



SPATIAL ANALYSIS OF GANDONG RIVER WATER POLLUTION FROM LEATHER INDUSTRY AT MAGETAN DISTRICT

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Abstract

Pollution of Gandong River occurs due to the disposal of waste water from the leather industry into the river body which still exceeds the quality standard even though it has gone through the neutralization stage. Organic substances from the tanning process that decompose can release gases such as sulfide or ammonia, causing unpleasant odors. The purpose of this study was to spatially map the distribution of BOD and COD levels in the Gandong River, Magetan Regency. This study used a descriptive method with a spatial approach. The data obtained from the results of laboratory tests will be analyzed comparatively to quality

standards. Then were analyzed using GIS-based spatial analysis (Geographical Information System) using ArcMap 10.3 software. The results of research conducted on river water from the upstream, middle and downstream rivers have parameters that exceed the quality standard according to the Government of the Republic of Indonesia Regulation Number 22 of 2021, namely the BOD parameter at point 2 with a value of 48.31 mg/l and at point 2 3 which is 45.43 mg/l. Meanwhile, the COD levels in the industry showed results of 184.01 mg/l and BOD levels of 75.37 mg/l so that they still exceeded the quality standard in accordance with the Regulation of the Minister of Environment and Forestry Number P.16 of 2019.

Keywords: river water pollution, :
leather industry, : water pollution index,
: spatial analysis

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Introduction

The leather tanning industry in Magetan Regency increase from year to year along the large market demand for leather products (Nopiasari, 2021). Leather products that are widely marketed in the leather center of Magetan are shoes, sandals, bags, jackets, wallets, etc. The leather tanning process uses chemicals that are not environmentally friendly such as chromium, sulfuric acid, formic acid and lime. Based on the results of the waste water quality test conducted by the leather tanning industry on February 2020 the total chromium parameter was 8.13 mg/l, on March 2020 the BOD parameter was 892.4 mg/l, the COD parameter was 1975 mg/l and the ammonia parameter was 892.4 mg/l. 302.3 mg/l.

According to the data from the Magetan Central Statistics Agency in 2018, the Gandong River was the longest river in Magetan Regency; it was 138.10 km. The classification of the water quality of the Gandong River belongs to class III, namely for fresh water fish cultivation, animal husbandry, water for irrigating crops or other usages that require the same water quality as these usages. The level of pollution in the Gandong River can be known through the COD and BOD parameters. Chemical parameters in water quality to determine the content of organic matter pollutants are BOD and COD. High levels of BOD and COD cause in decreasing dissolved oxygen levels in water bodies and they are dangerous for aquatic biota (Novia et al., 2019).

Due to the pollution originating from the leather industry, it causes problems for the environment. The liquid waste which be disposed has gone through the neutralization phase but the liquid waste still contains chemicals and visually there is foam in the Gandong River flow (Rasyid et al., 2018). For about 20 years, residents who have lived near the leather



industry and the flow of the Gandong River have felt bad smell and discomfort. The characteristic odor of leather tanning is caused by organic substances that decompose and emit gases such as sulfide or ammonia, causing an unpleasant odor (Riski et al.,2018). According to the decree of Environment Minister No. 5 of 1996, the limit of exposure to the smell of ammonia gas in residential areas continuously (24 hours) should not be more than 2 ppm. shortness of breath, dizziness and fainting (Susiyanto et al.,2007).

The application of Geographic Information System (GIS) technology for the purposes of data processing or analysis of geographically referenced data has developed in all fields. Geographic Information System (GIS) as a system capable of collecting, storing, transforming, displaying and correcting spatial data and geographical phenomena to obtain the distribution of pollution levels. This analysis is used to determine the distribution pattern of pollutants BOD and COD. After knowing the distribution pattern of pollution and the factors that influence it, it will be easier to plan effective pollution control efforts (Ramadona et al.,2012).

The researcher took a case study in the tanning industry area and Gandong River in order to determine the water quality as measured by BOD and COD parameters caused by tanning activities with a spatial distribution mapping model that is easy to understand.

