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Regional Case Study

Analysis of Lake Water Quality in Cimahi City, West Java Province

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Abstract

Cimahi City is experiencing raw water insecurity. This requires the local government to look for new water sources, such as rehabilitating the condition of existing lakes in their area so that they function again as raw water lake. This study aims to analyze water quality and parameters that exceed quality standards and to calculate the status of lake water quality. The data will be the basis for preparing priority recommendations for lake management. The calculation of this method uses the Pollution Index (PI) method. The lakes studied were lakes located at the Cimahi City Government location, at the Cibabat Hospital, Setiamanah, Ciseupan, and the Cimahi City Infantry Brigade Complex. Based on research results in 2021, all lakes will be in the moderately polluted category, while in 2022 they will be in the low-moderate pollutant category. Lake water quality that has improved is Setiamanah Lake and that in the Cimahi City Infantry Brigade Complex. The two lakes originally had moderate to moderate polluted status with an index value of 8.40 to 4.94, so efforts and control strategies are needed to reduce pollution in the 5 lakes.

Keywords: Cimahi city; lake; water quality; raw water; pollutant index

1. Introduction

Cimahi City is currently experiencing clean water insecurity. The availability of water is reduced in terms of quality and quantity. This causes the local government to try as much as possible to find alternative water from river water, rainwater, or lake water. The quality of river water in Cimahi City has been heavily polluted due to the activities of residents in the watershed. Polluted water quality is characterized by high water pollution parameters such as Biological Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), Total Phosphate, Sulfide, Nitrite, Free Chlorine, Phenol, and Detergent as Methylen Blue Active Surfactant (MBAS), Total Coliform, and Fecal Coliform. There are five rivers in Cimahi City whose quality has deteriorated, namely the Cibaligo River (Anggraini & Wardhani, 2021), the Cimahi River (Rafianto & Wardhani, 2021), the Cisangkan River (Wardhani & Rosmeiliyana, 2022), the Cibeureum River (Hermawan & Wardhani, 2021) and the Cibabat River (Alfaroby & Wardhani, 2021). Regarding the quantity of water discharge, the five rivers that cross Cimahi City experience high fluctuations in the rainy and dry seasons. In the dry season, the water discharge is minimal, but in the rainy season, the water overflows and can cause flooding in some areas (Alfaroby & Wardhani, 2021). This is due to damage to watersheds as a result of changes in land use from vegetated areas to built-up land (Rafianto & Wardhani, 2021). The high pollutant load of organic matter causes the dissolved oxygen concentration to decrease and the emergence of H_2S (Wardhani and Ananda, 2022).

The impact of damage to watersheds, in addition to the mainstay of the river, the quantity of groundwater has also decreased. Cimahi City has been included in the red zone of critical groundwater due to excessive exploitation of groundwater to provide clean water for domestic and industrial purposes (Wardhani & Putri, 2021). (Putri and Wardhani, 2021). Cimahi City can no longer open new water points, so it is predicted that it will impact the water crisis in 2030 (Cimahi City Government, 2021). In addition to the exploitation of groundwater by industry and the community, this symptom is also exacerbated by the conversion of infiltration land into a concrete area. The loss of vegetation causes changes in runoff and infiltration water composition. This land conversion causes the percentage of rainwater that becomes runoff water to be greater than that of water that seeps into the ground and becomes deep and shallow groundwater (Cimahi City Government, 2021).

The Cimahi City Government continues to seek raw water sources. Search by analyzing the potential for rainwater that can be harvested, looking for new springs, and identifying lakes in Cimahi City that can still be revitalized (Cimahi City Government, 2021). Cimahi City has 6 (six) lakes managed by the Department of Housing and Settlement Areas, namely Lake Citeureup, Cibabat, Leuwigajah 1, Leuwigajah 2, Setiamanah, and Melong. The lake already exists, but currently, its condition is not managed correctly. The lake land is increasingly squeezed by settlements, used as a wastewater disposal site, and becomes a place for garbage collection (Cimahi City Government, 2021). Revitalization of the existing lake conditions will be planned to include short, medium, and long stages. Revitalization activities require primary data on lake water quality and identification of border conditions and lake water catchment areas. The primary data is used as initial information to determine and formulate policies on efforts to prevent pollution and damage to lake water in Cimahi City.

