CIKAPUNDUNG RIVER POLLUTION LEVEL

Tati Ruhmawati[1], Agus Somad Saputra[2] Asep Fitri Hilman[1] Christine Pusch[3]*

[1*)] Departement of Health Promotion Poltekkes Ministry of Health Bandung, Cimahi City, West Java 40514, Indonesia, Email:muslimah_tati@yahoo.com;

[2] Departement of Environmental Health Poltekkes Ministry of Health Bandung, Cimahi City, West Java 40514, Indonesia

[3]Roehampton University, London, England

Abstract, Background: Rivers are very important ecosystems for humans, various human activities from industrial activities, households, and agriculture will produce waste water which contributes to the decline in river water quality. Determination of river ecological status is needed in the context of efforts to prevent and control river pollution, so that river water quality is maintained in accordance with its designation. The aim of the study was to determine the ecological status of the Cikapundung River and the factors that influenced it.

Method: The type of research is descriptive research with a survey approach. The population is all Cikapundung River water that crosses the residential neighborhood of Tamansari Village by taking sampling technique. Data collection techniques by measuring parameters are indicators of the assessment of the ecological status of the river. The collected data is processed and analyzed univariately.

Result: The results obtained an average water temperature of 23,33^{0}C, the river water was turbid and smelly, conductivity 333.5 µmhos/cm, suspended solids 91.9 mg/l, DO 3.17 mg/l, pH 7.55 and macrozoobenthos diversity 0.746.

Conclusion: The assessment score shows that the Cikapundung River is in moderately polluted conditions.

Keywords: Ecological, Status, River, Cikapundung, DO

Background

Water is a natural resource that is needed for the livelihood of many people, even by all living things. Therefore, these water resources must be protected so that they can still be used properly by humans and other living things. The use of water for various purposes must be done wisely by taking into account the interests of current and future generations [1]. One of the water sources that is widely used to meet the needs of human life and other living creatures is rivers. Rivers are very important ecosystems for humans. Rivers also provide water for humans both for various activities such as agriculture, industry and domestic [2]. River water that comes out of springs is usually of very good quality. However, in the process of flowing the water will receive various kinds of pollutants [3]. In recent years, the quality of river water in Indonesia is mostly in a polluted condition, especially after passing through residential, industrial and agricultural areas[4].

Changes in water quality conditions in river flows are the impact of disposal and use of existing land. Changes in land use patterns into agricultural land, moor and settlements as well as increased industrial activity will have an impact on the hydrological conditions in a watershed. In addition, various human activities in meeting their daily needs originating from industrial, household and

agricultural activities will produce waste that contributes to the decline in river water quality[5]. Changes in land use characterized by increased domestic, agricultural and industrial activities will affect and have an impact on the condition of river water quality, especially domestic activities that provide input for the largest concentration of Biochemical Oxygen Demand (BOD) to the river body [6].

The Cikapundung River which has a very important function and role for the development of the city of Bandung should be preserved and the function of the river. Residential conditions in the Cikapundung River border area, Tamansari Village, are very dense. Problems that occur as a result of the settlements of residents of Tamansari Village on the Cikapundung River border are river water pollution caused by dumping garbage and household waste into the river. Domestic wastewater produces organic compounds in the form of proteins, carbohydrates, fats and nucleic acids. In the dry season when the river water discharge drops, the input of organic matter into water bodies will result in a decrease in water quality. The results showed that the impact of domestic waste disposal affects the value of nitrate, with an increase of 22.7%. The increase in nitrate levels was caused by the presence of nitrate input contained in domestic waste. The entry of nitrate into river bodies is caused by humans throwing dirt in river water [7].

A river is said to have decreased water quality, if the water cannot be used in accordance with the normal water quality status. Water quality status is the level of water quality conditions at a certain time and compares it with the established water quality standard. Determination of river water quality can be seen from its ecological status. Determination of the ecological status of the river is based on physico-chemical factors and the diversity index (H`) of organisms that are used as parameters, such as macrozoobenthos. The variables of physico-chemical factors used in determining the ecological status of rivers are color, odor, water temperature, conductivity, suspended solids, dissolved oxygen, pH, and macrozoobenthos [8]. Diversity river, so that the quality of river water is maintained according to its designation.

