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Bandung City's Cikapundung River Water Quality Status Using Pollution Index for Fisheries Development

Penentuan Status Mutu Air menggunakan Metode Indeks Pencemaran di Sungai Cikapundung Kota Bandung bagi Pembangunan Perikanan

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Abstract

The Cikapundung River currently supports fisheries activities through carp cultivation, utilizing the river flow. Currently, domestic waste discharge, driven by the increasing growth of settlements around the river, has the potential to affect the water quality in the Cikapundung River. Information is needed regarding the quality status of the Cikapundung River so that management can be carried out according to its designation. This study was conducted in January 2024 using the pollution index (IP) method to measure its water quality. The research location was divided into five stations based on anthropogenic activities at each location. The water quality status of the Cikapundung River is classified as lightly polluted according to class II and class III quality standards. The Biochemical Oxygen Demand (BOD) and Total Suspended Solid (TSS) parameters are the causes of the high IP value in this study. The highest TSS and BOD values are at station 4, which is a densely populated area with fisheries activities. The Cikapundung River can be used for fisheries activities on condition that eurytolerant fish are used.

Keywords: Cikapundung River, Fisheries, Pollution Index, Water Quality

Abstrak

Sungai Cikapundung saat ini memiliki aktivitas perikanan berupa budidaya ikan mas dengan memanfaatkan aliran sungai. Saat ini buangan limbah domestik karena meningkatnya pertumbuhan pemukiman di sekitar sungai berpotensi memengaruhi kualitas air di Sungai Cikapundung. Perlu informasi mengenai status mutu Sungai Cikapundung agar dapat dilakukan pengelolaan sesuai dengan peruntukannya. Penelitian ini dilakukan pada bulan Januari 2024 dengan menggunakan metode indeks pencemaran (IP) untuk pengukuran kualitas airnya. Lokasi penelitian dibagi menjadi 5 stasiun berdasarkan aktifitas antropogenik pada tiap lokasinya. Status mutu air Sungai Cikapundung termasuk dalam kategori tercemar ringan berdasarkan baku mutu kelas II dan kelas III. Parameter *Biochemical Oxygen Demand* (BOD) dan *Total Suspended Solid* (TSS) merupakan penyebab tingginya nilai IP pada penelitian ini, nilai tertinggi TSS dan BOD terdapat di stasiun 4 yang merupakan daerah padat pemukiman dan aktivitas perikanan. Sungai Cikapundung dapat digunakan untuk aktivitas perikanan dengan syarat menggunakan ikan *eurytolerant*.

Kata kunci: Indeks Pencemaran, Kualitas Air, Perikanan, Sungai Cikapundung

1. Introduction

The Cikapundung River extends for 28 km and plays a vital role for the City of Bandung as a source of raw water for drinking, irrigation, and fisheries (Rahayu et al., 2018). The river has significant potential to support fisheries-related activities, both in aquaculture and capture fisheries. One such activity is the cultivation of common carp (*Cyprinus carpio*) using fixed-net cage systems, which contributes to the local economy, particularly in Taman Sari Subdistrict, Bandung City.

According to Government Regulation No. 22 of 2021, the recommended water quality standards for aquaculture correspond to Class II and Class III water categories. However, the discharge of domestic waste due to increasing residential development along the river poses a threat to the water quality of the Cikapundung River (Lestari et al., 2013). Waste discharge has a direct impact on fisheries activities in the river, leading to environmental changes such as fluctuations in pH, temperature, and nutrient levels, which may affect the tolerance and adaptability of fish species (Alfiah et al., 2019).

The water quality condition of the Cikapundung River, based on the study by Janetasari et al. (2020), falls within the polluted category, with parameters such as Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), and pH not meeting the national water quality standards outlined in Government Regulation No. 82 of 2001. Data from the Bandung City Central Bureau of Statistics also classify the Cikapundung River as polluted. This finding is supported by Wardhani (2022), who reported that the parameters of Biochemical Oxygen Demand (BOD), COD, and Total Suspended Solids (TSS) exceeded the permissible limits. The pollution index value of the Cikapundung River places it in the heavily polluted category, referring to the Decree of the Minister of Environment No. 115/2003.

High levels of human activity and population growth have negatively affected the water quality of the Cikapundung River. Bachrein (2012) reported that 80% of the river's pollution originates from domestic wastewater. Therefore, further research on the water quality status of the Cikapundung River is necessary to determine its current condition and natural purification capacity. Such an assessment is crucial to evaluate the river's water quality and ecological health for its sustainable utilization in fisheries activities.

