

EVALUATION OF MERCURY (HG) CONCENTRATION IN CILEMAHABANG RIVER, BEKASI REGENCY

Eva Kasih Sembiring^{1*}, Laila Fitria², Haryoto Kusnoputranto³, Asrit Jessica Kario⁴

Fakultas Kesehatan Masyarakat, Universitas Indonesia^{1,2,3,4}

*Corresponding Author : eva.kasih@ui.ac.id

ABSTRAK

Penelitian ini mengevaluasi konsentrasi merkuri dalam air sungai Cilemahabang, Kabupaten Bekasi yang diduga telah mengalami pencemaran. Pengambilan sampel dilakukan di tiga titik berbeda, yaitu hulu, tengah, dan hilir sungai. Sampel dianalisis dengan menggunakan metode ICP-MS (*Inductively Coupled Plasma Mass Spectrometry*) untuk mengukur konsentrasi merkuri (Hg). Data yang diperoleh dibandingkan dengan nilai batas aman air sungai yang berlaku menurut PP No. 22 Tahun 2021. Analisis sampel dilakukan di Laboratorium PT Bumi Ventila Indonesia. Waktu penelitian mulai dari survei pendahuluan, pengambilan sampel, uji laboratorium dan analisis data dilakukan pada bulan Oktober 2024 hingga Maret 2025. Hasil penelitian menunjukkan bahwa konsentrasi merkuri (Hg) pada air sungai Cilemahabang dengan rata-rata 0,003100 mg/l telah melebihi nilai batas aman yang ditetapkan pada PP No. 22 Tahun 2021 sebesar 0,001 mg/l dengan konsentrasi merkuri (Hg) semakin meningkat pada bagian tengah dan hilir sungai. Penelitian ini menemukan pencemaran merkuri yang signifikan pada bagian tengah dan hilir sungai, sehingga perlu adanya pengawasan yang lebih ketat terhadap implementasi kebijakan dan peraturan yang ada dalam mengurangi potensi pencemaran air sungai dan perlu dilakukan penelitian lebih lanjut mengenai penilaian risiko kesehatan lingkungan untuk merancang strategi mitigasi yang efektif.

Kata kunci : Cilemahabang, merkuri (Hg), pencemaran, air sungai

ABSTRACT

This study evaluates the mercury concentration in the Cilemahabang river water, Bekasi Regency, which is suspected to be polluted. Sampling was conducted at three different points, namely upstream, middle, and downstream of the river. Samples were analyzed using ICP MS (Inductively Coupled Plasma Mass Spectrometry) method to measure mercury (Hg) concentration. The data obtained were compared with the applicable river water safety limit value according to PP No. 22 of 2021. Sample analysis was conducted at PT Bumi Ventila Indonesia Laboratory. The results showed that the concentration of mercury (Hg) in Cilemahabang river water with an average of 0.003100 mg/l has exceeded the safe limit value set in PP No. 22 of 2021 of 0.001 mg/l with the concentration of mercury (Hg) increasing in the middle and downstream parts of the river. This study found significant mercury pollution in the middle and downstream parts of the river, so there needs to be stricter supervision of the implementation of existing policies and regulations in reducing the potential for river water pollution and further research needs to be done on environmental health risk assessment to design effective mitigation strategies.

Keywords : Cilemahabang, mercury (Hg), pollution, river water

INTRODUCTION

The increasing growth of industrialization will be followed by a growing population, potentially increasing contamination of water bodies through improperly treated waste disposal. This greatly affects the quality of surface water and groundwater. The presence of heavy metals such as Lead (Pb), Mercury (Hg), Cadmium (Cd), Chromium (Cr), Copper (Cu), Arsenic (As), Zinc (Zn) and Nickel (Ni) are often found in river water sourced from human activities including industrial, household, urban, mining, and agricultural activities (Handayanto et al., 2017; Sripanya et al., 2023; Tarigan et al., 2010). On the other hand, the increasing growth of industrialization will open up jobs to increase a region's economic

development. Bekasi Regency in West Java Province is known as the largest industrial area in Southeast Asia, with industries spread throughout the Jababeka industrial area and 11 other industrial areas. According to BPS data, it is known that the number of industries sectors in Bekasi Regency is 10.099 industries consisting of tobacco processing, textiles, apparel, leather, wood, paper, printing and reproduction of recording media, products from coal and petroleum refining, chemicals, pharmaceuticals, rubber, non-metallic minerals, basic metals, electronics, furniture, electrical equipment, production of machinery and equipment, motor vehicles, trailers and semi-trailers and other processing (BPS Kabupaten Bekasi, 2017; Disdukcapil Kabupaten Bekasi, 2024). The community utilizes this river water as a source of agricultural irrigation, freshwater aquaculture, and raw material for drinking water processed by the PDAM and the private sector.

