Pollutant Load and Assimilation Capacity in Martapura River, South Kalimantan, Indonesia

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Abstract: Rivers always have multifunctional role that is vital for drinking water needs. Until now the Martapura River has been used for various types of activities such as domestic households, tourism, fisheries, agriculture to the industry which all cause the quality of water to decrease. This study aims to calculate the pollution load and assimilation capacity by calculating the BOD, COD and TSS parameters analysed using linear regression. The results of parameter analysis of BOD, COD and TSS have shown that under the conditions of the current pollutant load and its assimilating capacity, the Martapura River water cannot carry out the refining process itself.

1 INTRODUCTION

The function of the river becomes very important because of its role as a transportation facility, community water source, fisheries, agricultural interests, and as a maintainer of natural hydrological conditions. However, even with those vital functions, the river as a final waste disposal site is still commonly encountered throughout Indonesia. Back then, the waste produced by human activities that was discharged into waterways did not become a severe problem because the river had sufficient assimilation capacity to accommodate the waste in the body river. However, as the river bank population grows, the declining assimilation capacity of river water against waste has become an important issue that must be carefully considered.

Currently, a hundred and two rivers have traversed the city of Banjarmasin, consisting of fifty-four creeks, forty-five average rivers and three large rivers, with the Barito river becomes the largest river in the area. With the Barito River estuary area reaches more than 2 kilometres per square and 900 km long, it makes it the most important waterway for water environment conditions in Banjarmasin City (South Kalimantan Province Environmental Agency, 2017). The declining quality of river water in the city of Banjarmasin has been caused mainly by the random domestic waste disposal into the river bodies (Normelani, 2003), followed by poor urban sanitation patterns and unhygienic behaviour among riverbank communities (Normasari, 2016).

Data from the Directorate of Water Pollution Control also shows that the most significant contribution of waste (range 58.31 to 94.16 per cent) comes from domestic waste and this waste tends to increase every year (Ministry of Environment and Forestry, 2017). With those conditions, this study aimed to investigate domestic pollutant loads and river assimilation capacity in Banjarmasin City.

2 RESEARCH METHOD

Sampling and measurement of water samples were carried out three times in September 2018 in the Martapura River, Banjarmasin City, South Kalimantan (figure 1). Observations and analyses were carried out in situ and ex-situ where ex situ study was carried out at the Banjarmasin City Environmental Laboratory. Total pollutant load per time was used to express the pollutant load.

According to Tebbut (1997), by multiplying the concentration and flow rate of the river, we can calculate the pollutant load value. For the capacity of assimilation, the amount is obtained by processing the

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correlation graph between the concentration of each waste parameter in the river with the pollutant load of the setting itself and then analysed by connecting it with the water quality standard line.

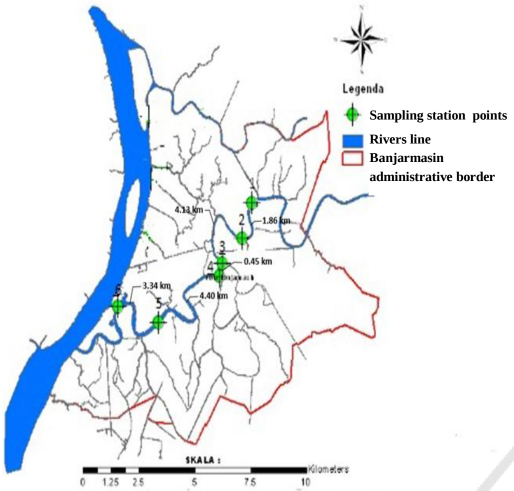

Figure 1: Sampling station point in the Martapura River, South Kalimantan.

Regression analysis is used as an auxiliary method to determine intersection lines between pollutant loads and the quality standards required for each parameter. Pollution load parameters are used as independent variables and pollutant concentration parameters are used as dependent variables. Thus, the pollution variables in the inlet can be mathematically written as follows.

$$Y = a + bx \quad (1)$$

remarks :
y = Pollution concentration parameters
x = Pollutant load parameter value
a = Intersection with upright axis (middle / general average)
b = slope/gradient (regression coefficient for parameters)

The pollutant load value of a certain parameter became the X variable while the parameter concentration value became the Y variable. A simple linear regression equation was used to answer whether the concentration of a parameter was affected by the parameter's pollutant load itself. The simple linear regression equation assumes that all pollutants from the land will flow into the river. The more the pollutant load enters the river, the higher the concentration in the water will be. Furthermore, the assimilation capacity value only applies to the area specified in the study.

3 RESULT AND DISCUSSION

Hydrologically, the city of Banjarmasin is surrounded by large rivers and their branches, flowing from the north and the northeast to the southwest and the south, and forming a dendritic drainage pattern. The Martapura River that flows across the centre of the city is located in densely populated residential areas with various industrial and domestic activities. This condition directly contributes to the decreasing quality of the Martapura River's water. We will further discuss the Martapura River's potential pollution loads and its assimilation capacity.

3.1 Martapura River's Potential Pollution Load

The magnitude of the Martapura River's potential pollution load sourced from domestic waste has been summarised in Table 1 below:

Table 1: Martapura River's Potential Pollution Load Resume

Domestic pollutant sources	Pollutant load potential (kg/day)		
	BOD	COD	TSS
Non-point source			
a.household waste	1137.45	1409.45	939.63
b. hotel waste	921.91	1267.63	875.81
c. restaurant waste	25.43	38.15	22.84
d. market waste	307.05	380.48	253.65
e. school waste	112.33	139.19	92.80
f. hospital waste	12.3	16.91	11.69
g. office waste	32.71	40.53	27,02
Point source	129,18	-	152.00
Total	**2678.36**	**3292.34**	**2375.44**

Based on Table 1, it can be seen that waste originated from households provides the most significant contribution as an indoor pollutant primary source. A poorly managed household waste was resulting in river highly polluted by domestic waste. These results are in line with the research by Palamuleni (2002) which has stated that the primary pollutant of water is the habit of dumping domestic waste massively as well as the lack of municipal sanitation facilities. The burden of river water pollution will continue to increase along with the development of population demographics in a region, synergising with economic growth and industry

(Goel, 2006), and this also applies to the city of Banjarmasin.

