Research on The Impact of Ciliwung River Water

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Research on The Impact of Ciliwung River Water on The Surrounding Environment in The DKI Jakarta Area

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Abstract. Ciliwung River flows through central Jakarta, passing through many residential and densely populated areas that cause heavy pollution in the Ciliwung River resulting from wastewater and solid waste. This research aims to know the water quality and pollution level in the Ciliwung river and determine the locations to install water quality online monitoring stations. The research method used in this study is to analyze the quality of water samples taken from several points of the Ciliwung River. The analysis results show that the Ciliwung river is highly polluted, especially in the areas going downstream of the river. In addition, the analysis results have determined 8 (eight) points/locations where the online water quality monitoring devices will be installed. Due to limited funds, however, only 3 (three) online monitoring devices are currently installed on site, representing upstream, middle, and downstream areas of the Ciliwung river.

1. Introduction

Ciliwung is one of the rivers that has a significant impact on the people of Jakarta. This river crosses cities, villages and slums with a variety of people's behaviours. Garbage and sewage from many places are dumped in the Ciliwung River [1]. The Ciliwung watershed serves both social and economic functions [2]. The length of the Ciliwung river from the upstream to the estuary on the coastline of Jakarta Bay is ± 117 km, with the watershed covering around 347 km2 area. The areas covered start from the upstream area at Tugu Puncak (Bogor Regen) to the downstream area at Jakarta Bay (North Jakarta) [3]. Likewise, another general description of the Ciliwung River is that the Ciliwung River in its course in the DKI Jakarta area receives additional capacity from canals/rivers and reservoirs both in terms of quantity and quality. The river flow that leads to the Ciliwung river starts from the Kelapa Dua river, Depok to the Manggarai river, which is a tributary of the JL. Fadilah Cijantung, tributary of Jl. Bridge I which is a sub-watershed of the West Tanjung. The Condet River holds a lot of domestic and industrial waste water, likewise in the MT Haryono river, Tanjung Lengkong river and Jl. North Manggarai IV [4]. Keeping this in mind, a study on changes in river water quality becomes critical because the rapid increase in population number in these areas is proportional to the increase in water use for household purposes. The water used for domestic purposes, usually referred to as household wastewater or domestic sewage generated by the households in these areas, is discharged chiefly into the aquatic ecosystem directly without proper treatment. What is the impact of Ciliwung river water on the surrounding environment of DKI Jakarta areas? The purpose of this study is to determine the condition of the water quality of Ciliwung river in several locations ranging from Kelapa Dua-Depok to the Istiqlal Mosque, as well as to determine the condition of water quality in several watercourses/river branches entering into Ciliwung River during the dry season. The target of this study is to calculate the pollution level of the Ciliwung river starting from Kelapa Dua-Depok to the Manggarai Water Gate and the pollution level of Ciliwung river water in the Manggarai Water Gate segment to the Istiqlal Mosque during the dry season. The locations where the online monitoring devices are to be installed for the Ciliwung Gajah Mada area (Jakarta Kota) will be determined after the analysis results of water quality and pollution level are discovered. Water from the river is poured into the monitoring devices alternately by looking at the amount of water discharge available for the activity. Therefore, the research method applied in this study is a Descriptive Qualitative research method.

2. Data and Methods

2.1. River Types and water quality classifications and criteria

A river is a surface water flow that is elongated in shape and flows continuously from upstream to downstream [5]. The direction of flow of a river corresponds to the nature of the water, from high places to low places. Rivers start from mountains or plateaus to lakes or oceans.

