Study of Water Quality in Bengalon River on Oil Palm Estate

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Abstract. Study of Water Quality in Bengalon's River on Oil Palm Estate. Increasing of population had effect the Land cover condition and cause the polluted. Oil palm land clearing are potentially cause the pollutants in waters so that required for monitoring the quality condition. Study aims to determine the water quality based on physical, chemical and biological parameters and determine water quality standard status in accordance the Government Regulation. Research was conducted for two months in Bengalon's River, East Kutai Regency, East Kalimantan Province. Research applies with Storet method by the reference on Government Ordinance Number 82 Year 2001, observation and documentation method, physical parameter: Temperature, TDS and TSS Turbidity, chemical parameters: pH, BOD, COD, DO, Nitrate, Nitrite , H2S as Sulfate and Iron and biological parameters: E.Coli Bacteria. The research results the waters of Bengalon's river have been polluted by TSS, DO and Iron whereas the other parameters are still in normal condition. It showed that the waters condition of Bengalon's river is still classified as lightly contaminated so that still can be used for class I, II, III, and IV but it provided through further processing.

1 Introduction

Human activities many affects the decline of river water quality, including the land clearing of oil palm estate which cleared the land relatively large area so it has great potential for pollution, as well as the use of fertilizers, pesticides and other chemicals also have the potential for pollution. The existence of oil palm estate certainly has a positive impact to improve the welfare of the community but behind it also affects the environmental damage caused by waste residue from oil palm estate activities, the waste can be liquid, solid and gas, waste is very dangerous for people's life especially if the waste are not controlled and move freely in such a way in the ecosystem of community life.

Behold condition the catchment area of Bengalon River was complex plus with the presence of oil palm estate, will certainly lead the pollution waste which is will be resulting in a decleane the water quality of Bengalon river.

This research aims to determine the extent to which the potential waste caused by the existence of oil palm plantations on the water quality of Bengalon River studied based on physical, chemical and biological parameters and Determining the status of water quality standard in accordance with Indonesians Government Ordinance[1].

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The expected benefit is to obtain the status of Bengalon River's water quality based on physical, chemical, and biological parameters and the determination of water quality status in accordance with water quality standard based on PP. No. 82 year 2001;

2 Materials and Methods

The research was conducted for 3 months starting from October up to December 2016. Research was located in Bengalon Rivers which is included in the area of oil palm plantation, Tepian Langsat Village, Bengalon Subs-District, East Kutai Regency, water sampling was concentrated in 4 areas, namely A region in the upstream (not included in oil palm plantation areas), area B region on Asem river (included in oil palm plantation areas), C region Mekanying river (included in oil palm plantation areas) and D region at downstream of bengalon river (outside of oil palm plantation areas). Sampling is done on the surface, middle and the bottom of the river, each region there are 5 point random sampling was taken and then composite into 1 liter of river water used as sample to be sent to the laboratory.

Observation Methods for retrieved data by conducted through systematic observation and recording of water sampling at 4 points observation. Observation parameters for physical, chemical and biology, analysis using storet method then compared with water quality standard listed in PP No. 82 year 2001.

Furthermore, the calculation of the quality status compared by the water quality standard which is adjusted by the designation to determine the status of water quality and management directives by using the value system of the US-EPA (United Status Environment Protection Agency) which is divides the water quality in four classes, namely:

a. Class A: excellent, score = 0 (comply the quality standard),
b. Class B: well, score = -1 up to -10 (light contamination),
c. Class C: medium, score = -11 s.d -30 (medium contamination),
d. Class D: bad, score = -31 (severe contamination),

3 Results and Discussions

Description location, administratively located in the area of East Kutai Regency, Bengalon sub-district Tepian Langsat Village, its area 2.571.870 ha of wet tropical rain forest, the physiography is composed by plains of alluvial, swamps, mainland and hilly terrain[2].

