Pollution Loads of the Cipanyairan and Cipalabuan Rivers : Part of the Sukabumi Regency ICM's Coastal Pollution Management Programs

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Abstract. The first step in the management of coastal pollution in the coastal area of Sukabumi Regency is the assessment of the pollution status of the two rivers, namely the Cipalabuan River and the Cipanyairan River, which is part of the integrated coastal management programme of Sukabumi Regency. Based on calculation of 35 water quality parameters shows that Cipanyairan River was considered heavily polluted with pollution index (PI) more than 10, characterized by low pH, low dissolved oxygen (DO), and high BOD, COD, TP, NO2, Cd, Pb, Mn, Cl2, total coliform, and fecal coliform. Meanwhile, water quality in Cipalabuhan River was better than Cipanyairan River, stated as moderately polluted with PI between 5 to 10, characterized by COD, Total Phosphorus, Co, Cd, and Pb. The higher water discharge in Cipalabuhan compared to Cipanyairan may had been the factor causing the better water quality in Cipalabuhan River. High concentration of Total P shows that human daily activities such as laundry and domestic wastes. Calculation on pollution load capacity shows that Cipanyairan has been shown for its higher value compared to that of Cipalabuhan, i.e for BOD5, the pollution load in Cipanyairan and Cipalabuhan are -102.64 kg/day and 2.74 kg/day, respectively.

1 Introduction

Rivers that flow into an estuary are a means for humans and also as a means of carrying pollutants [1, 2]. Thus, the waters of an estuary, including the bays within it, are waters that are highly influenced and at the same time dependent on human activities along the flowing watershed [3, 4]. Therefore, managing river pollution has become the community's main concern in order to maintain the quality of the estuary waters where the river flows end [5]. Various forms of estuary and bay water quality degradation have occurred, as many researchers have studied in Jakarta Bay [6, 7, 8].

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Cipalabuhan River and Cipanyairan River are water sources in Palabuhanratu sub-district. Those river flow from upstream to downstream passing over the city of Palabuhanratu and then discharged to the Palabuhanratu Bay. Those rivers get a lot of input from the mainland both in the form of solid waste and organic waste waste, which is as result of human activities living nearby in the watersheds. Some of these wastes get transported by the rivers to Palabuhanratu Bay. As such, integrated approaches to managing pollution in river systems and coastal areas are necessary.

In order for the quality of river water to be maintained as natural conditions, it is necessary for the management to achieve the desired water quality in accordance with the allocation of those rivers. Water quality management is done by keeping the water source not polluted. Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light.

Both rivers are actually located in the mountains in the area of Cikidang in Sukabumi District and is a downstream of the watersheds. In addition, Cipalabuhan also joins a small river to then form the Cipalabuhan River in the city of Palabuhanratu. Then, together with the Cipanyairan River, join the estuary together at Palabuhanratu Bay. The two rivers pass through the small town of Palabuhanratu and get the influence of all the human activities along its flow. Various human activities, such as settlement and residential activities, domestic activities to small industry food and fish processing are the main source of the water quality degradation of both rivers. At the end of the estuary, human activities are increasingly intense, including the market and fishing port as well as a variety of lodging activities (hotels and lodges). During weekends, the city of Palabuhanratu is also a quite crowded as tourist destination, and this also adds to the contribution to the change of water quality of both rivers generated by domestic activities of tourism.

The Status of water quality and pollution from both rivers is analyzed in this study. In addition, identifying pollution sources is also identified in this study, which is expected to be used as an input in decision making process of the water quality management of both rivers in the near future. This study is then concluded with a variety of recommendations that must be done in the near future which is expected that can keep the water quality in both rivers can be maintained. In addition, the results of this study are also used as a key inputs in the determination of water quality monitoring strategy that will be conducted by the Government of Sukabumi regency in the near future.

2 Introduction

Water quality sampling and field observation were conducted on May - July 2017 in four (4) sampling points in the River of Cipalabuhan and 3 sampling points in the river of Cipanyairan comprising upstream, middle and downstream of the rivers (Figure 1).

