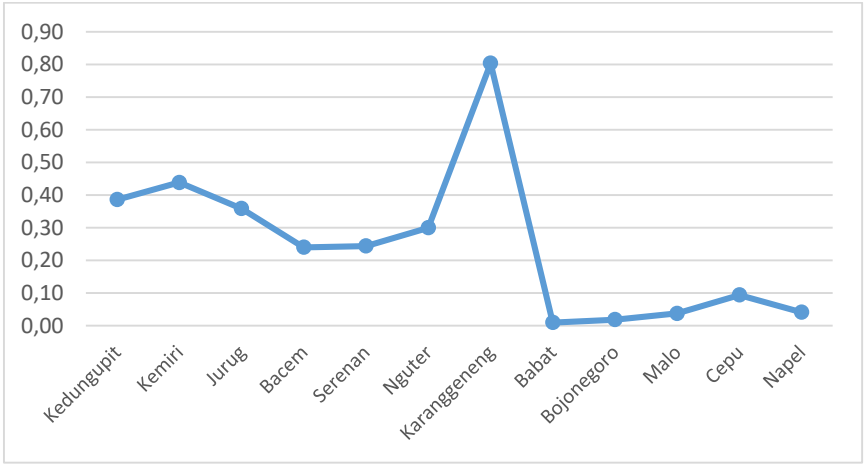
Figure 7. Nitrate measurement results.



In the figure, the average measurement of Nitrate at 12 measurement points tends to be stable with the highest concentration of 4 at the Bacem point and the lowest 2 at the Karanggeneng point. All points meet PP quality standards in all water quality standard classes.

Nitrite

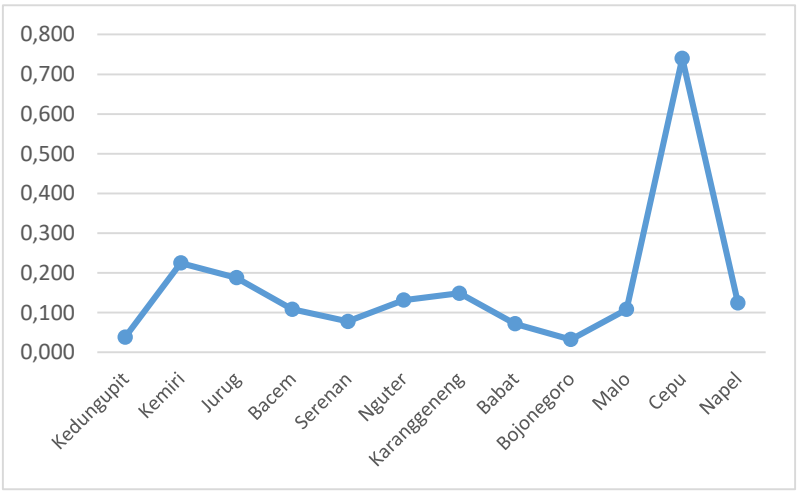
Figure 8. Nitrite measurement results



In the figure, the average measurement of Nitrite at 12 measurement points tends to decrease from upstream to downstream with the highest concentration of 0.8 at the Karanggeneng point and the lowest 0.01 at the Babat point. A total of 8 points do not meet the quality standards in classes 1, 2, and 3 water quality standards.

