

*Research Article*

# Analysis of Water and Sediment Quality, Mercury Pollution and Its Effect on Bacterial Populations in the Tabir River, Merangin Regency, Jambi Province

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**Abstract:** This research was conducted to determine the quality of the Tabir River which is increasingly being damaged by illegal gold mining. The purpose of this study was to determine the water quality and concentration of Hg in the water and sediment of the Tabir river and its correlation to bacterial population. Water and sediment samples were taken from 6 segments along the Tabir river to check pH, Hg, and total bacteria in each segment. Data analysis used the pollutant index method and the correlation was tested with SPSS 22. The results of observations on river water showed that the average pH was normal in the range of 6.6-7.1 and the level of Hg contamination was heavily polluted with a score of 10.72. On the river sediments, pH in segments 1 to 5 was in accordance with the quality standard, which ranged from 6.2 to 7.1 and in segment 6 was below the quality standard 5.9 while the level of Hg contamination ranged from 3-35Mg/L and lightly polluted with a score of 3.4. The number of bacterial populations in the waters ranged from  $1.52 \times 10^4$  to  $9.40 \times 10^3$ . Correlation analysis showed a significance value of 0.889, that can be concluded that the presence of Hg in the waters of the Tabir river does not have a significant effect on the number of bacterial populations. The number of bacterial populations in the sediment ranged from  $3.00 \times 10^4$  to  $9.05 \times 10^3$ . Correlation analysis obtained a significance value of 0.254 that can be concluded that the presence of Hg does not have a significant effect on the number of bacterial populations in the sediment of the Tabir river.

**Keywords:** *Bacteria, Heavy Metal, Illegal Gold Mining, Jambi, Mercury, Water Quality.*

## A. INTRODUCTION

Gold mining, both legal and illegal, which spreads from eastern to western Indonesia has long been carried out in Indonesia, one of which is on the island of Sumatra. In Jambi province itself, it is known that there are many illegal mining points, both those that have been researched and whose activities are unknown. Based on research data Marselon (2017) and Sahu & Basti (2021), there is a significant increase in illegal miners raft and machinery (dongfeng) activities every year. Starting from 760 units in 2019, it jumped to 1,250 units in 2020. The measurement of this number is seen from the increasing number of dompok machines that were successfully confiscated by the authorities. One example of gold mining activities carried out in the Tabir Ilir River, Ulak Makam Village, Merangin Regency, Jambi Province, which still traditionally uses mercury (Hg) in the gold mining process.

The case in Sarolangun Regency, Sungai Limun which has experienced changes in characteristics both in terms of physics and chemistry. The amalgamation of PETI activity reduces river water quality as seen from the graph of turbidity concentration, pH, TSS, TDS Cu, Pb, Zn, Mn, Hg. For 6 years from 2009 to 2015 which shows the Limun river and its surroundings have decreased water quality continuously (Yulianti et al, 2016; Welz et al., 2018; Nurfitriani et al., 2020).

Bacteria are microorganisms that are resistant to heavy metals. Bacteria can grow in places contaminated with heavy metals because they produce biosurfactant compounds or bioemulsions that can absorb various types of heavy metals (Ovetibo et al., 2019; Pushkar et al., 2019). Bacteria are also one of the microorganisms that have a crucial role in the global mercury cycle, and have genes that are resistant to mercury (resistance) so that they can detoxify mercury in certain forms (Bailon et al., 2022; Liu et al., 2021; Zhao et al., 2020). The aims of this research are: 1) Knowing the quality of the waters and sediments of the Tabir River; and 2) To determine the effect of water quality and sediment on the bacterial population in the Tabir River.

With the following hypothesis:

1. The waters and sediments of the Tabir River have been polluted by Mercury
2. The water quality and sediment of the Tabir River have a significant effect on the bacterial population.