Hence, this study was conducted to determine the water quality status of the Cikapundung River using the Pollution Index method and to evaluate its potential for fisheries development.

2. Material and Method

2.1. Time and Place

This research was conducted in the Cikapundung River, which flows through Bandung City and West Bandung Regency, and was divided into five observation stations. Sampling was carried out three times between January and February 2024. The analysis of nitrate and phosphate samples was conducted at the Laboratory of Aquatic Resource Management, Faculty of Fisheries and Marine Science, Universitas Padjadjaran. Meanwhile, the study of BOD, DO, ammonia, TSS, and TDS parameters was carried out at the Center of Environmental and Sustainability Excellence, Ecology Laboratory, Universitas Padjadjaran. Other parameters, such as temperature and transparency, were measured in situ.

2.2. Methods

The method used in this study was a survey method, with the research locations determined using a purposive sampling technique based on anthropogenic activities around the Cikapundung River. The measurement of the river's natural purification capacity was carried out using Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD) parameters. The research stations were classified based on land use into five stations, as presented in Table 1, while the map of the research stations is shown in Figure 1.

Table 1. Research locations

Location	coordinate	Information
Station 1	6°50'36.8"S 107°38'56.5"E	Upper Cikapundung River
Station 2	6°52'32.7"S 107°36'33.9"E	Agricultural area
Station 3	6°53'36.6"S 107°36'22.9"E	Tourism and shopping area
Station 4	6°53'58.6"S 107°36'24.3"E	Fishing activities
Station 5	6°55'13.4"S 107°36'30.6"E	Tourism, offices, and households

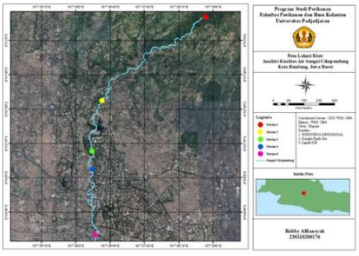


Figure 1. Research location map

2.4. Data Analysis

The analytical method applied was comparative descriptive analysis, referring to Government Regulation (PP) No. 22 of 2021 and Decree of the Minister of Environment (Kepmen LH) No. 115 of 2003, using the Pollution Index (PI) assessment method. The calculation of the water quality index using the Pollution Index method, according to the Decree of the Minister of Environment No. 115 of 2003, is expressed by the following formula:

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

Description :

Pij : Pollution Index for the designated water use
Lij : Concentration of the water quality parameter listed in the water quality standard
Ci : Concentration of the water quality parameter obtained from the survey results
(Ci/Lij)M : Maximum value of the ratio Ci/Lij
(Ci/Lij)R : Average value of the ratio Ci/Lij.

3. Result and Discussion

3.1. Water Quality

The results of water quality measurements at the five observation stations showed that all parameters met the Class II and Class III water quality standards, except for the BOD and TSS parameters. According to Government Regulation No. 22 of 2021, the water quality required to support fisheries activities must comply with Class II and Class III standards. Class II and III water is designated for recreational purposes, agricultural irrigation, and freshwater aquaculture.

The values and concentrations of water quality parameters at each station generally varied depending on the season and the environmental characteristics surrounding the sampling sites. Seasonal variations, human activities, and river flow dynamics, which influence the hydrological conditions of the watershed, are among the external factors that can alter water quality (Sidabutar et al., 2019). The average measurement results for each parameter are presented in Table 2.

