The 6th International Symposium on Sustainable Urban Development (The 6th ISoSUD) 2023

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The International Symposium on Sustainable Urban Development (ISoSUD) is a series of international activities organized by the Faculty of Landscape Architecture and Environmental Technology, Universitas Trisakti, Jakarta. The event is held once every 3 (three) years with themes related to current issues regarding sustainable urban development, in particular related to urban environmental management and environmental technologies. The activity aims to facilitate academics to publish their research results in order to enhance their scientific expertise as researchers.

The 6th ISoSUD in 2023 carried the theme "**From Recovery To Resilience: Building A Sustainable Future For A Better Life"** which means this symposium will focus on how we can recover from the difficult times caused by the COVID-19 pandemic and build a better future and sustainable. This theme also shows the importance of building resilience in facing future challenges, whether related to climate change, economic policies, or other social problems.

The COVID-19 pandemic that swept the world in the last four years has had a significant impact on human health, the global economy, and the daily lives of people around the world. It will take the concerted efforts of all countries and peoples to overcome this pandemic and rebuild the world after it. This pandemic underscores the need for global efforts to strengthen health systems, enhance societal resilience, strengthen international cooperation, and accelerate action to achieve sustainable development goals and combat climate change. This crisis provides an opportunity to make significant changes in the way we view and manage our economic and social activities and to create a world that is more sustainable and fairer for all people and our planet. Now is the time to make a difference, to make a profound systemic shift towards a more sustainable economy for the benefit of our people and our planet. In other words, now is the right time to undertake significant transformations in existing economic and social systems, which can help sustainably achieve the SDGs and fight climate change to ensure a better future for people and our planet. Overall, post-pandemic recovery must be based on the principles of sustainable development contained in the SDGs. By integrating the SDG goals into our recovery policies and actions, we can create a more sustainable, inclusive, and resilient future for our people and the world.

The 6th ISoSUD was held in the hybrid conference:

a. Day 1, on Wednesday, August 2nd, 2023, at Building M, 12th floor, Universitas Trisakti, Jakarta, Indonesia. There were 130 participants offline and 170 participants on the Zoom platform in the plenary session.

b. On day 2, on Thursday, August 3rd, 2023, using the Zoom meeting facility, 270 participants attended virtually on Day 2.

In this two-day International Symposium, experts, researchers, and academician shared their valuable insights and research findings. These esteemed presenters hail from 58 universities and institutions in Filipina, India, Indonesia, Iraq, Japan, Malaysia, Netherlands, Singapura, and Taiwan, reflecting the symposium's diverse and inclusive nature. The call paper system that has been used since the first ISoSUD in 2008 succeeded in inviting 165 manuscripts (more than 400 authors) that were presented offline and virtually. Then, 136 from 165 papers were selected further to be published in IOP Proceedings Indexed by Scopus. After another review process, 106 manuscripts were published in IOP EES. To improve the quality of the manuscripts, the organizing committee held a Coaching Clinic for Scientific Paper Writing on June 24th, 2023. Prof. Mohamad Ali Fulazzaky, Ph.D, delivered the coaching clinic.

The 6th ISoSUD 2023 involved co-host universities consisting of five from within the country and four from abroad: Universitas Jember (UNEJ), Jember, Indonesia; Universitas Islam Indonesia (UII), Yogyakarta, Indonesia; Universitas Pasundan (UNPAS), Bandung, Indonesia; Institut Teknologi Sepuluh November (ITS), Surabaya, Indonesia; Universitas Indonesia (UI), Jakarta, Indonesia; Universiti Teknologi Malaysia (UTM), Malaysia; Universiti Tun Hussein Onn Malaysia (UTHM), Malaysia; The University of Kitakyushu, Japan; Chung Yuan Christian University (CYCU), Taiwan. During the class presentation session, a presentation from the participants representing the 6th ISoSUD co-host was carried out. Besides that, The 6th ISoSUD 2023 was supported as well by the Indonesian Society of Sanitary and Environment Engineers (IATPI), which has continuously supported our symposium since 2008. And sponsored by PT Enviro Cipta Lestari.

In the plenary session, some main speakers delivered more focused seminar themes; they were:

Welcoming Speech:

Prof. Dr. Kadarsah Suryadi DEA – Rector of Universitas Trisakti

Opening Speech:

Ir. Diana Kusumastuti, MT. - Director General of Human Settlements, Ministry of Public Works and Public Housing Indonesia

Plenary Speakers:

Day-1

1. Prof. Lin Chi Wang - Chung Yuan Christian University (CYCU), Taiwan
2. Prof. Ir. Joni Hermana M.Sc.ES., Ph.D – Institut Teknologi Sepuluh November (ITS), Indonesia

Day 2

3. Prof. Ts. Dr. Azmi Bin Aris - Universiti Teknologi Malaysia (UTM), Malaysia
4. Prof. Dr. Eng. Toru Matsumoto - University of Kitakyushu, Japan
5. Associate Prof. Victor R Savage – Nanyang Technological University (NTU), Singapore

We believe that this event will be able to facilitate good networking among researchers, scientists, engineers, and practitioners with common interests, especially in sharing the latest research results, ideas, development, and applications in Sustainable Urban Development. Hopefully, all participants enjoyed the seminar and found this experience inspiring and helpful in their professional field. Thank you for choosing the 6th ISoSUD as your symposium reference. Let us embrace the spirit of collaboration and innovation as we strive towards a sustainable future for a better life. We hope to have your pleasant support and participation in the next three years on The 7th ISoSUD 2026.

