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Analysis Of Mercury (Hg) In Mujair Fish (*Oreochromis mosambicus*) In Limboto Lake, Gorontalo Province

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Abstract

The occurrence of silting of the lake and sedimentation in Limboto Lake has become a place for the deposition of heavy metals, especially mercury. In recent years it has been known that the water of Lake Limboto has been polluted by mercury based on data from the Agency for the Environment, Research and Technology (Balihristi), Gorontalo Province in 2007. This study aims to analyze the mercury (Hg) content of mujair fish (*Oreochromis mossambicus*) in Limboto Lake. This research was conducted in November 2018- June 2019. The method used in this research is the descriptive method. A sampling of water and fish was carried out by purposive sampling by dividing the research location into 2 stations, namely Station I in the floating net cages and Station II outside the KJA Measurement of mercury content (Hg) was carried out at the Laboratory of Fisheries Product Quality Development and Testing (LPPMHP) Gorontalo City using the Atomic Absorption Spectrophotometer (AAS). From the results of the study, it was found that the Mercury (Hg) Content in Lake Limboto Waters, Station I was 0.0014 ppm and Station II was 0.0007 ppm, and for mujair fish organs the highest was in meat, namely outside KJA 0.0037 ppm and meat, the lowest was in KJA 0.0035 ppm. Concentration mercury levels of tilapia in Lake Limboto are between 0.007 - 0.089 mg/kg while the mercury levels in the lake are between 0.0014 mg/L.

INTRODUCTION

Limboto Lake is one of the resources in Gorontalo Province. Limboto Lake has served as a source of income for fishermen, flood prevention, an irrigation water source, and a tourist attraction. The lake area is located in two regions, ± 30% in Gorontalo City and ± 70% in Gorontalo Regency, and covers 5 sub-districts. The quality of the Lake Limboto ecosystem continues to decline. This is indicated by the shallowing depth of the lake and the narrowing of its area (Hasim *et al.*, 2017). Limboto Lake is experiencing heavy sedimentation. The main causes are illegal logging upstream and

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erosion of the riverbank land in the watershed that empties into Lake Limboto. Besides that, the condition of the outlet of the Topadu River is narrow so the sediment cannot get out of the lake (Legowo, 2005).

At the end of the 20th century, sedimentation also occurred in Lake McCarrons in Roseville, Minnesota. The lake has experienced a decline in water quality only in the last few decades (Nusantari, 2010). Several studies have reported that the water quality of Limboto Lake and the surrounding rivers has been polluted, and the test parameters for nitrate phosphate, and hydrogen sulfide have exceeded the government regulation standard no. 82 of 2001 (Lihawa and Mahmud, 2017; Rahim *et al.*, 2020). The highest value of chloride content was in the water body of Limboto Lake with a value of 16.01 mg/L, chloride compounds are organic compounds that come from nature, and are usually found in pesticides (Hasan, 2013). There are human activities that use drugs containing mercury (Hg) to be used to eradicate pests in rice fields and then the waste is channeled into rivers so that it is suspected that it can contaminate the waters of Lake Limboto.

According to Noor and Ngabito (2018), the cause of siltation is related to shifting cultivation activities by communities around the lake, resulting in environmental damage characterized by erosion, flooding in the rainy season, and drought in the summer. This condition affects the role of Limboto Lake in supporting the lives of organisms living in Limboto Lake, including fish. The fish in Limboto Lake are diverse, consisting of native fish and introduced fish (outside fish cultivated in Limboto Lake). Limboto Lake receives water input from the surrounding rivers and is also used as a location for fish farming by the community. This triggers high nitrogen in the river apart from supplies from the surrounding agricultural areas. Many factors can affect the level of nitrate in a lake. Indrayani *et al.* (2015) stated that even every kilogram of pet fish will produce nitrate of 0.13–0.21 mg/day.

According to Said (2010), humans in their activities produce waste that then enters rivers, lakes, seas, and other surface waters. One of these contaminants is mercury (Hg). Mercury (Hg) causes water pollution, heavy metal pollution is generally caused by various types of waste, both domestic, industrial, agricultural, and mining. Nakoe *et al.* (2014) examined the risk of exposure to mercury (Hg) in humans who consume Tilapia (*O. niloticus*) from Lake Limboto using the Limboto approach. Limboto uses an environmental health analysis approach with a variable test method of body weight, consumption level, and frequency.