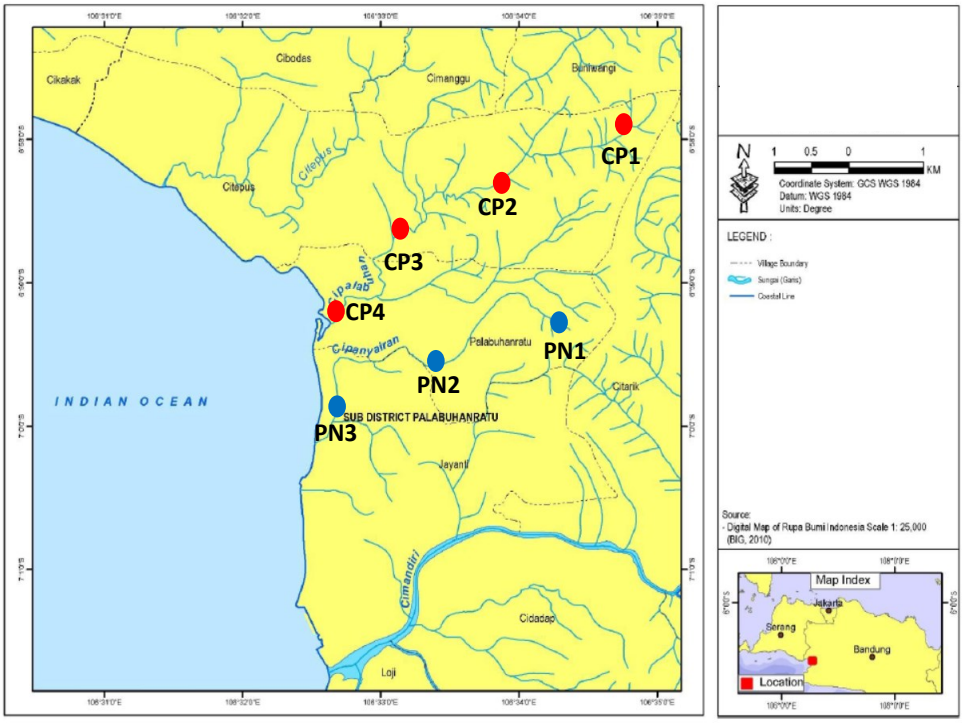

Fig. 1. Map of sampling points location.

2.1 Formatting the title, authors and affiliations

The data collected consists of secondary data and primary data. Secondary Data can be both quantitative and qualitative obtained from related agencies such as local governments, sub-districts and villages/village. The collection of primary data obtained from interviews and for water quality is carried out sampling at certain points that are considered to represent the condition of the river. The samples obtained are then analyzed in the laboratory at IPB University in Bogor.

Water quality samples collected using some PE bottles and preserved accordingly based on APHA method [9]. Some water quality parameters were determined on site using DO meter, pH meter and SCT meter. Other water quality characteristics were analyzed in the laboratory of ProLing of Faculty of Fisheries and Marine Sciences, Bogor Agricultural University (IPB) using standard methods [9].

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Water quality data were analyzed by comparing to the water quality criteria (West Java Water Quality Standard – Governor Regulation No. 12 Year 2013) in order to determine the water use classification. The water quality data were also analyzed using Nemerow Pollution Index as stated in the Ministerial Decree of Ministry of Environment and Foresty No. 27/2021 [10]:

$$IP_j = \sqrt{\frac{\left(\frac{C_i}{L_{ij}}\right)_M^2 + \left(\frac{C_i}{L_{ij}}\right)_R^2}{2}} \quad (1)$$

Where,
IP_j = pollution index
C_i = concentration of the ith parameter of observed water quality
L_i = the standard concentration of the ith parameter of water quality for specific water use
$\left(\frac{C_i}{L_{ij}}\right)$M = maximum value of $\left(\frac{C_i}{L_{ij}}\right)$
$\left(\frac{C_i}{L_{ij}}\right)$R = average value of $\left(\frac{C_i}{L_{ij}}\right)$.

