Mercury Contamination in Limboto Lake

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Abstract

The purpose of this study was to determine the content of heavy metal mercury (Hg) in Limboto Lake waters. Sampling was conducted at 5 stations, namely Station 1 (estuary of the Biyonga River), Station 2 (estuary of the Alopohu River), Station 3 (floating net cages), Station 4 (non KJA) and Station. 5 (Outlet at Sungai Tapodu). Sampling both at the surface and the bottom of the water is only done once. Analysis of the content of mercury (Hg) was carried out at the Gorontalo Province Fishery Product Quality Development and Testing Laboratory (LPPMHP). The results showed that the mercury (Hg) content in Limboto Lake waters for Station 1 in the water samples taken was 0.027 mg / L, the sediment samples were 13.61 mg / L, for Station 2 namely water sample 0.013 mg / L and sediment sample 12.27 mg / L, Station 3, namely water sample 0.003 mg / L sediment sample 8.35 mg / L, while Station 4, namely water sample 0.0142 mg / L sediment sample 7.71 mg / L and for Station 5, water sample 0.016 mg / L sediment sample 6.79 mg / L. The condition of the heavy metal content of mercury (Hg), based on water quality standards of 0.001 mg / L and sediment quality standards of 0.2 mg / L, on average, has exceed the maximum limit, namely the level of mercury in the water is 0.0146 mg / L (> 0.001 mg / L) and the mercury level in the sediment was 9,746 mg / L (0.2 mg / L).

Keywords: mercuri (Hg); water; sediment; Limboto

I. Introduction

Indonesia has 521 large and small lakes scattered throughout the region. The total area of the lake is 2.1 million ha. According to a study by the Ministry of Environment (KLH), 15 lakes are in critical condition. This critical condition is indicated by the decreasing volume of lake water and decreasing quality of lake waters. The decrease in the volume of lake water is generally caused by sedimentation, while the decrease in the quality of lake waters is contributed by the activity of the water catchment area and economic activities in the lake waters (Wulandari, 2013).

Limboto Lake is the largest lake in Gorontalo and has a very important role. Limboto Lake is one of the natural resources which is a source of pride and a source of livelihood for the people of Gorontalo, especially those living on the shores of the lake. This lake area is located in two areas, namely 30% of Gorontalo City area and 70% in Gorontalo Regency area and covers 5 districts. Limboto Lake is one of the places that is used by the surrounding community for fish cultivation, both in floating net cages and capture fisheries. These benefits cannot be fully enjoyed due to various problems, namely silting and shrinkage of area, decreasing lake water quality, decreasing water quantity, decreasing fishery productivity, decreasing biodiversity, flooding and forest destruction (Hasan, 2014).

According to Said (2010), humans in their activities produce waste which then enters rivers, lakes, seas and other surface water. One of the contaminants is mercury (Hg). Mercury (Hg) causes water pollution. Mercury (Hg) pollution comes from

many sources and has different characteristics. Mercury pollution in waters can occur both in aquatic life and humans.

Based on the description above, it is necessary to conduct research on the content of mercury (Hg) in Limboto Lake waters. It is hoped that the results of this research will become one of the important and scientific data in preserving the Limboto Lake ecosystem and developing aquaculture in the lake. This research is expected to be useful as material for information about heavy metal mercury (Hg) in the waters of Limboto Lake, as information to the public and government for safe water management in the future, as a scientific study in the field of water quality and limnology.

II. Research Methods

The research location is Limboto Lake, Gorontalo Regency, which is located in Gorontalo Province. The map of the research location can be seen in Figure 1.

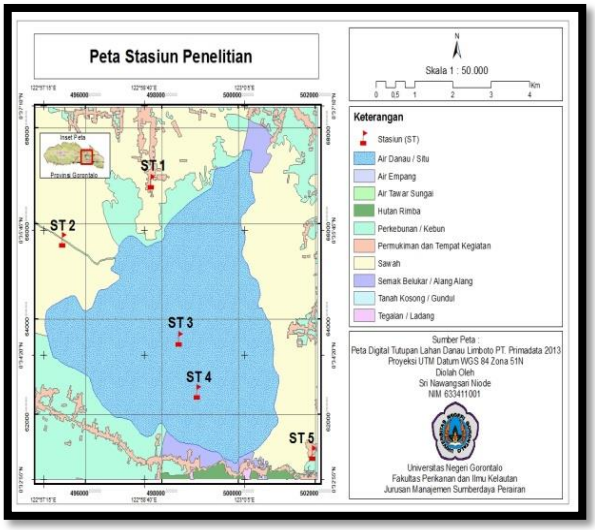

Figure 1. Research site (*source*: Digital map by PT. Primadata, 2013)

The tools used in this study were boats to go to the location for water and substrate / sediment sampling, bottles, plastic bags, thermometers, cool box containers, GPS gadget.

The materials used in this study were water samples and the substrate for the object of study, aluminum foil, label paper for marking samples, tissue for cleaning tools and litmus paper.

The analysis of dissolved mercury (Hg) samples used an Atomic Absorption Spectrophotometer (AAS) which had a wavelength of 283.3 nm and a gap width of 0.5 nm and had been calibrated before use.

