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Impact Analysis of Waste Water Disposal Through Drainage System for River Water Quality

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Abstract: In Indonesia, drainage system still is multifunctional, that is for storm water runoff as well as the effluent of domestic wastewater. These conditions take effect on river water quality. Including that occur in Cisadane river which is an important river for the city of Tangerang. This river is the main source of raw water for water supply to the city of Tangerang. Objective of this study is to get a level of pollution that occurs in Cisadane and analyze the impact of waste water drainage on water quality of the river. This research represent field research, is by taking water samples directly from drainage canal and river water based on residential areas, industrial and mixed used. The sample of water and then a laboratory test on the Laboratory of Environmental Engineering at the Universitas Indonesia. The results of the sample test are then analyzed by comparing the level of drainage and river water contamination with Government Regulation No. 82 of 2001 on water quality. Final results showed that effluent water from domestic waste affected the water quality of the river, especially in dense residential areas and industrial areas.

Key words: *Drainage System, Waste Water, Water Quality, Land Use,*

INTRODUCTION

Water becomes the main need for the community and other living creatures, so the existence of water sources must be maintained both in quantity and quality. River is one source of raw water to meet the needs of the community mentioned above. In accordance with Government Regulation No. 82/2001 on the classification of river water quality, the quality of river water must be in a certain class according to the regulation in order to be utilized by humans. Referring to Government Regulation No. 82/2001, water that can be used by the community is grade 1 and grade 2. River water is a low cost water source and easy to use, but now the quality of river water decreased. Pollution continues to occur, based on data from the Ministry Enviroment and Forestry in 2014, rivers in Indonesia as much as 75% have been polluted. Most pollution from waste comes from society and industry. Most domestic and industrial waste water discharges are not processed and directly enter drainage system. In Indonesia itself, drainage system are multi purpose. Wastewater (domestic and industrial) that flows in the drainage channel eventually enters the river body. This issue has become one of the factors causing river pollution. This pollution occurs due to the poor waste water discharge system, considering that in general the drainage system in Indonesia is still multi purpose or multi function, either to drain rain water or as household domestic waste water [1]. The multi function properties of this drainage can ultimately affect the final effluent in the River. One of the rivers that experience water degradation is the Cisadane river, this is due to pollution mainly from domestic waste discharges through rivers as part of the drainage system.

Cisadane a river that divides the central city of Tangerang and used as a source of clean water, irrigation, recreation, water transport and industrial. Cisadane River also the main source of raw water for the fulfillment of Municipal Water Supply or PDAM, and 1 of 15 rivers in Indonesia whose management a priority. This study aims to analyze the level of pollution occurring in river bodies and in nearby main drainage system. Site selection based on land use, ie mixed use area, industrial area, and settlement area. In Tangerang City, the special area of Cisadane watershed in Tangerang Municipality is still below 2%. The rest has not been served by the Tangerang City Government. Thus, the potential for pollution from domestic waste discharge is enormous. Need further research on the impact of drainage water drainage by pollution of

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Cisadane River segment of Tangerang City. Figure 1 below is an example of a primary drainage condition in the Cisadane watershed

Fig 1 example of a primary drainage condition in the Cisadane watershed

People actually have other alternatives to utilize water sources, one of which is groundwater, but this water source tends to be limited utilization. In addition, other alternatives to meet water needs by purchasing from a water supply company. The way it requires people to spend relatively small funds, consequently the cost to obtain water to be expensive.

REVIEW OF RELATED LITERATURE

Urban drainage channel is one of the infrastructure that acts as a drainage dryer and rain drainer from an urban area, drainage channel serves to control the excess surface water so as not to cause negative impacts, such as flooding. Thus drainage system are built to provide benefits for human life activities. Due to its water-draining function in open areas, water entering the drainage can be harmless and does not cause a decrease in river water quality.

Waste Water and Drainage System

Waste water coming from the community or public facilities should still be processed first. While the wastewater from industrial activities is very potential to reduce the quality of river water [2]. Wastewater treatment of domestic and industrial wastewater is necessary before entering the drainage channel, this is done so as not to affect the degradation of river water quality. Water that has met certain quality standards that can enter the drainage channel only, so the river water does not decrease the quality. In general, the drainage channel problem is the introduction of hazardous wastewater from disposal sources, especially from industrial activities resulting in drainage system leading to entry into public areas, such as residential areas. Reduced river water quality is also a result of human activities that do not care about the environment and ignore the rules of sustainable development [3].