Table 2. Parameter results

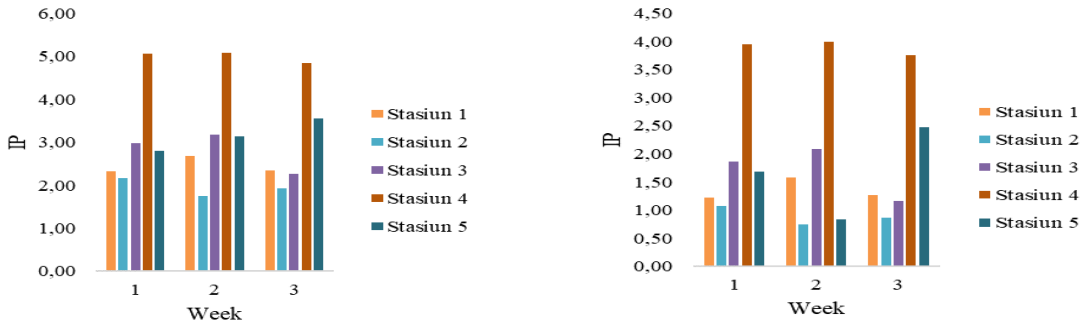
Parameter		Stasiun					PP(22/2021)	
		1	2	3	4	5	II	III
Temperature	k	20,6-22,5	22,3-24,1	23,2-24,3	24,2-24,8	24,7-26,1	Dev	Dev
	r	21,53±0,95	23,10±0,92	23,90±0,61	24,60±0,35	25,43±0,70	3	3
Transparency	k	15-44,5	10-60	7-14	6,5-25	8,5-15,5	-	-
	r	34,17±16,62	34,67±25,01	10±3,61	15,17±9,31	11,17±3,79		
TSS (mg/L)	k	65-170	21-56	128-203	672-792	64-87	50	400
	r	103,67±57,71	36,33±17,90	157±40,29	748±66,09	72±13		
TDS (mg/L)	k	148-292	156-264	172-212	196-256	152-236	1000	1000
	r	200±79,9	193,33±61,23	192±20	220±31,75	194,67±42,02		
pH	k	6,79-7,6	6,97-7,89	6,95-7,51	6,94-7,8	6,96-7,74	(6-9)	(6-9)
	r	7,31±0,45	7,43±0,46	7,31±0,31	7,40±0,43	7,40±0,40		
DO	k	6,40-8,40	6,3-8,3	5,1-8,8	6,1-8,6	6,1-8,6	4	3
	r	7,10±1,13	7,40±1,01	7,33±1,97	7,07±1,34	7,33±1,25		
BOD	k	5-8,36	5,7-7,32	6,04-14,1	9,14-18	6,04-18,4	3	6
	r	7,15±1,87	6,48±0,81	9,03±4,42	12,32±4,93	11,80±6,22		
Nitrate (mg/L)	k	0,047-0,092	0,061-0,091	0,071-0,106	0,069-0,091	0,064-0,091	10	20
	r	0,07±0,02	0,07±0,02	0,09±0,02	0,08±0,01	0,08±0,01		
Phosphate (mg/L)	k	0,079-0,254	0,07-0,273	0,071-0,232	0,063-0,298	0,083-0,247	0.2	1
	r	0,15±0,09	0,16±0,11	0,14±0,08	0,17±0,12	0,15±0,09		
Amonia (mg/L)	k	0,0014-0,007	0,0005-0,01	0,0033-0,0073	0,0034-0,018	0,0033-0,015	0.2	0.5
	r	0,004833±0,003007	0,005±0,00477	0,005867±0,002228	0,010867±0,007306	0,0108±0,006511		

Note: bolded numbers exceed quality standards; k: range; r: average

Based on the test results, the BOD and TSS parameters do not meet the quality standards for classes II and III. The quality standards for the BOD parameter, based on Government Regulation No. 22 of 2021, are 4 for class II and 3 for class III. Biochemical Oxygen Demand (BOD) is a measure of the amount of oxygen required by organisms to break down organic matter aerobically (Salmin, 2005). The Biochemical Oxygen Demand (BOD) value indicates the amount of oxygen required to oxidize or decompose pollutants in the water. The highest average BOD value was recorded at Station 4, with a concentration of 12.32 ± 4.93 mg/L, while the lowest value was found at Station 2, measuring 6.48 ± 0.81 mg/L. The high BOD concentrations observed at Stations 4 and 5 may be attributed to the intense human activities in these areas. According to Abidin et al. (2023), elevated BOD levels in river systems are often caused by the discharge of domestic waste and garbage. In addition, Station 4 hosts aquaculture activities, which may further contribute to the high BOD concentration at that site.

Residual feed and fish waste can decompose into organic matter, releasing phosphate and nitrogen nutrients. This decomposition process leads to a decrease in Dissolved Oxygen (DO) levels and an increase in BOD values (Rahmat, 2015). Based on these findings, the BOD levels in the Cikapundung River have exceeded the water quality standards for both Class II and Class III waters. The concentration of Total Suspended Solids (TSS) is one of the biophysical parameters of aquatic ecosystems that dynamically reflects changes occurring on land and within water bodies. TSS is also useful for analyzing water bodies affected by domestic waste discharges, evaluating water quality, and determining the efficiency of water treatment systems (Hidayat et al., 2016).