Sincerely,
Assoc. Prof. Ariani Dwi Astuti, ST., MT., PhD
Chairperson of The 6th International Symposium on Sustainable Urban Development (ISoSUD) 2023

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Analysis of pollutant index in Gunung Putri Pond, West Java Province, Indonesia

Analysis of pollutant index in Gunung Putri Pond, West Java Province, Indonesia

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Abstract. Gunung Putri Pond is one of the lakes in Bogor Regency that functions as water reservoir, agricultural irrigation, fisheries activities, which has an area of 120,645 m^2 and a depth ranging from 0.5 to 1.7 m. Gunung Putri Pond is surrounded by residential areas, agricultural land, and several industries which discharge their waste into the lake's water bodies, including the motorcycle manufacturing industry, industrial equipment suppliers, the automotive industry, and construction companies which directly or indirectly pollute the waters of the lake. The aims is identify pollutant sources that have the potential to pollute waters, analyze water quality, and quality status for Gunung Putri Pond. The research was carried out in March 2023-July 2023. Water sampling was carried out at 6 points using the grab sampling method. The parameters analyzed in this study were temperature, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrate (NO_3-N), Phosphate (PO_4), Iron (Fe), Lead (Pb) and E. coli. The results of water quality Gunung Putri Pond for parameters COD, Fe, Pb and E. coli exceed the quality standards of Government Regulation No. 22 Year 2021 Class 2. The water quality status of Gunung Putri Pond used Pollutant Index (IP) method with an average value of 2.78, which is lightly polluted category.

1. Introduction

There are not enough studies about water quality and lake management, while the number of lakes experiencing damage is increasing. Based on field observations using visual interpretation of lake conditions and remote sensing data, in Bogor Regency there are 106 lakes, but 101 can be identified with 23 damaged, 26 moderate, and 52 good conditions [1]. The damage that occurred in Bogor Regency lakes was generally in the form of a decrease in water holding capacity caused by a decrease in area and sedimentation. In previous research regarding the water quality status of Gunung Putri Pond in 2020, the water quality status of Gunung Putri Pond was in lightly polluted category with a value of 1.84 [2].

Area of Gunung Putri Pond has 120,645 m^2 and a depth ranging from 0.5 to 1.7 m. Gunung Putri Pond surrounded by residential areas, agricultural land, and several industries which discharge their waste into the waters, including the motorcycle manufacturing industry, industrial equipment suppliers, the automotive industry, and construction companies which directly or indirectly pollute the waters [3]. Activities around Gunung Putri Pond can reduce water quality, one of the managements can be done to maintain water quality so as not to decrease, namely by identifying sources of pollution from activities surrounding area and determine water quality starting from physical, chemical, and biological quality. The Pollution Index method has advantage of being able to determine status of monitored water quality with only one data series, so it requires relatively little time and money. The weakness is because the data that is calculated is a single data, it often happens that the single data does not adequately represent

the actual condition of water quality [4]. This article paper aim to identify pollutant sources that have the potential to pollute waters, analyze water quality, and quality status for Gunung Putri Pond. This research is to get an idea of capacity pollutan loads in Gunung Putri Pond and as information material for managing strategy in Gunung Putri Pond.

2. Methods

2.1. Location determination and research sampling

Determination of water sampling points is based on a preliminary survey conducted in the study area. It was conducted by looking at several considerations, namely sources of activities that are suspected of providing a pollution load such as residential areas, industry and other human activities, as well as input from drainage. Sampling was carried out every month from the end of March – July 2023, with 6 sampling points with 2 repetitions (duplo). In this study, the waters of Gunung Putri Pond divided into 3 segments to determine the concentration of the mixture in each segment. Segment division based on the inlet, middle and outlet areas of Gunung Putri Pond.

2.2. Water sampling

Water sampling was carried out using the grab sampling method. The procedure for taking surface water samples refers to Indonesia National Standard (SNI) 6989.57:2008 concerning Surface Water Sampling Methods. At each sampling point, 2 times or duplicates were taken to prevent mistakes made when taking water samples. The water sample has been taken 2 liter, then put into a cooler box to inhibit the rate of chemical reaction so the content of the parameters measured does not change due to the influence of temperature. Then the samples were analyzed at the Environmental Laboratory, Universitas Trisakti. The sampling locations can be showed in Figure 1 and Table 1.