Concentration mercury levels of tilapia in Lake Limboto are between 0.007 - 0.089 mg/kg while the mercury levels in the lake are between 0.0014 mg/L lake is around 0.0014 mg/L. The occurrence of silting of the lake and sedimentation in Limboto Lake has become a place for the deposition of heavy metals, especially mercury. In recent years it has been known that the water of Lake Limboto has been polluted by mercury based on data from the Agency for the Environment, Research and Technology (Balihristi), Gorontalo Province in 2007. This is the aim of the research that there is a need for continuous monitoring of the water quality of Limboto Lake, especially mercury. Monitoring lake water quality is also important as a basis for water resources management policy (Kulla *et al.*, 2020). This information is important in formulating sustainable Limboto Lake management policies.

METHODOLOGY

Ethical Approval

No animals were harmed or mistreated during this study. The test animals in this study were treated well under the optimal environment, both physical and chemical oceanographic parameters. Approved at the proposal seminar and research results seminar research result seminar at the Faculty of Marine and Fisheries, Gorontalo State University.

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Place and Time

This research was carried out from November 2018 to June 2019. The research location was in the waters of Lake Limboto, Gorontalo Regency. Analysis of Mercury (Hg) content was carried out at the Fisheries Product Development and Quality Testing Laboratory (LPPMHP) in Gorontalo City. The research location can be seen in Figure 1. Sampling of water and fish was carried out at a predetermined location, on March 6 2019 in Iluta Village. Water and fish samples were examined at the Fisheries Product Quality Application and Diversification Testing Center (BP2MDPP) Gorontalo Province on March 6 2019 to determine mercury (Hg) levels and for analysis results using the Atomic Absorption Spectrophotometer (AAS) tool which refers to the Indonesian National Standard (SNI). (BSN, 2006).

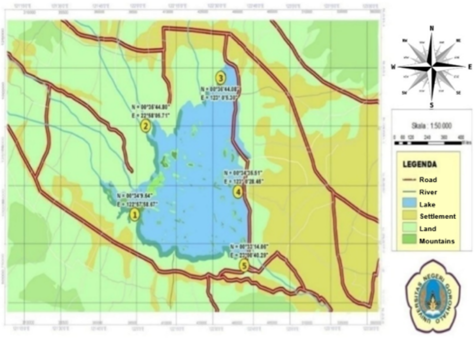

Figure 1. Map of the research location.

Research Materials

The tools used during the study were scales to measure the weight of mujair fish, knives to dissect mujair fish meat, aqua bottles to take water samples, pipettes, desiccators to heat the flask, Atomic Absorption Spectrophotometry (AAS) (Perkin Elmer, type 400, USA), For testing samples, Cool Box, for temporary storage of fish samples, Global Positioning System (GPSMAP 64csx) for determining research locations, Secci disk(PVC, INA).

The materials used during the study were mujair fish samples, water samples, ice to keep the fish from being damaged, tissue for cleaning tools, aquadest for rinsing research tools, label paper, and markers for marking mujair fish samples (*O. mossambicus*), plastic for store tilapia fish samples, litmus paper to measure the pH of sample water (PH Paper 0-14 Merk Kat NR 1.09535.0001, Germany), aluminium foil (DKM Plus premium), filter paper to filter water samples.

Research Design

This study used descriptive analysis of the purposive sampling method. The purposive sampling method is a sampling that is carried out deliberately based on certain considerations. the selected sample represents the geographical variation and environmental conditions around the lake. Observe factors such as industrial activities, human settlements, and river flow that could potentially affect mercury content in the lake. Water sampling and tilapia fish are taken at 2 observation stations, where sample 1 is taken in the area inside the KJA and station 2 is in the area outside the KJA, the reason for taking water and fish samples outside and inside the KJA is because they want to see the extent of pollution of lake water and tilapia fish in KJA and outside KJA. Water sampling and mujair fish are only done once in the morning. Sugiyono (2018) suggests that research methods are a scientific way to get data with specific purposes and uses.

