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Pollutant Load Capacity in Pemda Cibinong Lake, Bogor, Indonesia

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***Abstract*— Pemda Cibinong Lake is one of the lakes in the district of Bogor, West Java, Indonesia. The wide of Pemda Cibinong Lake is 4.5 ha. This study aims to see the load capacity of the pollutant in the Pemda Cibinong Lake. The research variables measured were morphology and hydrology, water quality and the activities that are surrounding of the lake. The research was conducted in 2015. The results showed that the volume of Pemda Cibinong Lake is 9.9 million l-18 million l, BOD_5 of 6.21 to 8.33 mg/l, COD is 16.80 to 52.50 with a load capacity pollutant wide based is 103 kg/m^2.year or 309 kg/year. Land cover and activities around the lake effect on the water quality. Pollutant load capacity on the Pemda Cibinong Lake had exceeded its capacity. Pemda Cibinong Lake managed by the Bogor local government and used by the community as a recreation.**

Keywords—Pollutant, Water Quality, Land Cover, Activities, Pollutant Load Capacity

I. INTRODUCTION

Pemda Cibinong lake is one of the lakes located in Bogor. Pemda Cibinong lake has been shrinkage of broad from 5.77 ha to 4.5 ha due to natural factors such as a sedimentation and land use changes. Pemda Cibinong Lake is a natural lake where the main source of water is from a spring. The development of Cibinong city where the Pemda Cibinong Lake is located supposedly effect on the existence of the lake Pemda Cibinong. Surrounding area of Pemda Cibinong Lake are offices, settlement, shops and mall. Pemda Cibinong Lake managed by the Bogor local government. Land around Pemda Cibinong Lake are 70% is abuild area and 30% of green open space.

Water pollution load capacity is the ability of water at a water source, in order to receive input pollution load without resulting in the water being polluted. Pollution load capacity is also often called the total maximum daily loads. Determination of pollutant load capacity is the water pollution control that approaches the quality of water (water quality-based control). The necessity calculate of pollutant load capacity refers to the Regulation of the Minister of Environment of the Republic of Indonesia Number 28 Year 2009 on Water Pollution Load Capacity lake and /or reservoir. The primacy of this research is to solve strategic problems with managing the water resources with land-use arrangement between the built area and open green spaces and activities that are environmentally friendly.

The purpose of this study were identify and analyze the types of activities and the characteristics of the waste water that potentially enter the lake; analyze and evaluate the condition of lake based on its capacity; and making plans to control pollution and restore the quality of the Pemda Cibinong Lake.

II. RESEARCH METHOD

A. Time and Location of Research

The research was conducted in March-September 2015 in Lake Pemda Cibinong, Bogor, located in the village of Karadenan, Bogor, West Java, Indonesia. The research location shown in Figure 2.1.

B. Variables and Analysis Methods

Purpose	Variable	Collecting data / Calculation / Data Analysis
Water quality status	Water quality	Measurement of parameters BOD, COD, TP, Detergents, Oils and Fats
Pollutant load capacity	Morphology and hydrology	Z = 100 x V/A; Þ = Qo/V
	The allocation of pollution load of parameters	$[Pa\}_{STD} = [Pa]_i + [Pa]_{WTS} + [Pa]_d$ $[Pa]_d = [Pa]_{STD} – [Pa]_i – [Pa]_{WTS}$
	Water pollution load capacity of parameters	$L = \Delta [Pa]d\ Z\ þ / (1-R)$; $R = 1 / (1 + 0{,}747\ þ^{0{,}507}$ $La = L \times A/100 = \Delta [Pa]d\ A\ Z\ þ /100\ (1-R)$
Lake management program	Technological, environmental, social	Analysis based lake management road map

III. RESULT AND DISCUSSION

The water of Pemda Cibinong Lake comes from springs and rainwater. The Pemda Cibinong Lake has an area of 4.5 ha with an average depth of 2.2 m in the dry season and 4 m in the rainy season, so the water has a volume capacity of 99,000 m^3-180,000 m^3. Water level, especially in the rainy season set with floodgates. Types of activities that are around the lake Pemda Cibinong is settlements, offices, a variety of small businesses such as food stalls, laundry, workshop, salon, shop and car wash.