Based the profile[2], it is seen that almost all of the village area is dominated by oil palm plantations managed by both plantation companies and individuals. Results of laboratory analysis of water samples at some point in the Bengalon river see Table 1.

a. Physical Parameters

1. Temperature

The average temperature of observations on the Bengalon River is 28.2 °C, this condition its normally categorized, so it does not genertae affect of increasing metabolism process and organisms spread. Its happened due to the fluctuation and dynamics of the waters caused by rainfall effects, and the magnitude of the intensity of sunlight that can penetrate into the river. The process of metabolism and respiration of aquatic organisms will increase the oxygen consumption so that the oxygen requirement will be increase 2 - 3 times, othrwise the waters temperature conditions are in normal so oxygen requrement running as required [3].

2. Dissolved solids (TDS)

The results showed an average of TDS content 256 mg/l or ranged between 110 up to 661 mg/l. the highest TDS value obtained in Mekanying River (location D), which is one of the Bengalon rivers tributary, which is the upstream there are the oil palm plantation area, increased the dissolved solids (TDS) allegedly derived from organic waste which is oil palm plantations waste that concentrated in company outlets and then spread to waters of Bengalon River. Even though there is a tendency to increase dissolved solids in company outlets but the value is still within the permissible value threshold based on water quality criteria (physics-chemical) according to PP. No. 82 Year 2001 on all groups.

Table 1. Laboratory analysis of physical, chemical and microbiological properties of Bengalon River

No	Parameter	Units	Sample				Average
			A	B	C	D	
	Physical						
1	Temperature	°c	28.3	28.2	28.2	28.1	28.200
2	Dissolved Residue	Mg/L	110	123	661	138	258.000
3	Suspended Residue	Mg/L	23	68	56	27	43.500
4	Turbidity	NTU	10	18	22	10	15.000
	An Organic Chemicals						
1	pH *	-	6.87	6.89	6.99	6.99	6.935
2	BOD-5	Mg/L	1.34	1.05	0.96	1.19	1.135
3	COD	Mg/L	17.5	12.7	31.9	29.5	22.888
4	DO *	Mg/L	3.36	2.78	2.28	3.42	2.960
5	NO3 As N	Mg/L	5.96	5.75	9.15	6.65	6.878
6	Nitrite As N	Mg/L	0.04	0.04	0.28	0.05	0.103
7	H2S	Mg/L	Nihil	Nihil	Nihil	Nihil	0.000
8	Iron	Mg/L	1.24	1.36	1.76	1.32	1.420
	MICROBIOLOGY						
1	Fecal Coliform	Jml/100ml	40	110	0	90	60.000
2	Total Coliform	Jml/100ml	40	210	0	150	100.000

Source of Data : Fields analysis on laboratory, (2016).

3 Suspended Solid (TSS)

Suspended solids produced when research conduct showed an average of 43.5 mg/l or ranged from 23 up to 68 mg/l, the data re-shown indicate that location B and C is the tributary which is the upstream on springhead in the oil palm plantation area shows a high figure 68 and 56 mg/l even though the figure is still in the safe zone for classes III and IV. This is in accordance by. [4]that states that if the TSS number is on the range of 25-80 it mean has little effect on the interest of the fishery.

Table 2. Water suitability for fishery interests based on the value of suspended solids (TSS)

Value of TSS (mg/l)	Influence on fishery interests
< 25	No influence
25-80	Little influence
81-400	Poorly for fishery
> 400	Not good for fishery

According to PP. No. 82 year 2001 TSS there are 2 locations (location C and D) not comply for allotment of class I and II whose value is 50mh/l, both two locations the upstream are the oil palm plantation area. Its caused due to the suspended solids of oil palm plantation waste spreading to the waters and undecomposed by the decomposing bacteria (Alabaster and Lloyd, 1982;Effendi 2000). The high of TSS in the waters is sourced from the amount of organic waste that pollutes the waters so difficult to decompose by microorganisms in the waters.

4.Turbidity

The results showed that the average turbidity is 15 NTU (Nephelometric Tubidity Unit) or is in the range of 10-22 MTU (Master Terminal Unit). This illustrates the optical properties of water determined by the amount of light absorbed and emitted by the materials which are contained in water.