Work Procedure

The sampling of water and mujair fish was only carried out once, namely in the morning. 3 times in 7 days with different sampling locations, namely station 1 and station 2. The sampling procedure for tilapia

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fish (*O. mossambicus*) is catching tilapia fish using nets, at predetermined stations. Weighing tilapia fish 250 grams each. Save tilapia fish samples in plastic containers and label each fish. Save tilapia fish samples in a coolbox that has been provided with ice cubes. Samples of mujair fish were brought to the Fisheries Products Quality Development and Testing Laboratory (LPPMHP) of Gorontalo Province.

Water sampling procedures are as follows, Rinsing the 600 ml sample bottle with lake water 3 times. Take a water sample, The water sample is given 2 ml of HNO3 solution, Then the pH paper is dipped into the sample water until it gets a pH value of 2. They label the water sample bottles and place them in the coolbox. Water samples were taken to the Gorontalo Province Fishery Product Quality Development and Testing Laboratory (LPPMHP) to be tested.

Data Analysis

The results of the data obtained (BP2MDPP) of Gorontalo Province were then analyzed descriptively and presented in the form of tables and graphs/histograms for each of the variables studied, The acquired data were processed using Microsoft Excel 2013. The parameters observed were the mercury (Hg) content in lake water and mujair fish (*O. mossambicus)* in the waters of Lake Limboto, Iluta Village. On water compared with the Water Quality Standards according to Government Regulation No.82 of 2001 concerning water quality management and water pollution control. Mujair fish quality standards (*O. mossambicus*) are compared with the Indonesian National Standard (SNI) 7387 of 2009 concerning the maximum limit of mercury contamination in food for fish and yields. the preparation is 0.5 mg/l.

RESULTS AND DISCUSSIONS

Content of Mercury (Hg) in the Water of Limboto Lake

The results of the mercury test on water samples using the AAS tool at the Gorontalo City Fishery Products Quality Development and Testing Laboratory (LPPMHP) inside KJA and outside KJA (Table 1).

Table 1. Results of Examination of Mercury (Hg) Content in Lake Limboto Waters Inside the KJA and Outside the KJA.

Station	Coordinates of Station N	E	Mercury Concentration (mg/l)	Quality Standard (mg/l)	Description
St 1	0°33'40"N	122°59'33"E	0.0014	0.001	*
St 2	0°33'44"N	122°59'31"E	0.0007	0.001	*

Notes: St 1= in Floating Net Cage (KJA)
St 2 = Outside Floating Net Cage (KJA)
** = Not eligible
* = Qualified

The results of the examination of mercury (Hg) content in Lake Limboto waters inside the KJA amounted to 0.0014 mg/l, and outside the KJA amounted to 0.0007 mg/l. This shows that the mercury (Hg) content outside the KJA still meets the requirements, while inside the KJA the mercury (Hg) content has exceeded the maximum allowable limit of 0.0014 mg/l. Fish feed used in Limboto Lake KJAs, especially fishmeal, may be contaminated with mercury. Lake Limboto has acidic water conditions and is rich in organic matter that facilitates the bioaccumulation of mercury in fish farms. As stipulated in government regulation no. 82 of 2001 on water quality management and water pollution control, the threshold value for mercury (Hg) is 0.001 mg/l. The heavy metal content in fish meat taken as a composite of all observations made (Hadiyanto *et al.*, 2022) in Lake Limboto, was in the range of 0.0360 ppm - 0.0722 ppm.

The heavy metal Hg in the fish meat is thought to be obtained from the Olopohu

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River water source. Heavy metal mercury (Hg) pollution in rivers can occur due to natural processes (weathering of mineralized rocks) traditional gold processing (amalgamation), as well as industrial processes that use raw materials containing heavy metal mercury (Hg). The content of heavy metals including mercury (Hg) found in waters can undergo a transformation process through the food chain or tropic level. Thus, high concentrations of H. Therefore, the high concentration of Hg in the waters of Lake Limboto will contaminate plankton as the main producer of the waters and at the same time food for fishery biota.

The content of heavy metal accumulation in Limboto Lake waters taken at 12-point positions showed that water Hg levels were 0.0070 - 0.1215 mg/L. This Hg content value has exceeded the limit based on the quality standards of PP No. 82 of 2001 concerning water quality management and pollution control. The high concentration of heavy metal mercury at Station 4 is suspected to have come from river water contaminated with mercury that has accumulated in the sediment.

Content of Mercury (Hg) in Mujair Organs

The results of measuring the mercury content in the organs of mujair fish include gills, kidneys, liver, and meat inside and outside the KJA (Table 2).