Drainage is an important infrastructure in urban development, if urban development is not well planned, it can bring negative effects. The results of studies related to urban development in the country of Vietnam also emphasized the magnitude of city development influence on the decrease of surface water quality as well as the increasing number of residents the more the amount of waste generated [4]. Urban development also affects land use, the faster the land use change leads to a decrease in river water quality [5].

Land Use Relationship and Pollution Load

In the previous study we have mentioned the relationship between land use and river water quality has several important linkages such as: type of land use and population density; management in land use change control; human activities that affect the quality and quantity of river water; the effect of waste and residue on the surface of the land; as well as population growth and development influence, competition for exploring water sources, and lack of land-use planning will contribute to degradation of water quality [6].

The relationship model between land use and river water quality, including its hydrological model is closely linked, it also confirms that there is a positive and negative relationship between the type and type of land use with the variables of river water quality [7]. Changes in land use can also have an impact on the quality of raw water sources and have implications for the allocation of water use for communities [8]. There are many studies showing the relationship between land use types and the quality and quantity of water among them, by Qiu and Wang [9], Gulbaz et al. [10], Ahmadi et al. [11], Ray et. al [12]

Water Quality Classification of Rivers

In accordance with Government Regulation No. 82/2001 on the classification of river water quality, the quality of the river water must be in a certain class according to the regulation in order to be used by the community. In the regulation to review the management of water quality and control of water pollution is the elaboration of the above mentioned laws in the field of water and wastewater. According to this rule (Article 8) the classification of water quality is set to 4 grade, namely;

1. Grade I, water whose designation may be used for drinking water, and / or other designations that require the same water quality as that purpose;
2. Grade 2 (lightly polluted), water intended for use in water recreation facilities, freshwater fish farming, water farms to irrigate crops, and / or other designations that require the same water quality as those uses;

3. Grade 3 (medium-polluted), water whose designation may be used for the cultivation of freshwater fish, livestock, water to irrigate crops, and or other designations that require water equal to those uses;
4. Grade 4 (heavily polluted), the water of which the designation may be used to irrigate crops and or other designations that require the same water quality as those uses.

By comparing the result of laboratory test with Government Regulation No. 82 year 2001 can be known level of pollution. Further analysis was obtained by comparing the level of pollution in Drainage System with adjacent River.

EXPERIMENT

This research was conducted only in Cisadane River Basin area of Tangerang City (west from Jakarta), the time taken in May and June 2016, while the location of the water samples were 3 primary drainage sites (near River of Cisadane) and 3 locations on the river body. The sampling was collected using bottles and on the same day taken to the Environmental Engineering Laboratory of the Faculty of Engineering, Universitas Indonesia.

This study uses two types of data, namely primary data and secondary data. Secondary data is obtained from data taken by city government, namely Tangerang City Drainage Network Map, Cisadane River Map segment of Tangerang City, and Land Use Map. For primary data obtained through the observation of research in the field. This data and information will be used as an ingredient in the analysis. The data have been collected, then processed and analyzed by mapping the primary drainage network and pollution level analysis through the approach of sample test conducted by the laboratory, laboratory test results will be compared with Government Regulation No. 82 of 2001 [13]. Figure 2 is the location of sampling of river water and drainage effluent.

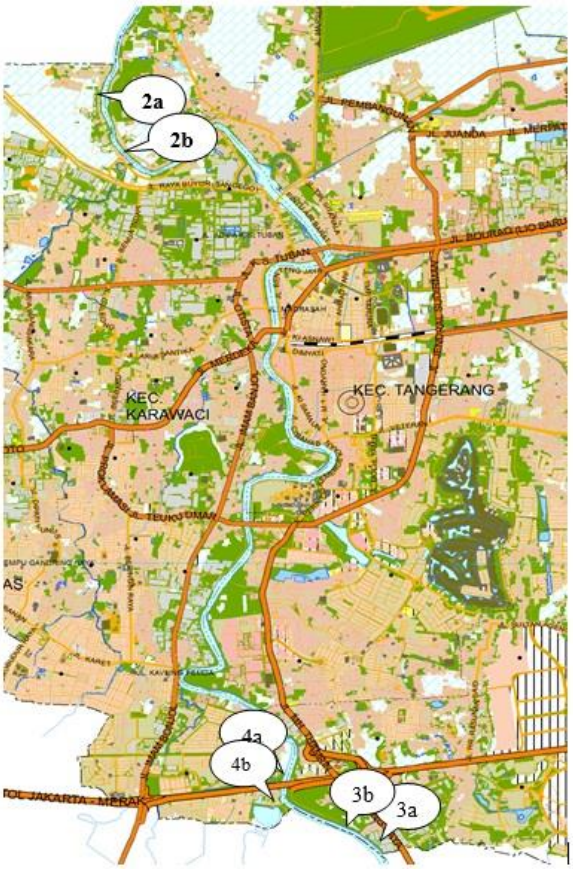

Fig 2 is the location of sampling of river water and drainage effluent

Tools and Materials

Tools and materials used are tools commonly used for water quality observation. Tools used such as inflatable boats, Secchi chips, stopwatch, cork, plastic bottles 600 ml, cool box, and rope.