The concentration of Total Suspended Solids (TSS) ranged from 80.33 to 792 mg/L, with the highest average concentration recorded at Station 4, measuring 756 ± 66.09 mg/L. The relatively strong water current influenced the high TSS concentration at Station 4 during sampling. This finding aligns with Akhrianti et al. (2014), who stated that higher current velocity tends to increase TSS concentrations. Station 4 is a densely populated area that produces a large amount of household and organic waste (Nurmalita et al., 2013). According to Peni et al. (2013), elevated TSS concentrations in water can also result from the presence of organic materials such as animal waste, sediment, and domestic effluents. The TSS concentrations in the Cikapundung River did not meet the Class II and Class III water quality standards, as the measured values exceeded the permissible limits.

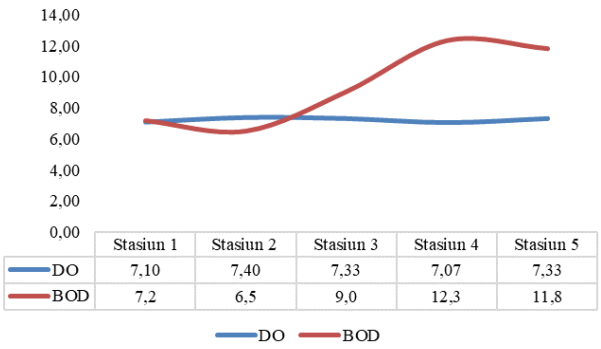


(a) (b)

Figure 2. Standard IP Values for Class II (a) and III (b)

The measurement and assessment of water quality standards were conducted for each parameter individually. In contrast, the overall evaluation of water quality status was based on the combined results of all measured parameters. Based on the calculation of water quality status using temperature, transparency, TSS, TDS, BOD, DO, ammonia, nitrate, phosphate, and pH parameters, the Pollution Index (PI) values for the Cikapundung River under the Class II water quality standard ranged from 1.75 to 5.09, whereas under the Class III standard, the PI values ranged from 0.74 to 3.99. These results indicate that some stations were categorized as meeting the water quality standard, while others were classified as slightly polluted, based on both Class II and Class III evaluations. The Pollution Index values for Class II and Class III water quality are shown in Figure 2.

The maximum index values in the pollution index calculation of this study were found in the BOD and TSS parameters, which were the main contributors to the decline in water quality status. At Station 4, during the second week of observation, the highest BOD concentration was recorded at 18 mg/L, while the highest TSS concentration reached 792 mg/L. The increase in both BOD and TSS levels caused the Pollution Index (PI) value at Station 4 to be higher than that of the other stations. The natural purification capacity of the Cikapundung River was assessed by measuring changes in Dissolved Oxygen (DO) levels in response to pollutants entering the river. Dissolved oxygen is a key parameter that reflects the ecological health of a river (Haider, 2010). It is vital for sustaining aquatic life and the survival of aquatic organisms (Abowei, 2010). When organic pollutants enter the water body, oxygen is consumed during the decomposition of organic matter, leading to a decrease in DO concentration. The graphical relationship between DO and BOD levels in the Cikapundung River is shown in Figure 3.



	Stasiun 1	Stasiun 2	Stasiun 3	Stasiun 4	Stasiun 5
DO	7,10	7,40	7,33	7,07	7,33
BOD	7,2	6,5	9,0	12,3	11,8

Figure 3. DO and BOD rates of the Cikapundung River

The dissolved oxygen (DO) levels in aquatic environments are often unstable and may fluctuate due to various physical, chemical, and biological processes occurring within the water system. The inflow of runoff and the oxygen demand for decomposing organic matter can reduce the oxygen concentration in the water (Abowei, 2010). Conversely, factors such as temperature, river geometry, and flow dynamics can enhance oxygen replenishment through the process of reaeration (Ughbebor et al., 2012).

Changes in dissolved oxygen concentration can serve as an indicator of a river's ability to self-purify from organic pollutants (Wahyuningsih et al., 2019). A high BOD value indicates a significant depletion of dissolved oxygen due to microbial activity in decomposing organic matter. This condition results in reduced water quality and limits the river's capacity for self-purification. Therefore, a high BOD value can be considered an indicator of disruption to the river's natural purification process, suggesting that the Cikapundung River possesses limited or no self-purification capacity.