This research aims to examine the water quality in 5 (five) lakes in Cimahi City so that different policies can be formulated to improve lake conditions. The purpose of this study is to inventory the water quality and the status of the lake's water quality. Revitalization of the lake is currently the concern of the Ministry of Environment and Forestry of the Republic of Indonesia. This is evidenced by the issuance of the Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 28/PRT/M/2015 concerning the Determination of River Border Lines and Lake Border Lines. This regulation aims to ensure that activities for the protection, use, and control of existing resources in rivers and lakes can be carried out in accordance with their objectives. The objectives to be achieved are (a) the function of rivers and lakes is not disturbed by activities that develop in their surroundings; (b) utilization activities and efforts to increase the value of the benefits of existing resources in rivers and lakes can provide optimal results while maintaining the sustainability of the functions of rivers and lakes; and (c) the destructive power of river and lake water to the environment can be limited (Permen PUPR, 2015). Another regulation issued by the ministry in managing lakes is the Regulation of the State Minister of the Environment Number 28 of 2009 concerning the Capacity to Carry Lake or Lake Pollution Loads (Permen LH, 2009).

Research on lake water quality has been carried out in various areas such as Lake Buyan and Tamblingan Bali, which results in lake water quality that does not meet the quality standards for BOD and COD parameters, indicating that the quality of lake water is organic waste originating from the catchment area (Sukmawati et al., 2020). The movement of pollutants in the water and sediment phases in Lake Kerinci, Jambi Province, was studied using water quality modeling (Ajiwibowo, 2018). Water Quality of Kotawaringin Lama Itch Lake, Central Kalimantan Province (Tyas, 2021). The water quality of the Lower Lake of West Sumatra Province was studied using an assessment of the condition of the water environment using a numerical method (Ajiwibowo, 2018). Movement of pollutants in the water and sediment phases of Lake Singkarak (Ajiwibowo, 2018). Saguling Lake water quality and pollution in water and sediment (Wardhani et al., 2018) (Roosmini, 2022). Water pollution by floating net cages in Jatiluhur Lake (Wardhani & Ananda, 2022). This study proves that the quality of lakes or lakes is a research that is widely given because it is related to one of the efforts in the conservation of water resources.

2. Methodology

The stages of preparing the Lake Water Quality Study report in Cimahi City in 2021 consist of the stages of preparation, identification, inventory of the required data, and processing so that conclusions and recommendations can be drawn. The stages of activities are presented in the following description. The preparatory stage involves coordination between the Cimahi City Environmental Service, searching for information about the lake's history and current condition. Water quality sampling locations were carried out in 5 (five) lakes, and their coordinates are presented in Table 1 and Figure 1. The water quality data comes from the monitoring results of the Cimahi City Environmental Service in 2021 and 2022. Water collection is carried out on October 6-18, 2021, and the sample is immediately brought to the laboratory for analysis. When sampling water quality, the weather is sunny, with air temperatures ranging from 23-280C. The water sampling conditions were cloudy, containing sediment, and yellowish cloudy. In 2022, sampling will be conducted in April 2022 (dry season) with monitoring at the same sampling point. The water collection method refers to the Indonesian National Standard Number 6989.57-2008 concerning water and wastewater-section 57: surface water sampling method.

Table 1. Coordinates of lake water sampling point in Cimahi

No	Lake Name	Coordinate		Description
		South	East	
1	Cimahi City Government	06°52'10.7"	107°33'17.6"	Located in the Cimahi City government office area. Currently, above the lake stands the mosque building, where the water used for ablution is accommodated in the lake
2	Cibabat	06°52'79.3"	107°33'04.5"	Located within the Cibabat Hospital area, the entrance to the lake must go through the hospital. Currently, the location of the lake is an open space area for the Cibabat Hospital
3	Setiamanah	06°52'23.1"	107°32'03.3"	It is located in a residential area in Setiamanah Village, Central Cimahi District. The location of the lake border has been filled with dense settlements.
4	Ciseupan	06°53'37.0"	107°30'54.9"	Located in a residential area on Jalan Cibeber, South Cimahi District. This lake is a former sand excavation that is no longer used
5	Infantry Brigade Office (Brigif) Cimahi	06°53'36.5"	107°31'49.1"	Located in the Military Area of the 15th Infantry Brigade/Kujang II RT 06 RW 13, Baros Village, Central Cimahi District. Currently, this lake is a green open area for military areas, and fishing facilities are served by the community every weekend or during holiday