Sample preparation was carried out for two days. Analysis of heavy metal mercury (Hg) with the AAS was carried out at the Laboratory of Fisheries Product Quality Development and Testing (LPPMHP) Gorontalo City. Water samples and sediment samples were filtered using 0.45 µm filter paper, then added 5 ml of sulfuric acid H_2SO_4, 2.5 ml HNO_3 and 15 ml $KMnO_4$, and let stand for 15 minutes. After that, add 8 ml of $K_2S_2O_8$ and the water and sediment samples were heated in the sample heating chamber at 95ºC for 2 hours, after heating the samples were cooled. Furthermore, 0.5 gram of boiling stone is added to the water and sediment samples. Then the sample is ready to be analyzed using the AAS variant 0.5-1000mg / liter.

The data analysis used in this research is descriptive analysis. According to Narbuko & Achmadi (2008), descriptive research is a research that seeks to address current problem solutions based on data. In Sugiyono (2008) it is stated that descriptive research is research conducted to determine the value of the independent variable, either one or more (independent) variables without making comparisons, or connecting with other variables. In this study, the parameters observed were mercury (Hg) levels in Limboto Lake waters. The procedure for testing mercury (Hg) is based on SNI 01-1754.7-2006 on how to test for bottled drinking water and SNI 06.6992.2.2004 on how to test for mercury (Hg) in cold vapor with a Mercury Analyzer and based on Government Regulation No. 82 of 2001 concerning water quality management and water pollution control for river water.

III. Results and Discussions

3.1 Parameters

Measurement of environmental parameters in the form of temperature and pH of water is carried out simultaneously with sampling and the results can be seen in Table 1.

Table 1. Parameters of water qualities

Parameter Kualitas Air	STASIUN				
	I	II	III	IV	V
Suhu (°C)	31,7	29,5	28,5	25,0	25
pH Air	7	6	6	6	7

3.2 Hg concentration

The results of testing the heavy metal mercury (Hg) content at Station 1 through to Station 5 obtained the value of heavy metal mercury (Hg) content for samples on the surface of the waters and on the bottom presented in Table 2

Table 2. Measurement result of Hg concentration

NO	Kadar Hg Terlarut	Stasiun					
		ST1	ST2	ST3	ST4	ST5	Rata-rata
1	Permukaan air (sampel air)	0.027 mg/L	0.013 mg/L	0.003 mg/L	0.0142 mg/L	0.016 mg/L	0.0146 mg/L
2	Dasar Perairan (sampel sedimen)	13.61 mg/L	12.27 mg/L	8.35 mg/L	7.71 mg/L	6.79 mg/L	9.746 mg/L
3	Baku Mutu Air	0.001 mg/L	0.001 mg/L	0.001 mg/L	0.001 mg/L	0.001 mg/L	0.001 mg/L
4	Baku Mutu Sedimen	0.2 mg/L	0.2 mg/L	0.2 mg/L	0.2 mg/L	0.2 mg/L	0.2 mg/L

Based on this, it can be said that the conditions of the waters in Lake Limboto have exceeded the permissible threshold (maximum value), namely for water samples it is 0.0146 mg / L (> 0.001 mg / L) and for sediment samples 9.746 mg / L (> 0.2 mg / L).

This can be seen from the various values of the heavy metal mercury content in two different samples. A significant difference can also be seen from the average value between the water sample and the sediment sample, where the mercury content in the sediment sample is higher than the water sample. This condition is in accordance with that stated by Tarigan and Edward (2003) in Hidayati, et al. (2013), that heavy metals can accumulate in sediments, so that the heavy metal content in sediment is always higher than in water. This is related to the nature of heavy metals which tend to form complexes, then settle and bond in sediments. The fine particulate matter in the sediment acts as a heavy metal carrier from the water to the sediment so that the heavy metal concentration in the sediment increases.

3.3 Hg contamination in water

The content of heavy metal mercury (Hg) obtained from the analysis of variant spectrophotometer shows that for all test water samples taken from five stations all of them are above 0.001 mg / l. The content of heavy metal mercury (Hg) at the research location can be seen in Figure 2 below:

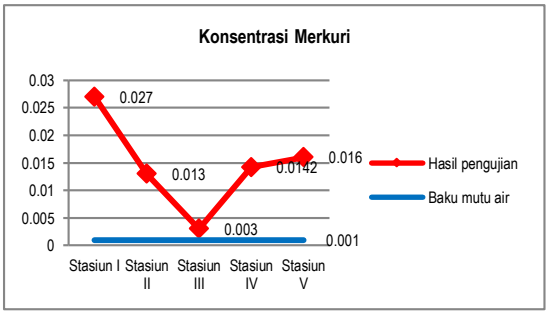

Figure 2. Hg contamination

The results of measuring the level of mercury contamination (Hg) in Figure 2 show that at Station 1 it is 0.027 mg / L, at Station 2 is 0.013 mg / L, Station 3 is 0.003 mg / l, Station 4 is 0.0142 mg / L and Station 5 with a value of 0.016 mg / L. This indicates that at each station the measured mercury (Hg) content has exceeded the maximum allowable limit. As stipulated in Water Quality Management and Water Pollution

Control based on PP. 82 of 2001 for mercury (Hg), namely 0.001 mg / l.