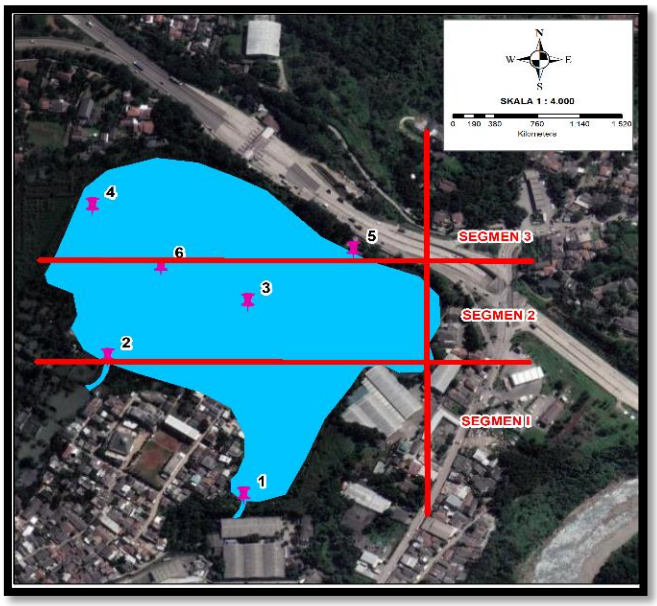

Figure 1. Sampling locations and segment.

Table 1. Coordinate locations.

Sampling point	Coordinate		Location
	LS	BT	
1	6°27'56.11"S	106°53'21.13"T	Inlet (industry) Gunung Putri Pond
2	6°27'50.32"S	106°53'15.66"T	Inlet (residential) Gunung Putri Pond
3	6°27'48.41"S	106°53'21.07"T	Middle Gunung Putri Pond
4	6°27'43.98"S	106°53'14.31"T	Outlet (irigation) Gunung Putri Pond
5	6°27'46.47"S	106°53'26.35"T	Outlet Gunung Putri Pond
6	6°27'47.90"S	106°53'17.00"T	Middle Gunung Putri Pond

2.3. Water quality

Water quality from Gunung Putri Pond were obtained through analysis of water samples at the Environmental Laboratory using methods according to SNI. The results of laboratory analysis for each parameter studied are compared with the existing quality standards in Government Regulation No. 22 of 2021. The results of the analysis are tabulated, displayed in graphical form and analyzed descriptively. The parameters and measurement methods to be used in this study are listed in Table 2.

Table 2. Parameters analysis method.

No	Parameter	Unit	Measurement tool	Measurement type
A	Physic			
1.	Temperature	^{o}C	Thermometer	In situ
B	Chemical			
1	pH	-	pH meter	In situ
2	DO	mg/L	DO meter	In situ
3	COD	mg/L	Titrimetric	Ex situ
4	BOD	mg/L	Titrimetric	Ex situ
5	Phosphate PO_4	mg/L	Spectrophotometric	Ex situ
6	Nitrate NO_3-N	mg/L	Spectrophotometric	Ex situ
7	Iron (Fe)	mg/L	Spectrophotometric	Ex situ
8	Lead (Pb)	mg/L	Spectrophotometric	Ex situ
C	Biology			
1	E. coli	MPN/100mL	Plate Count	Ex situ

2.4. Water quality status

The Pollutant Index method is used to determine the level of pollution relative to the permitted water quality standards and is used to improve water quality. As an index-based method, the Pollutant Index method has 2 (two) quality indices, namely the average index (IR) which shows the average pollution level of all parameters in one observation and the maximum index (IM) which shows one type of dominant parameter. which causes a decrease in water quality at one observation [5]. The Pollution Index method uses the following formula:

$$IPj = \sqrt{\frac{(\frac{Ci}{Lij})^2 M + (\frac{Ci}{Lij})^2 R}{2}} \quad (1)$$

Where:
IPj : Pollution index for designation j
Ci : Concentration of water quality parameters i
Lij : Concentration of water quality parameter i listed in the water allotment standard j
M : Maximum
R : Average

The parameters needed to calculate pollutant index status are DO, BOD, COD, Nitrate, Phosphate, Iron, Lead (Pb) and E.Coli. The water quality status values using Pollution Index (IP) method are classified into 4 classes as shown in Table 3 below.

Table 3. Water quality status assessment based on pollutant index [6] .

Pollutant Index (IP)	Measurement type
$0 \leq Pij \leq 1.0$	Good
$1.0 \leq Pij \leq 5.0$	Lightly polluted
$5.0 \leq Pij \leq 10$	Moderately polluted
$Pij \geq 10$	Heavily polluted

3. Result and Discussions

Gunung Putri Pond is utilized as a water reservoir, agricultural irrigation, fishing activities, and a tourist area. Based on the area calculations that have been carried out, currently Gunung Putri Pond has an area of 120,645 m^2. In Table 4 there is data on the physical characteristics of Gunung Putri Pond based on the measurements that have been made.