3.2 The Martapura River’s Assimilation Capacity

An indirect approach was taken to determine the assimilation capacity of the Martapura River, which is by linking water quality and its waste load. If the pollutant concentration is above the intersection line of the regression and the quality standard concentration line, it means that the pollutant load has exceeded the river's ability to clean itself. This condition causes polluted rivers. On the other hand, if the pollutant concentration is below the intersection line of the regression and the quality standard concentration line, it means that pollutants are still undergoing a self-purification process. This condition reflects the river in a non-polluted situation.

Table 2 shows the regression results for BOD, COD and TSS parameters to obtain assimilation capacity values. The function Y has shown the average quality of the Martapura River’s waters from upstream (Jingah River) to the downstream (Barito River), in the dry season of 2018.

Table 2: The relationship function for river pollution and river quality at the upstream, midstream, and downstream.

Para meters	Y function	Quality Std (mg/L)	Asimilation capacity (kg/day)
BOD	Y=6E-05x + 298,58	2	817.47
COD	Y=2E-05x + 1136,10	10	3110.47
TSS	Y=8E-08x + 178,21	50	487.89

Assimilation capacity is the limit of river pollutant load which can still be cleaned naturally through physical, chemical and biological events. From Table 2, the COD assimilation capacity value is 3110.47 kg/day, which is the maximum limit for pollutant loads that can still be accommodated by the river until the river conditions are not entirely polluted. In figure 2, we can see a graph of the relationship between the total BOD pollutant load and the water quality downstream for the BOD parameter.

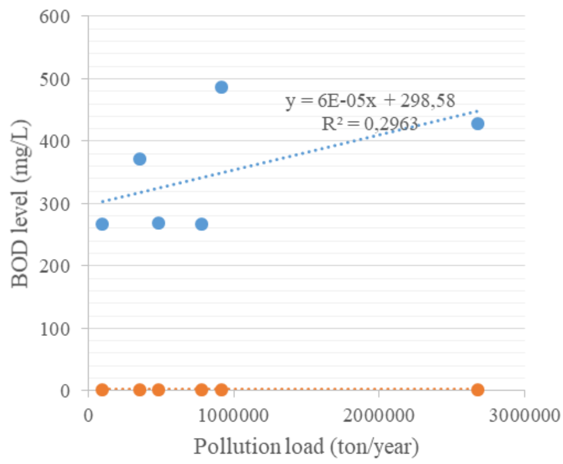

Figure 2: Regression analysis for BOD pollutant load and BOD level on the Martapura River.

In Figure 1, it can be seen that the river pollution load for the BOD parameter has exceeded the standard quality limit. This indicates the pollution load for the BOD parameter exceeds its assimilation capacity (817.47 kg/day). It can also be said that the river has experienced pollution.

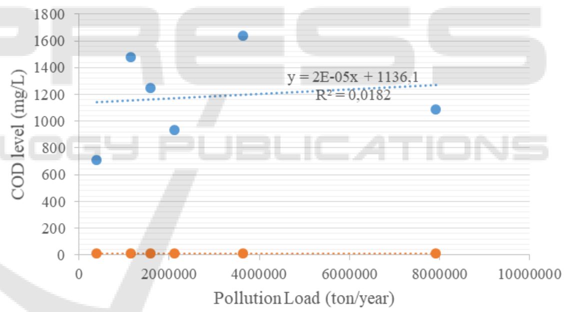

Figure 3: Regression analysis for COD pollutant load and COD level on the Martapura River.

Figure 3 shows that the river pollution load for COD parameters has exceeded the quality standard line. This condition indicates that the pollution load for the COD parameter exceeds its assimilation capacity, or in other words, the river has been categorised as polluted.

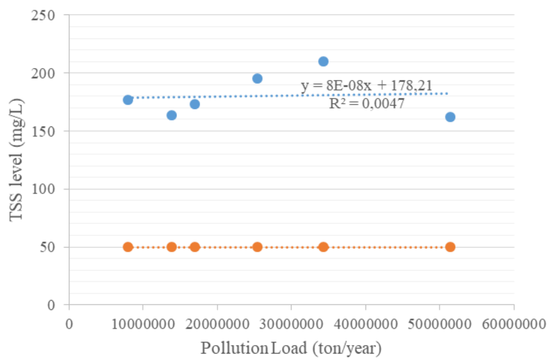

Figure 3: Regression analysis for TSS pollutant load and TSS level on the Martapura River.

Based on Figure 3, it can be seen that from 6 observation points, all of them are above the assimilation line capacity of the TSS parameter (487.89 kg/day). This means that the pollutant load value is higher than the assimilation capacity value and causes the river to be polluted.

4 CONCLUSIONS

All parameters studied at the observation point (BOD. COD and TSS) have exceeded assimilation capacity. The assimilation capacity of the Martapura River is strongly influenced by the burden of river pollutants originated from domestic waste, especially household waste. Synergistic intervention is needed to reduce the potential of pollutant load and at the same time, to increase the assimilation capacity of the Martapura River.

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