Table 2. Results of Examination of Mercury (Hg) Content in Gills, Kidneys, Liver, and Meat of Mujair Fish in Floating Net Cages.

Organ	Concentration of Mercury (Hg) (mg/l)	Quality Standard (mg/l)	Description
Gill	0.0024	0.5	*
Kidney	0.0019	0.5	*
Liver	0.0026	0.5	*
Meat	0.0035	0.5	*

Note: *= Qualify

The results of measuring the mercury content in tilapia fish in the waters of Lake Limboto Iluta Village in the KJA were gills 0.0024 mg/l, kidneys 0.0019 mg/l, liver 0.0026 mg/l and meat 0.0035 mg/l. This result indicates that the mercury content in the organs of the tilapia fish in the waters of Lake Limboto within the KJA has been contaminated with mercury although it is still below the maximum limit required by SNI 7387 of 2009, the limit for heavy metal mercury (Hg) pollution in the category of fish and fishery products including molluscs and shrimp is 0.5 mg/l, so it can be categorized as fish in floating net cages which are still safe for consumption. Widowati *et al.* (2008) explained that the accumulation of mercury in the bodies of aquatic animals is caused by the uptake of mercury by aquatic organisms which is faster than the expression process. Mercury levels in fish are usually higher than the mercury content in the water and its surroundings.

Similar research has been conducted by Syahrizal and Arifin (2017). The results of the observation range of average Hg 0.1660 – 0.2772 ppm can be categorized as content allowed for consumption according to the Indonesian National Standard (SNI). According to SNI 7387 of 2009, the limit for Hg heavy metal pollution in the category of food products from fisheries including molluscs and shrimp for predatory fish is 0.5 mg/l. According to Lasut and Yasuda (2009), aquatic organisms can accumulate mercury from water, sediments, and food consumed.

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Table 3. Results of Examination of Mercury (Hg) Content in Gills, Kidneys, Liver, and Meat of Mujair Fish Outside Floating Net Cages.

Organ	Concentration of Mercury (Hg) (mg/l)	Quality Standard (mg/l)	Description
Gill	0.0034	0.5	*
Kidney	0.0034	0.5	*
Liver	0.0034	0.5	*
Meat	0.0037	0.5	*

Note: *= Qualify

The results of measurements of mercury content in mujair fish in the waters of Lake Limboto, Iluta Village outside KJA were gills 0.0034 mg/l, kidneys 0.0034 mg/l, liver 0.0034 mg/l and meat 0.0037 mg/l. This shows that the mercury content in the organs of the tilapia fish in the waters of Lake Limboto outside the KJA has been contaminated with mercury, although it is still below the maximum limit required by SNI 7387 of 2009, the limit for heavy metal mercury (Hg) pollution in the category of fish and fishery products including molluscs, fish and shrimp is 0.5 mg/l, so it can be categorized as fish outside floating net cages which are still safe for consumption

The Differences in mercury content in gills, kidneys, liver, and meats of mujair fish (*O. mossambicus*) inside the KJA and outside the KJA in the waters of Lake Limboto, Iluta Village, can be seen in Figure 2, as follows :

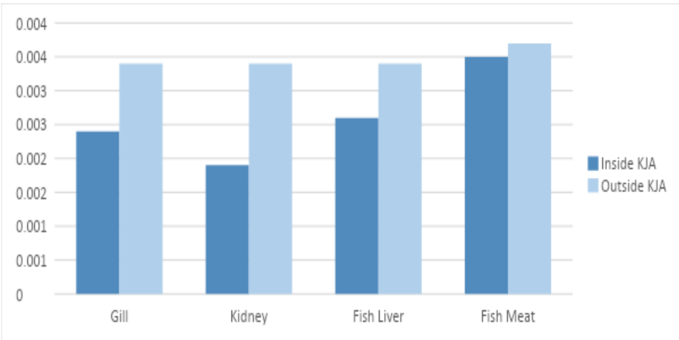

Figure 2. Differences in mercury content in the gills, kidneys, liver, and Meats of mujair fish (*O. mossambicus*) inside the KJA and outside the KJA in the waters of Lake Limboto.