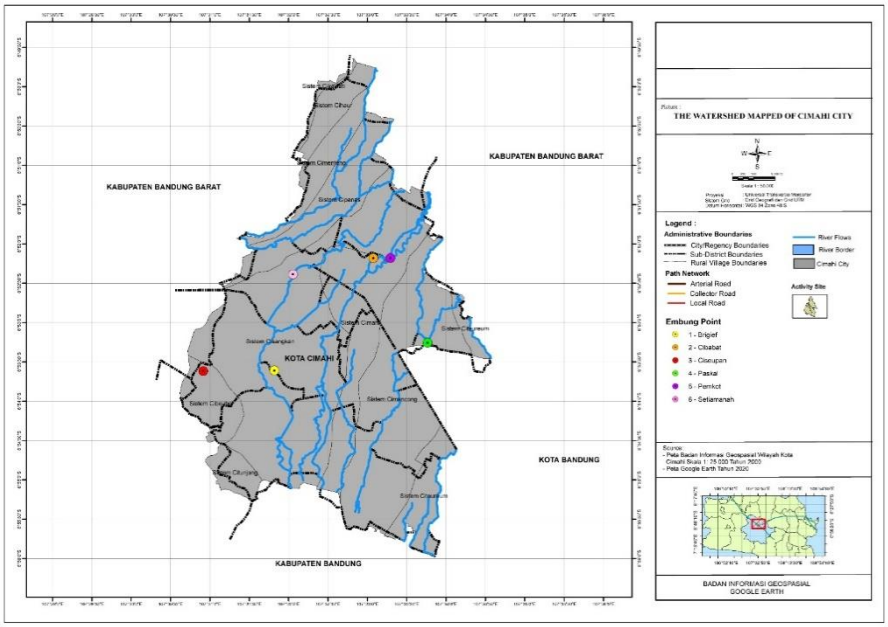


Figure 1. Location of lake distribution in Cimahi City

The stages of activities are presented in the following description. The preparatory stage involves coordination between the Cimahi City Environment Service, searching for information about the lake's history and current condition. The data that has been collected is processed by: (1) Comparing the results of the lake water quality test with Appendix VI of the Government Regulation of the Republic of Indonesia Number 22 of 2021 for the Lake category (PP 22 of 2021) and (2) determining the status of water quality using the Index method. Pollutants based on the Decree of the State Minister of the Environment Number 115 of 2003 concerning Guidelines for Determining the Status of Water Quality (Kepmen LH No. 115/2003). This method can directly relate the pollution level with whether or not the river can be used for specific uses and with the value of specific parameters. The pollutant index value is presented in Table 2.

Table 2. Pollutant index value

Value PI	Water State
$0 \leq PI_j \leq 1{,}0$	Meets quality standards (good condition)
$1.0 < PI_j \leq 5.0$	Light pollution
$5.0 < PI_j \leq 10$	Moderately polluted
$PI_j > 10$	heavily polluted

Source: Minister of Environment Decree No. 115/2003

3. Result and Discussion

Based on the analysis results in Cimahi City, there are eight lakes, namely Cimahi City Government Lake, Cibabat, Leuwigajah 1, Leuwigajah 2, Setiamanah, Melong, Ciseupan, and the Cimahi Infantry Brigade (Brigif) Office. The largest lake is Lake Ciseupan, with an area of 2 hectares with a water storage volume of 130,000 m3. The three lakes were not analyzed for water quality, namely. Based on the results of field research, three lakes have been severely damaged, characterized by dry conditions, and used as trash bins by residents:

1. Lake Leuwigajah 1, which is currently a trash can, Lake Leuwigajah 1, which is located in the Leuwigajah Sacred Tomb Complex, Leuwigajah Village, South Cimahi District, with an area of 0.108 Ha and a volume of 6,480 m^3 where the lake is located in a residential area.
2. Lake Leuwigajah 2 is currently not dry because the flow is small, so there is no water lake for Lake Leuwigajah 2, which is located in RW 2, Leuwigajah Village, South Cimahi District, with an area of 0.08 Ha and a volume of 4,020 m^3 where the lake is located in a residential area.

3. Lake Melong is currently dry and overgrown with grass. Melong Lake, which is behind the Melong flats, Cibeureum Village, South Cimahi District, with an area of 0.1 Ha and a volume of 6,336 m^3 where the lake is located in a residential area.

Other lake conditions will be studied in the following description. The lake under study still has potential as a source of raw water and groundwater recharge in Cimahi City.