## B. METHOD

### 1. Research Time and Location

Research on the quality of river waters and sediments was carried out from October 2021 to January 2022. The location studied was the Tabir River, Merangin Regency, Jambi Province because there was widespread PETI activity based on direct field observations. The researcher used a survey method on 6 sampling segments which were selected using a purposive sampling technique with special considerations. The six sampling points were selected from upstream, midstream and downstream locations. The following is a map of the land use of the sampling locations:

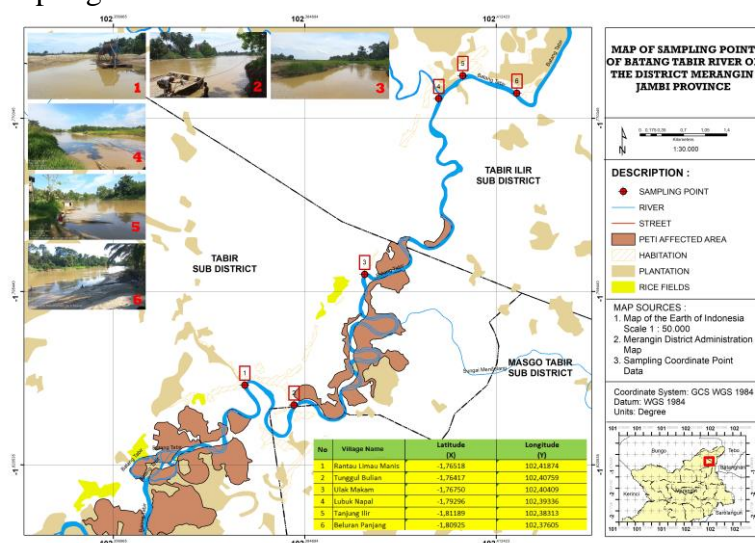


Figure 1. Sampling Map

### 2. Data Collection Materials and Tools

The main materials used in this study were the collection of 6 samples of Sungai Tabir water from 6 sampling segments, and 6 samples of Sungai Tabir sediments from 6 sampling segments. More detailed tools and materials can be seen in table 1:

**Table 1. Tools and Materials for Testing Hg Levels in Water and Sediment**

No	Tool	Ingredient
1	Polyethylene Bottles	HNO <sub>3</sub>
2	Cool Box	pH Paper
3	Oven	HCl

4	Plastic Bags	Ion free distilled water
5	Filter Tool	Polyethylene plastic
6	Cv Aas	Pore filter paper 0,45 $\mu\text{m}$
7	Mortar And Pestle	Aquabidest
8	Pipette	H <sub>2</sub> SO <sub>4</sub>
9	Volumetric flask 1000 mL	-
10	Volumetric flask 100 mL	-
11	Erlenmeyer	-
12	Analytical Balance	-
13	Eickman Grab	-

### 3. Procedure

The process of taking water samples from the Tabir river is carried out directly with a sample bottle at a depth of  $\pm 50$  cm in each segment. Previously, the polyethylene bottle had been soaked in 2 N HCl for 24 hours and then rinsed with ion-free distilled water 3 times to ensure cleanliness. The water sample that has been obtained is added with HNO<sub>3</sub> which functions as a preservative until a pH <2 is obtained. Next, the sample is stored in a cool box to be taken to the laboratory. The measurement of the heavy metal content was carried out at the Soil, Fertilizer, Water Laboratory, Bogor Research and Development Agency with reference to the Class II river water quality standard PP No. 22 year 2021.

The method used to analyze mercury content in river water and sediment is Cold Vapor Atomic Absorption Spectrophotometer. First, the sample water was filtered with filter paper (0.45 m pore), put into 1 N HNO<sub>3</sub> solution for approximately 60 minutes, then rinsed with distilled water. On the other hand, a blank solution was also prepared by filtering 50 mL of aquabidest with a rinsed filter. The water sample was filtered again with a 0.45 m filter then the results were added with concentrated HNO<sub>3</sub> to make it durable until the pH of the solution was < 2. The sample was ready to be analyzed by CV-AAS at 253.6 nm.