Several online news reports in 2020-2024 have highlighted changes in the water quality of the Cilemahabang River, which has changed its physical color to pitch black (CNN Indonesia, 2021; Jurnal Investigasi TV, 2024; Liputan6.com, 2020; Sindonews.com, 2022). The results of the literature review indicate that most inorganic mercury compounds are white powders or solutions, except for mercury sulfide, which is red in color and turns black when exposed to sunlight or heat (Handayanto et al., 2017; Inswiari, 2008). This condition is consistent with the research conducted by Elfidasari on the polluted Ciliwung River, which has experienced black discoloration and odor and shows the presence of heavy metal concentrations, one of which is relatively high Hg metal in water and river sediments that exceed the government regulation threshold (Elfidasari et al., 2020).

Research on river water and well water in the Kuantan River showed a significant increase in mercury (Hg) concentrations in the middle and lower reaches of the river. Hg concentrations in river water and well water were found to be 0.0325 mg/L and 0.0202-0.0231 mg/L, respectively, which exceeded the required quality standards (Hasibuan et al., 2021). This study focuses on mercury (Hg) concentration in river water to identify contamination in the river water, where polluted water utilized by the community may have an impact on environmental risk factors and public health.

METHODS

This study was conducted in the Cilemahabang River, Bekasi Regency, with water samples taken from three different points. The samples include river water. Sampling was carried out during the daytime on February 10, 2025. The samples were then analyzed using the ICP-MS method to measure mercury concentration. The mercury concentration analysis was performed at the PT. Bumi Ventila Indonesia Laboratory. The research period, including the preliminary survey, sample collection, laboratory testing, and data analysis, took place from October 2024 to March 2025. Sampling locations were at three different points: the first point was downstream of the Lemah Abang sluice gate (downstream), located near North Cikarang with coordinates 6°15'18.72"S 107°11'12.30"E; the second point was around the Lemah Abang sluice gate (midstream) with coordinates 6°16'7.57"S 107°10'55.70"E; the third point was upstream of the Lemah Abang sluice gate (upstream), located near Central and South Cikarang, with coordinates 6°18'58.82"S 107°9'25.49"E. The data obtained were compared with the safe threshold values established in PP No. 22 of 2021 on the Implementation of Environmental Protection and Management.

RESULTS

Figure 1 presents the location of river water sampling carried out in 3 locations, namely, Central Cikarang and South Cikarang Districts (upstream), North Cikarang District (Central

and downstream). The upstream location has a greater intensity of industrial area distribution. The middle location is a water gate managed by the government as a source of irrigation and a source of raw material for drinking water, besides that it is used by the community for daily needs such as washing, bathing and so on. The upstream location is the location point after going through the Lemah Abang sluice gate.