Ammonia

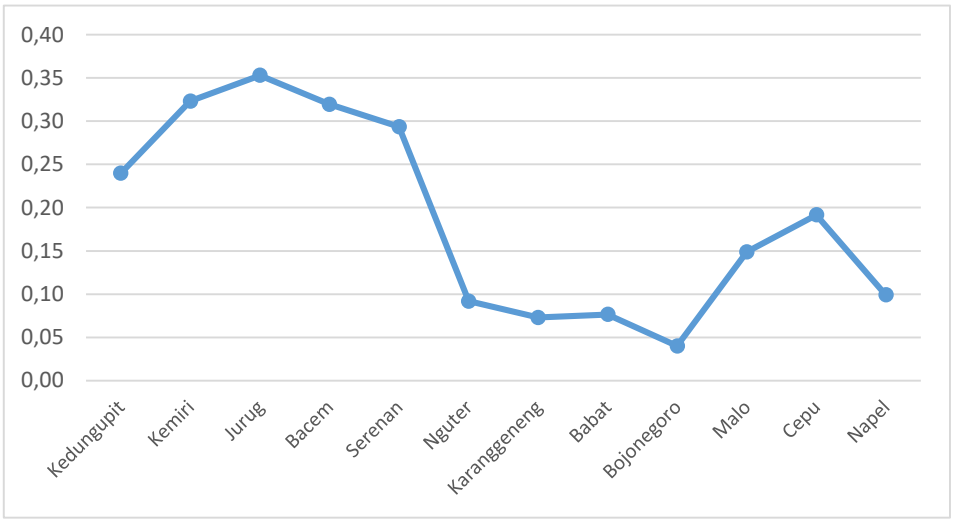
Figure 9. Ammonia measurement results



In the figure, the average measurement of ammonia at 12 measurement points tends to be stable and has increased at the Cepu point with the highest concentration of 0.74 and the lowest of 0.032 at the Bojonegoro point. A total of 1 point does not meet the quality standards in class 1 of the water quality book, namely at the Cepu point.

Phosphate

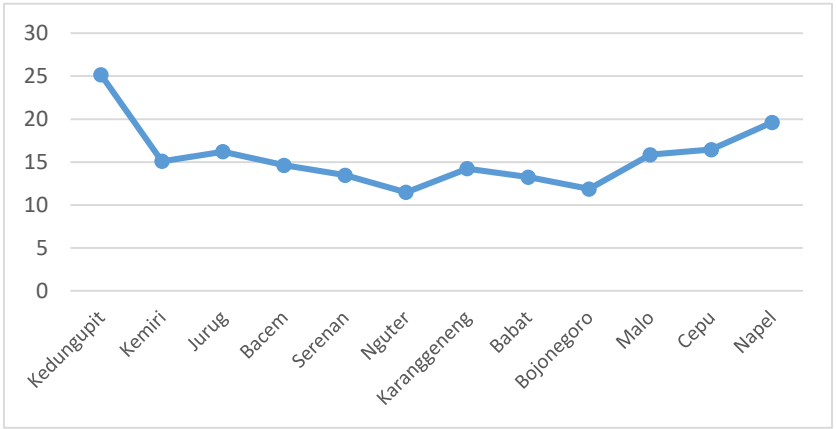
Figure 10. Phosphate measurement results.



In the picture, the average Phosphate measurement results at 12 measurement points decreased the concentration from upstream to downstream with the highest concentration of 0.35 at the Jurug point and the lowest 0.04 at the Bojonegoro point. A total of 5 points do not meet the quality standards in class 1 and 2 of water quality standards, namely at points 1,2,3,4, and 5.

COD

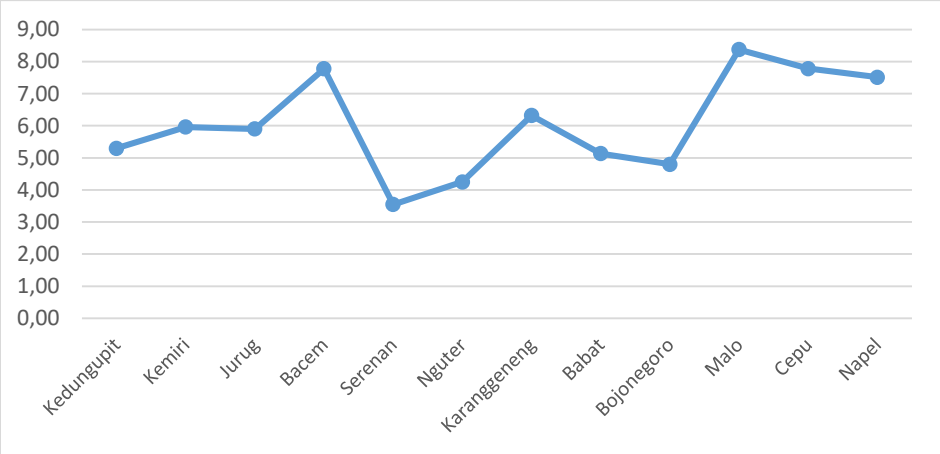
Figure 11. COD measurement results.



