Original Research Article

Water Quality ofCilutung River Sumedang Regency, West Java, Indonesia

ABSTRACT

Cilutung River is one of the sub-watersheds in the middle of the Cimanuk River which is located in Tomo District, Sumedang Regency. Cilutung River utilization is used for sand mining activities and may cause a negative impact on water resources, among others causing a decrease in water quality. Theobjective of this research effortis to determine the condition of water quality in the Cilutung River, Sumedang Regency in September - November 2020.The method used in this research is the survey method. The technique of determining the station was carried out by purposive sampling method and was carried out at three research stations. The sampling technique was carried out in situ and ex-situ. Parameters observed in situ consist of temperature, light transparency, DO, and pH and ex situ consist of TDS, TSS, nitrate, ammonia, and COD.The temperature value obtained is about 25℃ - 28,7℃. Light transparency value is about 17cm -23cm. TDS value was about 197 mgL^{-1} - 276 mgL^{-1}. TSS value was about27 mgL^{-1} - 94 mgL^{-1}. pH value is about 6.92 - 7.03. DO value was about 7.1 mgL^{-1}- 7.4 mgL^{-1}. Nitrate value was about 0.06 mgL^{-1}- 0.64 mgL^{-1}. Ammonia value was about 0.001 mgL^{-1} - 0.002 mgL^{-1}. COD value was about5.5 mgL^{-1}- 9.6 mgL^{-1}.In general, the water quality of the Cilutung River is classified as good and safe following the water quality standards class II for aquaculture from Regulation of The Government of The Republic of Indonesia No. 22 of 2021. However, the TSS value is above the class II threshold and close to the class III limit due to the sand mining in the Cilutung River.

Keywords: (Cilutung River, Dissolved Oxygen, quality standards, water quality)

1. INTRODUCTION

According toRafi'i and Maulana[1] the river is a form of aquatic ecosystem that has an important role in the hydrological cycle and serves as a water catchment area for the surrounding area so the condition of a river is strongly influenced by the characteristics possessed by the environment. Cimanuk River is one of the three major rivers in West Java which has its headwaters in Garut and flows to the north coast of Java Island [2]. Cilutung River is one of the sub-watersheds in the middle of the Cimanuk River which is located in Tomo District, Sumedang Regency, and is the longest sub-watershed on the Cimanuk River with a river length of 75 km and an area of 640 km^2 [3]. Land use in the Cilutung River itself is used for sand mining activities.

Sand mining activities have been carried out for a dozen years along the Cilutungriver. This mining activity is very worrying because uncontrolled group C excavation can increase

the rate of sedimentation which can lead to silting of the river[4]. Industrial, domestic, and other activities have a negative impact on water resources, among others causing a decrease in water quality [5]. This condition can cause disturbance, damage, and danger to all living things that depend on water resources [6].

Water quality is the nature of water and the content of living things, substances, energy, or other components in the water. Water quality is also a term used to describe the suitability or suitability of water for certain uses such as drinking water, fisheries, irrigation/irrigation, industry, recreation, and so on [7]. Water quality can be determined by conducting a water quality test. Water quality can be expressed by several parameters, namely physical parameters [Temperature, Light-Transparency, Total Suspended Solid (TSS), Total Dissolved Solid (TDS)], chemical parameters [pH, Dissolved Oxygen, Chemical Oxygen Demand (COD), Nitrate, Ammonia].

Water quality standard measurethe limit or level of living things, substances, energy, or components that exist or must exist and/or pollutant elements whose presence in the water is tolerance. The water quality value obtained from the test results must be compared with the river water quality standard, Government Regulation of the Republic of Indonesia Number 22 of 2021 to assess whether the water is suitable or not for living organisms or used by humans. Currently, no research has ever done on Cilutung River. Therefore this research is a preliminary research conducted in the Cilutung River, so there is no recorded data regarding the water quality condition of the Cilutungriver. Therefore, this research aims to determine water quality condition in the Cilutung River, Sumedang Regency, West Java Province.