Turbidity is caused by dissolved organic or anorganic materials such as mud, fine sand, anorganic materials, organic and other microorganisms. The high turbidity caused by large anorganic and organic particles can reduce the intensity of light entering the waters, thus interfering with the process of photosynthesis. [5]states that turbidity is mainly caused by mud and particles that can precipitate, thus blocking the sunlight that will enter into the waters area

b. Chemical Parameters**.**

1. Degree of acidity (pH)

The results showed that the average degree of acidity (pH) is 6.935, the degree of acidity is still in the range of normal 6-9. This shows the degree of acidity of the water in Bengalon River is still in normal condition so that the existing microorganisms can still activity. [4]states that if a waters have a normal pH then it will not affect the aquatic biology community.

2. Biochemical Oxygen Requirement (BOD5)

Research showed that BOD average value is 1.135 mg/l BOD 5 value when compared to Indonesians Government Regulation No. 82 year 2001 still comply by the requirements for all classes. This indicates that the amount of oxygen required by microorganisms in decomposition so that microorganisms in the waters still work. [6]states that the BOD value indicates the amount of oxygen present in the aquatic areas used for the survival of aquatic biota.

3. Chemical Oxygen Demand (COD)

The research result showed that COD is 22.888 mg/l in accordance with Indonesians Government Regulation PP No. 82 Year 2001 is still normally categorized as class II, III and IV, while class I is not comply, the most contaminated location of COD is at location C (estuary of Mekanying river) which is one of the sites whose estuaries are in the oil palm plantation area. The COD values indicate that the total amount of oxygen required to oxidize the anorganic materials present in the waters is still in a fairly good range. Furthermore [7] stated that the amount of COD content in the water indicates as a measure of water pollution by organic substances that can naturally be oxidized through microbial processes resulting in reduced oxygen supply in water.

3.1 Dissolved oxygen (DO)

The research results indicated that DO average 2.96 mg/l, in accordance to PP No. 82 Year 2001 not comply for the designation of classes I, II, and III but for class IV still comply. It is assumed that the amount of organic waste and mud that pollute the Bengalon River thus blocking the rate of photosynthesis process resulting in dissolved oxygen is increased because it is not utilized in the process of photosynthesis. According to[5], the photosynthesis process causes the increase of dissolved oxygen during the day and reaches maximum in the afternoon. Further [7]states that the amount of dissolved oxygen is also influenced by the photosynthesis process that occurs in the waters.

3.2 Nitrate (NO3-N)

The research result showed NO3-N average 6.878 mg/l and when compared with PP No. 82 year 2001 is still comply for all classes, indicating that the nitrite content is oxidized to perfection. The high nitrate in the water is influenced by the content of nitrite and dissolved oxygen, because the nitrate content that turns to nitrate is also influenced by the dissolved oxygen content contained in the waters [4]. The presence of oil palm plantations does not have a major effect on the increase of NO3-N, indicating the work of nitrobacterial bacteria is running perfectly.

3.3 NO2-N

The research results NO2-N average 0.103 mg/l, nitrite values in normal natural waters conditions found around 0.001 mg/l, but when compared by the water quality standard quality is still comply for allotment class I, II, III and IV. This indicates that the nitrification process in Bengalon River waters is normal. According to[4], states that industrial and domestic waste will cause an increase in nitrite content which if left unchecked will be toxic to animals and humans.

3.4 H2S (Hydrogen Sulfide)

The research results showed H2S content in Bengalon River waters so that they still comply by the requirements for the use of classes I, II, III and IV. This suggests that the decomposition of organic matter conducted by anaerobic bacteria goes well. [7]stated that H2S is very dangerous for aquatic biota life, and the biggest contributor of the waste comes from residential waste and industrial area.