The pollution status of water then were determined using the criteria as follows:
$0 \leq P_{Ij} \leq 1{,}0$: good (in compliant with the water quality standard)
$1{,}0 < P_{Ij} \leq 5{,}0$: slightly polluted
$5{,}0 < P_{Ij} \leq 10$: moderate polluted
$P_{Ij} > 10$: heavy polluted.

To estimate the pollution load capacity of the river in the particular segment (sampling point), using estimated river discharge on the day of observation, the formula used is (Ministerial Decree of the Ministry of Environment No. 1/2010):

$$I, i = \frac{Ci \times V \times OpHrs}{1\ 000\ 000} \qquad (2)$$

Where,
I,i : amount of load/emission of pollutant i, kg/year
Ci : concentration of the *i* type of pollutant in wastewater discharge, mg/L (field monitoring data)
V : wastewater discharge flow rate, L/hour
OpHrs : number of operating hours per year, hours/year
1 000 000 : conversion factor, mg/kg

3 Results and Discussion

3.1 Results

3.1.1 Water Pollution Index

Water pollution in Cipanyairan River was considered heavy polluted with pollution index (PI) more than 10 (Figure 2). This pollution indicated by low pH, low dissolved oxygen (DO), and high BOD, COD, TP, NO2, Cd, Pb, Mn, Cl2, total coliform, and fecal coliform. Those water quality parameters in the three observation station were not comply with the water quality standard, either class I, class II or class III. High BOD and COD but low in DO shows that this river is highly polluted by organic materials, which generated by anthropogenic activities around the river. Domestic waste and small scale industries of fish processing seems to be the most plausible souces of this pollutants. Some metals such as Cd, Pb, Mn are detected is also sourced from human activities around the river. However, contamination from the geological leakage can also be responsible for the relatively high concentration of this metals.

Water quality in Cipalabuhan River was somewhat better than Cipanyairan River. The Cipalabuhan River was also considered polluted but in the better water quality status i.e. moderately polluted with PI less than 10 (Figure 3). The water quality parameters that surpassed the class II standard are COD, Total Phosphorus, Co, Cd, and Pb. The higher water

discharge in Cipalabuhan compared to Cipanyairan may had been the factor causing the better water quality in Cipalabuhan River. High concentration of Total P shows that human daily activities such as laundry and domestic waste.