3.2. Fisheries Development in the Cikapundung River

Currently, the Cikapundung River supports aquaculture activities, specifically fixed-net cage aquaculture, located in the Pelesiran area of Bandung City (corresponding to Station 4 in this study). The main species cultured in the river is common carp. The water quality status of the Cikapundung River, based on the Pollution Index (PI) method, indicates that the river falls within the slightly polluted category under both Class II and Class III water quality standards.

Therefore, the cultivation of common carp is not recommended, as this species requires water quality within the good to excellent category to thrive (Wang et al., 2018). Polluted water bodies are generally not ideal for aquaculture activities; however, fish farming may still be feasible in slightly polluted waters by selecting fish species with high tolerance to poor water quality.

Several fish species are known for their high tolerance levels. The snakehead (*Channa striata*), for example, possesses a labyrinth organ in its gills that allows it to survive in low-oxygen and polluted waters (Karlina, 2017). The catfish (*Clarias* sp.) is also known for its tolerance to contaminated water, as it has a mucus coating that protects its body from toxins and pathogens while providing strong resistance to microbial infections (Loganathan et al., 2011). Another tolerant species is the Nile tilapia (*Oreochromis niloticus*), whose efficient respiratory system enables optimal oxygen utilization even in waters with low oxygen levels (Ramzy, 2013).

In addition to species selection, fish farming in moderately polluted rivers must also consider several other factors, such as aquaculture techniques, waste management, site selection, and feed quality. With strict water quality monitoring, proper species selection, the application of appropriate culture methods, and adequate farmer education, aquaculture activities in the Cikapundung River remain a feasible possibility.

4. Conclusions

The water quality status of the Cikapundung River is classified as slightly to moderately polluted under Class II standards, with an average Pollution Index (PI) ranging from 1.95 to 5.00, and under Class III standards, with an average PI ranging from 0.89 to 3.90. The BOD and TSS parameters had a significant influence on the high PI values observed in this study, with the highest BOD and TSS concentrations recorded at Station 4, showing an average BOD value of 12.32 ± 4.93 mg/L and a TSS value of 756 ± 66.09 mg/L. This condition was likely due to the dense residential area and the presence of aquaculture activities around Station 4. Based on the obtained PI values, the Cikapundung River can still be utilized for fisheries activities, provided that fish species with high tolerance to pollution are selected for cultivation.

5. References

Abidin, Z., Pratiwi, A.H., Afriandi, S. & Yusuf, R.I.M. (2023). Karakterisktik Oksigen Terlarut dan Beban Pencemaran BOD di Sungai Sembon, Kabupaten Malang. *Journal Environmental Science*, 5(2).

Abowei, J.F.N. (2010). Salinity, Dissolved Oxygen, pH, and Surface Water Temperature Conditions in Nkoro River, Niger Delta, Nigeria. *Advance Journal of Food Science and Technology*, 2(1): 36-40.

Akhrianti, I., Bengen, D.G. & Setyobudiandi, I. (2014). Distribution and Habitat Preference of Bivalvia in the Coastal Waters of Simpang Pesak Sub District, East Belitung District. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, 6(1):171-185.

Alfiah, M., Rasyad, M., Putra, I.D., Nurhariyati, T., Fu'adil, M.H., Putranto, T.W.C., Wanguyun, A.P., Sugiharto, and Affandi, M. (2019). Morphometric variations of fish from Brantas River, East Java, Indonesia. *Ecology, Environment and Conservation*, 25.

Bachrein, S. (2012). *Cikapundung River Basin (Das) Development: Diagnostic Area*. Bandung.

Haider, H., Ali, W., & Haydar, S. (2013). A Review of Dissolved Oxygen and Biochemical Oxygen Demand Models for Large Rivers. *Pakistan Journal of Engineering and Applied Sciences*, 12:127-142.

Hidayat, D., Suprianto, R., & Dewi, P.S. (2016). Penentuan Kandungan Zat Padat (Total Dissolve Solid dan Total Suspended Solid) di Perairan Teluk Lampung. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, 1.

Janetasari, S.A., Hamidah, U., Widyarani, W., & Sintawardani, N. (2020). *Simple Water Quality Observations in Cikapundung River from Upstream to Downstream to Determine the Quality*. IOP Conference Series: Earth and Environmental Science, 483. Institute of Physics Publishing.