In the picture, the average COD measurement at 12 measurement points tends to be stable with the highest concentration of 25.1 at the Kedungupit point and the lowest 11.4 at the Nguter point. All points do not meet the quality standard in class 1 and 11 points meet the quality standard for class 2.

BOD

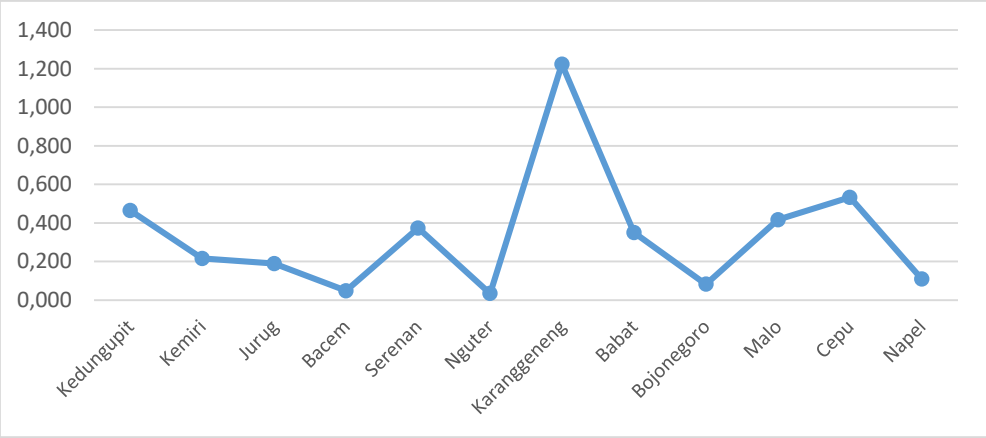
Figure 12. BOD measurement results



In the image, the average BOD measurement results at 12 measurement points tend to be stable with the highest concentration of 8.38 at the Malo point and the lowest 3.55 at the Serenan point. All points do not meet the quality standards in class 1 and 7 points meet the quality standard for class 3 and the rest are class 4.

Flourida

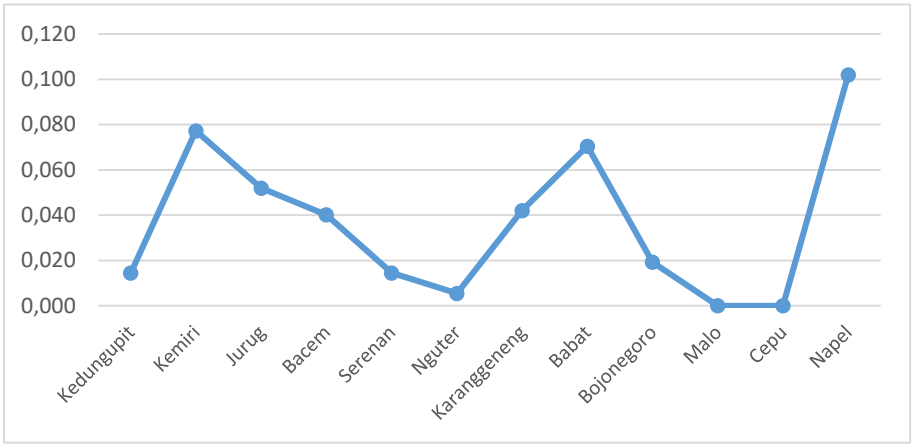
Figure 13.Florida measurement results



In the picture, the average measurement of Flourida at 12 measurement points tends to be stable with the highest concentration at the Karanggeneng point of 1.224 and the lowest at 0.034 at the Nguter point. All points meet the quality standards in all classes of water quality books.