Methods

This study uses a descriptive method with a spatial approach to identify and map the distribution of BOD and COD levels in the Gandong River, Magetan Regency. Spatial analysis uses the Inverse Distance Weighted (IWD) method, which is a conventional interpolation method that takes into account distance as a weight. Based on the IWD method,



the interpolation values will be more similar in the sample data that are closer than far away. Points that are closer to the estimated location will be given greater weight than those which are farther away (Perdana et al, 2013). The weighting is carried out based on the quality standards of PP RI Number 22 of 2021 by categorizing water quality into 3 categories, namely good (green zone), medium (yellow zone) and poor (red zone) weighting categories.

The first research location was carried out on the Gandong River, Magetan Regency by dividing it into 3 segments, namely the upstream, middle and downstream parts of the river. The second location of the study was carried out at the leather industry outlet. The time of the study was carried out in April 2021 at noon when the leather tanning industry was operating. Parameters analyzed include levels of BOD and COD. Water sampling is carried out based on the purposive sampling method, which is a sampling method based on several things that are considered by the researcher, based on the characteristics of the population that have been known previously (Notoatmodjo, 2012). The length of the river under study is ± 8 km which passes through Ringinagung Village, Magetan Village, Mangkujayan Village.

Results and Discussion

COD Parameter Test Results

There are levels of COD in the river due to liquid waste from the tanning industry activities where the tanning process uses chemicals, causing the COD levels in the river to increase. COD levels in the river can be seen in table 1.



Table 1. COD Parameter Test Results

Point	Location	Quality standards				Results
		I	II	III	IV	
1	Ringinagung	10	25	40	80	26.14
2	Ringinagung	10	25	40	80	48.31
3	Magetan	10	25	40	80	45.43
4	Magetan	10	25	40	80	29.55
5	Magetan	10	25	40	80	37.82
6	Mangkujayan	10	25	40	80	30.51
7	Mangkujayan	10	25	40	80	33.72
8	Outlet Leather Industry		150			184.01