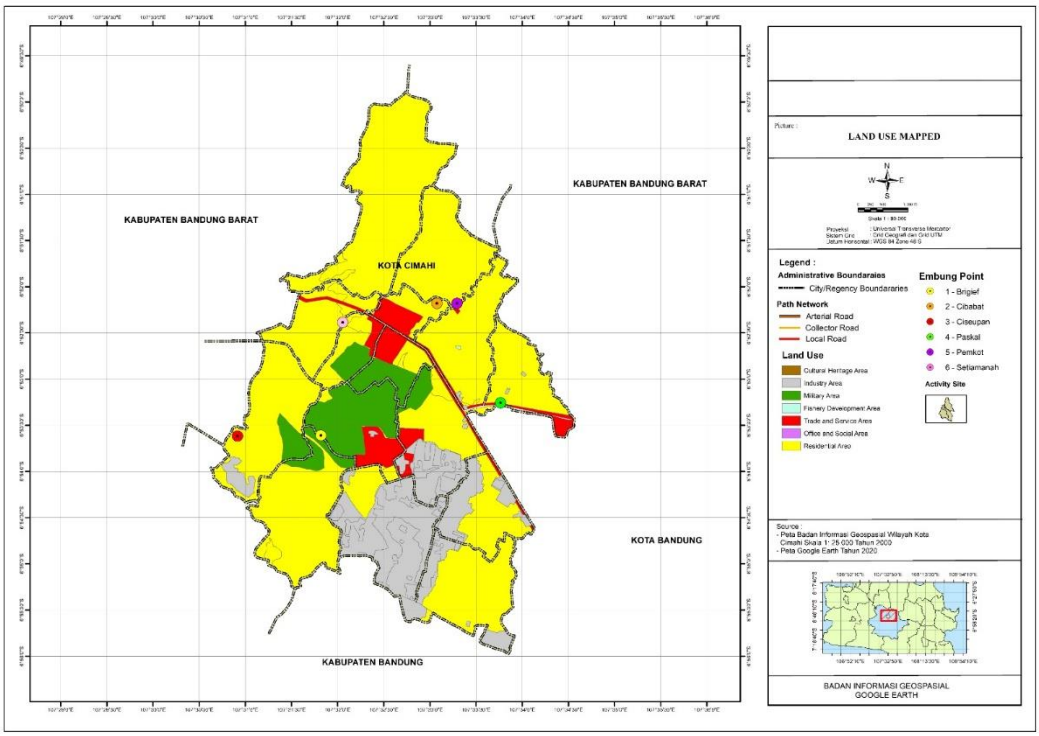
1. The lake is located in the Cimahi City Government Office. This condition is clean, and there is no trash. The City Government Lake is located in the Cimahi City Government Office Complex in Cibabat District, Cihanjuang Village, Cimahi City. The City Government Lake is located at the bottom of the mosque in the parking area. Many offices surround this lake. This lake has an area of 0.036 Ha and a volume of 1333,5 m^3.
2. Lake Cibabat is located in the area of the Cibabat Regional General Hospital, Cimahi City, surrounded by residential areas that can be said to be densely populated. Lake Cibabat is under the parking lot for visitors to the Cibabat Regional General Hospital, Cimahi City. Around the lake, many green plants grow so that they enter the waters of the lake. E Lake Cibabat has an area of 0.06 Ha and a volume of 3,040 m^3.
3. Setiamanah Lake is located in Setiamanah Village, Central Cimahi District. Based on field observations, this lake is surrounded by residential areas. Setiamanah Lake has an area of 0.04 Ha and a volume of 1,204.5 m^3.
4. Lake Ciseupan is located on Jalan Cibeber, South Cimahi District. Around the lake, there are settlements, and there are still many green open lands such as rice fields and plantations. Around the lake, there are many wild plants. Lake Ciseupan has an area of 2 Ha with a volume of 130,000 m^3.
5. Brigif Lake is located in the 15th Infantry Brigade Military Area/Kujang II RT 06 RW 13, Kelurahan. Baros, Central Cimahi District, Cimahi City. This lake has an area of 1.06 Ha with a volume of 10,666.5 m^3.

The location of the lakes based on land use is presented in Figure 2. Based on this figure, all lakes are located in residential areas. A lake is a place for domestic wastewater disposal, so water quality has decreased. The high content of organic matter that accumulates in the lake causes the uncontrolled growth of aquatic plants, which impacts the silting process. Mapping lake border and catchment areas are essential to identify land uses around the lake (Heriza, 2018). The water quality of the 5 (five) monitored lakes shows that the water quality is not suitable as raw water because several parameters do not meet the quality standards, including Free Chlorine, Total Suspended Solid (TSS), Total Phosphate, Sulfide, BOD5, COD, Oils and Fats, Phenol. Each lake's average concentration of high BOD and COD are presented in Table 3. The data presented in Table 3 serve as the basis for determining the lake management plan in Cimahi City. Identification and inventory of pollutant sources are needed to reduce the pollutant load entering each of these lakes.