Table 4. Physics characteristic of Gunung Putri Pond.

Segment	Average Width (m^2)	Average Depth (m)	Area Segment (m^2)	Volume (m^3)	Discharge (m^3/sec)	Area Pond (m^2)	Depth Pond (m)	Volume Max (m^3)
1 (Inlet)	30.29	1.40	42	3,002	0.62			
2 (Middle)	40.31	3.86	155	19,294	1.54	120,645	2.37	221,978
3 (Outlet)	43.56	1.84	80	5,154	2.43			

Based on the results of analysis on Gunung Putri Pond which has an area of 120,645 m^2 and 2.37m of depth. By being divided into 3 segments where segment 1 is the inlet, segment 2 is the midpoint, and segment 3 is the outlet of Gunung Putri Pond.

Segment 1 has an area of 42 m^2, a volume of 3,002 m^3, with a inlet discharge of 0.62 m^3/second. Segment 2 has an area of 155 m^2, a volume of 19,294 m^3, with a mid discharge of 1.54 m^3/second. Segment 3 has an area of 80 m^2, a volume of 5,154 m^3, with a outlet discharge of 2.43 m^3/second.

3.1. Sources of pollution in Gunung Putri Pond

Gunung Putri Pond area is surrounded by settlements, the paper industry, the cement industry, shops, junior high schools, high schools and places of worship such as mosques and churches. Currently Gunung Putri Pond is used a fishing and tourism spot. The source pollutant in Gunung Putri Pond from Domestic and non-domestic activities around Gunung Putri Pond.

Pollution in river can worsen due to increased discharge of untreated waste before entering river, this can cause eutrophication due to water receiving excessive nutrients originating from runoff from settlements and agricultural land [7]. Gunung Putri Pond is in a residential, industrial and toll road area. The water Gunung Putri Pond waters currently comes from rainwater, small rivers and residents' drainage channels. Gunung Putri Pond has two inlets, the first inlet comes from the drainage channel around the industry which measures 150 cm and the second inlet comes from residential areas which measures 100 cm and the Gunung Putri Pond outlet measures 200 cm.

3.2. Water quality in Gunung Putri Pound

Water quality can determine function and use in an area. Polluted waters will reduce the value of water even further impact on aquatic ecosystems and health humans due to the presence of excess or toxic chemical waste [8].The parameters analyzed at Gunung Putri Pond consisted of physical parameters namely temperature, chemical parameters namely pH, DO, BOD, COD, Nitrate, Phosphate, Iron (Fe) and Lead (Pb) and biological parameters namely E.Coli. The results of the analysis water quality of Gunung Putri Pond will be compared with the Pond/Lake water quality standards based on Government Regulation Number 22 of 2021 for class II designations, namely water that can be used for water recreation infrastructure/facilities, freshwater fish cultivation, animal husbandry, water for irrigation. plantations, and/or other uses that require the same quality of water as those uses. The results of measuring the water quality of Gunung Putri Pond can be seen in Table 5.

Table 5. Results of Gunung Putri Pond water quality analysis.

Water Quality												
No	Parameters	Unit	Unit	Sampling						Max	Min	Average
				1	2	3	4	5	6			
A						Physic						
1	Temp	C	Deviation 3	28.1	28.3	30	27.8	27.2	30.4	30.4	27.2	28.63
B						Chemical						
2	pH	-	9	6.70	6.90	7.11	6.67	6.90	7.10	7.11	6.67	6.90
3	DO	mg/L	4	6.81	6.66	6.84	5,11	6.66	6.76	6.84	5.11	6,47
4	BOD	mg/L	3	2.10	2.17	2.05	2,05	2.10	1.70	2.17	1.70	2,.3
5	COD	mg/L	25	**4.60**	**40.00**	**36.80**	**36.80**	**40**	**38.40**	**41.60**	**36.80**	**38.93**
6	Nitrate	mg/L	10	0.10	0.11	0.11	0,08	0.08	0.07	0.11	0.07	0.09
7	Phosphate	mg/L	0.75	0.20	0.23	0.14	0,36	0.46	0.18	0.46	0.14	0.26
8	Iron (Fe)	mg/L	0.30	**0.54**	**0.69**	**0.65**	**0.55**	**0.54**	**0.52**	**0.69**	**0.52**	**0.58**
9	Leak (Pb)	mg/L	0.03	**0.10**	**0.03**	**0.04**	**0.04**	**0.13**	**0.09**	**0.13**	**0.03**	**0.07**
C						Biology						
10	*E.coli*	MPN/ 100ml	5,000	**16,300**	**17,100**	**10,700**	**13,200**	**11,800**	**13,500**	**17,100**	**10,700**	**13,766**