Lead

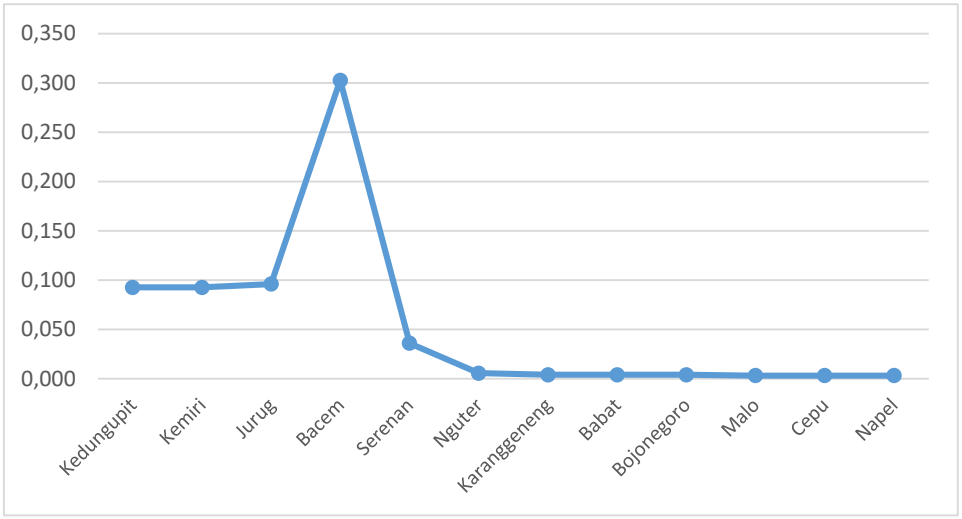
Figure 14. Lead measurement results



In the image, the average measurement of Lead at 12 measurement points occurs an increase and decrease in concentration from upstream to downstream with the highest concentration of 0.102 at point 12 and the lowest 0.0001 at points 10 and 11. A total of 6 points do not meet the standards in class 1 standard water quality.

Copper

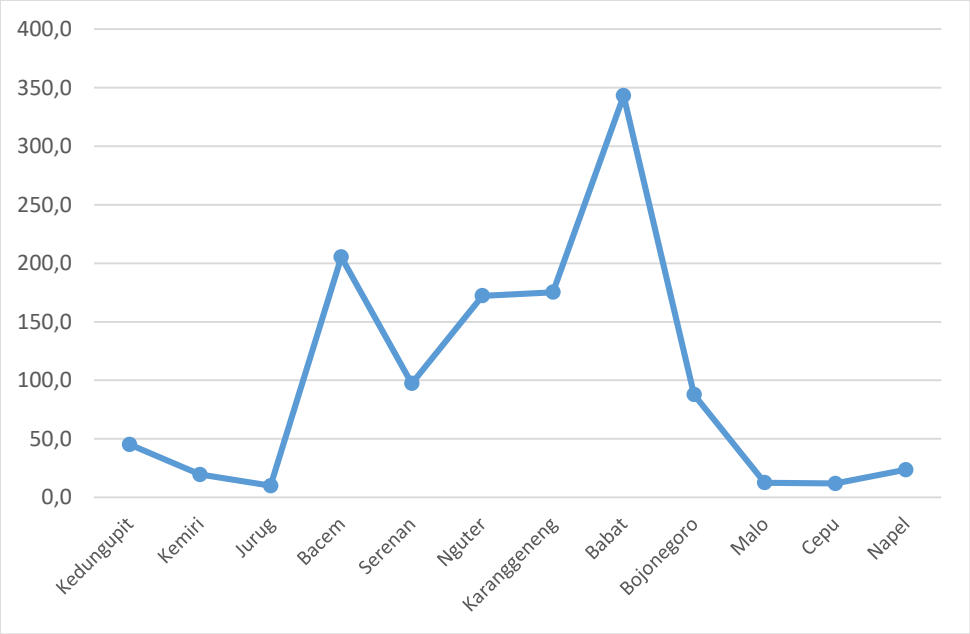
Figure 15. Copper measurement results



In the picture, the average measurement of Phosphate at 12 points of measurement of decreasing concentration from upstream to downstream with the highest concentration of 0.35 at point 3 and the lowest 0.04 at point 9. 5 points do not meet the quality standards in class 1 and 2 books water quality.