Table 3. Parameters that do not meet the quality standards of 5 lakes in Cimahi City

No	Lake Name	Parameters that do not meet quality standards	
		2021	2022
1	Cimahi City Government	Free Chlorine, TSS, Dissolved Zn, Total Phosphate, Sulfide, BOD5, COD, Dissolved Oxygen (DO), Oils and Fats, Phenol	Free Chlorine, Total Phosphate, Sulfide as H2S, BOD5, COD, Phenol, Oils and Fats, Total Coli, and Fecal Coli
2	Cibabat	Free Chlorine, TSS, Total Phosphate, Sulfide, BOD5, COD, DO, Oils and Fats, Phenol	Free Chlorine, Total Phosphate, Sulfide as H2S, BOD5, COD, Phenol, Oils and Fats, and Total Coli

No	Lake Name	Parameters that do not meet quality standards	
		2021	2022
3	Setiamanah	Free Chlorine, TSS, Dissolved Zn, Sulfide, BOD5, COD, DO, Oils and Fats, Phenol	Ammonia, Sulfide as H2S, BOD5, COD, Phenol, Oils and Fats, Total Coli, and Fecal Coli
4	Ciseupan	Free Chlorine, TSS, Total Phosphate, Sulfide, BOD5, COD, Oils and Fats, Phenol	Free Chlorine, Total Phosphate BOD5, COD, Phenols, Oils and Fats, and Total Coli
5	Infantry Brigade Office (Brigif) Cimahi	Free Chlorine, TSS, Total Phosphate, Sulfide, BOD5, COD, Oils and Fats, Phenol	Free Chlorine, BOD5, COD, Phenol, Oils and Fats, Total Coli and Fecal Coli



Gambar 2. Distribution of lakes based on land use in Cimahi City

Water quality parameters that do not meet the quality standards in five lakes throughout Cimahi City will be explained in detail in the following description.

1. Total Suspended Solid or suspended solids are solids that cause water turbidity, are not dissolved, and cannot settle directly. Suspended solids consist of particles more diminutive in size and weight than sediments such as certain organic materials, clay, and others. Particles that reduce light intensity suspended in water generally consist of phytoplankton, zooplankton, animal waste, plant and animal residues, human waste, and industrial waste (Marbun, 2019. Presents a profile of TSS concentrations in 5 lakes in Cimahi City, the highest concentration of TSS is in Lake RSUD Cibabat, reaching 85.5 mg/L, and the lowest is Lake Setiamanah at 29.8 mg/L. All lakes in Cimahi City exceed the specified quality standard of 25 mg/L. The high value of TSS in City Government Lake, Cibabat Lake, Setiamanah Lake, Ciseupan Lake, and Brigif Lake is caused by erosion of the lake body, which is eroded by water when it rains because the lake body is soil that is easily eroded by water if there is heavy rain. In addition to causing high TSS values, erosion also causes turbidity in lake water. Other factors that cause high TSS values in City Government

Lake and Setiamanah Lake are caused by the presence of domestic waste from human waste due to household activities around the lake (Saputro, 2020).