- For the sediment sample of the Tabir river,  $\pm 300$  grams were taken with the Eickman Grab Sampler and then put into polyethylene plastic and stored in a cool box to be investigated in the same laboratory. 1 mL of Hg is pipetted into a 1000 mL volumetric flask, compressed with a standard 0 to approach the line mark. 1 mL of 1000 ppm Hg basic solution was pipetted back into a 100 mL volumetric flask, and a standard solution of 10 ppm Hg was obtained. After that, the standard concentration of 0 was set; 0.05; 0.1; 0.2; 0.5; and 1 ppm. Standard Hg 10 ppm pipette 0; 0.5; 1; 2; 5; and 10 mL into a 100 mL volumetric flask, then the volume was adjusted with ionized water until it was close to the line mark. This standard solution is recommended always in a fresh condition. The prepared sample was put into a 100 mL erlenmeyer. Then dissolved 1 g of SnCl<sub>2</sub> with H<sub>2</sub>O to  $\pm 500$  mL in a 1 L volumetric flask. Added little by little 10 mL of H<sub>2</sub>SO<sub>4</sub> while the flask was shaken and aquabidest was added until it became 1 L and then shaken until mixed (homogeneous). Finally, the samples were ready to be analyzed by Cold Vapor–Atomic Absorption Spectrophotometer (CV-AAS) at 253.6 nm.

Examination of the abundance of bacteria using the Total Plate Count (TPC) method with Plate Count Agar (PCA) media (Yuspita et al., 2018). 22.5 grams of PCA media was put into an Erlenmeyer tube and 1000 mL of distilled water was added and then tightly closed with aluminum foil. Then stir the media so that it is homogeneous with a hotplate magnetic stirrer.

The purpose of bacterial isolation is to grow bacteria on PCA media from samples that have gone through the dilution process. The sample from the second tube was planted using

the pour plate technique, namely pouring 1 mL of the sample using a micropipette in a sterile petri dish and then pouring it into liquid PCA media. The petri dish is then rotated to form a figure of eight to flatten the media and samples. After hardening, the opaque paper was wrapped in a wrapped petri dish and left for 24 hours in the incubator.

#### 4. Data Analysis Method

To analyze the status of water quality using the Pollutant Index (IP) method, the parameters used in this study were the level of acidity (pH) and mercury content (Hg) which were then compared with the water quality standard criteria for class II PP No. 22 of 2021. The use of class II as a comparison takes into account the reason that Tabir river water is not consumed as drinking water so it is not included in the criteria for class I. To determine the status of water pollution from the Tabir river, the Pollution Index (IP) equation formula is used as follows:

$$PI_j = \sqrt{\frac{(C_i/L_{ij})_M^2 + (C_i/L_{ij})_R^2}{2}}$$

The evaluation of the PI value is as follows:

0 PIj 0.1 (meets quality standards)

1 < PIj 5.0 (lightly polluted)

5.0 < PIj 10 (medium polluted)

PIj > 10 (heavy pollutant)

The following is a table of sources of quality standards that is used as a reference in the data analysis method:

**Table 2. Quality Standards for Hg Pollution in River Water and Sediments**

No	Sample	Unit	Quality Standards	Quality Raw Source
1	River water	mg/L	0.002	Class II PP No. 22 year 2021
2	Sediment	mg/Kg	6.6	Canadian Soil Quality Guidelines

Furthermore, to determine the relationship between mercury levels, both in the waters and sediments of Sungai Tabir, with the number of existing bacterial populations, the researchers used a simple regression equation, with the help of SPSS 22, whose equation is as follows:

$$\bar{Y}_t = a + bX$$

Where:

Y = Dependent variable (bacteria population)

X = Independent variable (Hg content)

a = constant

b = regression coefficient

With:

$$b = \frac{n \sum XY - \sum X \sum Y}{n \sum X^2 - (\sum X)^2}$$

$$a = \frac{\sum Y \sum X^2 - \sum X \sum XY}{n \sum X^2 - (\sum X)^2}$$

### C. RESULT AND DISCUSSION

#### 1. The Results of the Analysis of the Quality and Population of Bacteria in the Water

The results of the calculation of the water quality status of the Tabir River using the IP method are summarized in Table 3 as follows:

**Table 3. Results of Tabir River Water Quality Analysis**

No	Parameter	Unit	Sampling Point	C <sub>i</sub>	L <sub>ij</sub>	C <sub>i</sub> /L <sub>ij</sub>	New C <sub>i</sub> /L <sub>ij</sub>
1.	pH	-	Segment 1	6.6	6-9	0,38	0,38
		-	Segment 2	7.0	6-9	0,25	0,25
		-	Segment 3	7.0	6-9	0,25	0,25
		-	Segment 4	7.1	6-9	0,21	0,21
		-	Segment 5	6.8	6-9	0,37	0,37
		-	Segment 6	6.7	6-9	0,35	0,35
2.	Hg	mg/L	Segment 1	0.00	0.002	0	0
		mg/L	Segment 2	0.91	0.002	455	14.30
		mg/L	Segment 3	0.99	0.002	495	14.47
		mg/L	Segment 4	0.25	0.002	125	11.50
		mg/L	Segment 5	0.33	0.002	165	12.09
		mg/L	Segment 6	0.00	0.002	0	0
Amount							54.17
Average							4.52

Source: Primary Research Data 2022

To determine the status of water pollution from the Tabir river, the researchers used the Pollution Index (IP) equation as follows:

$$PI_j = \sqrt{\frac{(C_i/L_{ij})_M^2 + (C_i/L_{ij})_R^2}{2}}$$

It is known that the average value ((C<sub>i</sub>/L<sub>ij</sub>)<sub>R</sub>) is 4.52, while the highest value ((C<sub>i</sub>/L<sub>ij</sub>)<sub>M</sub>) is 14.47, so the results are:

$$PI_j = \sqrt{\frac{14,47^2 + 4,52^2}{2}} = \sqrt{\frac{209,38}{2}}$$

$$PI_j = \sqrt{114,91} = 10,72$$

While the results of the TPC test obtained the number of bacterial populations in the water as follows:

**Table 4. Bacterial Count in Tabir River Water**

No	Sampling Point	pH	Hg (mg/L)	Bacteria Count (CFU/L)
1.	Segment 1	6.6	0.00	7.05 x 10 <sup>3</sup>
2.	Segment 2	7.0	0.91	9.40 x 10 <sup>3</sup>
3.	Segment 3	7.0	0.99	8.85 x 10 <sup>3</sup>
4.	Segment 4	7.1	0.25	1.52 x 10 <sup>4</sup>
5.	Segment 5	6.8	0.33	1.52 x 10 <sup>4</sup>
6.	Segment 6	6.7	0.00	8.90 x 10 <sup>3</sup>

Source: Primary Research Data 2022

To test the hypothesis, which is to ascertain the relationship between mercury levels and the number of bacterial populations, a simple regression test was conducted. The results of calculations with SPSS 22 are presented in the following table:

**Table 5. Simple Hg Regression Results and Bacterial Populations in Tabir River Waters**

ANOVA <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11013,417	2311,056		4,766	,009
	Hg	-596,976	4023,438	-,074	-,148	,889

a. Dependent Variable: Bakteri

Source: Primary Research Data 2022

To confirm the results of the regression test, the researchers calculated the correlation coefficient (r) between the amount of mercury (Hg) and the total population of bacteria in the waters, the results are as follows:

$$r = \frac{n \sum_{i=1}^n X_i Y_i - \left( \sum_{i=1}^n X_i \right) \left( \sum_{i=1}^n Y_i \right)}{\sqrt{\left[ n \sum_{i=1}^n X_i^2 - \left( \sum_{i=1}^n X_i \right)^2 \right] \left[ n \sum_{i=1}^n Y_i^2 - \left( \sum_{i=1}^n Y_i \right)^2 \right]}}$$

$$r = \frac{6 (26131,5) - (2,48)(64600)}{\sqrt{[6 (1,9796) - (6,1504)] [6 (757675000) - 115921182,9]}} = \frac{-3,419}{159286,64} = -2,15$$

## 2. The Results of the Analysis of the Quality and Population of Bacteria in the Sediment

The results of the calculation of the sediment quality status of the Tabir River using the IP method are summarized in Table 6 as follows:

**Table 6. Results of Tabir River Sediment Quality**

No	Parameter	Unit	Sampling Point	C <sub>i</sub>	L <sub>ij</sub>	C <sub>i</sub> /L <sub>ij</sub>	C <sub>i</sub> /L <sub>ij</sub> baru
1.	pH	-	Segment 1	7.1	6-9	0.21	0.21
			Segment 2	6.9	6-9	0.29	0.29
			Segment 3	6.5	6-9	0.4	0.4
			Segment 4	6.4	6-9	0.42	0.42
			Segment 5	6.2	6-9	0.46	0.46
			Segment 6	5.9	6-9	0.52	0.52
2.	Hg	mg/kg	Segment 1	35	6.6	5.30	4.62
			Segment 2	3	6.6	0.45	0.45
			Segment 3	20	6.6	3.03	3.4
			Segment 4	17	6.6	2.58	3.24
			Segment 5	6	6.6	0.91	0.91
			Segment 6	8	6.6	1.21	1.39
Amount							15.91
Average							1.33

Source: Primary Research Data 2022

While the results of the TPC test obtained the number of bacterial populations in the sediment as follows:

**Table 7. Bacterial Count in Tabir River Sediment**

No	Sampling Point	pH	Hg (mg/kg)	Bacteria Count (CFU/kg)
1.	Segment 1	7.1	35	3.46 x 10 <sup>3</sup>
2.	Segment 2	6.9	3	3.00 x 10 <sup>4</sup>
3.	Segment 3	6.5	20	4.50 x 10 <sup>3</sup>
4.	Segment 4	6.4	17	9.05 x 10 <sup>3</sup>
5.	Segment 5	6.2	6	4.20 x 10 <sup>3</sup>
6.	Segment 6	5.9	8	7.75 x 10 <sup>3</sup>

Source: Primary Research Data 2022

To test the hypothesis, which is to ascertain the relationship between mercury levels and the number of bacterial populations, a simple regression test was conducted. The results of calculations with SPSS 22 are presented in the following table:

**Table 8. Simple Hg Regression Results and Bacterial Population of Tabir River Sediment**

ANOVA <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16842,478	6527,001		2,580	,061
	Hg	-472,976	355,460	-,554	-1,331	,254

a. Dependent Variable: Bakteri

Source: Primary Research Data 2022

The test of calculating the value of the correlation coefficient (r) obtained the following results:

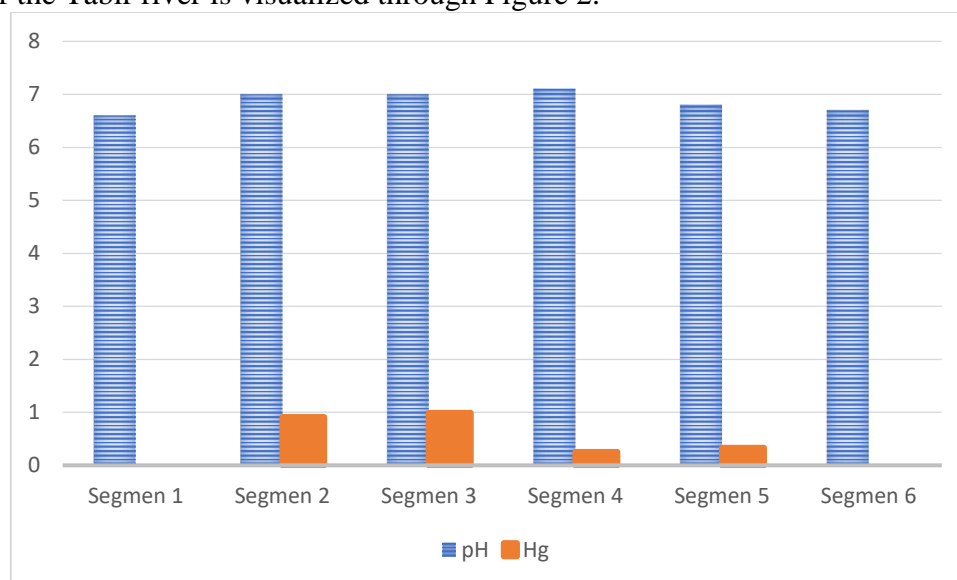
$$r = \frac{n \sum X_i Y_i - \left( \sum X_i \right) \left( \sum Y_i \right)}{\sqrt{\left[ n \sum X_i^2 - \left( \sum X_i \right)^2 \right] \left[ n \sum Y_i^2 - \left( \sum Y_i \right)^2 \right]}}$$

$$r = \frac{6(542150) - (89)(58960)}{\sqrt{[6(2023) - (7921)] [6(1091826600) - 9826,67]}} = \frac{-1994540}{5255986,35} = -0,38$$