2. MATERIAL AND METHODS

2.1 TIME AND PLACE

The research was conducted from September - November 2020 in the Cilutung River, Marongge Village, and Tolengas Village, Tomo District, Sumedang Regency, West Java.The study was conducted at three stations with three sampling times as repetition at the same times with a sampling period once a month. Water quality measurements were analyzed at the Laboratory of the Center for Water Resources Research and Development of Water Resources (PUSAIR) Dago, Bandung. The map of the research station can be seen in **Figure 1.**

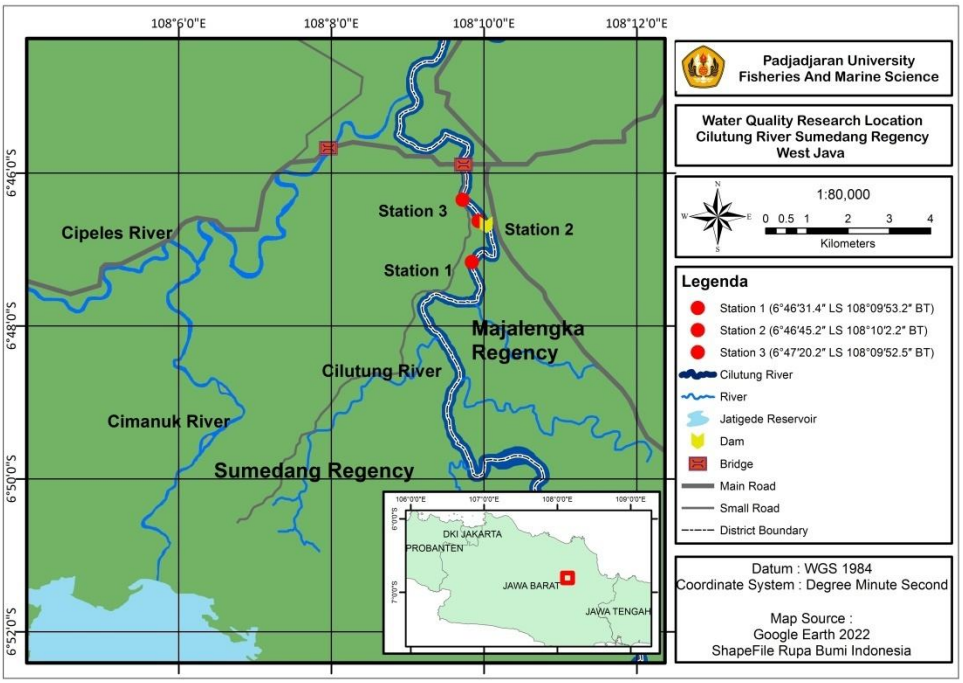

Figure 1. Map of Water Quality Research Location

2.2 STUDY AREA DESCRIPTION

The research was conducted in the Cimanuk Sub-watershed (Watershed Area) namely the Cilutung River consisting of 3 stations. Station 1 is located in Marongge Village, Tomo District, Sumedang Regency at coordinates 6˚46 31.4 S and 108˚09 53.2 E. The land use around the location is farm, rice fields, sand mining, and community settlements. . Environmental conditions at station 1 have a lot of vegetation, such as bamboo (*Bambusa*sp), coconut (*Cocos nucifera*), mango (*Mangiferaindica*), and weeds (*Imperata cylindrical*). Station 2 is located in Tolengas Village, Tomo District, Sumedang Regency at coordinates 6° 46′45.2″ S and 108°10′2.2″ E. The land use around the location, namely the main location of sand mining, Kamun dam, community settlements, and river waters are used for fishing. Fishing activities usually use *cast nets* and fishing rods. There are various kinds of vegetation, such as thatch (*Imperata cylindrical*), mango (*Mangiferaindica*), and Chinese petai (*Leucenaleucocephala*). Station 3 is located in Tolengas Village, Tomo District, Sumedang Regency at coordinates 6°47′20.2″ S and 108°09′52.5″ E. Station 3 is a location that is close to the path of sand transport vehicles to enter the sand mining area. Due to the ease of access and the location adjacent to the highway, this station is often used as a fishing location using cast nets and fishing rods by the local community. The condition

of the aquatic environment at the station contains several types of vegetation such as bamboo (*Bambusasp*), weeds (*Imperata cylindrical*), and Chinese petai(*Leucenaleucocephala*).The picture of the station can be seen in **Figure 2.**

a. Station 1

b. Station 2

c. Station 3

Figure 2. Research Station

2.3 RESEARCH METHOD

The method used in the research is the survey method. The water sampling technique is determined based on purposive sampling. The determination of the research station is based on when conducting a preliminary survey in the field, namely the objective of the research station with consideration of accessibility. The sampling method was carried out *ex-situ* and in-*situ. In situ* consists of temperature, light transparency, pH, and DO. While *ex-situ* consists of TDS, TSS, nitrate, ammonia, and COD.

