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STUDY OF QUALITY CHANGES AND DETERMINATION OF WATER POLLUTION INDEX AT RIVER WATERSHED BENGKULU

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ABSTRACT: Bengkulu Existing problematic conditions on water quality. Seeing the importance of water quality because it is the only source of mineral water Bengkulu city in which the water flowing from the fountain in Central Bengkulu Regency. Context territory that includes two administration (city of Bengkulu and Central Bengkulu District) causing the water quality is not controlled and there is no valid data for data management of the waters of the river basin. So, the purpose of this study to analysis the quality of river water in the river watershed segmentation Bengkulu. In order to obtain the level of water quality and water pollution index of a river that became a trend among regions and be detail data for watershed management policies. This study was conducted to test the water quality of the physical parameters, chemical and biological by comparing the results of laboratory tests of water quality 2 seasons. This method is very good for being able to analyze and describe the trend of changes in water quality in the watershed Bengkulu. Data obtained from secondary data and primary data. Secondary data is the result of testing during the dry season. Primary data are data that represent the results of field tests of the rainy season. After the data collected then do the test according to river water quality standards appropriate Government Regulation No.82 of 2001 each parameter water. Then calculated the level of pollution in accordance with the model *storet* Minister of Environment Decree 115 of 2003. Based on exposure to the above results it can be concluded that the water quality in the watershed physically Bengkulu river water during the rainy season and dry season condition with variations in color and turbidity is murky brownish with no difference significant changes in temperature. Chemical and Biological water quality is a significant change in the elements of the TSS, BOD_5, COD, and metal content (Fe, Mn, and Cu) which exceeds the limit of the watershed water quality standard Bengkulu. These changes will have an impact on water biota that live in the river because of the water conditions so. So, it can be seen that the river water biota disrupted by the changes in the water. Indications are some companies that exist in mines and factories dump wastes in the river. The quality of water exceeds the water quality standards in the segment of river watershed upstream section that is affected by the mining activities and encroachment of forests due to agricultural extension *ie*. oil palm plantations by the community. While in the Central Part of the watershed is affected by rubber and palm oil processing plant palm. Bengkulu watershed-level water contamination, that the river is heavily polluted with values exceeding water quality standards of pollution. Pollution caused by the exploitation of mining and agricultural extension in DAS Bengkulu give clear results that Bengkulu river is heavily polluted with an indicator that the water turbidity never be above normal during the rainy season and the dry season and the area of the river segment.

Keywords: Water, Watershed, Quality, Pollution

1. INTRODUCTION

Changes in water quality conditions caused by land use, lithology, time, rainfall and human activities that lead to pollution of river water, whether physical, chemical, and biology [1] [2] [3] [4] [5] his is further exacerbated by the activities of border communities along the river Bengkulu like opening the palm plantation, rubber, rice fields, the expansion of settlements, and others that result in reduced extent of watersheds and riparian plants typical of the impact on the ecosystem in the waters of the river. At this time, one of the topics raised in Bengkulu within 2 to 3 years of the past is the presence of coal mining waste from watersheds (DAS), especially those in Central Bengkulu District to the coastal zone of Bengkulu in Bengkulu City.

Indications mine material is derived from the erosion of the hill containing the coal in the upper reaches, and which is a private company mining center [6] [7] [8] [9] [10]. It is probable also that the fragments of coal that dissolve on the river water has condition has been polluted by the coal is very dangerous to health according to the research results communal land in the year 2009, the level of turbidity waters of Bengkulu was on the threshold of which

amounted to 421 NTU of 5 NTU *Permenkes* 907 set in 2002 on water quality control. In addition to the level of turbidity, discoloration tolerated by 15 PERUSAHAANCO already stood at 267 PERUSAHAANCO. The iron content stood at 0.76 mg / L of intolerable numbers of 0.30 mg / L. Waste coal washing after investigation contain substances that are very harmful to human health if the water is consumed [11] [12] [13] [14] [15], The waste contains sulfur, mercury, clarida acid, sulfuric acid manganese and lead. Hg and Pb is a heavy metal causing human skin diseases such as skin cancer. Coal waste comes from upstream, from coal washing. There are two companies active in mining 20 years ago, and the washing thrown into the Bengkulu. Coal waste can be found 30 kilometers from the Bengkulu River from the village of Karang High Penanding Central Bengkulu district to Bengkulu River estuary.