Sampling and Measurement

Measurements of physical and chemical factors of surface water of the river are done instantly both in situ and ex situ. Observation and measurement of temperature and weather factors, as well as stable current velocity. Measurement of Total Suspended Solid (TSS), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) in a plastic bottle 600 ml and stored in the coolbox during the trip to the laboratory.

CALCULATION AND DATA ANALYSIS

For land use, industrial land, settlement land and mixed land. Of the total of 34 sample locations were selected 6 adjacent locations, 3 primary drainage sites and 3 locations of river bodies close to the drainage site. The water quality of Cisadane River is known based on physical and chemical factors and analyzed

descriptively. Quality analysis by comparing water quality to standard quality threshold that has been specified in Government Regulation No. 82 Year 2001. The parameters used in data analysis are DO, BOD, COD, TSS, and TDS.

RESULT AND DISCUSSION

Based on data from City Goverment Tangerang, Land use in the watershed area includes green open areas, settlements, offices, trade and services, public facilities, and industry. In this study land type is made into 3 types, namely settlements, industries, and mixed use (trade, offices, services, and public facilities). As for open land, the percentage is very small. For open areas the value is ignored. The 3 locations sampled are as follows; mixed use area in Subdsitric Neglasari, residential area in Subdistric Pinang, industrial area in subdistric Cibodas.

For the wastewater domesic service, there is a off site system of WWTP Tanah Tinggi serving 2,758 household connections with 2,179 connections from toilets and wash basins, 218 units of wash basin and 361 unit of garden. Based on data from the Public Works Agency of Tangerang City (2010), there are 2,758 connections of WWTP Tanah Tinggi house serving 10,646 people or 0.67 % of the population of Tangerang City. The pump conditions in WWTP Tanah Tinggi are often damaged due to overload of wastewater loads, Overall, the level of service is still below 2% this figure is still very minimal, because the target of BAPPENAS in 2012 the level of WWTP (*IPAL-IPLT)* services must be at a minimum of 20%.

Whereas, for on-site system, especially the communal service coverage has been over 42%. The local system (onsite) is a domestic wastewater treatment system within the boundaries of land owned, this facility is an individual sanitation facility such as a septic tank. In addition, small communal facilities, such as communal septic tanks (for 5 until 20 family) and communal facility, example ; Toilet Public and Toilet Public Plus with septic tank (on site), can be considered as a local facility. All adequate on-site systems need a tank to accommodate sludge, also depending on the permeability of the soil to filter wastewater into the soil. Source data from Work Public Agency (DPU) Tangerang City in 2014, obtained data as below (table 1).

Table 1 Data WWTP Onsite System at 5 Sub Distric

SUB DISTRIC	Number of Families	Pre ODF		HOUSEHOLD TOILET		COMMUNAL	
		Σ	%	Σ	%	Σ	%
CIBODAS	41.267	82	0,05	43.509	105,43	--	--
PINANG	47.333	740	0,39	44.675	94,38	40	3,38
KARAWACI	48.830	939	0,52	47.090	96,44	346	28,34
TANGERANG	43.451	79	0,05	42.006	96,67	40	3,68
NEGLASARI	27.399	2.251	1,97	24.018	87,66	50	7,30

Source : POKJA Sanitation of Tangerang City 2014

There's still 0.5% Pre ODF, and there's 58% that WWTP Communal has not served yet. These domestic waste discharges into the drainage system, thereby increasing the pollution load in river bodies and affecting the quality of river water.

Laboratory test results in the table below shows the condition of pollution on the drainage and on the river body. The chosen location point is very close, between the primary drainage and the river body. Selection of 3 pairs of locations (6 points) based on 3 types of land. The following results in table 2.a, 2.b (mixed use), 3.a, 3.b (residential), 4.a and 4.b (industrial) below.