2.4 DATA ANALYSIS

The data obtained were analyzed by station and time with Microsoft Excel. The water quality data obtained were analyzed using a quantitative descriptive method and then compared with the Government Regulation of the Republic of Indonesia Number 22 of 2021. The water quality parameters measured can be seen in Table 1.

Table 1. Water Quality Parameters and Analysis Tools.

Parameter	Unit	Testing Method	Analysis Tools	Location
Physique				
Temperature	^{0}C		DO meter	Field
Light Transparency	Cm		secchi disk	Field
TDS	mgL^{-1}	APHA-AWWA-WEF 2540-C-2017	-	Laboratory
TSS	mgL^{-1}	APHA-AWWA-WEF 2540-D-2017	-	Laboratory
Chemical				
pH	-	Potentiometric	pH meter	Field
DO	mgL^{-1}	Potentiometric	DO meter	Field
Ammonia (NH_3)	mgL^{-1}	SNI 06-6989.30-2005	Spectrophotometer	Laboratory
COD	mgL^{-1}	SNI 6989 2:2019	Spectrophotometer	Laboratory
Nitrate	mgL^{-1}	APHA-AWWA-WEF 4500-NO_3-2017	Spectrophotometer	Laboratory

3. RESULTS AND DISCUSSION

3.1Water Quality Parameters

Water quality in principle can affect the life of the organisms in it [8]. Water quality parameters that have been measured during the research include physical factors such as temperature, light-transparency, *Total Dissolved Solid* (TDS), *Total Suspended Solid* (TSS), and chemical factors such as pH, DO, Nitrate, Ammonia and COD. The results of water quality measurements in the Cilutung River were carried out in *situ* and *exsitu*. When compared with the Water Quality Standards, Government Regulation of the Republic of Indonesia No. 22 of 2021 can be seen in Table 2.

Table 2. Results of Measurement of the Water Quality of the Cilutung River

Parameter	Unit	Station 1	Station 2	Station 3	Grade 2*	Grade 3*
Temperature	℃	28.7℃	25℃	25℃	Deviation3˚ (25±3º)**	Deviation 3˚ (25±3º)**
Light Transparency	cm	23 cm	`17 cm	19 cm	-	-
TDS	mgL^{-1}	197	276	236	1,000	1,000
TSS	mgL^{-1}	54	94	27	50	100
pH	-	6.92	7.03	7.03	6-9	6-9

DO	mgL^{-1}	7.2	7.4	7.1	4	3
Nitrate	mgL^{-1}	0.64	0.41	0.06	10	20
Ammonia	mgL^{-1}	0.002	0.002	0.001	0.2	0.5
COD	mgL^{-1}	9.6	9.2	5.5	25	40

Source : (*) Water Quality Standards Government Regulation no. 22 Year 2021.
(**) [9].

3.2.1 Temperature

Temperature is very influential on the growth and life of aquatic biota. In general, the growth rate increases in line with the increase in temperature, can suppress the life of cultivated animals and even cause death if the temperature increases to an extreme [10]. Water temperature conditions in the Cilutung River range from 25℃to 28.7℃. The temperature difference of each station is influenced by the time difference at the time of sample measurement. The water temperature measurement was carried out from 10.00 am to 02.00 pm.

The water temperature at station 1 on the Cilutung River is higher than at station 2 and station 3. This is because the temperature measurement at station 1 was carried out during the day at 02.00 pm. Temperature measurement starts from station 3 and then station 2 because this location is easier to access. After all it is close to the highway and the weather is still early so the water surface is not too exposed to sunlight. Water temperature is influenced by season, latitude, altitude from sea level (*altitude*), time of day, air circulation, cloud cover, and the flow and depth of water bodies. Sunlight that enters the waters will experience absorption and change into heat energy [6].

The measurement results at stations 1, 2 and 3 are still within the water quality standard based on Government Regulation no. 22 of 2021. Water quality standards for temperatures in class 2 and class 3 require that the normal water temperature has a deviation of 3 from the normal natural temperature in the local environment. The water temperature in the Cilutung River is still quite good for the life of organisms in the Cilutung River. According to Effendi [6], the optimum temperature range for the life of organisms in the waters is 20 – 30 ℃ .

3.2.2 Light Transparency

Primary productivity is limited by the light, because the light is needed for photosynthesis. The rate of photosynthesis will be high when the level of light intensity is high and decreases when the level of light intensity decreases [11]. The transparency of light in the Cilutung River ranges from 17 cm to 23 cm. The level of light transparency at stations 1 and 2 is low/short, namely 19 cm at station 1 and 17 cm at station 2 because it is suspected that there are many particles such as sand and mud from the sand mine. At station 3 the value is

23 cm higher than stations 1 and 2 because the location of the station is only close to the vehicle entry route to the main mine site at station 2.