Figure 2 shows the striking difference between mercury (Hg) concentrations at each station. The high level of mercury contamination at Station 1 which is on the Biyonga River is caused by the influence of human activities such as disposal of household waste and agricultural activities or industrial activities.

Based on this figure, when reviewed or compared with the maximum standard of mercury (Hg) levels allowed according to government regulation no. 82 of 2001 concerning water quality management and water pollution control, the levels of mercury (Hg) at Station 1 have exceeded the maximum levels, especially at the bottom of the waters, and at Station 3 levels of mercury (Hg) both on the surface of the waters are still in low condition, allegedly because of the water hyacinth around the station. The water hyacinth plant is an evaporating plant, that is, a plant that absorbs a lot of water.

3.4 Hg contamination in sediment

The content of heavy metal mercury (Hg) obtained from the analysis of variant spectrophotometer has shown that for all the test sediment samples taken from five stations all of them are above 0.2 mg / l. The level of contamination with mercury (Hg) content in Limboto Lake, is presented in graphic form in Figure 3 below.

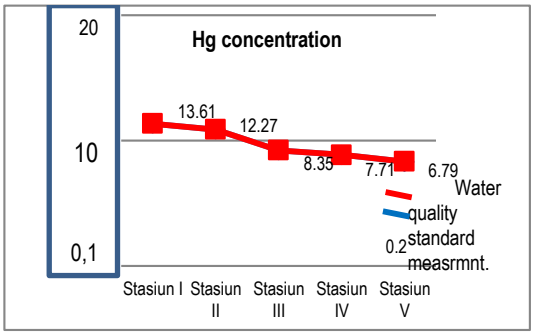

Figure 3. Mercury concentration in sediment

The results of measuring mercury (Hg) in the sediment based on Figure 3 show that the highest contamination level is at Station 1 with a value range of 13.61 mg / L which is heavily polluted. Station 2 with a value range of 12.27 mg / L, Station 3 with a value range of 8.35 mg / L, Station 4 with a value range of 7.71 mg / L and the lowest mercury level is at Station 5 ranging from 6.79 mg / L .

The levels of heavy metal mercury (Hg) in the sediments at each station indicate a range that is above the quality standard. According to Purnawan et al. (2013) this value has exceeded the mercury concentration standard set by the United State (US) Environmental Protection Agency (EPA), which is 0.2 mg / L. Wulandari (2006) states that the metal content that can be tolerated in the sediment is at the same time seeing the level of heavy metal pollution in the sediment, especially for heavy metal Hg in sediments in the study location, which is above the quality standard. Where is the target level if the contaminant concentration present in the sediment has a greater value, then the distribution that is in the sediment is too dangerous for the environment.

Based on the results of measuring the level of contamination in the sediment in the Biyonga River, it is around 13.61 mg / L and the Alopohu River is 12.27 mg / L, the levels of heavy metal Hg are above the existing quality standards, so heavy metal Hg in sediments is too dangerous for environment. According to Balihristi (2009) in Dewi (2013) Biyonga River is the main sediment-carrying river, where the Biyonga River contributes 56% of the total sediment that enters the lake. At the upper reaches of the Biyonga River there are no mining activities. Activities that occur in the Biyonga River body are sand excavation, and the Biyonga River flows through agricultural areas. However, this condition cannot be ignored, it is necessary to carry out further prevention and control to prevent heavy metal pollution, especially mercury which is even higher because heavy metal mercury is very dangerous for human life and organisms and the environment.

This is in accordance with the statement of Shreadah et al (2012) in Trisnawaty (2013), that

mercury (Hg) is listed as a very dangerous pollutant because its toxicity can accumulate in the environment and can have an impact on living things. The high level of heavy metal Hg in sediments is due to the use of heavy metal mercury in human activities around the Biyonga River, Alopohu River, Floating Fish Cage (FFC), non-FFC and Tapodu River (lake outlet). The presence of heavy metals, either from natural sources or from anthropogenic sources in sediments in the aquatic system is one of the most important environmental problems, especially because this sediment is an important reservoir of the elements and other pollutants (Ridgway and Shimmield, 2002 in Hidayati, et al. , 2013), heavy metals in the waters can be quickly adsorbed into the sediments, causing contamination that affects the ecosystem in estuary waters. This is in accordance with the statement of Trisnawaty (2013), that the high heavy metal Hg in the sediment is suspected that the use of Hg by miners or other activities is still frequently carried out. This is because Hg is the most dangerous heavy metal among other metals and is cumulative and can cause death.

IV. Conclusion and Suggestion

The heavy metal mercury (Hg) content in water at each station on average has passed the maximum threshold of 0.001 mg / L. The heavy metal mercury (Hg) content in the sediment at each station is on average higher than water, which has passed the maximum threshold of 0.2 mg / L.

It is necessary to do research related to the heavy metal content in lakes and in cultured fish carried out in lakes.

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