River is a source of human livelihood, there are three types of rivers; rain rivers, glacier rivers and mixed rivers. Rivers are widely used for human needs such as water reservoirs, means of transportation, irrigating rice fields, other types of irrigation, livestock needs, industrial needs, housing, water catchment areas, fisheries, and also as a place of recreation [6]. River as a source of water is a natural resource that has a multipurpose function for human life and livelihood. Human activity and industrial growth cause rivers to become vulnerable to water pollution [7]. A river has three environmental conditions: upstream, downstream, and estuary. The three conditions have different water quality, there are; (a) upstream has better water quality in terms of clarity. (b) Downstream has a much greater potential for pollution; (c) The mouth of the river, it contains a lot of dissolved materials, the mud from downstream forms a delta, and the water colour is very turbid. Water quality classifications and criteria refer to Government Regulation Number 82 of 2001 concerning Water Quality Management and Water Pollution Control which stipulates water quality into four classes. Class one, its designation, can be used for raw drinking water and/or other designations that require water quality that is the same as the designated uses. Second class, the designation, can be used for infrastructure/facilities for recreational water activities, freshwater fish farming, animal husbandry. Third class, the designation can be used for freshwater fish farming, animal husbandry, water to irrigate crops, and other designations requiring the same water quality as the designated uses. The fourth class, the designation, can be used to irrigate plants and/or other designations requiring the same water quality as the designated uses.

Clean Water Requirements

Clean Water Requirements Based on the Regulation of the Minister of Health of the Republic of Indonesia No. 416 / MENKES / PER / IX / 1990 [8]. Clean water requirements can be reviewed from physical, chemical, microbiological, and radioactivity parameters contained in water, namely: (1) Physical parameters; physically clean water must be clear, odorless, and tasteless. (2) Chemical parameters; clean water must not contain chemicals in amounts that exceed the limit [8].(3) Microbiological parameters; clean water should not contain pathogenic and parasitic germs that interfere with health. (4) Radioactivity parameters.

River WaterPollution

Water pollution is the entry or inclusion of living things, substances, energy, and or other components into water. These components of water pollution are grouped as follows: (1) Solid Waste Material is a solid waste material, both coarse (large grains) and fine (small grains). (2) Organic Waste Materials generally are wastes that can rot or are easily degraded by microorganisms. (3) Inorganic Waste Materials are generally wastes that cannot rot and are difficult to degrade by microorganisms [9]. (4) Processed Waste Materials from food materials are processed waste materials that can also be included in the group of organic waste materials [10].

River Water Pollution Impacts

River Pollution is the pollution of river water caused by industrial waste, population waste, livestock waste, chemicals and nutrients contained in water, and chemical and physical disturbances that can interfere with human health. Water pollution can have a far-reaching impact for to Impact on health Impact on environmental aesthetics.

2.2. Research method

The research method used is a descriptive qualitative research method for the following activities

2.2.1.. Place and Time [11]

The research location along the Ciliwung river, starting from Kelapa Dua-Depok represents the upstream area, and the location of the Istiqlal Mosque-Central Jakarta represents the downstream area. Water parameters were sampled and measured on November 4 and 5, 2014, from 09.00 to 16.30 WIB (Western Indonesian Time). Water sampling was carried out at 9 (nine) spots; 7 (seven) samples at the Ciliwung river and 2 (two) samples at the Ciliwung channels or branches. *Materials and Equipment*. The equipment and materials used in water sampling consist of: meters, conductive meters, thermometers, and discharge gauges. Glass containers and bottles for test samples: organic compounds, total and dissolved metals, and bacteriology. Preservatives, coolers, stopwatches, notebooks, etc.

2.2.2. Working Stages

Sampling is based on the purposive sampling method, a procedure based on considerations. The considerations are related to the locations of the activity sources suspected of contributing to pollution. Sampling in the upstream area is based on the fact that the upstream area has no activities contributing to pollution in the Ciliwung river. In contrast, sampling in the middle of the river is based on the number of activities suspected to contribute to pollution. The sampling was conducted by taking water samples, and the samples were analyzed at the Karsa Buana Lestari (KBL) laboratory in Jakarta. The parameters analyzed were temperature, pH, Dissolved Solids (TDS), total suspended solids (TSS), dissolved oxygen (DO), fats, BODs, COD permanganate numbers, and detergents (MBAS)

3. Results and Discussion

The pH parameters from Kelapa-Dua to Istiqlal mosque are relatively normal, ranging from 6.6 to 7.5. The pH at the Istiqlal mosque sampling point has the highest value (7.5), and the lowest (6.6) is at the sampling point after the Manggarai water gate (Table 1). The effluent generated from the laundry of the hospitals near the area (Cipto Mangunkusumo and Cikini) may have caused the increase in the pH value at the Istiqlal mosque point.