Table 2.a Result of Cisadane River Water Quality Analysis on Mixed Use

PARA METER	UNIT	DATA	Level Quality				Level of Pollution
			I	II	III	IV	
TSS	mg/L	16	50	50	400	400	Low
TDS	mg/L	327	1000	1000	1000	2000	Low
DO	mg/L	2.67	6	4	3	0	High
BOD	mg/L	17.96	2	3	6	12	Vey High
COD	mg/L	11	10	25	50	100	Low

Table 2.b Results of Analysis Waste Water Disposal at Drainage System on Mixed Use

PARA METER	UNIT	DATA	Level Quality				Level of Pollution
			I	II	III	IV	
TSS	mg/L	0.024	50	50	400	400	Low
TDS	mg/L	677	1000	1000	1000	2000	Low
DO	mg/L	3.79	6	4	3	0	Medium
BOD	mg/L	33,64	2	3	6	12	Very High
COD	mg/L	56	10	25	50	100	High

Explanation from table 2.a and 2.b is mixed used areas, the result is TSS and TDS in the river body and the primary drainage level of pollution is still low. For the DO content of the lower river bodies, but the drainage is

still medium. For BOD content, in the river or in the dranase is very high and exceeds the threshold. For COD the high content is in the drainage, when entering the body of the womb becomes low.

Tabel 3.a Result of Cisadane River Water Quality Analysis on Residential Area

PARA METER	UNIT	DATA	Level Quality				Level of Pollution
			I	II	III	IV	
TSS	mg/L	62	50	50	400	400	Medium
TDS	mg/L	465	1000	1000	1000	2000	Low
DO	mg/L	5.55	6	4	3	0	Low
BOD	mg/L	15.76	2	3	6	12	Very High
COD	mg/L	21	10	25	50	100	Low

Tabel 3.b Result of Analysis Waste Water Disposal at Drainage System on Residential Area

PARA METER	UNIT	DATA	Level Quality				Level of Pollution
			I	II	III	IV	
TSS	mg/L	0.072	50	50	400	400	Low
TDS	mg/L	859	1000	1000	1000	2000	Low
DO	mg/L	2.95	6	4	3	0	High
BOD	mg/L	178.8	2	3	6	12	Very High
COD	mg/L	298	10	25	50	100	Very High

Explanation from table 3.a and 3.b (residential areas), it can be seen that the similarity of pollution in river bodies and waste water in drainage for TDS content is still low, while for TSS content in river body at middle level, and at drainage is at low level. For the DO content at low drainage but when entering the river body the content of DO becomes high. For BOD content, there are similarities in both drainage and river bodies at high levels. While the COD content is only high on drainage, but when entering the body of the COD content becomes low.

Table 4.a Result of Cisadane River Water Quality Analysis on Industrial Areas

PARA METER	UNIT	DATA	Level Quality				Level of Pollution
			I	II	III	IV	
TSS	mg/L	8	50	50	400	400	Low
TDS	mg/L	465	1000	1000	1000	2000	Low
DO	mg/L	3.35	6	4	3	0	Medium
BOD	mg/L	27.95	2	3	6	12	Very high
COD	mg/L	36	10	25	50	100	Medium

Table 4.b Result of Analysis Waste Water Disposal at Drainage System on Industrial Area

PARA METER	UNIT	DATA	Level Quality				Level of Pollution
			I	II	III	IV	
TSS	mg/L	0.154	50	50	400	400	Low
TDS	mg/L	794	1000	1000	1000	2000	Low
DO	mg/L	3.9	6	4	3	0	Medium
BOD	mg/L	18,97	2	3	6	12	Very High
COD	mg/L	58	10	25	50	100	High

Explanation from table 4.a and 4.b, on industrial land, TSS and TDS content are at low level. As for the DO content of the river body and the drainage is at the medium level, For the BOD content in the river body and in the drainage have similarities are at very high levels exceeding the threshold. While the content of COD in high drainage when entering the river body into a medium.

CONCLUSION

The results of the analysis of the type 3 type of land, waste water contained in the drainage have an effect on the quality of river water, both of which show very high, high and medium pollution load, especially for BOD, COD, and DO contents. While TSS and TDS in the river and in Drainae is still relatively low, except on the river body in the residential area. There is similarity, the burden of pollution between the waste water in the drainage with the nearest river body.

The final results showed that effluent water from domestic waste affected the water quality of the river, especially in dense residential areas and industrial areas. It takes wastewater treatment (WWTP) to prevent water from public and industrial waste can be reduced. There should be an integrated river water quality management model, which involves communities for success in managing river water quality.

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