Method

This type of research includes descriptive research with a survey approach. The variables in this study include the ecological status of the Cikapundung River. The purpose of this study was to determine the value of water temperature, color, odor, conductivity, suspended solids, dissolved oxygen, pH, and diversity of macrozoobenthos contained in Cikapundung river water, as indicators in determining the ecological status of the river. The population in this study is all the water from the Cikapundung River that crosses the settlements of the Tamansari Village residents around the Cikapundung River border area, while the sample is part of the Cikapundung river water which will be taken for examination of the ecological status assessment of the Cikapundung river. The sampling technique was carried out by the combined place method. Sampling was carried out in three parts, namely upstream, middle and downstream. In each place, a grab sampling was carried out by taking river water samples, by first measuring the river water discharge. Determination of sample points based on the amount of river water discharge. The sampling point of river water is based on SNI 06-2412-1991. The data collection technique was carried out by taking a sample of Cikapundung River water and then examining it in the laboratory which included parameters of color, odor, water temperature, conductivity, suspended solids, dissolved oxygen, pH, and diversity of macrozoobenthos. The data that has been collected is processed by giving a value (score) and then adding up the scores to see the ecological status of the river, as shown in the table below [9].

Table 1. Score Determination of the Ecological Status of a River of Waters Based on Variables of Water Physico-Chemical Factors and Macrozoobenthos Diversity Index

Variable	Score			
	1	3	6	10
Color	Clear	A bit cloudy	Cloudy yellow	So cloudy, chocolate
Smell	No smell	Smells a bit	Rancid smell, kerosene	Smell bed, kerosene
Temperature (^{0} C)	16-20	21-25	26-31	> 31 ; < 16
Conductivity (µmhos/cm)	< 50	50-100	101-500	> 500
Suspended residue (ppm)	≤ 20	> 20 - 100	101-400	> 400
Dissolved oxygen (ppm)	> 6,5	4,5-6,5	2,0-4,4	< 2
pH	6,5-7,5	5,5-6,5	4,0-5,4	< 4,0
		7,4-8,5	8,6-11	> 11
H`(Surber)	> 2,5	1,5-2,5	1,0-1,5	< 1,0

Source : Rondo, 1982 in Sulistyawati, Endah, et al., 2007

Description for ecological status:
1. Not yet or slightly polluted = average score 2.00
2. Lightly polluted = average score 2.00 – 4.00
3. Moderately polluted = average score 4.00 – 6.00
4. Severely polluted = mean score > 6.00

Result and Discussion

The results of laboratory examinations which include parameters of color, odor, water temperature, conductivity, suspended solids, dissolved oxygen, pH, and diversity of macrozoobenthos, both in the upstream, middle, and downstream parts of the river, can be seen in table 2 below:

Table 2. Results of Measurement of Water Quality in the Cikapundung River in the Upper, Middle and Lower Rivers

No.	Parameter	Unit	Analysis Results		
			Upstream	Middle	Downstream
	Physics				
1	Temperature	^{0}C	22.3	23,5	24,2
2	Turbidity	NTU	72,7	35,0	90,7
3	Color	-	cloudy	a bit cloudy	cloudy
4	Smell	-	smells	Smells a bit	smells
5	Electrical conductivity (DHL)	Umhos/cm	281,7	358	360,7
6	Suspended residue (TSS)	mg/l	94,0	47,7	134
	Chemical				
1	Acidity (pH)	-	7,64	7,56	7,45
2	Dissolved oxygen (DO)	mg/l	2,77	3,23	3,5

Based on table 2, it can be seen that the water temperature of the Cikapundung River tends to increase, 22.3 0C in the upstream and 24.2 0C in the downstream, the level of water turbidity is very volatile, the highest is 90.7 NTU in the downstream, while the lowest located in the middle of 35.0 NTU. The highest electrical conductivity (DHL) is found downstream of 360.7 mhos/cm. The TSS value tends to fluctuate, downstream is 134 mg/liter. The highest pH value in the upstream is 7.64. The highest dissolved oxygen (DO) level in the downstream is 3.5.

The results of measuring the diversity of macrozoobenthos in the upstream, middle and downstream parts of the Cikapundung River can be seen in table 3.

Table 3. Measurement results of macrozoobenthos diversity of Cikapundung River water in the Upper, Middle and Lower Rivers

No.	Organism	Station								
		1 (Upstream)			2 (Middle)			3 (Downstream)		
		A	B	C	A	B	C	A	B	C
1	*Physastra sp.*	30	9	18	12	6				
2	*Melanoidis sp.*	12								
3	*Hydrpsyche sp.*	6	15	6			24			
4	*Hyrudinaria*	45	105	108	129	144	15	9	18	60
5	*Tubifex sp*	6	12	9	36	24	9	723	669	717
6	*Lymngeg sp.*		6	3						
7	*Tachopterix sp*		3		6					
8	*Thiara sp.*			3						
9	*Paratelphusa sp.*				3					
10	*Chironomus sp.*				3	15	180	3	30	51
		99	150	147	189	189	228	735	717	828
	H'	**1,316**	**1,058**	**0,944**	**0,993**	**0,780**	**0,730**	**0,093**	**0,290**	**0,487**

Based on table 3, it can be seen that the results of measuring the diversity of macrozoobenthos in the three regions of stations 1 (upstream), 2 (middle) and 3 (downstream) showed a decrease in the diversity of macrozoobenthos, the lower the diversity decreased.