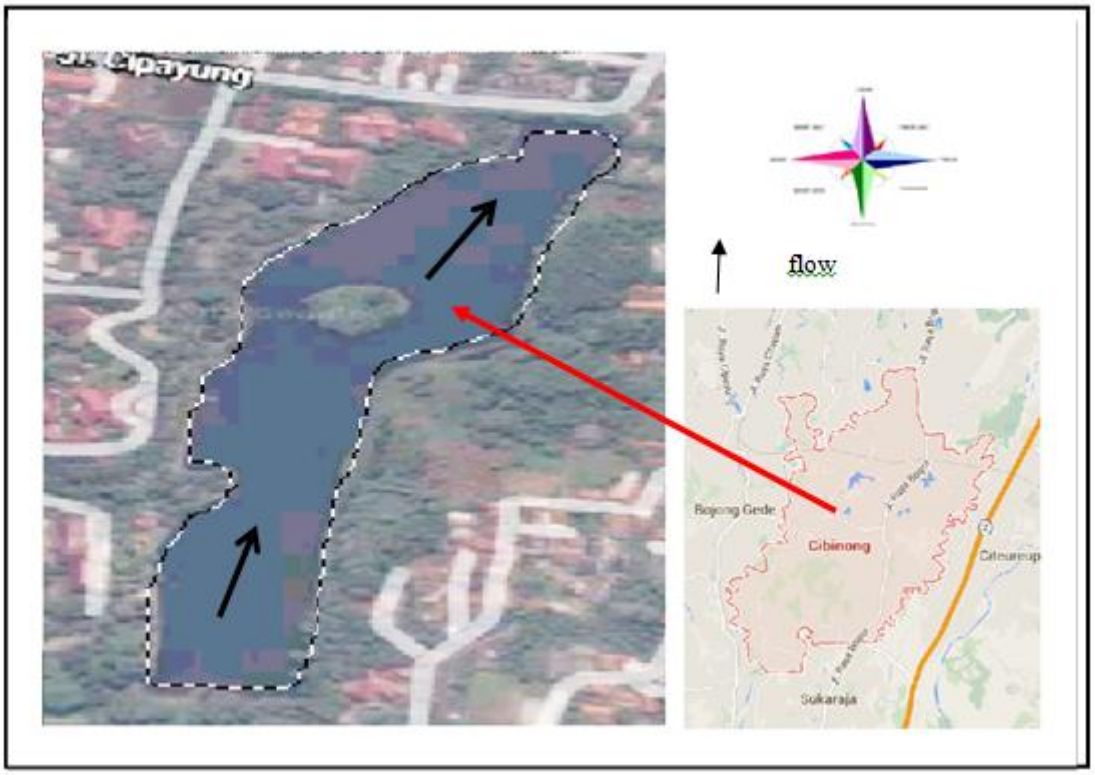

Figure 1 Location of research (Source: Google map, 2015)

Water quality becomes important to give a describe the condition of the lake. That affect the water quality of the lake is the entry of pollutants into water bodies and the condition of the lake ecosystem. The entry of contaminants into the lake will certainly affect the quality of the water where occur in water quality decrease. The value of the measured parameters compared to the Indonesian Government Regulation No. 82 of 2001 on water quality management and water pollution control. Pemda Cibinong Lake water quality including a second-class category, the allocation of water which can be used for water recreation, freshwater fish farming, animal husbandry, water to irrigate crops, or other uses that require the same water quality with the utility.

Table 1 show that all parameters in the Pemda Cibinong Lake generally is above the quality standard. Activities in the surrounding area that do not have waste water treatment facilities supposedly contributing to the pollution in the Pemda Cibinong Lake.

Table 1 Water Quality of Pemda Cibinong Lake

Parameter	Unit	QS	Sampling point					
			1	2	3	4	5	6
BOD	mg/l	3	7,88	7,5	8,12	8,78	7,29	7,31
COD	mg/l	25	54,5	63,1	32,7	18	55,7	33,7
Phosphat	mg/l	0,2	0,28	0,23	0,18	0,2	0,34	0,37
Detergent	mg/l	0,2	1,08	0,50	0,36	0,32	0,34	0,45
Oil & fat	mg/l	1	0,48	3,69	2,60	0,25	0,83	0,5

Of the value of the ratio of BOD/COD in the range of 0.12 to 0.49 show that persistent pollutant. That is, Pollutant comes from an organic chemical. Some organic chemical materials can come from soaps, detergents, phenols and fatty oils. Detergents, phenols, oils and grease were typical compounds of pollutant in urban areas. The activity of laundry and the high use of detergent in urban area also influenced the water quality in surrounding area. Household products that contain phenols were floor cleaners. Meanwhile, variety of oils and fat were compounds in many products that were used daily by urbanites.

The lake should be maintained in order to the water quality accordance with the quality standard. The lake water quality standard is also used as calculation of the water pollution load capacity. The allocation of the burden of pollution of the lake water to be assessed with due regard to the use and preservation of water in the lake, the sources of pollution on the activities in watershed. Pollution load capacity is used for giving permission locations; water management and water resources;determination of the spatial plan;disposal of waste water discharge permit and determination of water quality objectives and work program of water pollution control. Development without considering the environment resulted the lake was considered doesn't have economic value. Increasing population and economic development cause an increasing pressure on the natural ecosystem. The development of infrastructure in the context of the expansion of the city, lake becomes a natural resource were subjected to pressure, as a result many of lake are degraded in quality and quantity. Table 2 show the pollutant load capacity of Pemda Cibinong Lake.