Low brightness during normal weather can provide an indication or indication of the number of suspended particles in these waters [12]. According to the brightness of a water is related to suspended solids, water color and the penetration of incoming light, so that it can reduce the intensity of light available to aquatic organisms [13].

3.2.3. Total Dissolved Solid (TDS)

The results of the calculation of the TDS value contained in the water at each station on the Cilutung River can be seen in Figure 1. Station 1 has a value of 197 mgL^{-1}, at station 2 has a value of 276 mgL^{-1}, and station 3 has a value of 236 mgL^{-1}. The TDS value at stations 2 and 3 is higher than station 1, this can be happen because there are a lot of rocks and residential zones at stations 2 and 3. This is thought to come from minerals and rock ions that are eroded due to continuous river currents, TDS is also influenced by the results of domestic waste disposal such as soap and detergent from settlements. This result is in accordance with the statement that the TDS value of the waters is strongly influenced by weathering of rocks, runoff from the soil, and anthropogenic influences (in the form of domestic and industrial waste) [6].

Based on the comparison between the results of TDS obtained with water quality standards Government Regulation no. 22 of 2021 is still quite far from the maximum limit of class 2 and class 3 which is 1000 mgL^{-1} so that the TDS level is still quite good for the survival of organisms in the Cilutung River. High levels of TDS if not managed and processed can pollute water bodies. In addition, it can kill aquatic life, and has adverse side effects on human health because it contains chemicals with high concentrations and levels of suspended and dissolved solids [14].

3.2.4 . Total Suspended Solid (TSS)

TSS is a material or suspended material that causes water turbidity consisting of mud, fine sand and micro-organisms which are mainly caused by soil erosion carried by water bodies [6]. The results of the measurement of the TSS value contained in the waters of the Cilutung River vary widely. TSS values ranged from 27 mgL^{-1} to 94 mgL^{-1}.

The highest value of TSS content was found at station 2 with a value of 94 mgL^{-1}, then station 1 with a value of 54 mgL^{-1}, and the lowest value was found at station 3 with a value of 27 mgL^{-1}. The high value of TSS at station 2 is thought to be caused by sand dredging carried out by sand mining so that the sediment at the bottom of the river becomes uplifted and accumulates with water. At station 1 the same thing happened but with smaller mining activities, while at station 3 the TSS value was small because there was no direct sand

mining activity at that location. The TSS levels found at station 3 are thought to come from sediment carried by water flows from stations 1 and 2 that do not settle to the riverbed.

If the results of the Cilutung River TSS are compared with the water quality standards, Government Regulation no. 22 In 2021, stations 1 and 2 have already exceeded the class 2 limit which is worth 50 mgL^{-1} even for station 2 it is almost close to the class 3 threshold value, which is 100 mgL^{-1} . For station 3, it is still below the threshold value. According to the value of suspended solids of 81-400 mgL^{-1} is not good for fisheries, and the value of suspended solids of 25-80 mgL^{-1} has a smaller effect [6]. This shows that the waters of the Cilutung River are inadequate for the life and breeding of aquatic organisms.

3.2.5 . Degree of Acidity (pH)

The degree of acidity (pH) affects the life of organisms, so that pH can be used to state the good or bad of a water [15]. Based on the measurement results, the pH of the Cilutung River ranged from 6.92 to 7.03.

It is known that the pH at station 1 has a value of 6.92, station 2 has a value of 7.03, and station 3 has a value of 7.03. According to the water quality standard Government Regulation no. 22 of 2021, these results show that the condition of the waters of the Cilutung river is still in good condition and good for aquatic life because it is still in the range of numbers 6 to 9 of grade 2 and class 3 water quality standards. Water conditions that are very alkaline or very acidic will endanger the survival of the organism because they will interfere with metabolic and respiratory processes [12]. A very low pH causes the solubility of metals in the water to increase which is toxic to aquatic organisms, conversely a high pH can increase the concentration of ammonia in water which is also toxic to aquatic organisms [16].