Watershed conservation value [16] [17] [18] [19] [20] which is especially important as a buffer of community life in the capital of the province of Bengkulu. Bengkulu DAS is one source of tap water in the city of Bengkulu. Bengkulu River water source watershed serving 6,000 customers, while 21,000 customers served from the source of the Air Nelas. DAS Air Bengkulu ecosystem conditions currently experiencing degradation due to the absence of a good concept and integrated management. Air Bengkulu upper watersheds as water catchment areas are no longer functioning properly. Conversion of forests to agriculture and farming, the practice of illegal logging in protected forests and nature reserves, as well as agricultural patterns, are not conservative are the main reasons for the increased erosion, sedimentation and river discharge fluctuations [21] [22].

2. RESEARCH METHODS

The research data is analysis and hypothesis testing is done by regression logistic. Based on the source, the data can be divided into two primary data and secondary data [24] [24], the following will explain the types of data and data sources used in this research are:

Data

Primary data is data obtained and measured in the field. The primary data used in the study is the result of water quality measurements watershed Bengkulu The Environment Agency laboratory Bengkulu province and interviews with sources and documentation field. Primary data in this study is the river water to determine water quality. Primary data of water qualityDAS Bengkuluis as follows: Sampling of water plays an important role in water quality monitoring. Therefore, the required accuracy and precision analysis sampling system because it will affect the analysis result data [25] [26] If there is an error in the sampling, the samples taken are not representative that will be the basis of considerations that one of the conclusions and policy. To get a good sample and a representative one of the requirements that must be met in selecting the right location, otherwise, it means sampling and treatment of samples in the field is to be done properly [27] [28] [29] [30] [31] the location is set to represent sampling locations:

1). The quality of the water before the influence of human activities, namely at locations upstream which is intended to determine the water quality naturally as the baseline station.
2). The influence of human activities on water quality and the effect of utilization. This location is intended to determine the effect of human activity called "impact stations".
3). The sources of pollution that can enter hazardous substances into the water source. This location is intended to determine the source of the spread of dangerous materials so that it can be tackled.

With the above considerations, as well as the number of funds available, then determined the sampling point three (3) locations, the location of the river water samples were determined by using a "sample survey method" is the method of survey divides the study area into stations are expected to represent the study population [32] [33] [34] [35] [36], Determination of the sampling point do 3 point is to divide the river into three segments based on the characteristics of the land use and community activities while considering ease of access, cost and time to be determined dots that are supposed to represent the water quality of the river watershed Bengkulu.

1). The location is assumed to be uncontaminated (uplands) that is in the river area Bengkulu High Karang Tengah.
2). Location midpoint along the stretch of river where river water is used as a domestic sewage and industries are in the river area Talang District of Central Bengkulu District Four.
3). The location downstream of the point where the river water used (coal mining) that is in the river area Muara Bangkahulu Bengkulu City.

River water sampling done as much as 1 (one) time on March 30, 2015 on the river at the rate of 5 m3 / sec - 150 m3 / sec, samples taken at two points each at a distance of 1/3 and 2/3 the width of the river at a depth of 0.5 times the depth of the surface. At this point

Data analysis technique

Analysis of the data for physical and chemical parameters of river water in the river basin water is by the method *storet* Bengkulu is one method for determining water quality status that is commonly used [37] [38] [39] [40] [41] With this *storet* method, can be known parameters that have met or exceeded the water quality standard. In principle, *storet* method is to compare water quality data with water quality standards that are tailored to its purpose in order to determine the status of water quality. How to determine the status of water quality is to use the system value of "US-EPA (Environmental Protection Agency)" to classify the water quality in four classes, as in Table 1.

Table 1. Determination of Water Quality Status

Class	Score	Information
Class A: excellent	0	meet quality standards
Class B: good	-1 s / d -10	lightly blackened
Class C: medium	-11 s / d -30	blackened medium
Class D: bad	≥ -31	heavy polluted

Source: US-EPA (Environmental Protection Agency)

Determination of the status of water quality by using *storet* done with the following steps:

1) Perform water quality data collection and discharge of water periodically so as to form the data over time (time-series data).
2) Compare the measured data of each parameter water quality standard value which corresponds to the water.
3) If the measurement results meet the water quality standard value (the measurement result <standard quality) then given a score of 0.
4) If the measurement results do not meet the water quality standard value (the measurement results> quality standards), it is given a score. In accordance with the calculation of the value system/score to determine the status of water quality.
5) The negative amount of all the parameters are calculated and determined its quality status in accordance with the quality standards