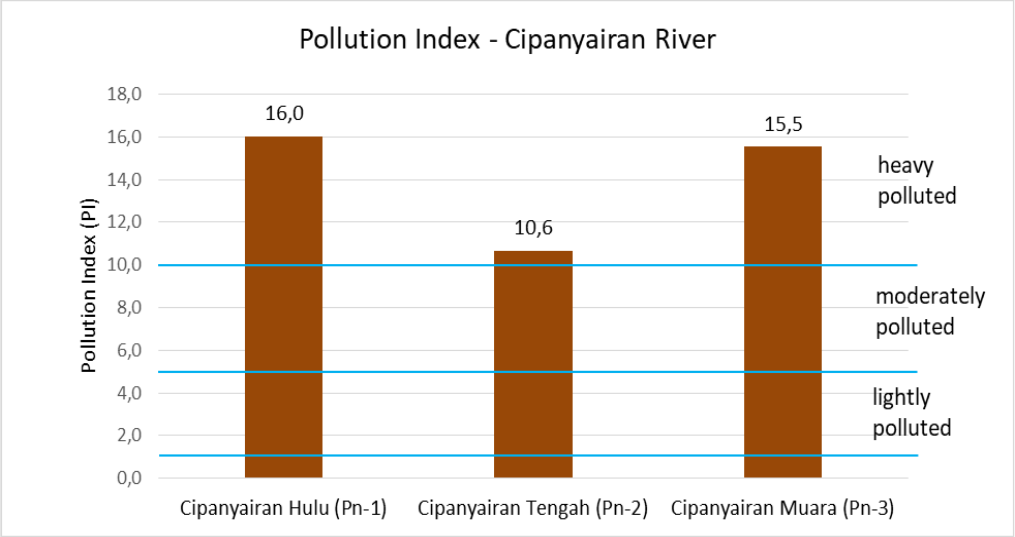

Fig. 2. Pollution Index and pollution status of each station at Cipanyairan River. Cipanyairan Hulu = Upstream; Cipanyairan Tengah = Middle Stream and Cipanyairan Muara = Down-stream.

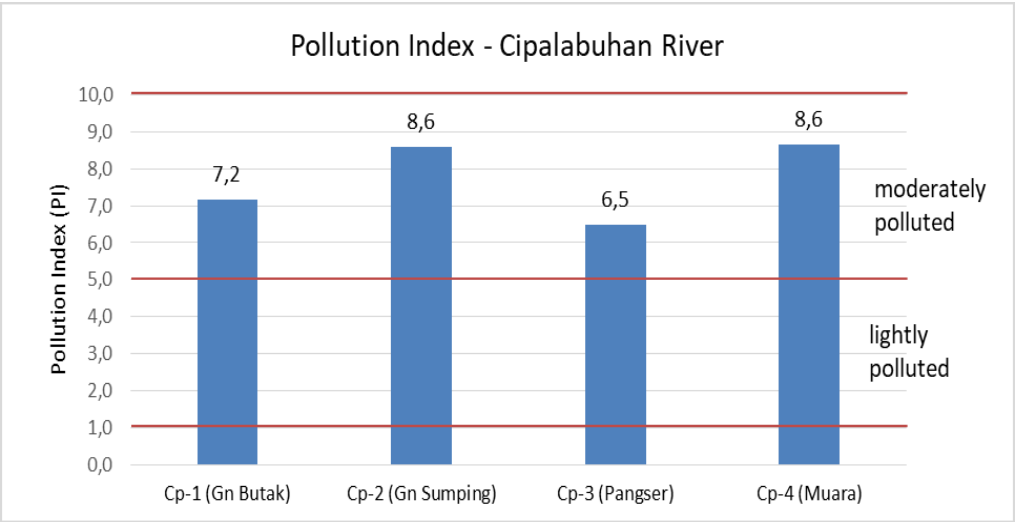

Fig. 3. Pollution Index and pollution status of each station at Cipalabuhan River.

3.1.2 Water Pollution Load Capacity

3.1.2.1 Cipalabuhan River

Water pollution load capacity of Cipalabuhan River for some water pollutants, i.e. TSS, BOD, COD, Total P, TAN, and detergent were considered low, either based on class I, class II or class III of West Java water quality standard. Some pollutants even having negatif values, meaning that its load capacity has been surpassed (Table 1, Table 2, and Table 3).

Table 1. Pollution load capacity of Cipalabuhan River based on Class I water quality standard of West Java (Governor Regulation of West Java No. 12/2013).

Parameter	Observation value (mg/L)			WQ Std (mg/L)	Differrence from WQ Std			Pollution Load Capacity (kg/day)		
	Cp-1	Cp-2	Cp-3	Class I	Cp-1	Cp-2	Cp-3	Cp-1	Cp-2	Cp-3
TSS	6	6	8	50	44	44	42	301	301	287
BOD	2,8	2,6	3	2	-0,8	-0,6	-1	**-5,47**	**-4,11**	**-6,84**
COD	40,28	43,72	45,86	10	-30,28	-33,72	-35,86	**-207**	**-231**	**-245**
Total P	0,088	0,087	0,443	0,2	0,112	0,113	-0,243	0,77	0,77	**-1,66**
TAN	0,009	0,103	0,111	0,1	0,091	-0,003	-0,011	0,62	**-0,02**	**-0,08**
Deterjen	0,076	0,084	0,096	0,2	0,124	0,116	0,104	0,85	0,79	0,71

Table 2. Pollution load capacity of Cipalabuhan River based on Class II water quality standard of West Java (Governor Regulation of West Java No. 12/2013).