Source: Primary Data Research Results

Spatial Analysis of Gandong River Water Quality COD

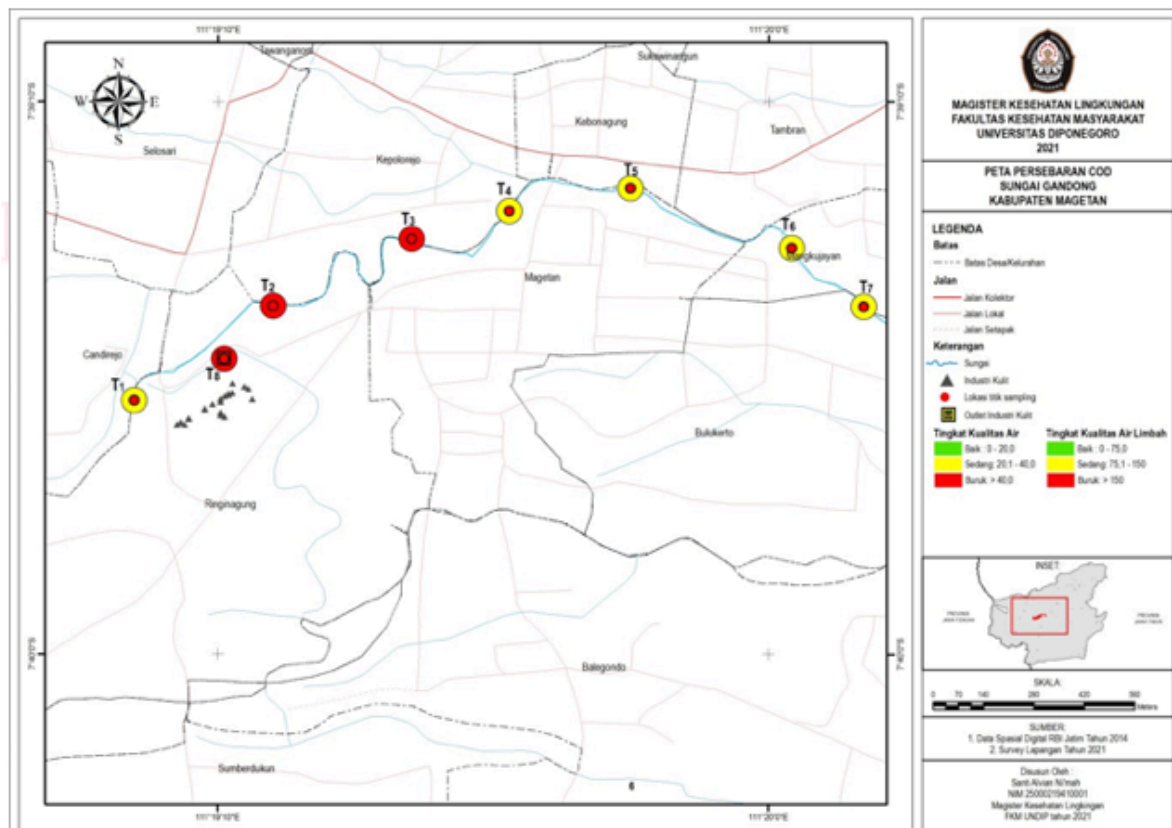


Figure 1. Map of Spatial Distribution Pattern of COD . Content



Based on the test results on 7 samples, it showed that river water had COD content ranging from 26.14 mg/l – 48.31 mg/l. It can be seen on the map of the spatial distribution pattern that COD levels fluctuate from the upstream to downstream rivers. This is caused by residential activities and leather industry around the watershed. The decomposition of the rest of the tanning process contained in the liquid waste can affect the values of BOD and COD levels. At point 1 or the upstream part of the river is a river segment before there is input from industrial liquid waste so that the COD level still meets the quality standard, but after the input of liquid waste from the leather industry results in an increase in COD levels at points 2 and 3 which exceed the quality standard. This is in line with Prasetya's research in 2015 where there was an increase in the concentration of COD in the Bledek River due to the input of liquid waste from the leather tanning industry. High levels of COD indicate a large level of pollution, the amount of oxygen needed for the oxidation of waste materials in the water (Yudo,2010).

Pollution occurs at point 2 with a COD value of 48.31 and point 3 with a COD value of 45.43 which is classified as exceeding the quality standard based on PP Number 22 of 2021 which is in the red zone at the sampling point. This happened because the sampling location was close to the waste disposal channel to the river body in Ringinaguang Village and Magetan Village. While at the 1st sampling point, 4th point, 5th point, 6th point and 7th point are in the yellow zone which shows the COD level in the river with a moderate category. The COD level at the outlet which is 184.01 mg/l is included in the red zone which indicates that the COD level is in the bad category. A high concentration of COD can indicate a greater level of pollution that occurs in awaters (Yudo,2010).



BOD Parameter Test Results

The presence of BOD levels in the water is caused by the activities of the leather tanning industry. Disposal of liquid waste into river bodies containing organic matter results in high BOD concentrations in river water. The higher the BOD level, it can indicate that the river has been polluted. The presence of BOD in tannery wastewater is used to determine the level of pollution due to industrial waste, in terms of the oxygen required when the waste is discharged into environmental water under aerobic conditions. BOD levels in the river can be seen in table 2.

Table 2. BOD Parameter Test Results

Sample	Location	Quality standards				Results
		I	II	III	IV	
1	Ringinagung	2	3	6	12	3.16
2	Ringinagung	2	3	6	12	5.74
3	Magetan	2	3	6	12	4.52
4	Magetan	2	3	6	12	3.38
5	Magetan	2	3	6	12	4.63
6	Mangkujayan	2	3	6	12	3.45
7	Mangkujayan	2	3	6	12	3.91
8	Outlet Leather Industry			60		75.37