3. RESULTS AND DISCUSSION

Water quality

Water quality is a condition that indicates water content of living creatures, substances, energy or other components present in the water. The water quality is expressed by parameters that describe the condition of the water. Water quality parameters include parameters of physics, chemistry, and biology. These parameters are measured using specific methods in accordance with the applicable legislation. Physical parameters include temperature, dissolved solids, and suspended solids. Chemical parameters include pH, BOD, COD, DO, and levels of metals include iron (Fe), manganese (Mn) and copper (Cu). Biological parameters include the presence of coliform bacteria. These parameters are compared with Government Regulation No.

DAS Bengkulu River is one of the pre-determined allotment corresponding stream classes. According to In Regional Regulation No. 6 of 2005 concerning Water Quality Standard and Class Cross River Water District/City in Bengkulu that DAS Bengkulu set criteria for water quality class I, *ie* water allocation can be used for drinking water or other uses that require the same water quality with these purposes.

Water quality data obtained by performing secondary data and primary data in order to analyze the changes in the water quality of the watershed Bengkulu. Data used in this study is a comparison and analysis of the research conducted. Data obtained from the Environment Agency Bengkulu province conducting monthly monitoring period Bengkulu River water quality on October 16, 2014, so the data can represent the water quality analysis in the rainy season.

While the primary data obtained by direct sampling and laboratory analysis conducted on March 30, 2015. From these results, we can represent the analysis of water quality in the dry season. Collecting data with secondary data and primary data will be described as follows:

Physical properties of water

Physical parameters were measured and observed in the study site is the color, smell, temperature and suspended solids (TSS).

Color

The results of measurements and observations of the colors in the research area of the Upper Part, Middle and Lower River watershed Bengkulu is as follows: States that the river water discoloration caused the unit value increased color. The increase in the unit value of

the color indicates the addition of dye in water, thus increasing the deviation or cause discoloration of the original color of the river water. While the decline in the unit value of the color gradually due to the deposition process and decomposition of solid particles, causing the color of the water approaches its normal condition.

Indonesian Government Regulation No. 82 of 2001 on water quality management and water pollution control is not set water quality standards for color. In general, the river water watershed Bengkulu still a quite murky brown. Watercolor detection performed by the senses of sight, this detection will be more accurate if you proceed with the detection of turbidity.

The observations were carried out during the dry season the river water brownish, yellowish-brown and murky brown. The observations can be presumed that water contaminated by iron, and in the rainy season the water becomes murky color on the river upstream, middle and on the river downstream brownish color. The color combination of the water so the erosion caused by the flow of water carrying soil material as a result of coal mining in the headwaters of Bengkulu River watershed. Turbidity is an efFect that happens if the beamforming material suspended in the water. Water turbidity can be caused by the presence of organic materials and inorganic sludge and effluent, from a certain surface that leads water to become cloudy.

Turbid water caused by soil particles, in which the soil particles are capable of binding some minerals, so that the water looks partly there are black, white, and there is also visible watercolor orange [42] [43] [44] [45] [46]. For the watercolor can be identified that the color black water contains calcium and magnesium, the color of water identified as containing aluminum, arsenic muscilage, and asbestos, while the orange color identified water containing oxidized iron.

Water containing high turbidity will have trouble when processed to a clean water source. The difficulty, among others in the screening process. If the screening process can be done will require greater costs and possibly expensive [47] [48] [49] [50] [51].

Table 2. Color Parameter Analysis Results

River	Dry season	Rainy season	Quality standards
The upstream	Chocolate	cloudy	
Middle part	Yellowish-brown	cloudy	-
downstream	Brown cloudy	yellowish	

Smell

The results of measurements and observations water smell in the research area of the Upper Part, Middle and Lower River watershed Bengkulu is as follows:

The smell of the water can be caused by foreign objects into the water like dead animals, waste material, or due to the decomposition of organic compounds by bacteria. In the event of decomposition of organic compounds made by these bacteria produced foul-smelling gases and some even poisonous. The smell of the water arising from the decomposition of organic substances and wastes from factories are located at the headwaters of the river estuary.