Parameter	Observation value (mg/L)			WQ Std (mg/L)	Differrence from WQ Std			Pollution Load Capacity (kg/day)		
	Cp-1	Cp-2	Cp-3	Class II	Cp-1	Cp-2	Cp-3	Cp-1	Cp-2	Cp-3
TSS	6	6	8	50	44	44	42	301	301	287
BOD	2,8	2,6	3	3	0,2	0,4	0	1,37	2,74	0,00
COD	40,28	43,72	45,86	25	-15,28	-18,72	-20,86	**-105**	**-128**	**-143**
Total P	0,088	0,087	0,443	0,2	0,112	0,113	-0,243	0,77	0,77	**-1,66**
TAN	0,009	0,103	0,111	0,5	0,491	0,397	0,389	3,36	2,72	2,66
Deterjen	0,076	0,084	0,096	0,2	0,124	0,116	0,104	0,85	0,79	0,71

Table 3. Pollution load capacity of Cipalabuhan River based on Class III water quality standard of West Java (Governor Regulation of West Java No. 12/2013).

Parameter	Observation value (mg/L)			WQ Std (mg/L)	Differrence from WQ Std			Pollution Load Capacity (kg/day)		
	Cp-1	Cp-2	Cp-3	Class III	Cp-1	Cp-2	Cp-3	Cp-1	Cp-2	Cp-3
TSS	6	6	8	400	394	394	392	2696	2696	2682
BOD	2,8	2,6	3	6	3,2	3,4	3	21,90	23,27	20,53
COD	40,28	43,72	45,86	40	-0,28	-3,72	-5,86	**-1,92**	**-25,5**	**-40,1**
Total P	0,088	0,087	0,443	1	0,912	0,913	0,557	6,24	6,25	3,81
TAN	0,009	0,103	0,111	1	0,991	0,897	0,889	6,78	6,14	6,08
Deterjen	0,076	0,084	0,096	0,2	0,124	0,116	0,104	0,85	0,79	0,71

From the calculation of the pollution load capacity of Cipalabuhan River, which was done based on the current position compared to the water quality standard per class of river. In the quality standards of the national and West Java water classes, there are 4 classes, namely Class I, II, III and IV. Grouping The class is based on the provision of river water usage for humans. The smaller the class, the higher the water quality. Class I shows the river water can be used for the raw water of drinking water, and or other provisions that require the same quality of drinking water. Class II is a river water allocated for the second class, the water for which can be used for water recreation facilities, the cultivation of freshwater fish, livestock, water for agricultural purposes, and or other allocation that requires the same quality of water with such uses. Class III is a river water that can be used for the cultivation of freshwater fishes, farms, water to irrigate cropping, and or other provisions that require the same water as the use, and class IV is a river water destined for the activities of agricultural, cropping and or other provisions that require the same quality of water with such uses.

The calculations shows that the Cipalabuhan River is marked by COD parameter. For COD, in the third location, the value are negative, which means that there is currently no space for additional load of COD in the river. For the river water with the quality standards of class I, II and III, the Cipalabuhan River should reduce input that can increase COD concetration in the river. Load of pollutant is higher as approaching river mouth. For other parameters, i.e. TSS, BOD, TAN, Total P and detergent parameters, they are still located below the limit allowable loads, and can still receive input the pollution of these parameters.

3.1.2.2 Cipanyairan River

The calculation of pollution loads in Cipanyairan River has been carried out and the results are presented in the following tables for each class. The result of the calculation shows that

the Cipanyairan River receives higher pollution load when compared to the Cipalabuhan. This remembers the smaller dimensions of the Cipanyairan River causing lower river discharge. Meanwhile, enter from a very intense human activity in a path location that causes a very high concentration of parameters. It can be seen from the concentration value of each parameter in each research station.