Based on the diagram, the difference in mercury (Hg) content in the organ of mujair fish in the waters of Lake Limboto outside the KJA is higher than inside the KJA. Both of these are still below the maximum limit required by SNI 7387 of 2009, the limit for heavy metal mercury (Hg) pollution in the category of fish and fishery products including molluscs, fish and shrimp is 0.5 mg/l. Results of the mercury content in fish organs can be seen in Figure 2 The highest was in the meat inside the KJA of 0.0035 mg/l and outside the KJA of 0.0037 mg/l. The high mercury content in meat is caused by a physiological process in the body of fish, namely the process of the entry of heavy metals together with water which diffuses so that heavy metals accumulate in the meat.

Based on Yuniar (2009), the high and low levels of mercury in the sampled fish meat are thought to be influenced by the position of the sampling station. Water stations that are deeper in conditions of calmer water currents than shallower water. Stations 1 and 2 have a flowing water ecology (± 6 m/minute), while stations 3 and 4 have a calm water ecology (± 0.6 m/minute) on the water surface. The mercury content in the gills inside the KJA was 0.0024 ppm and outside the KJA

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was 0.0034 ppm. According to Erlangga (2007), the entry of heavy metals into the gills is caused by the gills being one of the media for the entry of various kinds of suspended particles in the waters, and gills are also important organs in fish (osmoregulation) and are very sensitive to metal toxicity. Heavy metals enter the body tissues of organisms mostly through the food chain, phytoplankton is the beginning of the food chain that will be preyed upon by zooplankton. Zooplankton are preyed upon by small fish. Small fish are preyed upon by large fish and eventually consumed by humans. This process continues, resulting in the accumulation of metals in the human body (Arifin *et al.*, 2012).

The results of the mercury content in the kidneys inside the KJA were 0.0019 ppm and outside the KJA were 0.0034 ppm. This is due to water, metal, and absorption in the animal's body by the blood, which is related to blood protein which is then distributed throughout the body's tissues. The highest accumulation of metals is usually in energy (kidneys), the kidneys as the main excretion organs in the blood, so the kidneys become the target organs of metal poisoning. The results of the mercury content in the liver inside the KJA were 0.0026 ppm and outside the KJA were 0.0034 ppm. This is because the liver is an organ that can neutralize toxins that enter the fish's body, or can detoxify, namely the process of losing the toxic properties of a toxic substance through biochemical pathways or other processes so that the mercury accumulated in the liver is at relatively low levels.

Widowati *et al.* (2008) explained that the accumulation of mercury in the bodies of aquatic animals is caused by the uptake of mercury by aquatic organisms which is faster than the excretion process. Mercury levels in fish are usually higher than mercury levels in the surrounding water. This research is also in line with Marsyalita *et al.* (2012) which shows that the average mercury level in the waters of the Jagir River, Surabaya, is 0.0063 ppm.

Compared the mercury levels in the two fish samples, namely the keting fish (*Airus cealatus)* was 0.0096 and the tilapia fish (*O. mossambicus*) was 0.0112 ppm. 64% of this mercury contamination is contributed from industrial waste and 34% from domestic waste. This study shows that mercury levels in the waters tend to be lower than the biota that lives in these waters. The results of the research by Nakoe *et al.* (2014) regarding the risk of exposure to mercury (Hg) in people who consume tilapia in Lake Limboto, showed that tilapia had been exposed to mercury at concentrations of 7 – 89 mg/L when organisms such as fish are exposed to high concentrations of heavy metals, they are toxic and tend to accumulate in vital organs (Akoto, 2008). Such accumulation can impact the food chain, affecting human health and making it unsafe for consumption. The study concluded that this fish is not safe to eat for the next 30 years, so risk management is needed by reducing mercury levels in fish, and reducing the level of consumption of fish from Limboto Lake. Pollutants that enter the waters can change an aquatic ecosystem order called pollution. Pollutants that enter the waters come from organic waste, heavy metals, and oil (Pranaditia, 2011)

Water Quality Measurement

The results of measurements of the chemical physics of water inside the KJA and outside the KJA in the waters of Lake Limboto, Iluta Village can be seen in Table 4.

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Table 4. Results of Water Chemical Physics Measurements Inside the KJA and Outside the KJA.