2. DO concentrations in 5 lakes in Cimahi City. The highest DO concentration is in Lake Brigif, reaching 11.6 mg/L, and the lowest is in Lake Setiamanah at 1.97 mg/L. Lake Ciseupan and Lake Brigif meet the quality standard, while other lakes do not meet the specified quality standard, which must be above 6 mg/L. City Government Lake, Lake Cibabat, and Lake Setiamanah have DO values that do not meet the quality standards because the dissolved oxygen value in the three lakes has a low value. in harmony with the color of the water from the lake, which is cloudy due to the lack of supply of sunlight. Another factor that causes DO values not to meet quality standards is the decomposition of organic substances from plants in dead lake waters (Santoso, 2019).
3. The highest BOD concentration was in Lake Ciseupan, reaching 29.4 mg/L, and the lowest was in Lake Setiamanah at 20.3 mg/L. All lakes with BOD concentration did not meet the quality standard set at 2 mg/L. Domestic waste that enters the lake waters cause's high BOD values in the five lakes. The relationship between DO and BOD values is that the higher the BOD value in water, the lower the dissolved DO value because the content of organic substances in BOD needs oxygen to degrade (Wardhani & Ananda, 2022). Lake Brigif, the high BOD value is caused by fish farming activities for fishing. Metabolic residues in fish and feeding fish in the form of pellets can increase BOD levels due to the accumulation of organic matter in these waters (Wardhani and Ananda, 2022).
4. COD concentrations in 5 lakes in Cimahi City. The highest COD concentration is in Lake Ciseupan, reaching 73.6 mg/L, and the lowest is in Lake Setiamanah and the City Government at 59.6 mg/L. All lakes with COD concentration did not meet the quality standard set at 10 mg/L. The high COD value is caused by the presence of domestic waste around the lake, where the organic substances contained in the waters are difficult to degrade biologically.
5. Sulfide concentration in 5 lakes in Cimahi City. The highest sulfide concentration is in Lake RSUD Cibabat, reaching 0.059 mg/L, and the lowest is in Lake Setiamanah at 0.014 mg/L. All lakes with Sulfide concentration do not meet the quality standard set at 0.002 mg/L. This indicates that the lake water has been contaminated with organic waste and an anaerobic decomposition process occurs so that H_2S is produced.
6. Total phosphate concentration in 5 lakes in Cimahi City. The highest total phosphate concentration is in Lake RSUD Cibabat, reaching 0.244 mg/L, and the lowest is in Lake Pemkot at 0.018 mg/L. All lakes do not meet the quality standard for the total phosphate concentration, which is set at 0.002 mg/L. Total phosphate levels that exceed the quality standard in all lakes can be caused by the weathering of rocks from the DTA that enters the run-off flow to each lake. Plant fertilizers also cause high levels of total phosphate in Lake Setiamanah and Lake Ciseupan because the surrounding lakes are agricultural and plantation land. In addition, the high value of total phosphate in City Government Lake, Cibabat Lake, and Brigif Lake comes from domestic waste that pollutes the lake waters.
7. Free Chlorine concentration in 5 lakes in Cimahi City. The highest concentration of Free Chlorine was found in Lake Ciseupan, reaching 0.76 mg/L, and the lowest at Lake Pemkot and Setiamanah at 0.46 mg/L, and Lake Brigif at 0.46 mg/L. The Free Chlorine concentration lakes do not meet the standard of 0.03 mg/L. The high value of free chlorine in Brigif Lake comes from fish feed, while the high value of free chlorine in City Government Lake, Cibabat Lake, Setiamanah Lake, and Ciseupan Lake is caused by domestic waste or organic waste discharged into the waters and can cause a lack of dissolved oxygen levels in the water.
8. Zn concentration in 5 lakes in Cimahi City. The highest Zn concentration was found in the City Government Lake, reaching 0.099 mg/L, and the lowest was in Brigif Lake at 0.015 mg/L. There are two lakes whose Zn concentration does not meet the quality standards: City Government

Lake and Setiamanah. In contrast, the other lakes still meet the specified quality standard of 0.050 mg/L. In the City Government Lake and Setiamanah Lake, Zn metal levels exceeded the quality standard. This is due to the lake's relatively high value of zinc (Zn) because heavy metals settle in the sediment and accumulate in the sediment surface layer. Zn in water can also come from industrial waste.

9. Oil and grease concentrations in 5 lakes in Cimahi City. The highest concentration of Oils and Fats is in the City Government Lake, reaching 23.4 mg/L, and the lowest is in Setiamanah Lake at 10.6. All lakes with oil and fat concentrations do not meet the quality standard set at 1 mg/L. Oils and fats can come from domestic sewage pollutant sources. In the five lakes, the high parameters of oil and fat are caused by the behavior of residents who throw domestic waste directly into the lake, which causes these parameters to be high. Parameters of oil and fat in the waters can result in a lack of sunlight entering the lake, which can interfere with the entry of sunlight to reduce the rate of photosynthesis in the water.
10. Phenol concentrations in 5 lakes in Cimahi City. The highest phenol concentration was found in Lake Brigif, reaching 0.451 mg/L, and the lowest in Lake RSUD Ciseupan at 0.234 mg/L. All lakes with Phenol concentration do not meet the standard of 0.002 mg/L. High phenol levels in City Government Lake, Cibabat Lake, Setiamanah Lake, Brigif Lake, and Ciseupan Lake are sourced from household waste or domestic waste discharged into the waters.
11. Nitrite concentration in 5 lakes in Cimahi City. The highest Nitrite concentration is found in Lake RSUD. High levels of Nitrite in the lake come from household waste or domestic waste discharged into the waters.

This water quality status assessment aims to determine whether the quality of a water body is polluted or not. Based on the calculation results, five lakes in Cimahi City have mild to moderately polluted water quality. The pollution status index is one method used to determine a water source's water quality status. In 2021 the water quality status of five lakes in Cimahi City was in the moderately polluted category, with index values ranging from 8.40-9.39. In 2022, there will be improvements in water quality, where three lakes are categorized as polluted, while two lakes, namely Setiamanah and Ciseupan, are categorized as lightly polluted. The status of lake water quality in Cimahi City is presented in Table 4.