Table 1. Quality Standards for Domestic Wastewater of DKI Jakarta Province [11]

Parameters	Units	Individual/household	Communal
pH	-	6-9	6-9
$KMnO_4$	mg/l	85	85
TSS	mg/l	50	50
Amoniak	mg/l	10	10
Oils & Fats	mg/l	10	20
Methylene Blue Compound	mg/l	2	2
COD	mg/l	100	80
BOD	mg/l	75	50

The DO or dissolved oxygen concentration at the Sampling Point of Kelapa Dua is 3.5 mg/l. This value is relatively lower than the standard allocation of class I river water for the allocation of raw drinking water, which is 6 mg/l. The DO concentration of the Ciliwung river is getting smaller downstream, which can be seen at the Istiqlal sampling point. The DO concentration becomes 2 mg/l. This number results from a drastic DO concentration decrease when pollutants enter the waters. This number also indicates that the pollution level downstream of the Ciliwung river is increasing. With a DO concentration of 2 mg/l, the river water is approaching an anaerobic state. The concentration of Ammonia (NH4) at the sampling point of Kelapa Dua was 0.05 mg/l, and at the sampling point before Condet area slightly dropped to 0.02 mg/l. After that it went higher downstream. At the Istiqlal sampling point, the ammonia concentration was 0.4 mg/l. A very sharp increase in ammonia concentration occurred in the lower reaches of the Ciliwung river, namely the Manggarai–Istiqlal segment (Figure 1a).

This increase in ammonia concentration is because all the locations passed are in areas with higher population density than other areas [12]. High ammonia levels indicate the presence of organic matter pollution from domestic waste [13]. We can indicate that visually when we go further to the north, the water of the Ciliwung river is black, and the smell is getting stronger. For detergent parameters (MBAS), high concentrations were found at the river branches' sampling points, respectively, on Jl. Fadilah, Condet river, after R.S. Cipto Mangunkusumo (RSCM) and Istiqlal mosque. The detergent concentration (MBAS) at the sampling point located at the outlet of Cipto Mangunkususo hospital and Istiqlal mosque was 1.0 mg/l. This number indicates that domestic waste and effluent generated from hospital activities, such as washing clothes, wounds, hemodialysis, and others, contributed to pollution [14]. Detergents are hazardous to the environment. Some studies found that detergents can dissolve carcinogenic materials, such as Benzonpyrene.

(a)

(b)

Figure 1. (a) Manggarai–Istiqlal segment. (b) River water sampling points

The parameters of organic substances (KMnO4, COD, and BOD) showed almost the same tendency. At the Kelapa Dua sampling point, the COD concentration was 27 mg/l, and the BOD concentration was 15 mg/l. These values have exceeded the quality standards for class B [13] water allocations or the quality standards for class 1. This shows that the Ciliwung river that enters the DKI Jakarta area is polluted due to activities in the upstream area (Depok and Bogor). At the sampling points before the Condet river, the concentration of organic substances was slightly lower than that at the Kelapa Dua sampling point, apart from the fact that it is mixed with the river branch of Jl. RA Fadilah, where the concentration of organic substances was relatively high. This data indicated that there is still natural purification (self-purification) in the Ciliwung river on the Kelapa Dua segment, up to before the confluence with the Condet river. At the sampling point of the Condet river, before entering the Ciliwung river, the concentration of organic substances is relatively high, namely organic substances ($KMnO_4$) 21 mg/l, COD 57 mg/l, and BOD 27 mg/l. Condet river is a branch that has the potential to pollute the Ciliwung river because domestic and industrial wastewater have been polluting it. This increase is because the population and density around the Condet river (Kramat Jati sub-district) is relatively high, contributing to domestic waste's organic matter levels [11]. At the Manggarai sampling point, 20 river water quality statuses showed COD concentration of 34 mg/l and BOD concentration of 22 mg/l [14]. After reaching the Istiqlal sampling point, the COD concentration was 228 mg/l, and the BOD concentration was 126 mg/l. This indicated that the burden of organic pollution had increased sharply in the areas from Manggarai to Istiqlal segments.