Based on Table 5, parameters that exceed quality standards are COD, Iron (Fe), Lead (Pb), E.Coli. The highest COD at Gunung Putri Pond was obtained at sampling point 1 with a COD value of 41.60 mg/L and the lowest was obtained at sampling point 3 with a COD value of 36.80 mg/L. High COD can also affect several water quality parameters supporting phytoplankton life such as DO and pH are not good for phytoplankton survival [9]. The highest iron (Fe) in Gunung Putri Pond was obtained at the sampling point 2 with a value of Iron (Fe) of 0.69 mg/L and the lowest was obtained at sampling point 6 with a value of Iron (Fe) of 0.52 mg/L. The properties of heavy metals are difficult to degrade, so they easily accumulate in the aquatic environment and their presence naturally is difficult to remove [10]. The highest lead (Pb) in Gunung Putri Pond was obtained at sampling point 5 with a lead value of 0.13 mg/L and the lowest was obtained at sampling point 2 with a Lead value of 0.03 mg/L. Lead (Pb) is a pollutant

in the aquatic environment which is often questioned because it is toxic and harmful to aquatic biota, and has an indirect impact on humans who consume it. [11]. The highest concentration of E. Coli was found at sampling point 2, which is 17,100 MPN/100ml and the lowest at sampling point 3, which is 10,700 MPN/100ml.

3.3. Status water in Gunung Putri Pond

Determination of water quality status is carried out to determine the quality description of a waters, results of calculations and analysis of the water quality status of Gunung Putri Pond can be sshowed in Table 6.

Table 6. Water status of Gunung Putri Pond.

Period	Sampling						Water Quality Status Value	
	1	2	3	4	5	6		
May-23	2.79	2.94	2.24	2.39	2.77	2.76	2.59	Lightly Contaminated
June-23	3.63	3.10	3.01	2.99	3.27	3.38	3.18	Lightly Contaminated
July-23	2.87	2.82	2.18	2.43	3.21	2.69	2.58	Lightly Contaminated
Average							2.78	Lightly Contaminated

Based on Table 5, it can be concluded during 3 (three) sampling times, the water quality status of Gunung Putri Pond is classified as lightly polluted waters with a value of 2.78. In May 2023 sampling, water quality status of Gunung Putri Pond was lightly polluted category with a value of 2.59, the second sampling, in June 2023, water quality status of Gunung Putri Pond was lightly polluted category with a value of 3.18, and the third sampling in July 2023, water quality status of Gunung Putri Pond is slightly polluted category with a value of 2.58. This showed that the water quality of Gunung Putri Pond did not change significantly during those 3 (three) months.

4. Conclusion

Gunung Putri Pond is located in Gunung Putri District, Bogor Regency, West Java. Gunung Putri Pond has an area of 120,645 m^2 and 2.37m of depth; volume 221,978 m^3; inlet discharge 0.62 m^3/second; and outlet discharge of 2.43 m^3/second. Results of the water quality values of Gunung Putri Pond for parameters COD, Iron (Fe), Lead (Pb) and E. coli exceed the quality standards of Government Regulation No. 22 Year 2021 Class 2. The water quality status of Gunung Putri Pond used Pollutant Index (IP) method with an average value of 2.78, which is lightly polluted category.

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Analysis of pollutant index in Gunung Putri Pond, West Java Province, Indonesia

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Abstract. Gunung Putri Pond is one of the lakes in Bogor Regency that functions as water reservoir, agricultural irrigation, fisheries activities, which has an area of 120,645 m^2 and a depth ranging from 0.5 to 1.7 m. Gunung Putri Pond is surrounded by residential areas, agricultural land, and several industries which discharge their waste into the lake's water bodies, including the motorcycle manufacturing industry, industrial equipment suppliers, the automotive industry, and construction companies which directly or indirectly pollute the waters of the lake. The aims is identify pollutant sources that have the potential to pollute waters, analyze water quality, and quality status for Gunung Putri Pond. The research was carried out in March 2023-July 2023. Water sampling was carried out at 6 points using the grab sampling method. The parameters analyzed in this study were temperature, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrate (NO_3-N), Phosphate (PO_4), Iron (Fe), Lead (Pb) and E. coli. The results of water quality Gunung Putri Pond for parameters COD, Fe, Pb and E. coli exceed the quality standards of Government Regulation No. 22 Year 2021 Class 2. The water quality status of Gunung Putri Pond used Pollutant Index (IP) method with an average value of 2.78, which is lightly polluted category.

1. Introduction

There are not enough studies about water quality and lake management, while the number of lakes experiencing damage is increasing. Based on field observations using visual interpretation of lake conditions and remote sensing data, in Bogor Regency there are 106 lakes, but 101 can be identified with 23 damaged, 26 moderate, and 52 good conditions [1]. The damage that occurred in Bogor Regency lakes was generally in the form of a decrease in water holding capacity caused by a decrease in area and sedimentation. In previous research regarding the water quality status of Gunung Putri Pond in 2020, the water quality status of Gunung Putri Pond was in lightly polluted category with a value of 1.84 [2].