Determination of the ecological status of the river is obtained by conducting an assessment (scoring) of several parameters. The results of the analysis of the ecological status of the river can be seen in table 4.

Table 4. Determination of the Ecological Status of the Cikapundung River Based on Variables of Water Physico-chemical Factors and Macrozoobenthos Diversity Index

Variable	Analysis Results	Score
Color	Cloudy	6
Smell	Smells	6
Temperature (^{0} C)	23,33	3
Conductivity (µmhos/cm)	333,5	6
Suspended solids (mg/l)	91,9	3
DO (mg/l)	3,17	6
pH	7,55	1
H`(Surber)	0,746	10
Average		**5,125**

Based on table 4, it can be seen that the average score of the ecological status of the Cikapundung River is 5.125, this indicates that the Cikapundung river is in moderately polluted condition where the average score ranges from 4-6.

The water temperature of the Cikapundung river tends to increase, 22.3 ^{0}C upstream and 24.2 ^{0}C downstream. Water temperature plays an important role in biological and chemical processes of aquatic organisms such as metabolism and certain reactions in water. An increase in temperature causes a decrease in the solubility of gases in water, such as O_2, CO_2, N_2, CH_4 gases and so on. In addition, an increase in temperature also causes an increase in the rate of metabolism and respiration of water, and further results in an increase in oxygen consumption. An increase in water temperature by 10% causes an increase in oxygen consumption by aquatic organisms by about 2-3 times. An increase in temperature also causes an increase in the decomposition of organic matter by microbes [9].

Electrical conductivity/conductivity tends to increase, the highest average electrical conductivity is in the downstream part of 360.7 mhos/cm. The high and low electrical conductivity of water shows the large amount of metal dissolved in water, the conductivity value is strongly influenced by content of dissolved ions in water. High conductivity values tend to have poorer water quality because it can be assumed to have a lot of organic and inorganic mineral content.

The TSS value tends to fluctuate from upstream to downstream and has a significant increase in the downstream part of 134 mg/liter. Total suspended solids (TSS) includes all suspended particles in water that will not pass through the filter. Suspended solids in sanitary wastewater and various types of industrial wastewater. As TSS increases, water bodies will lose their ability to support diverse aquatic environments. Suspended solids absorb heat from sunlight, which raises the temperature of the water and then lowers dissolved oxygen levels (warm water holds less oxygen than cold water). Photosynthesis will also decrease due to lack of light penetrating the water.

Data on the acidity (pH) of the Cikundung River shows a trend that is going downstream the more alkaline is increasing this is due to the increasing amount of household waste mixed with river water in the downstream area. The increase in the value of the degree of acidity or pH is influenced by organic and inorganic waste that is discharged into the river. The process of decomposition of organic matter in the riverbed, the concentration of bicarbinate and carbonate salts as well as the concentration of gases in river water [10].

Dissolved oxygen (DO) value from upstream to downstream tends to increase. The flow pattern is relatively unsettled and the amount of turbulence due to the large number of rocks in the downstream area which causes the process of aeration of air into the water to increase so that the self-purification of the river becomes very optimal. The reaeration process on the water surface causes the DO concentration in river water to increase [11].

The results of the measurement of the diversity of macrozoobenthos in the three regions of stations 1 (upstream), 2 (middle) and 3 (downstream) showed a decrease in the diversity of macrozoobenthos, the lower the diversity decreased. Environmental factors that affect the distribution of macrozoobenthic animals because each type of macrozoobenthos has a different way of life that is adapted to the type of basic substrate of its habitat. Factors that affect the presence of macrozoobenthos are physical and chemical factors in the aquatic environment, including light penetration which affects water temperature, chemical elements such as hydrogen ion content (pH), dissolved oxygen (DO), and biological oxygen demand (BOD). The abundance of macrozoobenthos depends on its tolerance or sensitivity to environmental changes. Each community responds to changes in habitat quality by adjusting to the community structure [12].

Conclusion

Based on the determination of the ecological status using the results of the assessment/scoring, it can be concluded that the ecological status of the Cikapundung River is currently in a moderately polluted condition.

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