Karlina, I. (2017). *Perbandingan Anatomi dan Histologi Organ Insang Berlabirin pada Ikan Lele Dumbo (Clarias gariepinus) (Burchell, 1882) dan Ikan Gabus (Channa striata) (Bloch, 1793).* Universitas Islam Negeri Sunan Kalijaga.

Lestari, A., Satwika, R., Iqbal, P., & Soewondo, P. (2013). Study about Treatment of Tanggulan River Water using Floating Treatment Wetlands with Community Participation Potential. *Jurnal Ilmu Lingkungan*, 19.

Loganathan, K., Muniyan, M.K., Prakash, A.A., Raja, P.S., & Prakash, M.S. (2011). Studies on the Role of Mucus from *Clarias batrachus* (Linn) against Selected Microbes. *Journal of Aquaculture Research and Development*.

Nurmalita, M., & Syukri, M. (2013). *Analisa Kekeruhan dan Kandungan Sedimen dan kaitannya dengan Kondisi DAS Sungai Krueng Aceh.* Seminar Nasional Pengelolaan Daerah Aliran Sungai Berbasis Masyarakat Menuju Hutan Aceh Berkelanjutan.

Peni, P., Ismail, B., & Pranoto, P. (2013). Kualitas dan Beban Pencemaran Perairan Waduk Gajah Mungkur. *Ekosains*, 5(1).

Rahayu, Y., Juwana, I., & Marganingrum, D. (2018). Kajian Perhitungan Beban Pencemaran Air Sungai di Daerah Aliran Sungai (DAS) Cikapundung dari Sektor Domestik. *Rekayasa Hijau*, 2(1): 264-488.

Rahmat, R.A., Nugraha, W.D., & Sudarno, S. (2015). Studi Kemampuan Self Purification pada Sungai Progo ditinjau dari Parameter Organik DO dan BOD (Point Source: limbah sentra tahu Desa Tuksono, Kecamatan Sentolo, Kabupaten Kulon Progo, Provinsi D.I. Yogyakarta). *Jurnal Teknik Lingkungan*, 4(3).

Ramzy, E., Nahla, N., & Mahdy, O.A. (2013). A Contribution in Ectoparasitic Infection and Its Control in Cultured *Oreochromis niloticus* in Egypt. *Journal of Aquaculture Research and Development*.

Salmin, S. (2005). Oksigen terlarut (DO) dan Kebutuhan Oksigen Biologi (BOD) sebagai Salah Satu Indikator untuk Menentukan Kualitas Perairan. *Oseana*, 30(3): 21-26.

Sidabutar, E., Afriyani, A., Sartimbul, A., & Handayani, M. (2019). Distribusi Suhu, Salinitas dan Oksigen Terlarut terhadap Kedalaman di Perairan Teluk Prigi Kabupaten Trenggalek. *Jurnal Perikanan dan Kelautan*, 3.

Tjut, S., & Suharyanto, S. (2016). Analisis Daya Tampung Beban Pencemaran Air (DTBPA) dalam Pengelolaan Kegiatan Budidaya Ikan Intensif (Studi Kasus: Keramba Jaring Apung Waduk Cirata). *Jurnal Teknik Lingkungan*, 22(1): 93-103.

Ughbebor, J.N., Agunwamba, J.C., & Amah, V.E. (2012). Determination of Reaeration Coefficient K2 for Polluted Stream as a Function of Depth, Hydraulic Radius, Temperature, and Velocity. *Nigerian Journal of Hydrology*, 31(2): 175-180.

Wahyuningsih, S., Novita, E., & Ningtias, R. (2019). Laju Deoksigenasi dan Laju Reaerasi Sungai Bedadung Segmen Desa Rowotamtu Kecamatan Rambipuji Kabupaten Jember. *Jurnal Ilmiah Rekayasa Pertanian dan Biosistem*, 7(1): 1-7.

Wang, H., Wu, Z., & Chen, J. (2018). Water Quality Criteria for Common Carp (*Cyprinus carpio*) in China. *Ecotoxicology and Environmental Safety*, 154: 99-105.

Wardhani, E., & Salsabila, D. (2022). Pemilihan Sistem Pengolahan Air Limbah Domestik Terbaik sebagai Upaya Peningkatan Kualitas Air di DAS Cikapundung Kabupaten Bandung Barat. *Serambi Engineering*, 7(2).