Detergent

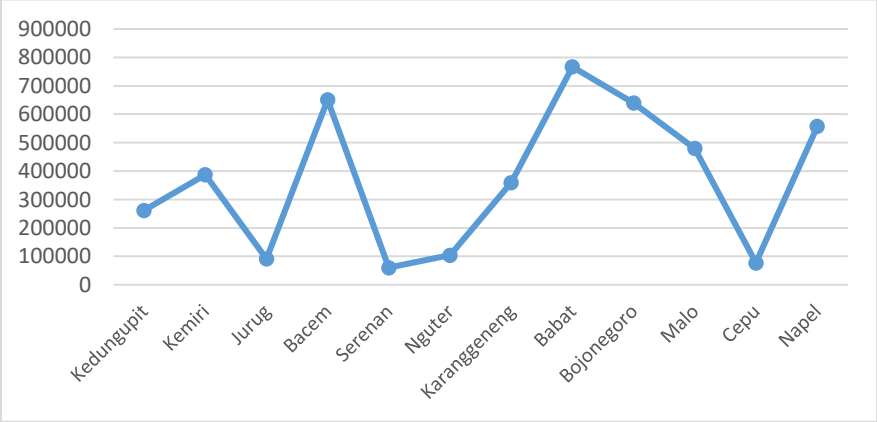
Figure 16. Detergent measurement results.



In the picture, the average Detergent measurement results at 12 measurement points have increased at point 4 the decrease in concentration at point 9 with the highest concentration is 343.1 at point 8 and the lowest is 10 at point 3.A total of 2 points do not meet the quality standards in class 1, 2 and 3 water quality books, namely at points 4 and 8.

Total Coliform

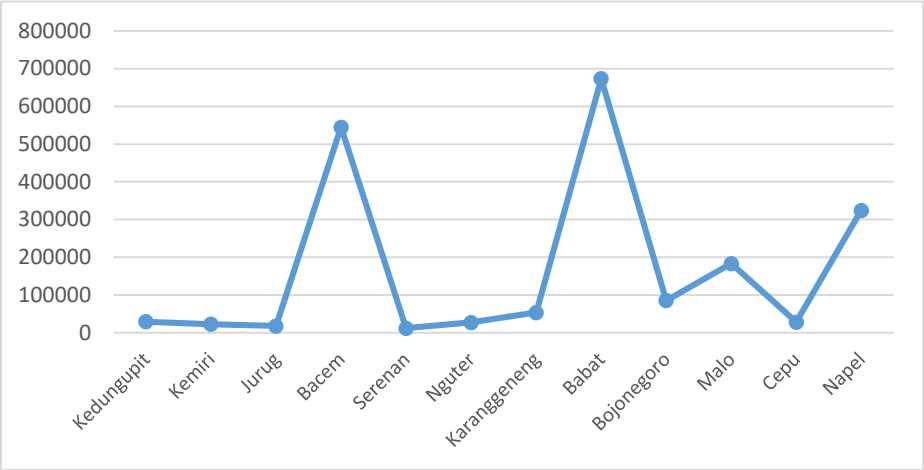
Figure 17. Total Coliform measurement results



In the image, the average measurement results for Total Coliform at 12 measurement points, there is an increase and decrease in concentration from upstream to downstream with the highest concentration of 766,666 at point 8 and the lowest 60,466 at point 5.All points do not meet quality standards in all classes of water quality books

Fecal Coliform

Figure 18. Fecal Coliform Measurement Results

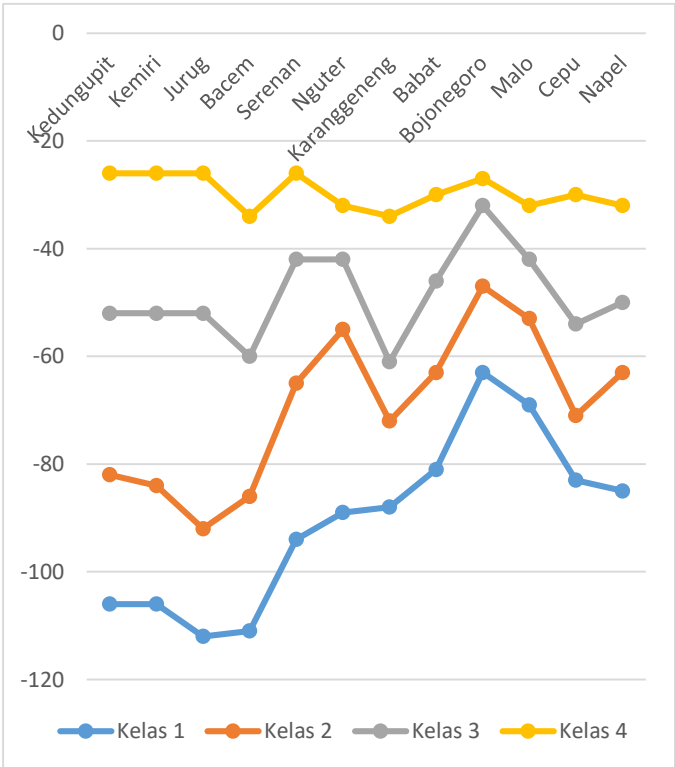


In the image, the average measurement results for Coliforms in the 12 measuring points have an increase and decrease in concentration from upstream to downstream with the highest concentration of 673,333 at point 8 and the lowest 12,033 at point 5. All points do not meet the quality standards in all water quality book classes.