Location	Coordinate		Parameters			
	N	E	Temp (°C)	pH	DO (‰)	Brightness (m)
St 1	$0^0$33'40"N	$122^0$59'33"E	31.38	6.37	4.79	0.95
St 2	$0^0$33'44"N	$122^0$59'31"E	31.49	6.90	3.82	0.85
Quality Standard			Dev 3	6-9	3-4	

Notes: St 1= in Floating Net Cage (KJA)
St 2 = Outside Floating Net Cage (KJA)

Based on this study, The temperature measurement results obtained are still by deviation 3 where, the temperature range of the waters of Limboto Lake during the observation, was 31.38°C - 31.49°C. (Noor, and Ngabito. 2018), showed that the temperature of Lake Limboto waters ranged from 30-34 °C. In general, temperature values in Lake Limboto waters are mostly above the quality standard of PPRI No. 82/2001 class II for freshwater aquaculture, which is 20-30 °C (Hadiyanto *et al*., 2022). Water temperature measurements during the study showed that the water temperature at each research station did not show high variations, ranging from 30.50 to 33.00°C.

The results of measuring the degree of acidity (pH) in the waters of Lake Limboto, Iluta Village, were 6.37 inside the KJA and 6.90 outside the KJA. The pH value in the KJA looks very low at 6.37. Selayar *et al.* (2015) stated that the lower pH value will cause an increase in the solubility of mercury in waters, causing mercury to transform into methylmercury which has a higher toxicity. This range is still normal and below the threshold for tilapia survival. This value is still classified as feasible for fish farming in KJA under the quality standard value of PP RI No. 82 Year 2001 Class II for freshwater fish farming which ranges from 6-9. In the research of Lihawa and Mahmud (2017), the pH value of Limboto lake water is 7.7-8, while in the study of Noor and Ngabito (2018), the pH value of Limboto lake water is 8-8.5. This shows that the pH value of Limboto Lake water is still in normal conditions for fish survival.

The results of dissolved oxygen (DO) measurements in the waters of Lake Limboto, Iluta Village, within the KJA, were 4.79, and outside the KJA were 3.82. According to Tobing *et al*. (2014), the metabolic process in fish can consume up to 2 times the oxygen. The higher the BOD and COD values, the lower the DO value.

This is because microorganisms decompose organic matter (indicated by BOD and COD values) which requires a supply of oxygen. According to Sastrawijaya (2001), water can be categorized as good water if the dissolved oxygen level is at least 5 ppm. The brightness value of a water body is closely related to the penetration of sunlight into the water body. Sunlight will help the process of photosynthesis which will produce dissolved oxygen which is an important factor in aquatic life. The results of Brightness measurements in the waters of Lake Limboto, Iluta Village, inside the KJA were 0.95, and outside the KJA were 0.85. Both of these values indicate that the brightness in the waters of Lake Limboto is very low. From the observations, it was found that the remaining fish feed was not eaten by fish in the waters, thus affecting the brightness to be low. Meanwhile, according to Tatangindatu *et al*. (2013), a good level of brightness for lake waters is 2 m. Based on Kulla *et al*. (2020) Water clarity depends on color and turbidity, clarity values are strongly influenced by weather conditions, and measurement time and depth affect the volume of water discharge.

CONCLUSION

From the results of the study, it was found that the Mercury (Hg) Content in Lake Limboto Waters, Station I was 0.0014 ppm and Station II was 0.0007 ppm, and for mujair fish organs the highest was in meat, namely outside KJA 0.0037 ppm and meat, the lowest was in KJA 0.0035 ppm. Further research needs to be done on the content of heavy metals other than mercury, NH_3 content, phosphate, and others so that it can be known what heavy metals are contained in the fish in the lake.

CONFLICT OF INTEREST

There is no conflict of interest among all authors upon writing and publishing the manuscript.

AUTHOR CONTRIBUTION

The contribution of each author is as follows; Munirah Tuli, Citra Panigoro, Funco Tanipu collected and analyzed the data, Novianti Walangadi followed the conception, design trial, drafting and drafting of the manuscript, and revising it.

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REFERENCES

Arifin, B., Deswati and Loekman, U., 2012. Analysis of Metal Content of Cd, Cu, Cr and Pb in Seawater around Bungus Teluk Kabung Waters in Padang City. *Jurnal Dampak*, *9*(2), pp.116-120. https://doi.org/10.25077/dampak.9.2.116-122.2012

Akoto, O., Bruce, T.N. and Darko, D., 2008. Heavy metals pollution profiles in streams serving the Owabi reservoir. *African Journal of Environmental Science and Technology*, *2*(11), pp.354-359. https://doi.org/10.5897/AJEST.9000061

BSN (National Standardization Agency), 2006. SNI 01 2346-2006. Guidelines for Organoleptic or Sensory Testing. National Standardization Agency. Jakarta. https://www.slideshare.net/arbydjactpartii/sni-01-23462006-petunjukpengujian-organoleptik-dan-atau-sensori.