Gold mining activities in the Tabir Ilir River, Ulak Makam Village, Merangin Regency, Jambi Province, are still carried out traditionally using riverbed alluvial deposition techniques, namely by using dredgers and boats accompanied by dromping machines to suck up mud containing gold ore (Niane et al., 2019; Aljerf & Al-Masri, 2018; Beattir et al., 2020). In the mining process, the extracted mud will be filtered using a sluice box which is on the boat or in the pools that are made. Furthermore, mercury (Hg) will be used to burn at high temperatures to release the Hg bonds from the gold ore. According to Bravo et al. (2020) and Orani et al. (2020), Hg is a heavy metal with high toxicity. The amalgamation process can be carried out at home or at the PETI location as happened in the Tabir river area. After the end of this process, the waste is channeled into a simple tub without going through any processing process, to be subsequently discharged into the river body, causing potential environmental contamination.

Based on the results of research conducted for approximately 3 months in 6 segments spread along the Tabir river, it was found that the pH of the Tabir river was still within the

range of pH quality standards based on class II in Government Regulation of Indonesia no. 22 of 2021. The pH level of the waters ranges from 6.6-7.1 from the quality standard range of 6-9. The next point, it was found that the sampling point that was free from dissolved mercury (Hg) was only segments 1 and 6 (Hg = 0). For segments 2 to 5, the Hg content exceeds the minimum water quality standard ( $> 0.002$ ). The depiction of pH and mercury (Hg) levels in the waters of the Tabir river is visualized through Figure 2.



**Figure 2. Graph of pH and Hg Levels in Tabir River Waters**

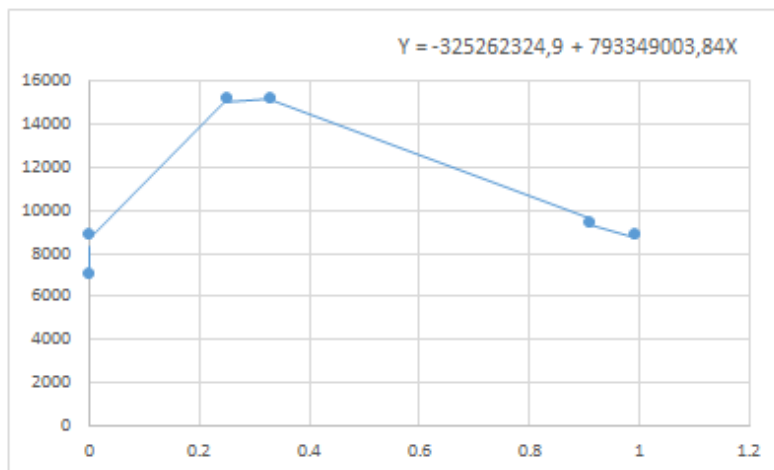
Source: data proceed

The Hg levels found in the six river segments ranged from 0-0.99 mg/L. Segments 1 and 6 are free from mercury levels (Hg = 0), while segments 2 to 5 have Hg levels that exceed the quality standard ( $> 0.002$ ). As a comparison, the results of testing the Kerinci Lake water sample carried out by the Sumatra Ecoregional Development Control Center (P3E) in 2021 found mercury contamination. in 5 samples of water, obtained mercury content with a value of 0.13 ppm; 0.09 ppm; 0.15 ppm; 0.11 ppm; and 0.08 ppm. This indicates an increase in the accumulation of mercury contamination along the river. While this level is worse in comparison to research from Kulon Progo, Yogyakarta City, cases of gold mining have also needs more attention. Based on research (kusuma et al, 2017) Hg levels for water surface in Sangon Village, Subdistrict Kokap, Kulon Progo is under detection limit or still in good condition environment. While the value of Hg for river sediment ranged from 7.57 – 8.43 ppb with the most Hg level is in the upstream area.