Storetic Assessment Method

The results of the water quality assessment using the STORET method at 12 points can be seen in the table as follows:

Figure 19. Results of STORETS for the Bengawan Solo River



The picture above is the result of calculations using 4 classes of river water quality standards based on PP 82 of 2001 showing that the class 1 quality standard has the lowest calculation value and the class 4 quality standard has the highest calculation value. Storet calculation with class 1 quality standard has the highest value of -63 at the Bojonegoro point and the lowest point of -112 at the Jurug point. Parameters that cause class 1 quality standard pollution include TSS, DO, Nitrite, Phosphate, Iron, Manganese, COD, BOD, Lead, Copper, Detergent, Total Coliform and Fecal Coliform. The grade 1 quality standard graph tends to experience an increase in quality from upstream to downstream of the Bengawan Solo River, although it has experienced a decrease in quality from Bojonegoro to Malo and so on.

The calculation of quality with class 2 quality standards has the highest value of -47 at the Bojonegoro point and the lowest point of -92 at the Jurug point. Parameters that cause grade 2 quality standard pollution include TSS, DO, Nitrite, Phosphate, COD, BOD, Lead, Copper, Total Coliform and Fecal Coliform. The class 2 quality standard graph tends to experience an increase in quality from upstream to downstream of the Bengawan Solo River, although it has decreased in quality from the Karanggeneng, Malo and Napel points.

There was a shift in the lowest peak in the calculation of the quality standard for class 3. The calculation of quality with the quality standard for class 3 had the highest value of -32 at the Bojonegoro point and the lowest point of -61 at the Karanggeneng point. Parameters that cause grade 3 quality standard pollution include DO, Nitrite, Lead, BOD, Total Coliform and Fecal Coliform. Class 3 quality standard graph tends to fluctuate in quality from upstream to downstream of the Bengawan Solo River.

Calculation of quality with grade 4 quality standards has the highest value of -26 at the point of Kedungupit, Kemiri, Jurug, and Serenan and the lowest point of -34 at the point of Bacem. Parameters that cause grade 4 quality standard pollution are Total Coliform and Fecal Coliform. The grade 4 quality standard graph tends to experience stable quality values from upstream to downstream of the Bengawan Solo River.

From the results of the analysis of the STORET assessment for Suangai Bengawan Solo, the main cause of pollution of the Bengawan Solo River is Biological Pollutants, namely Total Coliform and Fecal Coliform. In addition, Nitrite, as well as heavy metals such as Lead and Copper, also increase pollution in the Bengawan Solo River. According toSetiawan (2014). Industrial activities that use heavy metals in their production processes are the main factors causing heavy metal pollution in waters. In addition, domestic and agricultural waste are problems, according to the studyDawud et al (2016)that as much as 4.8% of the people dispose of feces into the river, because the Feces Treatment Plant (IPLT) is still limited so that operations are not optimal. Disposal of domestic waste in rivers also increases pollution because it contains pollutants including BOD, COD, Ammonia, Phosphate, Detergent, Total Coliform, and Fecal Coliform.(Yudo, 2018)

Table 5. Classification of the Water Quality Status of the Bengawan Solo River

Location	Quality Standards (PP 82 Year 2001)			
	Class 1	**Class 2**	**Class 3**	**Class 4**
Kedungupit	Bad	Bad	Bad	Moderate
Candlenut	Bad	Bad	Bad	Moderate
Jurug	Bad	Bad	Bad	Moderate
Bacem	Bad	Bad	Bad	Bad
Serenan	Bad	Bad	Bad	Moderate
Nguter	Bad	Bad	Bad	Bad
Karanggeneng	Bad	Bad	Bad	Bad
Tripe	Bad	Bad	Bad	Bad
Bojonegoro	Bad	Bad	Bad	Moderate
Malo	Bad	Bad	Bad	Bad
Cepu	Bad	Bad	Bad	Bad
Napel	Bad	Bad	Bad	Bad