Area of Gunung Putri Pond has 120,645 m^2 and a depth ranging from 0.5 to 1.7 m. Gunung Putri Pond surrounded by residential areas, agricultural land, and several industries which discharge their waste into the waters, including the motorcycle manufacturing industry, industrial equipment suppliers, the automotive industry, and construction companies which directly or indirectly pollute the waters [3]. Activities around Gunung Putri Pond can reduce water quality, one of the managements can be done to maintain water quality so as not to decrease, namely by identifying sources of pollution from activities surrounding area and determine water quality starting from physical, chemical, and biological quality. The Pollution Index method has advantage of being able to determine status of monitored water quality with only one data series, so it requires relatively little time and money. The weakness is because the data that is calculated is a single data, it often happens that the single data does not adequately represent

the actual condition of water quality [4]. This article paper aim to identify pollutant sources that have the potential to pollute waters, analyze water quality, and quality status for Gunung Putri Pond. This research is to get an idea of capacity pollutan loads in Gunung Putri Pond and as information material for managing strategy in Gunung Putri Pond.

2. Methods

2.1. Location determination and research sampling

Determination of water sampling points is based on a preliminary survey conducted in the study area. It was conducted by looking at several considerations, namely sources of activities that are suspected of providing a pollution load such as residential areas, industry and other human activities, as well as input from drainage. Sampling was carried out every month from the end of March – July 2023, with 6 sampling points with 2 repetitions (duplo). In this study, the waters of Gunung Putri Pond divided into 3 segments to determine the concentration of the mixture in each segment. Segment division based on the inlet, middle and outlet areas of Gunung Putri Pond.

2.2. Water sampling

Water sampling was carried out using the grab sampling method. The procedure for taking surface water samples refers to Indonesia National Standard (SNI) 6989.57:2008 concerning Surface Water Sampling Methods. At each sampling point, 2 times or duplicates were taken to prevent mistakes made when taking water samples. The water sample has been taken 2 liter, then put into a cooler box to inhibit the rate of chemical reaction so the content of the parameters measured does not change due to the influence of temperature. Then the samples were analyzed at the Environmental Laboratory, Universitas Trisakti. The sampling locations can be showed in Figure 1 and Table 1.

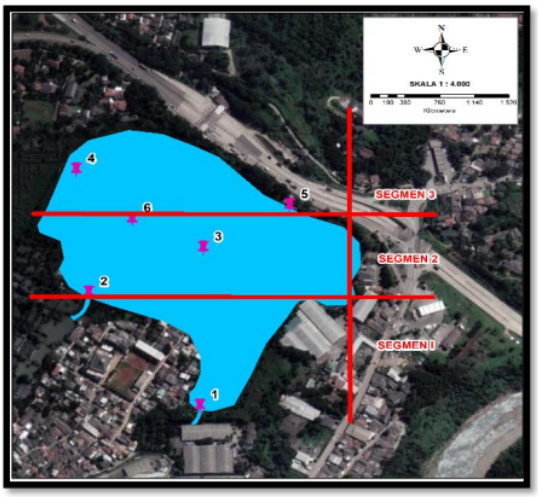

Figure 1. Sampling locations and segment.

Table 1. Coordinate locations.

Sampling point	Coordinate		Location
	LS	BT	
1	6°27'56.11"S	106°53'21.13"T	Inlet (industry) Gunung Putri Pond
2	6°27'50.32"S	106°53'15.66"T	Inlet (residential) Gunung Putri Pond
3	6°27'48.41"S	106°53'21.07"T	Middle Gunung Putri Pond
4	6°27'43.98"S	106°53'14.31"T	Outlet (irigation) Gunung Putri Pond
5	6°27'46.47"S	106°53'26.35"T	Outlet Gunung Putri Pond
6	6°27'47.90"S	106°53'17.00"T	Middle Gunung Putri Pond

2.3. Water quality

Water quality from Gunung Putri Pond were obtained through analysis of water samples at the Environmental Laboratory using methods according to SNI. The results of laboratory analysis for each parameter studied are compared with the existing quality standards in Government Regulation No. 22 of 2021. The results of the analysis are tabulated, displayed in graphical form and analyzed descriptively. The parameters and measurement methods to be used in this study are listed in Table 2.

Table 2. Parameters analysis method.