Erlangga, 2007. Effects of Pollution of Kampar River Waters in Riau Province on Baung Fish (Hemibagrus Nemurus). Thesis. Graduate School, Bogor Agricultural University. https://repository.ipb.ac.id/handle/123456789/9166

Hasan, M., 2013. Chloride Content Test in Lake Limboto Water Body, Gorontalo Regency. Thesis. Department of Public Health, Faculty of Health and Sport Sciences, Gorontalo State University. https://repository.ung.ac.id/skripsi/show/811409041/uji-kandungan-klorida-pada-badan-air-danau-limboto-kabupaten-gorontalo.html

Hadiyanto, Hasim and Juliana, 2022. Mercury, Lead, and Cadmium Heavy Metal Content in Water, Fish, and Sediment in Limboto Lake. *Jurnal Sumberdaya Akuatik Indopasifik*, *6*(1), pp.1-10. https://doi.org/10.46252/jsai-fpik-unipa.2022.Vol.6.No.1.195

Hasim, Koniyo, Y. and Kasim, F., 2017. Suitable location map of floating net cage for environmentally friendly fish farming development with Geographic Information Systems applications in Lake Limboto, Gorontalo, Indonesia. *AACL Bioflux*, *10*(2), pp.255-264. http://www.bioflux.com.ro/docs/2017.254-264.pdf

Indrayani, E., Nitimulyo, K.H., Hadisutanto, S. and Rustadi, 2015. Analysis of Nitrogen, Phosphorus and Organic Carbon Content in Lake Sentani Papua. *Jurnal Manusia dan Lingkungan*, *22*(2), pp.217-225. https://doi.org/10.22146/jml.18745

Kulla, O.L.S., Yuliana, E. and Supriyono, E., 2020. Analysis of Water Quality and Environmental Quality for Fish Farming in Lake Laimadat, East Nusa Tenggara. *PELAGICUS*, *1*(3), pp.135-44. http://dx.doi.org/10.15578/plgc.v1i3.9290

Lasut, M.T. and Yasuda, Y., 2008. Accumulation of Mercury in Marine Biota of Buyat Bay, North Sulawesi, Indonesia. *Coastal Marine Science*, *32*(1), pp.33–38. https://repository.dl.itc.u-tokyo.ac.jp/record/40720/files/CMS320105.pdf

Legowo, S., 2005. Pendugaan Erosi dan Sedimentasi dengan Menggunakan Model GeoWEPP (Studi Kasus DAS Limboto, Propinsi Gorontalo). Bandung, Institut Teknologi Bandung. https://english.ftsl.itb.ac.id/wp-content/uploads/sites/75/2019/03/Pendugaan-Erosi-Dan-Sedimentasi-dengan-Menggunakan-Model-GEOWEPP-Studi-Kasus-DAS-Limboto-Propinsi-Gorontalo.pdf

Lihawa, F. and Mahmud, M., 2017. Evaluation of Lake Limboto Water Quality Characteristics *Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan*, *7*(3), pp.260-266. http://10.29244/jpsl.7.3.260-266.

Marsyalita, F., Rahardja, B.S. and Cahyako, Y., 2012. Analysis of Mercury (Hg) Content in Water, Sediment, Keting Fish (Arius Caelatus) and Mujair Fish (*Oreochromis mossambicus*) in Jagir River Surabaya. *Jurnal Ilmiah Perikanan dan Kelautan*, *4*(2), pp.113-118. https://e-journal.unair.ac.id/JIPK/article/view/11557/6573

Nakoe, M.R. Ardian, Y., Ruhardi, A., Dwinugroho, F., Yudhastuti, R., Sulistyorini, L., Azizah, R. and Indriani, D., 2014. Risk Assesment Exposure of Mercury (hg) at People Who Cumsuming Nila Fish (*Oreochromis niloticus*) From Limboto Lake of Gorontalo Province. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, *5*(5), pp.1420-1427. https://www.rjpbcs.com/pdf/2014_5(5)/[216].pdf