According to research conducted by (Hidayat, 2020), field conditions at the time the samples were taken also influenced the results obtained, for example the sampling in this study was carried out in the rainy season which allowed sampling of water samples in segments 1 and 6 to be a collection of rainwater on that day, so that the mercury content is low, or it could be due to silting in many parts of the Tabir River and the damage to the river body which results in disruption of water flow. The IP method is obtained by comparing the concentration ratio of a parameter with its maximum quality standard ( $C_i/L_{ij}$ ) and the average ratio of a number of water quality parameters, only in one water quality sampling activity. Thus, it can be said that the data obtained are temporary condition data (Purnamasari, 2017). The results of the calculation of the level of pollution of the waters of the Tabir river using the Pollutant Index (IP) method show  $PI_j = 10.72$  which, based on the Guidelines for the Status of Water Quality by the Minister of the Environment in 2021, indicates that the waters of the Tabir river are heavily polluted, so public awareness must be increased because mercury itself is

bioaccumulative, which where the effects can arise in the long term (Irsan et al., 2020; Shuaib et al., 2021; Wang et al., 2019).

Visualization of water Hg levels and their effect on bacterial populations can be seen in the following graph 3:

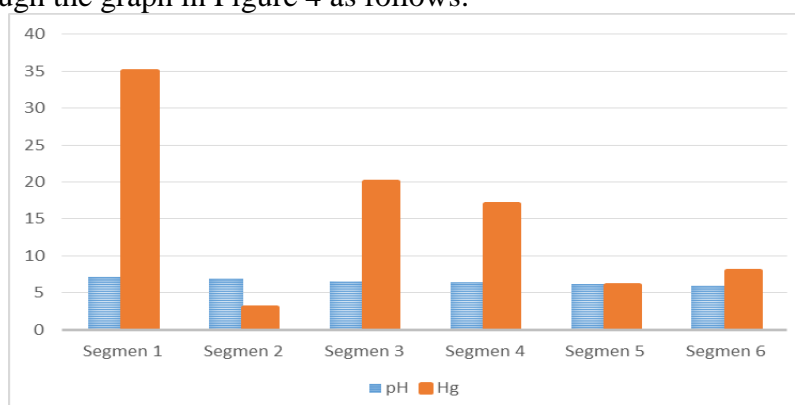


**Figure 3. Graph of Hg Levels and Bacterial Populations in Tabir River Waters**

Source: data proceed

This figure shows that the relationship between the variable X (Hg level) and the variable Y (the number of bacterial populations in the waters of the Tabir River) cannot be drawn straight line to see the correlation between the two. The pH level of the waters ranged from 6.6 to 7.1 from the quality standard range of 6-9. This pH level is possible to be one of the factors that affect the number of bacterial populations that develop at the sampling point because pH is related to the activity of enzymes needed by bacteria to catalyze their growth reactions. If the pH level decreases or increases, the nature of the amino acid group will interfere with the optimal growth of bacteria and affect the metabolic products they produce (Fuhrmann et al., 2021; Jones et al., 2020). Bacteria are microorganisms that are resistant to heavy metals. Bacteria can grow in places contaminated with heavy metals because they produce biosurfactant compounds or bioemulsions that can absorb various types of heavy metals (Ovetibo et al., 2019; Pushkar et al., 2019).

Visualization of pH and mercury (Hg) levels in the sediments of the Tabir river are visualized through the graph in Figure 4 as follows:



**Figure 4. Graph of pH and Hg Levels in the Tabir River Sediment**

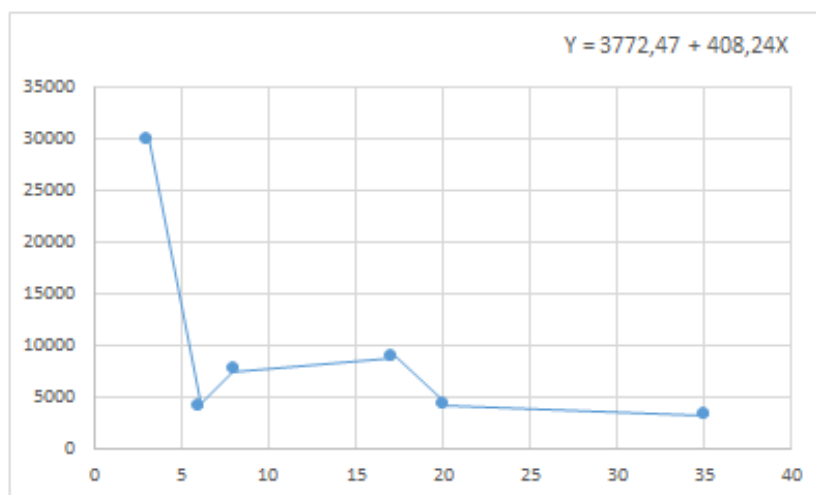
Source: data proceed

From the results of field investigations, the results of the separation between gold and its layers resulted in sand deposits which were placed in a special place while the water

containing mercury residue was simply thrown away. This proves that in illegal mining activities there is no waste and emission management, especially mercury residue. These wastes and emissions result in mercury contamination and reduce environmental quality. In river sedimentary soils, mercury levels were found to be much higher than Hg levels in the waters. Mercury levels in the six segments did not meet the quality standard, namely between 3-35 mg/kg, while the minimum limit according to the Canadian Soil Quality Guidelines (2013) was 6.6 mg/kg. The lowest level of Hg (3 mg/kg) was found in segment 2, while the highest level was in segment 1 (35 mg/kg). Calculation of the level of sediment pollution in the Tabir river with IP obtained the results of  $PI_j = 3.4 (< 5)$  which is included in the lightly polluted level. High or low levels of Hg in certain segment sediments can be influenced by various factors such as the distance of the segment to the Hg source and processing unit, different types of sediment, water depth, water current velocity, temperature, and pH (Irsan et al., 2020). In the research of Irsan et al. (2020) in the Waelata River and Maluku Anahoni River, it was found that the deeper the river, the lower the basic stirring power or friction of the current in the sediment, so the amount of mercury is high due to not being carried by the current. Conversely, the shallower the river, the Hg content will be more easily reduced due to the influence of currents and waves.

The high levels of Hg in sediments than in water are due to the fact that more Hg accumulates and settles in the soil (Basir et al., 2020). This is related to the natural nature of Hg which is easily soluble and changes the stability of carbonates into hydroxides which form particle bonds in the waters and settle to form mud, so that the levels in sediments will be higher than in waters.

The depiction of Hg levels in the sediment and its effect on the bacterial population can be seen in the following graph of Figure 5:



**Figure 5. Hg Levels and Bacterial Population of Tabir River Sediment**

Source: data proceed

This figure shows that the relationship between the variable X (Hg level) and the variable Y (the number of bacterial populations in the sediment of the Tabir river) cannot be drawn in a straight line to see the correlation between the two. The regression results on the relationship between the Hg levels of the Tabir river sediment and the bacterial population showed that if the amount of Hg in the sediment was 0, then the number of bacteria was  $16.84 \times 10^5$  CFU/kg, while for each addition of 1 mg Hg, the number of bacteria in the sediment would decrease by  $4,73 \times 10^2$  CFU/kg. This is in line with the research of Ghosh et al. (2021) which shows that bacterial growth will decrease if the amount of heavy metal content increases. However, the significance results obtained, both in waters ( $0.889 > 0.05$ ) and in sediments

(0.254 > 0.05) showed that the addition of Hg concentration did not significantly reduce the bacterial population in the Tabir river.

#### D. CONCLUSION

The conclusion of this study is that illegal gold mining activities have an effect on decreasing river water quality based on the water quality standard criteria for class II PP No.22 of 2021. Four of the two segments of river water are categorized as heavily polluted by mercury compounds based on the results of calculations using the Pollutant Index method (IP). In river sediments, it is known that all segments have been lightly polluted by mercury compounds based on the results of calculations using the Pollutant Index (IP) method. Based on the results of a simple regression test, high levels of mercury in the waters and sediments did not significantly affect the number of bacterial populations. If illegal mining continues to be carried out by the community, the physical, chemical and biological damage along the river will get worse. This condition will have a huge impact in the short and long term. The community must be aware of the environmental damage that occurs nowadays. Government regulations related to environmental management must be detailed and strict legal regulations by the authorities will help to reduce the rate of environmental damage.

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