Somewhat different from the calculation result for Cipalabuhan River, parameters that have exceeded the maximum burden of pollution to Cipanyairan River more, namely BOD, COD, Total P and TAN. At grade III quality standards, the pollution load value is relatively lower when compared to class I and II. The difference is that the allocation of weights that can still enter the river becomes smaller, as the river allocation class increases (Table 4, Table 5, and Table 6)

Table 4. Pollution load capacity of Cipanyairan River based on Class I water quality standard of West Java (Governor Regulation of West Java No. 12/2013).

Parameter	Observation			WQ Standard	Differrence from WQ Std			Pollution Load Capacity (kg/day)		
	Pn-1	Pn-2	Pn-3	Class I	Pn-1	Pn-2	Pn-3	Pn-1	Pn-2	Pn-3
TSS	12	27	30.5	50	38	23	19.5	260.03	157.39	133.44
BOD	14	14.4	18	2	-12	-12.4	-16	**-82.11**	**-84.85**	**-109.49**
COD	85.79	55.74	84.07	10	-75.79	-45.74	-74.07	**-518.62**	**-312.99**	**-506.85**
Total P	0.733	0.127	1.133	0.2	-0.533	0.073	-0.933	**-3.65**	0.50	**-6.38**
TAN	0.048	0.007	2.097	0.1	0.052	0.093	-1.997	0.36	0.64	**-13.67**
Deterjen	0.092	0.094	0.094	0.2	0.108	0.106	0.106	0.74	0.73	0.73

Table 5. Pollution load capacity of Cipanyairan River based on Class II water quality standard of West Java (Governor Regulation of West Java No. 12/2013).

Parameter	Observation			WQ Standard	Differrence from WQ Std			Pollution Load Capacity (kg/day)		
	Pn-1	Pn-2	Pn-3	Class II	Pn-1	Pn-2	Pn-3	Pn-1	Pn-2	Pn-3
TSS	12	27	30.5	50	38	23	19.5	260.03	157.39	133.44
BOD	14	14.4	18	3	-11	-11.4	-15	**-75.27**	**-78.01**	**-102.64**
COD	85.79	55.74	84.07	25	-60.79	-30.74	-59.07	**-415.98**	**-210.35**	**-404.21**
Total P	0.733	0.127	1.133	0.2	-0.533	0.073	-0.933	**-3.65**	0.50	**-6.38**
TAN	0.048	0.007	2.097	0.5	0.452	0.493	-1.597	3.09	3.37	**-10.93**
Deterjen	0.092	0.094	0.094	0.2	0.108	0.106	0.106	0.74	0.73	0.73

Table 6. Pollution load capacity of Cipanyairan River based on Class III water quality standard of West Java (Governor Regulation of West Java No. 12/2013).

Parameter	Observation			WQ Standard	Differrence from WQ Std			Pollution Load Capacity (kg/day)		
	Pn-1	Pn-2	Pn-3	Class III	Pn-1	Pn-2	Pn-3	Pn-1	Pn-2	Pn-3
TSS	12	27	30.5	400	388	373	369.5	2655.0	2552.4	2528.4
BOD	14	14.4	18	6	-8	-8.4	-12	**-54.7**	**-57.5**	**-82.1**
COD	85.79	55.74	84.07	40	-45.79	-15.74	-44.07	**-313.3**	**-107.7**	**-301.6**
Total P	0.733	0.127	1.133	1	0.267	0.873	-0.133	1.8	6.0	**-0.9**
Amonia	0.048	0.007	2.097	1	0.952	0.993	-1.097	6.5	6.8	**-7.5**
Deterjen	0.092	0.094	0.094	0.2	0.108	0.106	0.106	0.7	0.7	0.7

4 Discussion

The results of the pollution index calculation show that the Cipanyairan River shows Heavy Polluted status, which indicates that this river is receiving a high pollution load. Calculation of the pollution index is by comparing each water quality parameter with the appropriate quality standard, in this case Class II Water Quality Quality Standards, namely for the use of raw materials for drinking water with previous management. When compared with all classes/classes of quality standards, the parameters that have exceeded the quality standards in each class are presented in the following Table 7 and Table 8.