Water research results DAS Bengkulu upstream, middle and downstream sections are odorless. The study was conducted with the sense of smell in water samples taken, water conditions are not contaminated by the smell in the water. The smell of the water in the study area had no effect on coal mining. But coal mining in river watershed Bengkulu odor-causing little mud as a result of due posed by the water.

Table 3. Temperature Parameter Analysis Results

River	Dry season	Rainy season	Quality standards
The upstream	odorless	odorless	
Middle part	odorless	odorless	-
downstream	odorless	odorless	

Temperature

The results of temperature measurements and observations in the research area of the Upper Part, Middle and Lower River watershed Bengkulu is as follows Height lower river water temperature is influenced by the temperature of the surrounding air. Besides, the intensity of sunlight that enters water bodies as well as the density of vegetation around water banks will also affect the temperature of the river water. The intensity of sunlight is affected by cloud cover, season, and time of day of the study. The more the intensity of sunlight on the water body will make the higher temperature of the river water. Similarly, more and denser vegetation around the banks of the water will make the surrounding air temperature becomes lower, so the river water temperature is also lower [52] [53]. The results of temperature measurements DAS Bengkulu waters of river segments to Section Downstream Upstream section shows the water temperature ranges between 24-250C. The temperature conditions are still in the water quality standard limits according to Government Regulation No.82 of 2001, where the water quality standard Class II requires that the temperature of the river water has different conditions of temperature deviation of 30C from the natural surroundings. This means that the river water can still be considered normal that they can be used for drinking water allotment of raw materials that can be consumed by humans.

Total Suspended Solids (Total Suspended Solid)

The results of measurements and observations total suspended solids (total suspended solids) or TSS On-site research from Section Upper, Middle, and Lower River watershed is as follows Bengkulu Suspended solids are solids that can cause turbidity in water, not dissolved and can not be settled directly [54] [55]. This is in accordance with the [1] [7] [8] [9] [10] suspended solids positively correlated with turbidity. The higher the value of suspended solids, the turbidity value is also higher. Turbidity in waters inundated (tapering) as the lake is mostly caused by suspended material in the form of colloid and fine particles, while the turbidity of the river that is flooding caused by the materials suspended larger form of the surface layer of soil-borne the flow of water during the rains.

TSS measurement Bengkulu watershed water conditions at the time of sampling cloudy because there is stormwater runoff from the land caused by coal mining activities in the Region Upstream and coal mining or collecting waste along the riverbanks. The suspended solids content was positively correlated with turbidity that will reduce the penetration of sunlight into the water and affect the production of oxygen by photosynthesis [1] [56] [57].The higher the solids suspended in the water then the water will be turbid. Turbidity in the river caused by suspended solids in the form of a surface layer soil carried by the flow of water during the rains, According to [1] [9] [10] that sediment in runoff water coming from forest land is strongly influenced by mining activity, which at the time mining the amount of sediment in the water has increased.

This condition causes the value of TSS in the river water in the watershed Bengkulu to exceed the quality standards required. River upstream section 219.20 exceeds the quality standard that is during the dry season and the rainy season 175.75. While the upstream section of the river, the Middle and Lower fluktuasi diferent experiences during the rainy season. Part of the river upstream exceeds the quality standard that is 175.5 and Fell below the river water quality standard that is Central Section 24.50 and 15.00 downstream. In the dry season the river section upstream TSS condition, Central and Lower Sections quality standard that exceeds the upper section 154.90, 219.20 and the central part of the downstream section 68.52. For more details, here are presented in graphical form as follows:

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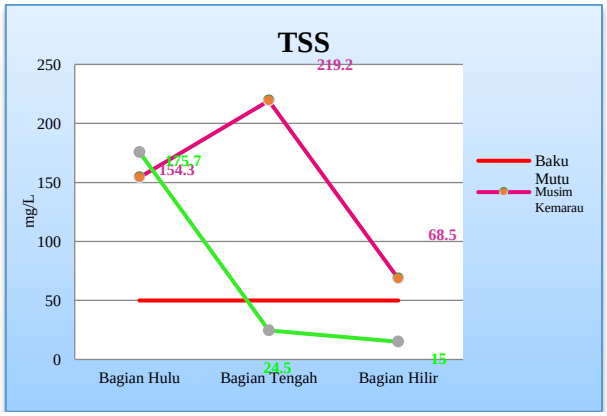