In addition to chemical parameters, river discharge measurements also took place at several sampling points. The discharge of the Ciliwung river at the Kelapa Dua sampling point was 17.92 m^3/second. After arriving at the sampling point of the Kalibata Bridge, it increased to 39.43 m^3/second due to the flow speed at this particular area being relatively high, which is caused by the river body being straight for ±500 m. While at the Istiqlal sampling point, the discharge of the Ciliwung river was 6.75 m^3/second. Sampling points where the water discharge value is low tend to be polluted. The higher the discharge, the smaller the organic content (BOD and COD) caused by the dilution process.

The pollution level that enters the Ciliwung river can be calculated from the water quality analysis and river discharge measurements. The formula to calculate organic load (COD): Discharge multiplied by COD concentration. The result is the total Organic Load (COD). The results of these calculations (BPM

= Discharge × Polluting Elements) reveal that the organic load (COD) at the Kelapa Dua sampling point was 483.84 grams of COD per second, the one at the Kalibata Bridge sampling point was 1,237.83 grams of COD per second. An increase occurred at the Manggarai Water Gate, i.e., 1,360 grams of COD per second. Thus, the additional organic load from the Kelapa Dua segment to the Kalibata Bridge is 753.99 grams of COD per second or 65,144,736 kg of COD per day. This value was calculated for a moment only. The value fluctuates depending on the size of the pollution source. Meanwhile, the additional organic load in the Kalibata Bridge segment up to Manggarai is 122.17 grams of COD per second or 10,555.5 kg of COD per day. If calculated from Kelapa Dua to Manggarai, the total addition of organic load (COD) is 876.16 grams of COD per second or 75,700.22 kg of COD per day, therefore, the lower amount is caused by the dilution process.

Table 2. Test results of research

No	Location	Element	mg/l	Riverdischarge (m^3/sec)	Pollution load, BPM=discharge × Polluting Elements (gram COD/sec)	Inf: The result of the measurement and calculation, that:
1	Kelapa dua	O2 raw water, pH	3.5 6. 6.6	17.92	483.84	Because detergent solution will raise the pH of the water and can interfere with the life of organisms in the water
	NH4	0.05				The value of the NH4 parameter is high indicative of the presence of of organic matter from domestic waste. Physically, it can be seen that the more to the north the water of the Ciliwung river is black and the smell is getting stronger
	Organic	27				
2.	COD, BOD	57.27	39.43	1,237.83; 1,360		
3.	Condet	NH4	0.02			
4.	Ciliwung	DO (O2 Dissolved, towars D.stream)	2	6.75		Anaerobic (organic substances will decompose into CO2 and NH4, while N-NH4, while S- H2S. so that the water become black and smelly
5	Istiqlal M.	pH, COD, BOD	7.5; 228.1 26			Its low water discharge value tends to be polluted stronger

3. Conclusions

Some Conclusion as follows, the closer to the downstream area, the higher the pollution level is. To quickly monitor the condition of the water quality of the Ciliwung river, we recommend the installation of online monitoring sensors at 7 (seven) monitoring points ranging from Kelapa Dua to The Istiqlal Mosque. Due to limited funds, only 3 (three) water quality monitoring stations are currently available online. These three areas are Kelapa Dua area-Depok represents the upstream, the Manggarai Water Gate represents the middle, and the Istiqlal Mosque bridge represents the estuary of the Ciliwung river. In addition to chemical parameters, river discharge measurements were carried out at several sampling points. The discharge of the Ciliwung river at the Kelapa Dua sampling point was 17.92 m^3/second; after arriving at the sampling point of the Kalibata Bridge, the river discharge increased to 39.43 m^3/second due to a relatively high flow speed in the area as the result of the river body being straight for ±500 m. Meanwhile, at the Istiqlal sampling point, the Ciliwung river discharge was 6.75 m^3/second. Sampling points where the water discharge value is low tend to be polluted. The higher the discharge, the smaller the organic content (BOD and COD) caused by the dilution process. The summary of the above discussion or test results of river water elements at 5 locations is available in table 2.