Table 7. Summary of observed water quality of Pn-1, Pn-2 and Pn-3 of Cipanyairan River compared to each class of Water Quality Standard of West Java.

Compared to Water Quality Standard (West Java)	Number of parameters beyond standard	Parameters beyond standard
Class I	12	pH, DO, BOD, COD, TP, NO_2, Cd, Pb, Mn, Cl_2, total coliform, fecal coliform
Class II	12	pH, DO, BOD, COD, TP, NO_2, Cd, Pb, Mn, Cl_2, total coliform, fecal coliform
Class III	11	pH, DO, BOD, COD, NO_2, Cd, Pb, Mn, Cl_2, total coliform, fecal coliform
Class IV	5	BOD, Cd, Mn, total coliform, fecal coliform

Table 8. Human activity sources associated with high concentration of some parameters in the Cipanyairan River.

No.	Parameter	Source of Pollutants in the study area
1.	DO, BOD, COD, TAN	Domestic activities, household activities, food processing small industries, solid waste disposal, organics degradation, laundry, agriculture activities , hotels and restaurants
2.	Co, Cd, Pb, Mn	Geological and soil erosion, laundry (colouring agent of clothes)
3.	Total Coliform and Fecal Coliform	Hausehold Toilets , hotels and restaurants

Meanwhile for the Cipalabuhan River, the water pollution index appears to be better than the Cipanyairan River, which shows the pollution class is Moderately Polluted. A comparison with the available River Water Quality Standards for each class for the Cipalabuhan River is presented in the following Table 9.

Table 9. Summary of observed water quality of Cp-1, Cp-2 and Cp-3 of Cipalabuhan River compared to each class of Water Quality Standard of West Java.

Compared to WQ Standard (West Java)	Observation Station	Number of parameter beyond standard	Parameters beyond standard
Class I	Cp-1 & Cp-2	4	TAN, COD, Cd, Pb
	Cp-3	6	TAN, DO, COD, TP, Pb, Fecal coli
Class II	Cp-1 & Cp-2	4	COD, Co, Cd, Pb
	Cp-3	4	COD, TP, Co, Pb
Class III	Cp-1 & Cp-2	4	TAN, Co, Cd, Pb
	Cp-3	4	TAN, Co, Cd, Pb
Class IV	Cp-1 & Cp-2	1	Cd
	Cp-3	0	

From the results of the comparison analysis of the quality standard of river water, the class I, II, III and IV, it appears that some parameters have exceeded the quality standards of water. In general, the class that is suitable for water from both rivers is class II, which is can be used as raw material for drinking water but need to be processed first. For the downstream area of the Cipalabuhan River, namely the Cp-3 and Cp-4 stations and where it is located in Palabuhan Ratu City and gaining influence from human waste, the appropriate class is class III or even IV class. In the area, the river water is not feasible to be used as a raw material of drinking water, even with the processing first.

Parameters that are above the quality standards can be grouped into organic groups namely DO, BOD, COD and TAN. Then the parameters associated with the metal such as Cd and Pb. As well as health related parameters are Coliform bacteria and E-Coli. The presence of this bacteria shows the high activity of disposal of the human faeces into the river water, and also causes the high content of organic materials that will eventually lead to the high value of BOD and COD and the low DO. The existence of high metal parameters indicate that there are several possibilities, namely from the heavy industry or textile or from the natural form of rock abrasion on the upstream. This is seen from the parameters of the Cd and Pb metal since the upstream area, namely in the stations CP-1 and Cp-2.