No	Parameter	Unit	Measurement tool	Measurement type
A	Physic			
1.	Temperature	^{o}C	Thermometer	In situ
B	Chemical			
1	pH	-	pH meter	In situ
2	DO	mg/L	DO meter	In situ
3	COD	mg/L	Titrimetric	Ex situ
4	BOD	mg/L	Titrimetric	Ex situ
5	Phosphate PO_4	mg/L	Spectrophotometric	Ex situ
6	Nitrate NO_3-N	mg/L	Spectrophotometric	Ex situ
7	Iron (Fe)	mg/L	Spectrophotometric	Ex situ
8	Lead (Pb)	mg/L	Spectrophotometric	Ex situ
C	Biology			
1	E. coli	MPN/100mL	Plate Count	Ex situ

2.4. Water quality status

The Pollutant Index method is used to determine the level of pollution relative to the permitted water quality standards and is used to improve water quality. As an index-based method, the Pollutant Index method has 2 (two) quality indices, namely the average index (IR) which shows the average pollution level of all parameters in one observation and the maximum index (IM) which shows one type of dominant parameter. which causes a decrease in water quality at one observation [5]. The Pollution Index method uses the following formula:

$$IPj = \sqrt{\frac{(\frac{Ci}{Lij})^2 M + (\frac{Ci}{Lij})^2 R}{2}} \quad (1)$$

Where:
IPj : Pollution index for designation j
Ci : Concentration of water quality parameters i
Lij : Concentration of water quality parameter i listed in the water allotment standard j
M : Maximum
R : Average

The parameters needed to calculate pollutant index status are DO, BOD, COD, Nitrate, Phosphate, Iron, Lead (Pb) and E.Coli. The water quality status values using Pollution Index (IP) method are classified into 4 classes as shown in Table 3 below.

Table 3. Water quality status assessment based on pollutant index [6] .

Pollutant Index (IP)	Measurement type
$0 \leq Pij \leq 1.0$	Good
$1.0 \leq Pij \leq 5.0$	Lightly polluted
$5.0 \leq Pij \leq 10$	Moderately polluted
$Pij \geq 10$	Heavily polluted

3. Result and Discussions

Gunung Putri Pond is utilized as a water reservoir, agricultural irrigation, fishing activities, and a tourist area. Based on the area calculations that have been carried out, currently Gunung Putri Pond has an area of 120,645 m^2. In Table 4 there is data on the physical characteristics of Gunung Putri Pond based on the measurements that have been made.

Table 4. Physics characteristic of Gunung Putri Pond.

Segment	Average Width (m^2)	Average Depth (m)	Area Segment (m^2)	Volume (m^3)	Discharge (m^3/sec)	Area Pond (m^2)	Depth Pond (m)	Volume Max (m^3)
1 (Inlet)	30.29	1.40	42	3,002	0.62			
2 (Middle)	40.31	3.86	155	19,294	1.54	120,645	2.37	221,978
3 (Outlet)	43.56	1.84	80	5,154	2.43			

Based on the results of analysis on Gunung Putri Pond which has an area of 120,645 m^2 and 2.37m of depth. By being divided into 3 segments where segment 1 is the inlet, segment 2 is the midpoint, and segment 3 is the outlet of Gunung Putri Pond.

Segment 1 has an area of 42 m^2, a volume of 3,002 m^3, with a inlet discharge of 0.62 m^3/second. Segment 2 has an area of 155 m^2, a volume of 19,294 m^3, with a mid discharge of 1.54 m^3/second. Segment 3 has an area of 80 m^2, a volume of 5,154 m^3, with a outlet discharge of 2.43 m^3/second.

3.1. Sources of pollution in Gunung Putri Pond

Gunung Putri Pond area is surrounded by settlements, the paper industry, the cement industry, shops, junior high schools, high schools and places of worship such as mosques and churches. Currently Gunung Putri Pond is used a fishing and tourism spot. The source pollutant in Gunung Putri Pond from Domestic and non-domestic activities around Gunung Putri Pond.

Pollution in river can worsen due to increased discharge of untreated waste before entering river, this can cause eutrophication due to water receiving excessive nutrients originating from runoff from settlements and agricultural land [7]. Gunung Putri Pond is in a residential, industrial and toll road area. The water Gunung Putri Pond waters currently comes from rainwater, small rivers and residents' drainage channels. Gunung Putri Pond has two inlets, the first inlet comes from the drainage channel around the industry which measures 150 cm and the second inlet comes from residential areas which measures 100 cm and the Gunung Putri Pond outlet measures 200 cm.

3.2. Water quality in Gunung Putri Pound

Water quality can determine function and use in an area. Polluted waters will reduce the value of water even further impact on aquatic ecosystems and health humans due to the presence of excess or toxic chemical waste [8].The parameters analyzed at Gunung Putri Pond consisted of physical parameters namely temperature, chemical parameters namely pH, DO, BOD, COD, Nitrate, Phosphate, Iron (Fe) and Lead (Pb) and biological parameters namely E.Coli. The results of the analysis water quality of Gunung Putri Pond will be compared with the Pond/Lake water quality standards based on Government Regulation Number 22 of 2021 for class II designations, namely water that can be used for water recreation infrastructure/facilities, freshwater fish cultivation, animal husbandry, water for irrigation. plantations, and/or other uses that require the same quality of water as those uses. The results of measuring the water quality of Gunung Putri Pond can be seen in Table 5.

Table 5. Results of Gunung Putri Pond water quality analysis.