References

[1] Satmoko Y 2010 Water Quality Conditions In The Ciliwung River In The Jakarta Capital Region Viewed From Organic, Ammoniac, Phosphate, Detergent And Coli Bacteria Parameters *Jurnal Air Indonesia* **6**(1)

[2] Tri Ratna Saridewi's 2019 A market-based mechanism as an alternative solution for watershed management: a case study of the Ciliwung Watershed, Indonesia *International Journal of Global Environmental* **18**(2) 171 DOI:10.1504/IJGENVI.2019.102304

[3] Yudo S 2010 Water Quality Condition of Ciliwung River in Dki Jakarta Area Reviewed Organic Parameter, Ammonia, Phosphate, Detergents, and Coli Bacteria *Jurnal Air Indonesia* **6**(1)

[4] Satmoko Yudo and Nusa Iman Said, (2018), Water Quality Status of the Ciliwung River in the DKI Jakarta Region and Water Quality Status of the Ciliwung River in the DKI Jakarta Region, Journal of Environmental Technology Vol. 19, No 1, January 2018 Center for Environmental Technology, Agency for the Assessment and Application of Technology Geostech Building 820, Puspiptek Serpong 15314, Indonesia, satmoko.yudo@bppt.go.id.

[5] Alfredo S B 2019 *Development of a Book enriching Hydrosphere Dynamics in Inland Water Material as Disaster Knowledge at the State High School 1 Kartasura, Sukoharjo Regency* (Thesis. Faculty of Teacher Training and Education, University of Muhammadiyah Surakarta)

[6] Hendrawan 2005 *II Physical Chemistry* (Malang: UM.PRESS)

[7] Soemarwoto O 2003 *Environmental Impact Analysis* (Yogyakarta: Universitas Gadjah Mada Press)

[8] Regulation of the Minister of Health of the Republic of Indonesia No. 416 / MENKES / PER / IX/ 1990

[9] Huda T 2009 Techniques for Making Coconut Oil. http://diploma.chemistry.uii.ac.id/index.php?option=com_content&task=view&id=48&Itemid=119. [5 September 2013]

[10] Brilhante, et al. 2002 *Environmental Impact Assessment Training* (Rotterdam: Ellias Modem Publishing)

[11] Annisa M S S 2019 *Calculation of Pollution Load from Total Suspended Solid (TSS) and Total Caliform Parameters and the Influence of Community Behavior on Water Quality Percut River* (Thesis TR. USU Environment. Terrain)

[12] Wilson S M and Serre M L 2007 Use of passive samplers to measure atmospheric ammonia levels in a high-density industrial hog farm area of eastern North Carolina *Atmospheric Environment* **41**(28) 6074-86

[13] Buenrostro D O, et al. 2007 Comparative analysis of hazardous household waste in two Mexican regions *Waste Management* **27** 792–801

[14] Anonymous 1995 *Total Population By Gender and Subdistrict 2014* (BPS East Jakarta City. Available from: https://jaktimkota.bps.go.id/dynamictabl_2015/12/29/3/total-population-according to- gender-and- kecamatan-2014.html).

[15] Inoy T, Haerawati I and Ficky A 2001 Spatial Analysis of Water Quality in Area of the Riverbank of Musi River in Palembang City, *Conference: 2nd Sriwijaya International Conference of Public Health (SICPH 2019)* DOI:10.2991/ahsr.k.200612.014

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