Source: Primary Data



Spatial Analysis of Gandong River Water Quality BOD

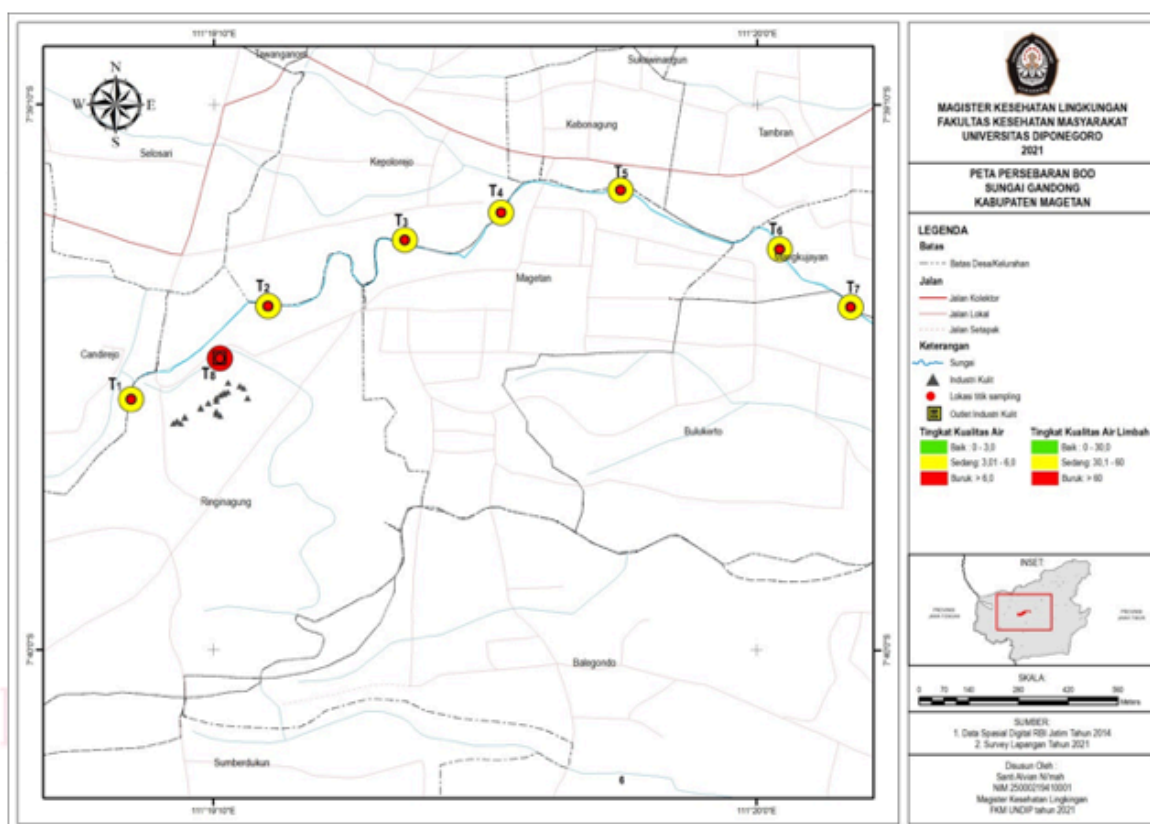


Figure 2. Map of Spatial Distribution of BOD . Levels

Based on the test results on 7 samples, it shows that river water has a BOD content ranging from 3.16 mg/l – 5.74 mg/l. It can be seen on the map of the spatial distribution pattern that BOD levels fluctuate from upstream to downstream. This is caused by residential activities around the watershed. At point 1 or the upstream part of the river is a river segment before input from industrial waste so that the BOD level still meets the quality standard. Pollution occurs in. BOD levels in rivers still meet the quality standards. All sample points are in the yellow zone which indicates that the BOD level in the river is in the moderate



category. BOD level at point 1 is 3.16 mg/l, point 2 is 5.74 mg/l, point 3 is 4.52, point 4 is 3.38 mg/l, point 5 is 4.63 mg/l, point 6 is 3.45 mg/l and point 7 is 3.91 mg/l. Meanwhile, at industrial outlets, the BOD level has exceeded the quality standard, which is 75.37 mg/l.

BOD levels in the river are very low due to sampling during the rainy season so that the water discharge in the downstream area increases. The results of Rahmawati's research in 2011 on the Diwak River in the dry season there was an increase in the value of BOD, COD when compared to water quality in the rainy season because the water discharge in the rainy season was greater than in the dry season. Rainwater that enters the river can dilute organic matter so that it can reduce COD and BOD levels in the river (Hilda et al, 2016)(Permana, 2013)(Permana, 2013)(Permana, 2013)(Permana, 2013)(Permana, 2013). Based on data from the BMKG in 2021 the rainfall in May is 269 mm. In addition, the more downstream the population density decreases and it is far from the source of pollution (outlet drains). The BOD level at the outlet, which is 184.01 mg/l, is included in the red zone which indicates that the BOD level is in the bad category.