Water Quality												
No	Parameters	Unit	Unit	Sampling						Max	Min	Average
				1	2	3	4	5	6			
A				Physic								
1	Temp	C	Deviation 3	28.1	28.3	30	27.8	27.2	30.4	30.4	27.2	28.63
B				Chemical								
2	pH	-	9	6.70	6.90	7.11	6.67	6.90	7.10	7.11	6.67	6.90
3	DO	mg/L	4	6.81	6.66	6.84	5,11	6.66	6.76	6.84	5.11	6,47
4	BOD	mg/L	3	2.10	2.17	2.05	2,05	2.10	1.70	2.17	1.70	2,.3
5	COD	mg/L	25	**4.60**	**40.00**	**36.80**	**36.80**	**40**	**38.40**	**41.60**	**36.80**	**38.93**
6	Nitrate	mg/L	10	0.10	0.11	0.11	0,08	0.08	0.07	0.11	0.07	0.09
7	Phosphate	mg/L	0.75	0.20	0.23	0.14	0,36	0.46	0.18	0.46	0.14	0.26
8	Iron (Fe)	mg/L	0.30	**0.54**	**0.69**	**0.65**	**0.55**	**0.54**	**0.52**	**0.69**	**0.52**	**0.58**
9	Leak (Pb)	mg/L	0.03	**0.10**	**0.03**	**0.04**	**0.04**	**0.13**	**0.09**	**0.13**	**0.03**	**0.07**
C				Biology								
10	*E.coli*	MPN/ 100ml	5,000	**16,300**	**17,100**	**10,700**	**13,200**	**11,800**	**13,500**	**17,100**	**10,700**	**13,766**

Based on Table 5, parameters that exceed quality standards are COD, Iron (Fe), Lead (Pb), E.Coli. The highest COD at Gunung Putri Pond was obtained at sampling point 1 with a COD value of 41.60 mg/L and the lowest was obtained at sampling point 3 with a COD value of 36.80 mg/L. High COD can also affect several water quality parameters supporting phytoplankton life such as DO and pH are not good for phytoplankton survival [9]. The highest iron (Fe) in Gunung Putri Pond was obtained at the sampling point 2 with a value of Iron (Fe) of 0.69 mg/L and the lowest was obtained at sampling point 6 with a value of Iron (Fe) of 0.52 mg/L. The properties of heavy metals are difficult to degrade, so they easily accumulate in the aquatic environment and their presence naturally is difficult to remove [10]. The highest lead (Pb) in Gunung Putri Pond was obtained at sampling point 5 with a lead value of 0.13 mg/L and the lowest was obtained at sampling point 2 with a Lead value of 0.03 mg/L. Lead (Pb) is a pollutant

in the aquatic environment which is often questioned because it is toxic and harmful to aquatic biota, and has an indirect impact on humans who consume it. [11]. The highest concentration of E. Coli was found at sampling point 2, which is 17,100 MPN/100ml and the lowest at sampling point 3, which is 10,700 MPN/100ml.

3.3. Status water in Gunung Putri Pond

Determination of water quality status is carried out to determine the quality description of a waters, results of calculations and analysis of the water quality status of Gunung Putri Pond can be sshowed in Table 6.

Table 6. Water status of Gunung Putri Pond.

Period	Sampling						Water Quality Status Value	
	1	2	3	4	5	6		
May-23	2.79	2.94	2.24	2.39	2.77	2.76	2.59	Lightly Contaminated
June-23	3.63	3.10	3.01	2.99	3.27	3.38	3.18	Lightly Contaminated
July-23	2.87	2.82	2.18	2.43	3.21	2.69	2.58	Lightly Contaminated
Average							2.78	Lightly Contaminated

Based on Table 5, it can be concluded during 3 (three) sampling times, the water quality status of Gunung Putri Pond is classified as lightly polluted waters with a value of 2.78. In May 2023 sampling, water quality status of Gunung Putri Pond was lightly polluted category with a value of 2.59, the second sampling, in June 2023, water quality status of Gunung Putri Pond was lightly polluted category with a value of 3.18, and the third sampling in July 2023, water quality status of Gunung Putri Pond is slightly polluted category with a value of 2.58. This showed that the water quality of Gunung Putri Pond did not change significantly during those 3 (three) months.

4. Conclusion

Gunung Putri Pond is located in Gunung Putri District, Bogor Regency, West Java. Gunung Putri Pond has an area of 120,645 m^2 and 2.37m of depth; volume 221,978 m^3; inlet discharge 0.62 m^3/second; and outlet discharge of 2.43 m^3/second. Results of the water quality values of Gunung Putri Pond for parameters COD, Iron (Fe), Lead (Pb) and E. coli exceed the quality standards of Government Regulation No. 22 Year 2021 Class 2. The water quality status of Gunung Putri Pond used Pollutant Index (IP) method with an average value of 2.78, which is lightly polluted category.

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