Table 4. Status of lake water quality in Cimahi City

No	Lake Name	IP Value		Water Quality Status	
		2021	2022	2021	2022
1	Cimahi City Government	9.06	7.05	Medium Polluted	Medium Polluted
2	Cibabat	8.43	5.25	Medium Polluted	Medium Polluted
3	Setiamanah	8.40	4.94	Medium Polluted	Lightly Polluted
4	Ciseupan	9.39	5.34	Medium Polluted	Medium Polluted
5	Infantry Brigade Office (Brigif) Cimahi	9.20	4.83	Medium Polluted	Lightly Polluted

Water quality in Cimahi City is not much different from lakes/lakes in other areas such as Lake Toba, Pangururan District, including the category of lightly polluted (Silaban & Silalahi, 2021), Situ Gunung Putri in Bogor Regency is lightly polluted (Aristawidya et al., 2020).), Lake Expo Arena Area, Jaya Pura City, is moderately polluted (Prasetia & Walukow, 2021), Situ Gede Water, Tanggerang City, is moderately polluted (Purwanti H, 2019), Gili Meno Saltwater Lake, Lombok City is moderately polluted (Abdullah, 2021), Situ Jatijajar and Gadog, Depok City are lightly polluted (Permana et al., 2021), Sunter Lake, Jakarta City, is lightly polluted (Saputro, 2020), and Situ Cibuntu, Bogor City, is lightly polluted (Alfilaili, 2020).

Based on the results of data analysis, it can be concluded that the quality of the lake in Cimahi City is in poorly maintained condition with moderately polluted water quality. Water from the lake is not suitable as a source of raw water for drinking water. Lake management must be carried out both

technically and non-technically. The thing that can be done to obtain other data to be used as a basis for planning is by determining the status of the lake ecosystem and its management. In determining the quality status of the ecosystem, three things must be examined in detail: the standard criteria for lake damage, lake water quality standards and assessment of its quality status, and the capacity of the lake water pollution load. (KLHK, 2008). Its management targets include aquatic ecosystems, the status of border ecosystems, and terrestrial ecosystems in water catchment areas. Research is not only conducted to determine the quality or quality of water but how the condition of borders and water catchment areas affect water quality.

4. Conclusions

Based on the research results from 8 lakes in Cimahi City, five lakes and three lakes are in damaged condition. In comparison, the lakes that can be used are 5 (five) lakes consisting of Cibabat Lake, Ciseupan Lake, Setiamanah Lake, City Government Lake, and Brigif Lake. The lake is monitored to show water quality unsuitable for use as raw water because several parameters do not meet the class I lake water quality standards based on PP 22 of 2021. The water quality of 5 (five) lakes analyzed for water quality is included in the lightly polluted category with an index value. Pollutants index ranged from 8.40-9.39 (lightly polluted-medium polluted) with polluted parameters in the five lakes: DO, COD, BOD, free chlorine, TSS, sulfide, total phosphate, oil and fat, and phenol and zinc (Zn) parameters which were only polluted in the City Government Lake and Lake Setiamanah. Sources of pollutants from domestic waste, agricultural activities, and KJA activities around the lake cause these parameters to be polluted. Therefore, technical and non-technical management improvements must be made by taking into account several aspects, namely physical aspects, benefits aspects, environmental aspects, and policy aspects.

References

Abdullah, T. 2021. Determination of water quality status of gili meno saltwater lake using pollution index method. Journal of Sanitation and the Environment 2(2), 199-208.

Alfilaili, F. N. 2020. Comparison of various methods of determining water quality status in siru buntu, cibinong, bogor, west java. Indonesian Islamic University.

Aristawidya, M., Hasan, Z., Iskandar, I., Yustiawati, Y., and Herawati, H. 2020. Pollution status of situ gunung putri in bogor regency based on STORET method and pollution index. Limnotek: tropical inland waters in Indonesia, 27(1).

Cimahi City Government. 2021 Environmental performance information document (DIKPLH) cimahi city. Cimahi City Environment Agency, West Java Province.

Decree of the State Minister of the Environment Number 115 of 2003 concerning Guidelines for Determining the Status of Water Quality.

Desi, S. T., Tri, R., Jumari. 2021. Water quality of itchy lake, kotawaringin lama, central kalimantan. Journal of Ecological Engineering 2021 22(3), 99-110.

Dwina, R, Eka, W., Suprihanto, N. 2022. Risk assessment and fractionation of cadmium contamination in sediment of saguling lake in west java indonesia. Journal of Engineering and Technological Sciencesthis.

Eka, W., Luvina, O. L. P. 2021. Analysis of shallow groundwater quality for drinking water in cimahi city. Journal of Serambi Engineering 6 (3).