3.2.6 . Dissolved Oxygen (DO)

Dissolved Oxygen (DO) is a limiting factor for the aquatic environment and can be used as an indication of the presence of organic matter pollution [6]. Based on the measurement results, the DO levels of the Cilutung River ranged from 7.1 mgL^{-1} to 7.4 $mgL^{-1.}$

The value of dissolved oxygen in the Cilutung River at station 1 is 7.2 mgL^{-1}, station 2 with a value of 7.4 mgL^{-1}, and station 3 with a value of 7.1 mgL^{-1}. When compared with water quality standards Government Regulation no. 22 of 2021, the value of dissolved oxygen is still in very good condition for the life of aquatic organisms because the value is more than 3 mgL^{-1}, where this value is the minimum threshold value which means that dissolved oxygen should not be less than 4 mgL^{-1} in class 2 and should not be less than 3 mgL^{-1} in class 3 of the water quality standard value.

3.2.7 . Nitrate

The nitrate content in the Cilutung River ranges from 0.06 mgL^{-1} to 0.64 mgL^{-1} . The nitrate value at station 1 is 0.64 mgL^{-1} , station 2 is 0.41 mgL^{-1} , and the lowest value is 0.06 mgL^{-1} at station 3. Stations 1 and 2 have higher values than station 3, presumably because of the existence of waste disposal from agriculture such as rice fields, farms, and domestic waste originating from settlements[6]. Waste originating from these sources will affect the nitrate content which will have an impact on water quality.

Based on the comparison of the results of the nitrate content in the Cilutung River with water quality standards, Government Regulation no. 22 of 2021 is still below the maximum limit for class 2 which is 10 mgL^{-1} and class 3 which is 20 mgL^{-1} . This shows that the waters of the Cilutung River are still in a good category and safe for aquatic organisms as well as for animal and human life. Nitrates can be used to classify water fertility levels. Nitrate levels between 0 – 1 mgL^{-1} include oligotrophic, nitrate levels between 1 – 5 mgL^{-1} include mesotrophic, and nitrate levels between 5 – 50 mgL^{-1} including eutrophic waters [6]. According to Alaerts and Santika[17], abundant nitrate concentrations can stimulate growth and development of aquatic organisms, especially algae (phytoplankton) if supported by the availability of other nutrients.

3.2.8 . Ammonia

The source of ammonia in waters is the breakdown of organic nitrogen (protein and urea) and inorganic nitrogen found in soil and water, which comes from the decomposition of organic matter (dead aquatic plants and biota) by microbes and fungi [6]. The ammonia content of the waters of the Cilutung River ranges from 0.001 mgL^{-1} to 0.002 mgL^{-1} .

The value of ammonia contained in station 1 was 0.002 mgL^{-1} , station 2 with a value of 0.002 mgL^{-1} , and station 3 with a value of 0.001 mgL^{-1}. Ammonia levels in natural waters are usually less than 0.1 mgL^{-1} [18]. High concentrations of ammonia in waters can cause a decrease in dissolved oxygen which can cause disturbances in physiological and metabolic functions such as respiration [19].

Based on the comparison with the results of the ammonia content in the Cilutung River with water quality standards, Government Regulation no. 22 of 2021, it is still below the maximum limit for class 2, which is 0.2 mgL^{-1} and below the maximum limit for class 3, which is 0.5 mgL^{-1}, so it is still in the good category for the survival of aquatic organisms.

3.2.9 . Chemical Oxygen Demand (COD)

Chemical Oxygen Demand (COD) is the total amount of oxygen needed to oxidize all organic matter in the waters [20]**.** The value of COD content in the Cilutung River ranges from 5.5 mgL^{-1} to 9.6 mgL^{-1} .

The values at station 1 are 9.6 mgL^{-1} , stations are 9.2 mgL^{-1} , and stations are 5.5 mgL^{-1} . This difference is thought to be due to pesticide discharge from rice fields and fields located at station 1 and household waste originating from community settlements around station 2. Meanwhile, the low COD value at station 3 is caused by not having many settlements or agricultural land around the area[6]. Household waste is the main source of organic waste and is the main cause of high COD concentrations [21]. When compared with water quality standards by Government Regulation no. 22 of 2021, COD in the Cilutung River is still below the maximum limit for class 2, which is 25 mgL^{-1} and is below the maximum limit for class 3, which is 40 mgL^{-1}.

A high COD value indicates a greater level of pollution. Waters that have high COD values are undesirable for fisheries and agriculture [22]. According to Effendi (2003) COD value in unpolluted waters is usually less than 20 mgL^{-1}, while in polluted waters it can be more than 200 mgL^{-1}.

4. CONCLUSION

The waters of the Cilutung River are generally still in a good and safe category for the survival of the aquatic organisms contained in them according to the water quality standards of Government Regulation of the Republic of Indonesia Number 22 of 2021.

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