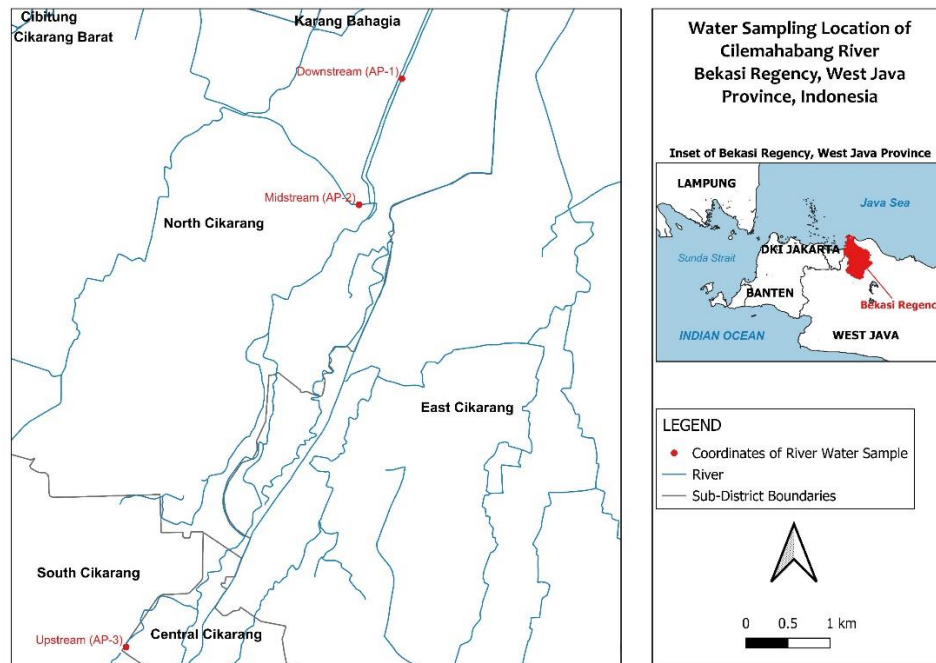


Figure 1. Map of Cilemahabang River Water Sampling Location

Table 1 presents the results of the average mercury (Hg) concentration found in the Cilemahabang river of 0.003100 mg/l. The highest concentration of mercury (Hg) is found in the downstream river water at 0.0063 mg/l, and the lowest concentration is found in the upstream river water. The average mercury (Hg) concentration exceeded the allowable safe limit.

Table 1. Comparison of Hg Concentration in Cilemahabang River Water with Quality Standard

No	Lokasi Sampel	Hg (mg/l)	Safety Limit*	Coordinates
1	Downstream (AP1)	0,0063	0,001	6°15'18.72 "S 107°11'12.30 'E
2	Midstream (AP2)	0,0029	0,001	6°16'7.57 'S 107°10'55.70 'E
3	Upstream (AP3)	<0,0001	0,001	6°18'58,82 'S 107°9'25,49 'E
Average		0,0031		

*PP Nomor 22 Tahun 2021

DISCUSSION

The outcomes of laboratory tests in this study, the average concentration of mercury (Hg) in river water has exceeded the safe limit based on PP No. 22 of 2021 by 0.001 mg/l. Table 1 presents that the concentration of mercury (Hg) in the upstream section is still below the safe limit value, while in the middle to the downstream section it tends to get higher at 0.0029 mg/l and 0.0063 mg/l indicating the potential for river water pollution in the middle to downstream section.

Some sources of mercury (Hg) occur naturally in the earth's crust and are released into water bodies. Industrial activities that use mercury materials such as electronics production,

automotive, electrical appliances, light bulb production, medical and pharmaceutical equipment, coal-fired power plants, coal combustion, metal extraction from ores and cement manufacturing can generate mercury-containing waste (Habuer - et al., 2020; WHO, 2017). The continuous release of mercury through small amounts of effluent can lead to further accumulation of mercury in the middle and lower reaches of the river. This is influenced by several factors such as sediment texture, turbidity, river water currents that contribute to the increase of mercury levels in the lower reaches of the river (Hasibuan et al., 2021; Panda et al., 2015).

Mercury concentrations that exceed safe limits will have a major impact on the environment and humans. Long-term exposure will cause toxic effects on the nervous, digestive, immune systems, lungs, kidneys, skin and eyes [14]. Mercury exposure can be through direct use of river water, contamination of wells through groundwater seepage and consumption of contaminated plants and fish through the process of biomagnification, increasing health risks (Abd-Elaty et al., 2022; Hasibuan et al., 2021; Ningrum, 2018).

CONCLUSION

The concentration of mercury (Hg) in the Cilemahabang river with an average of 0.003100 mg/l has exceeded the safe value limit set in PP No. 22 of 2021 by 0.001 mg/l with the concentration of mercury (Hg) increasing in the middle and lower reaches of the river. Suggestions in this study, the need for stricter supervision of the implementation of existing policies and regulations with coordination by the government, related agencies and the community in reducing the potential for river water contamination. With various exposure pathways, further research is needed to environmental health risks assessment to design effective mitigation strategies.

ACKNOWLEDGMENTS

The researcher would like to thank the Faculty of Public Health, University of Indonesia and the Director General of Health Workers, Ministry of Health for supporting this research.