Table 2 Pollutant Load Capacity of Pemda Cibinong Lake

Parameter	Unit	Pollutant Load Capacity of Pemda Cibinong Lake
Morphometry		
Wide (A)	Ha	4,5
Average depth (Z)	m	3,1
Volume (V)	m^3	139,500
Discharge out (Q_o)	m^3/sc	0,033
The amount of discharge out (Q_t)	m^3/year	1.040.688
Flow rate (p)	per year	7
Detention time (Td)	Year	0,07
Water quality		
Parameter concentration (P_i)	mg/m^3	7810
Standard of parameter (P_{std})	mg/m^3	3000
Allocation P_{WTS}	mg/m^3	-4810
Pollutant load capacity of lake		
PLC/wide	kg/m^2. year	103
PLC total	kg/year	309

From the table above, seen that the Pemda Cibinong Lake with an average depth of 3.1 m and wide of 4.5 ha has a volume of 139,500 m^3 or 13.95 million liter. With a large enough of volume capacity, the Pemda Cibinong Lake is potential as a flood control for the downstream area.

BOD parameter used in the calculation of this pollutant load of 7.81 mg/l or 7,810 mg/m^3 while the quality standard of BOD is 3 mg/l or 3,000 mg/m^3 that has particularly overloaded pollutant at 4810 mg/m^3. Pollutants that enter comes from activities surrounding, so the Pollutant load allocation is -4810 mg/m^3. Pemda Cibinong lake has a load capacity pollutant wide based is 103 kg/m^2.year or 309 kg/year. While the calculation using the COD parameter, obtained the value are the pollutant load of 42,930 mg/m^3 with the quality standard of COD is 25,000 mg/m^3 so the Pemda Cibinong Lake have overloaded of COD of 17,930 mg/m^3. Pemda Cibinong Lake has a load capacity pollutant calculated by COD with wide based is 858 kg/m^2.year or 2,573 kg/year.

Pollutant that enter the body of the water comes directly from the activity around the lake and carried by the flow of the river. Therefore in pollution prevention planning, the concept of thinking directed at the catchment area of the lake. Control/prevention of water pollution in Indonesia has been arranged through the Government No. 82 of 2001 on Management of Quality and Water Pollution Control. One that has been made by the Government in controlling water pollution through the Clean River Program which covers all types of freshwater. This program is an effort to reduce the burden of waste particularly from business activities of medium and large scale, as well as carried out in stages to control the pollution load from other sources. The program also trying to organize the settlements along the river/lake with involving local communities (Ministry of Environment, 2004).

Population growth in the catchment area of the lake, small or lack of green open spaces and the activities does not have wastewater treatment will an effect on the quality of the water and overload the capacity of the lake. Pollutant reduction targets to achieve water quality targets. Water quality target seen of of the lake functions. Pemda Cibinong Lake, the function is for recreation (water quality target is a class 2, BOD 3 mg/l). Pollutant reduction scenario to get the water quality target by making the arrangement density of settlements, wastewater treatment and increase the green open spaces.

Arrangement of settlement environment is an arrangement residential program are harmonious, healthy, productive, and sustainable. In the arrangement of this settlement should be carried out by community-based. The most important thing in the process of structuring of participatory society is the right and authority to decide. Thus, the people are involved from the planning to implementation. So urban spatial planning are arranged and the implementation of development should give added value to the community.

Environmentally friendly sanitation is sanitation that focuses on sustainability. The approach is based on the principles of pollution prevention and waste processing human waste. Domestic wastewater treatment is done by determining the area to be served, the observation of topography, water bodies and determining the location of the piping configuration, then designated wastewater treatment plant is used. Sewerage system is done by counting the number of population, services of domestic and industrial waste water, waste water quantity and planning criteria. General domestic waste water accounted for 80% of the drinking water used.

Vegetation diversity and density of plants in the open green space in the area around the lake there is help keep the damage from erosion, absorb pollutants, contributes to the micro climate and habitat for wildlife.

CONCLUSION

Pemda Cibinong Lake is one of the natural lakes in Bogor that is under pressure because of the growth of the city. The parameters in the Pemda Cibinong Lake generally is above the quality standard. The pollution capacity in Pemda Cibinong Lake has been over load. Pollutant reduction scenario to get the water quality target by making the arrangement density of settlements, implementating of wastewater treatment and increase the green open spaces. With a large enough of volume capacity, the Pemda Cibinong Lake is potential as a flood control, important role in the water flow and ground water supply.

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