The results of the total STORET calculation obtained the water class quality standard in the Bengawan Solo River based on Government Rule No. 82 of 2001 for water class quality standards, amounting to 100% of the points in Bad condition (≥-30), namely the heavily polluted conditions according to classes I, 2 and 3 For class 4 it is 41.6% in moderately polluted conditions and the remaining 58.4% in heavily polluted conditions. Based on the STORET Scoring, the Bengawan Solo River is in the class 4 category, this is not in accordance with Governor Regulation number 61 of 2010 concerning the determination of the water quality of the Bengawan Solo river which is in class 2 and 3.The class 4 river is designated for irrigating land and / or for other designation which is the same as that utility

CONCLUSIONS AND RECOMMENDATIOS

Conclusion

Conclusions that can be drawn based on the results of the analysis and discussion are as follows:

1. The largest pollutant parameters on the Bengawan Solo River with 12 monitoring points, measurements carried out every month from January, February, and March are parameters of TDS, TSS, DO, Nitrite, Phosphate, COD, BOD, Lead, Copper, Total Coliform and Fecal Coliform. Most of these parameters do not meet the quality standards in accordance with PP 82 of 2001.
2. The results of the water quality of the Bengawan Solo river through 12 monitoring points using the STORET method were heavily polluted and did not meet the quality standards for classes 1, 2, and 3. 41.6% were in moderately polluted conditions and the remaining 58.4% were in heavily polluted conditions in the standard Class 4 quality, this is not in accordance with the Decree of the Governor of East Java Number 61 concerning the designation of rivers in East Java. The Bengawan Solo River is a class 2 and 3 river so it requires special monitoring to improve the quality of Bengawan Solo water.

Suggestion

Suggestions based on the results of the analysis that have been carried out are as follows:

1. Due to the limitations of this analysis, it is hoped that further and long-term analysis of river water quality monitoring is expected.
2. To related parties to manage the disposal of domestic, agricultural and industrial waste in the Bengawan Solo River and the tributaries of the Bengawan Solo River
3. Creating a Fecal Waste Treatment Plant (IPLT), both facilities and infrastructure to treat waste from feces before it is directly discharged into the river and pollutes the river.
4. Implementing education and repression to all those who pollute the Bengawan Solo River to maintain water quality.

REFERENCES

Dawud, M. et al. (2016) 'Community-Based Analysis of Cisadane River Water Pollution Control Systems at Tanggerang City', in. 2016 National Seminar on Science and Engineering, Faculty of Engineering, University of Muhammadiyah Jakarta, p. 8.

Pristianto, H., La Goa, Y. and Saputra, A. (2018) 'Klasaman Water Quality Assessment', Teknika, 13 (1), p. 22. doi: 10.26623 / teknika.v13i1.1048.

Ramadhani, FTW, Harisuseno, D. and Yuliani, E. (2014) Application of the Water Quality Index (WQI) Method and the STORET Method to Determine Water Quality Status in the Lower Brantas River Section, Irrigation Universitas Brawijaya, p. 9.

Republic of Indonesia. 2001. Government Regulation Number 82 Year 2001. Concerning Water Quality Management and Water Pollution Control. Jakarta: Secretary of State.

Republic of Indonesia. 2003. KepMen LH Number 115 Year 2001. concerning Guidelines for Determining Water Quality Status. Jakarta: Secretary of State

Republic of Indonesia. 2010. Regulation of the Governor of East Java Number 61 of 2010. Concerning the determination of water class in river water. East Java: Governor of East Java.

Setiawan, H. (2014) 'Heavy Metal Pollution in the Coastal Waters of Makassar City and Efforts to Prevent It', EBONI Technical Info, 11 (1), p. 14.

Yudo, S. (2018) 'Water Quality Concentration of Ciliwung River in the DKI Jakarta Region in terms of Organic, Ammonia, Phosphate, Detergent and Coli Bacteria Parameters, Indonesian Journal of Water, 6 (1). doi: 10.29122 / jai.v6i1.2452.