3.5 Iron (fe)

The research results showed the average iron content 1.42 mg/l and when compared with the standard quality listed in Indonesians Government Regulation PP No. 82 year 2001 is not comply for the use of all classes. This shows the amount of metal waste that enters the waters of the Bengalon River. Soemarwoto (2004) states that iron waste is potentially produced from metal waste derived from the metal industry, erosion and use of pest eradication, disease and weed materials using metal raw materials.

c. Biological Parameters

1. Fecal Coliform

The research results showed the average Fecal Coliform 60 Jlh / 100 ml which is still comply for use all the classes as required in Indonesians Government Regulation PP No. 82 year 2001, although at the location of observation B (Asem River) exceeds the required threshold for class I. This indicates that Bengalon river waters are still in normal condition or not contaminated by coliform bacteria that are commonly found in animal waste, including humans. [4] states that the presence of coliform bacteria is often found in animal or human feces.

2. Total coliform

The research results that the average Total Coliform 100 ml/100 ml, this indicates that the Bengalon River waters are still comply for use all classes. It also indicates that the microorganisms in these waters have not been contaminated by pathogens. The status of water quality in Bengalon river after comparing with the water quality status of each class and calculated by Store method see table 3.

Table 3. Quality Status of Bengalon River by Storet method

Water Quality Status	Number of Storet Calculations	Water Quality Status of Bengalon River
Class I	*-42*	Heavily Contamination
Class II	*-21*	Medium Contamination
Class III	*-16*	Medium Contamination
Class IV	*0*	Comply Quality Standards

Source of Data: Primary data that has been processed in 2017

The calculation result of Storet as shown in table 3 shows the number - 42 which if compared with water quality standard class I can be categorized as heavily contamination. Parameters that exceed the standard water quality class I sourced from chemical parameters namely TSS, COD, DO, NO2-N, Iron and Fecal Coliform. This indicates that Bengalon river waters if intended for drinking water sources must go through a processor to reduce the level of waste.

Based on table 3 above, it can be seen that water quality status for class II is contaminated with total scor -21, pollutant source that exceeds the water quality standard occurs on physical parameters ie TSS and chemical parameters ie COD, DO and NO2-N. this indicates the allocation for aquaculture but lack of oxygen or DO in Bengalon river waters which averages only 2.96 mg/l should be anticipated. In accordance with the opinion of [5] states that the oxygen conditions in the waters are in good condition it will allow the biota to breed optimally, good DO value is > 4 mg/l. the average value of DO 96 Mg/L has an adverse effect on the fishery interest of the lack of dissolved oxygen value is thought to be the result of oil palm plantation waste.

The calculation result of Storet as shown in Table 3 for class III is categorized as medium polluted with total scoring of -16, pollutant source is derived from chemical parameters ie DO and NO2. This indicates that the Bengalon River is poorly used for aquaculture needs and for the purposes of watering agricultural crops, but if doing the processing first, for example by an opinion it can be used for those needs. Table 3 shows the total score for the class IV water quality is 0 so it can be categorized as comply the quality standard intended for class IV. This shows that the waters of the Bengalon River water can be utilized for irrigation. Generally, Bengalon river waters condition is still categorized as medium pollution or can still be used for allotment of class I, II, III, and IV as long as through the processing first, it shows that the existence of oil palm plantation in Bengalon river catchment area does not have much effect to pollution water.

4 Conclusion

Based on the research results can be taken some conclusions as follows; (1) The condition of the Bengalon river waters at the time of the research has begun to be contaminated with physical and chemical waste especially TSS, DO and Iron, (2) The Bengalon River Quality Status for class I was categorized as heavily polluted with a total score of -42, class II was classified as medium polluted with a total score of -21, and class III was classified as medium polluted with a total score of -16. While for class IV is categorized to fitness the water quality standard with a total score of 0, (3) The existence of oil palm plantations located in the upstream of the Bengalon River does not significantly affect the pollution of waste either on physical, chemical, or biological parameters. In order to maintain the water quality of the Bengalon River, it is necessary to manage the limitation of waste disposal. Monitoring the water quality of the Bengalon River also needs to be carried out periodically to determine changes in water quality

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