REFERENCES

- Abd-Elaty, I., Abd-Elmoneem, S. M., Abdelaal, G. M., Vrána, J., Vranayová, Z., & Abd-Elhamid, H. F. (2022). *Groundwater Quality Modeling and Mitigation from Wastewater Used in Irrigation, a Case Study of the Nile Delta Aquifer in Egypt*. *International Journal of Environmental Research and Public Health*, 19(22). <https://doi.org/10.3390/ijerph192214929>
- BPS Kabupaten Bekasi. (2017). *Jumlah Perusahaan dan Tenaga Kerja Menurut Klasifikasi Industri pada Industri Besar dan Sedang, 2017—Tabel Statistik*. <https://bekasikab.bps.go.id/id/statistics-table/1/MTgxMiMx/jumlah-perusahaan-dan-tenaga-kerja-menurut-klasifikasi--industri-pada-industri-besar-dan-sedang--2017.html>
- CNN Indonesia. (2021). *FOTO: Hidup dari Hitam Kali Cilemahabang Bekasi*. nasional. <https://www.cnnindonesia.com/nasional/20210907160207-22-690950/foto-hidup-dari-hitam-kali-cilemahabang-bekasi>
- Disdukcapil Kabupaten Bekasi. (2024). *Profil Perkembangan Kependudukan Kabupaten Bekasi Tahun 2023*.
- Elfidasari, D., Ismi, L. N., & Sugoro, I. (2020). *Heavy metal concentration in water, sediment, and Pterygoplichthys pardalis in the Ciliwung River, Indonesia*. *AACL Bioflux*, 13(3).

- Habuer -, Fujiwara, T., & Takaoka, M. (2020). *Environmental impact analysis of anthropogenic mercury releases in China*. 457. https://doi.org/10.14912/jsmcwm.31.0_457
- Handayanto, E., Nuraini, Y., Syam, N., & Fiqri, A. (2017). *Fitoremediasi dan Phytomining Logam Berat Pencemar Tanah*. UB Press.
- Hasibuan, D. K. A., Riani, E., & Anwar, S. (2021). Kontaminasi Merkuri (Hg) Pada Air Sungai, Air Sumur, Sedimen Dan Ikan Di Sungai Kuantan, Riau. *Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan (Journal of Natural Resources and Environmental Management)*, 10(4), 679–687. <https://doi.org/10.29244/jpsl.10.4.679-687>
- Inswiari. (2008). Paradigma Kejadian Penyakit Pajanan Merkuri (Hg). *Jurnal Ekologi Kesehatan*, 7, 775–785.
- Jurnal Investigasi TV. (2024). *Sudah Bertahun-tahun Air Kali Cilemahabang Berwana Hitam Ini Kata: Warga Setempat*. <https://www.mediajurnalinvestigasi.com/2024/06/sudah-bertahun-tahun-air-kali.html>
- Liputan6.com. (2020, July 26). *Air Kali Cilemahabang Tercemar Limbah, 3 Desa di Bekasi Krisis Air Bersih*. liputan6.com. <https://www.liputan6.com/news/read/4314880/air-kali-cilemahabang-tercemar-limbah-3-desa-di-bekasi-krisis-air-bersih>
- Ningrum, S. O. (2018). Analysis Quality of Water River and Quality of Well Water in The Surrounding of Rejo Agung Baru Sugar Factory Madiun. *Jurnal Kesehatan Lingkungan*, 10(1), 1. <https://doi.org/10.20473/jkl.v10i1.2018.1-12>
- Panda, A., Nitimulyo, K. H., & Djohan, T. S. (2015). Akumulasi Merkuri Pada Ikan Baung (Mytus Nemurus) di Sungai Kahayan Kalimantan Tengah (The Accumulation of Mercure on Baung Fish (Mytus nemurus) in The Kahayan Rice of Central Kalimantan, Indonesia). *Jurnal Manusia dan Lingkungan*, 10(3), Article 3. <https://doi.org/10.22146/jml.18610>
- Sindonews.com. (2022). *5 Sungai Paling Kotor di Bekasi, Limbah Pabrik dan Sampah Jadi Masalah Utama | Halaman Lengkap*. <https://metro.sindonews.com/read/960445/171/5-sungai-paling-kotor-di-bekasi-limbah-pabrik-dan-sampah-jadi-masalah-utama-1670217171?showpage=all>
- Sripanya, J., Vongsombath, C., Vannachak, V., Rattanachan, K., Hanjavanit, C., Mahakham, W., & Sangpradub, N. (2023). *Benthic Macroinvertebrate Communities in Wadeable Rivers and Streams of Lao PDR as a Useful Tool for Biomonitoring Water Quality: A Multimetric Index Approach*. *Water*, 15(4), 625. <https://doi.org/10.3390/w15040625>
- Tarigan, Z., . E., & Rozak, A. (2010). Kandungan Logam Berat Pb, Cd, Cu, Zn dan Ni dalam Air Laut dan Sedimen di Muara Sungai Membramo, Papua dalam Kaitannya dengan Kepentingan Budidaya Perikanan. *MAKARA of Science Series*, 7(3). <https://doi.org/10.7454/mss.v7i3.368>
- WHO. (2017). *Mercury and health*. <https://www.who.int/news-room/fact-sheets/detail/mercury-and-health>