Eka, W., Rosmeiliyana. 2022. Selection of domestic wastewater management system in cisangkan watershed. Journal of Environmental Engineering 10 (1).

Eka, W., Zulfah, A. S. 2022. Depth profiles of dissolved oxygen (DO) and hydrogen sulfide (H2S) concentration in a tropical freshwater lake. Journal of Precipitation: Communication Media and Environmental Engineering Development 19 (2) 316-329.

Eka, W., Suprihanto, Notodarmojo, Dwina, Roosmini. 2018. Assessment of heavy metal contamination in saguling lake water west java province indonesia. Paper presented at the E3S Web of Conferences.

Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning Implementation of Environmental Protection and Management.

Harman, A. 2018. Numerical model of sedimentation and water quality in kerinci lake. International Journal of GEOMATE 2018 15(51), 77-84 Geotec., Const. Matt. & Env., Japan.

Harman, A., R.H.B. Ash-Shiddiq, Munawir, B. P. 2019. Water quality and sedimentation modeling in singkarak lake, western sumatra. International Journal of GEOMATE 2019 16(54) 94-102.

Harman, A., R.H.B. Ash-Siddiq, Pratama, M.B. 2018. Assessment of hydro-environmental condition using numerical modeling in under lake, western sumatra, indonesia. International Journal of GEOMATE 2018 15(51) 140-146.

Heriza, D., Sukmono, A., Bashit, N. 2018. Analysis of changes in the water quality of lake rawa pening for the period 2013, 2015 and 2017 using multitemporal landsat 8 imagery data. Journal of Geodesy Undip 7(1), 79-89.

Luvina, O. L. P., Eka, W. 2021. Analysis of groundwater quality in cimahi city of west java province. Paper presented at the IOP Conference Series: Earth and Environmental Science.

Mochammad, A. R. A., Eka, W. 2021. Planning for a domestic wastewater treatment system in the cibabat river basin, cimahi city. Journal of Serambi Engineering 6 (2).

Muhammad, V. R., Eka, W. 2021. Improving the quality status of the cimahi river by formulating a master plan for domestic wastewater treatment systems. Journal of Serambi Engineering 4 (2).

Marbun, C. 2019. Analysis of lake toba water quality around hotel and settlement ports in ajibata district, toba samosir regency in 2019.

Ni, M. H. S., Ni, W. R., Anny, E. P. 2020. Physical, chemical, and biological water quality characteristics of buyan lake and tamblingan lake. Warmadewa Medical Journal 5(1), 8-15.

Permana, D. E. S., Hendrawan, D. I., and Fachrul, M. F. 2021. Determination of water quality status at situ jatijajar and situ gadog depok city, west java using the pollutant index. Bhuwana Journal, 83-97.

Prasetia, A., and Walukow, A. F. 2021. Analysis of the water quality of the lake expo arena area using the pollution index method in the city of jayapura. Indonesian Journal of Environmental Dynamics, 8(1), 42-47.

Purwanti H, F. M., Hendrawan D. 2019. Determination of water quality status at situ gede, tangerang city using the water quality index-national sanitation foundation (IKA-NSF) method. National Seminar on Sustainable Urban and Regional Development.

Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 28/PRT/M/2015 concerning Stipulation of River Border Lines and Lake Border Lines.

Regulation of the State Minister of the Environment Number 28 of 2009 concerning the Load Capacity of Lake and/or Lake Pollution.

Santoso, A. 2018. Performance of DO, BOD and COD values in ex-coal mining lake. Journal of Environmental Technology 19(1).

Saputro, S., Fahdiran. 2020. Sunter lake water quality based on physical and chemical parameters using pollution index method. Proceedings of the National Physics Seminar.

Silaban, W., and Silalahi, M. V. 2021. Analysis of water quality in lake toba waters, pangururan district, samosir regency. Journal of Science and Technology 10(2), 299-307.

State Ministry of Environment. 2008. Guidelines for management of lake ecosystems. Government of the Republic of Indonesia, Jakarta.

Wardhani, E., and Sugiarti, Z. A. 2022. Jatiluhur lake water quality analysis at various depths. Journal of Precipitation: Communication Media and Environmental Engineering Development 18(3), 400-411.

Yanfa, I. H., Eka, W. 2021 Status of cibeureum river water quality, cimahi city. Journal of Natural Resources and Environment Universitas Brawijaya 8 (1).

Yulia, A., Eka, W. 2021. Study of the water quality of the cibaligo river, cimahi city, west java province with the pollutant index method. Serambi Engineering Journal 6 (1).