Furthermore, the pollution load calculation shows that the parameters related to domestic activities have exceeded the tamping capacity of the rivers studied. For both rivers, it appears that the most appropriate class quality standard is currently Class III Quality Standard, namely use as raw water for agricultural activities. Meanwhile, if you use Class II, let alone Class I, namely as raw material for drinking water, either with prior processing or without processing, the Cipalabuhan and Cipanyairan Rivers are no longer suitable.

Human activities producing organic waste appear to dominate the sources of pollution entering the flow of these two rivers. In the upstream area, which is mostly an agricultural area, the influence on the river seems to be dominated by community agricultural and plantation activities. This is similar to the situation at the Ciliwung River watershed in Jabotabek Area as studied by Prismayanti [11] and Damar [12] which shows the high load of organic pollution resulting from human domestic activities. There is relatively little specific research on the two rivers in this study, and no studies were even found in this area. However, the results of this study show that human domestic activities in the watershed area of these two rivers are dominated by domestic activities such as domestic activities, household activities, food processing small industries, solid waste disposal, organics degradation, laundry, agricultural activities, hotels and restaurants [13]. Apart from organic matter, which is characterized by the parameters BOD5 and COD, parameters that need attention from the two rivers studied are the presence of pathogenic organisms Total Coliform and Fecal Coliform. These two parameters indicate human waste contamination in the two rivers studied, which indicates the practice of toileting in the river, either directly or indirectly. The presence of these pathogenic bacteria makes the water of the two rivers unfit to be used as raw material for drinking water.

The flow of these two rivers is in the estuary waters of Pelabuhan Ratu Bay which is a deep bay which is part of the Indian Ocean. The relatively poor water quality conditions of these two rivers also have an impact on the condition of the Pelabuhan Ratu estuary waters. However, at least until now, from many previous studies, the condition of organic content in the waters of the Pelabuhan Ratu estuary is relatively low, which is caused by the high flushing rate and depth of the waters as well as strong waves and currents [14]. Conditions of high-water dynamics cause waters to always move and immediately be flushed into the open ocean and the opportunity for accumulation to occur is minimal [14, 15]. This condition is indeed a characteristic of the estuary waters of South Java which has a more open, open sea, oceanic character and thus causes a high flushing rate and low accumulation of pollutants [16]. Meanwhile, the results of research conducted by Sanusi [17] show that the pollution condition of Pelabuhan Ratu Bay is still at a low level. Many other researchers also convey these favorable conditions, which are generally caused by the oceanographic character of the South Coast of Java, which has fast currents, deep depths and high of flushing rate [14,15].

By considering the condition of the final receiving waters, namely the waters of the Pelabuhan Ratu Bay Estuary, which are relatively good at flushing out pollutants, however, with the development of increasingly better infrastructure in the city of Pelabuhan Ratu, this has caused the growth of tourist activities followed by various types of waste disposal for residents and hotels and restaurants, causing concern. and waste management is an urgent

matter. Although the oceanographic conditions of the waters of Pelabuhan Ratu Bay are considered favorable, it is important to pay attention to the future. The entry of organic materials from human activities cannot be ignored, as stated by Damar et al. [18], which reviews the dangerous impacts of eutrophication in estuary waters. The growth in population in the Pelabuhan Ratu city area, especially due to tourism activities, makes attention more important. Various consequences of domestic liquid waste for decreasing the quality of the receiving water ecosystem have occurred, such as algae blooms [18], reduction in fisheries production [19] and various declines in water quality in estuary water areas [2], 20, 21].

5 Conclusion

Water quality of the two rivers studied, the Cipanyairan and the Cipalabuhan is already in the level of heavily and moderately polluted. Most of the water quality parameters which are already exceeded the water quality standard are those related to domestic waste disposed by human activities such as households, restaurants, laundries and hotels. Pollution loads of those two rivers studied are already far above the capacity of each river. In the near future, rapid development of tourism industry in the city of Pelabuhan Ratu will increase the pollution risk in the area and this needs an urgent pollution management especially related to organic wastes produced by domestic activities in the city of Pelabuhan Ratu.

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