Pollution Index

Determining the status of water quality can use the Pollution Index method in accordance with the Decree of the State Minister of the Environment No. 115 of 2003. Pollution index is one of the methods used to determine the status of water quality in a waters. Water quality status shows the level of river conditions in a polluted condition or in good condition by comparing it with a predetermined quality standard.

This Pollution Index describes river pollution by comparing the quality standards according to the water class that is determined based on the Government Regulation of the Republic of Indonesia No. 22 of 2021. So as to obtain information to determine whether



river water can be used for certain purposes according to water class. The pollution index can be used as a basis for improving the water quality of the Gandong River if the calculation results show that there is pollution. The following are the results of the calculation of the Gandong River Pollution Index:

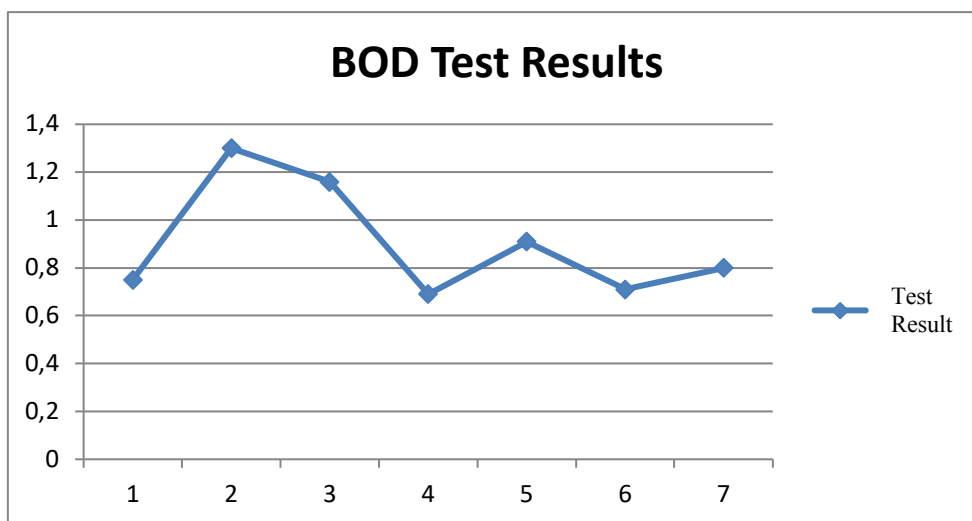


Figure 5. Gandong River Pollution Index

Based on the results of the calculation of the pollution index, it shows that there is a decrease in river water quality at 2 sample points. The results of the calculation of the pollution index at point 1 are 0.75, the 2nd point is 1.3, the 3rd point is 1.16, the 4th point is 0.69, the 5th point is 0.91, the 6th point is 0.71, the 7th point is 0.8. The status of light contamination occurs because it is influenced by increased levels of COD and BOD. Pollution only occurs at point 1 and point 2 because at that point it is still close to the leather industry waste disposal channel. This is in line with Sahabuddin's research in 2013 the Wanggu River was polluted with moderately polluted status for class III rivers with a score of 3.11-3.48, pollution occurred due to an increase in the parameter values of COD, BOD and DO.



Conclusion and Recommendation

Based on the research that has been done, the following conclusions can be drawn:

1. The results of the measurement of river water are only COD parameters that exceed the quality standard at two sampling points, namely point 2 with a value of 48.31 mg/l and point 3 with a value of 45.43 mg/l.
2. The results of measurements of wastewater (outlet) of the leather industry WWTP there are two parameters that exceed the quality standard, namely COD with a value of 184.01 mg/l and BOD with a value of 75.37 mg/l.
3. The results of the calculation of water quality status with a pollution index on the Gandong River experienced a light polluted status at point 2 with a score of 1.3 and at point 3 with a score of 1.16. While at point 1, point 4, point 5, point 6, point 7, it still meets the quality standard baku



Recommendation

For the government of Magetan Regency, the results of this study can be continued with the preparation of pollution control programs and activities Gandong River direction which pays more attention to the condition of river water quality and involves the participation of the community and business actors around the river.



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