Noor, S.Y. and Ngabito, M., 2018. Pollution Level of Lake Limboto Gorontalo Waters. *Gorontalo Fisheries Journal*, *1*(2), pp.30-39. https://doi.org/10.32662/gfj.v1i2.437

Nusantari, E., 2010. Lake Limboto Damage and Conservation Efforts through Community Empowerment and the Role of Higher Education. *Journal of Biology Education*, *1*(2). https://journal.um.ac.id/index.php/jpb/article/view/3843

Pranaditia, R., 2011. Study of Cadmium Heavy Metal Content in Several Species of Fish, Mollusks and Crustaceans in Kenjeran Beach. Thesie. Surabaya, Universitas Airlangga. http://repository.unair.ac.id/id/eprint/26395

Rahim, T.R., Hasim and Juliana, 2020. Aquatic Quality Parameter at Lake Limboto. JPs: *Jurnal Riset dan Pengembangan Ilmu Pengetahuan*, *5*(1), pp.93-98. https://ejurnal.pps.ung.ac.id/index.php/JPS/article/view/439

Said, N.I., 2010. Removal of mercury metal in industrial wastewater. *Jurnal Air Indonesia*, 6(1), p.11. https://dx.doi.org/10.29122/jai.v6i1.2447

Sastrawijaya, T.A., 2001. Pencemaran Lingkungan. Rineka Cipta Jakarta.

Selayar, N.A., Tumembouw, S. and Mondoringin, L.L.J.J., 2015. Analysis of Heavy Metal Content of Mercury (Hg) Around the Bay of Manado. Jurnal Budidaya Perairan, 3(1), pp.124-130. https://ejournal.unsrat.ac.id/v3/index.php/bdp/article/view/6947/6452

Cite this document as Tuli, M., Panigoro, C.F., Tanipu, F. and Walangadi, N., 2024. Analysis Of Mercury (Hg) In Mujair Fish (*Oreochromis mosambicus*) In Limboto Lake, Gorontalo Province. *Journal of Aquaculture and Fish Health*, *13*(2), pp.244-254.

Syahrizal and Arifin, M.Y., 2017. Analysis of Mercury (Hg) Content in Water and Meat of Siamese Patin (*Pangasius Hypopthalmus*) in Lake Sipin Jambi. *Jurnal Akuakultur Sungai dan Danau*, *2*(1), pp.9-17. http://dx.doi.org/10.33087/akuakultur.v2i1.13

Sugiyono, 2018. Quantitative, Qualitative, and R&D Research Methods, publisher Alfabeta, Bandung.

Tatangindatu, F., Kalesaran, O. and Rompas, R., 2013. Study of Physical Parameters of Water Chemistry in Fish Farming Areas in Lake Tondano Paleloan Village, Minahasa. *e-Journal Budidaya Perairan*, *1*(2), pp.8-19. https://doi.org/10.35800/bdp.1.2.2013.1911

Tobing, S.L., Barus, T.A. and Desrita, 2014. Analysis of Water Quality Due to Floating Net Cages in Lake Toba Sualan Hamlet Sibaganding Village Simalungun Regency North Sumatra. North Sumatra: Department of Aquatic Resources Management. Faculty of Agriculture. University of North Sumatra. https://www.academia.edu/48250452/Analisis_Kualitas_Air_Akibat_Keramba_Jaring_Apung_Di_Danau_Toba_Dusun_Sualan_Desa_Sibaganding_Kabupaten_Simalungun_Sumatera_Utara

Widowati, Sastiono, A. and Jusuf, R., 2008. *Toxic Effects of Metals Pollution Prevention and Management*. Yogyakarta: ANDI

Yuniar, V., 2009. Toxicity of mercury (Hg) on survival rate, growth, blood picture, and organ damage in tilapia (*Oreochromis niloticus*). Thesis, Faculty of Fisheries and Marine Science, Bogor Agricultural University

Cite this document as Tuli, M., Panigoro, C.F., Tanipu, F. and Walangadi, N., 2024. Analysis Of Mercury (Hg) In Mujair Fish (*Oreochromis mosambicus*) In Limboto Lake, Gorontalo Province. *Journal of Aquaculture and Fish Health*, *13*(2), pp.244-254.