Figure 1. TSS Bengkulu River Basin

TSS measurement results Bengkulu River watershed upstream section, Middle and Lower show TSS ranged from 68-154 mg / l in the dry season while in the rainy season between 15-219mg / l. Increasing the value of TSS in the Central Part of the river allegedly sewage plant BAM COMPANY, ITS BBP, AST and COMPANY CREW. Identification of significant shows a drastic increase in the value of TSS river that passes through the Central Section 4 COMPANY flowing from it. Additionally, for the affected land cover change in DAS (Prathap, stiff, Chakraborty, & Tanushree, 2016), DAS Bengkulu Upper and middle part of this now emerging will open up land for oil palm plantations. It is also a major problem for the high open land in watershed areas that often rain. So that the flow of run-off gives the cause of the turbidity level of the water and TSS parameters. The DAS Bengkulu. The suspended solids parameter exceeds a threshold water quality standards according to Government Regulation No. 82 of 2001, where the water quality standard Grade I and II requires that the suspended solids in river water are a maximum of 50 mg / l.

So it can be said that the river does not meet the criteria for Class I. This means the water quality of river water watershed Bengkulu can not be used as raw material for drinking water.

Chemical Properties of Water

pH

Results of pH measurement and observation in the study site of the Upper Part, Middle and Lower River watershed Bengkulu is as follows: Water that has a high pollutant material will have a low pH. In accordance with the statement [6] [7] [8] [9] [10] that a low pH indicates the number of wastewater discharged into water bodies and can not be recovered naturally (self-purification) by river water. The waste particles can be dissolved, suspended or who is colloidal. Stated that the location with the lowest pH may have a total suspended solid (TSS) highest. Results of pH measurement Bengkulu DAS river water showed pH of the water from the Upper Section, Middle and Lower river is at a normal condition that has a pH value of the average is 6. For more details, here are presented in graphical form as follows:

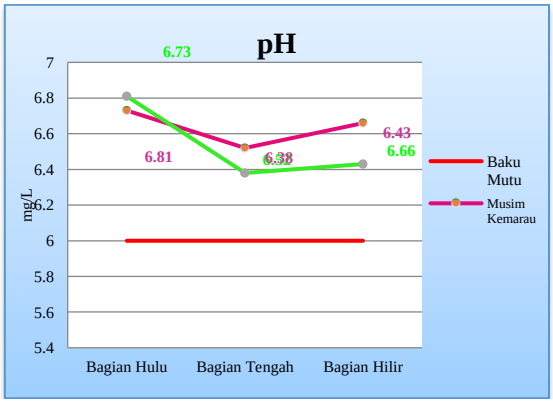

Figure 2. pH Bengkulu River Basin

From the picture above can be explained that the River Midsection decreased pH value even though still considered normal, but if the observed pH value decreased alleged contamination of the effect of the Company's factory BAM, the Company MDS, the Company AST and Company KRU that is along the river segment Middle part. Indications are that the decrease in the pH value caused because the sewage plant undergoes a chemical reaction and lead to a decrease in the pH value of water.

The degree of acidity (pH) of water indicates the presence of hydrogen ions in From the picture above can be explained that the River Midsection decreased pH value even though still considered normal, but if the observed pH value decreased alleged contamination of the efFect of the Company's factory BAM, the Company MDS, the Company AST and Company KRU that is along the river segment Middle part. Indications are that the decrease in the pH value caused because the sewage plant undergoes a chemical reaction and lead to a decrease in the pH value of water.

The water. This is because the hydrogen ions are acidic. Most aquatic organisms are sensitive to changes in pH and the pH value greatly affects the biochemical waters, for example, the process will end on a low pH. Effect of pH value on aquatic biological communities can be seen at a pH value 6 of the research results in the watershed according to Bengkulu.

BOD

BOD measurement results and observations in the research area of the Upper Part, Middle and Lower River watershed Bengkulu are as follows Based on the BOD measurement of the river water upstream section, Middle and Lower show BOD values ranging between 1,21- 4,43 mg / l. BOD value from upstream to downstream tends to fluctuate. In the dry season the river Central Section and Section Downstream BOD concentration below the water quality standard. While the rainy season is quite high concentrations of BOD values of the Upper Section 2.82, Middle Section 4.43 and Section 2.00 Downstream. BOD is the amount of oxygen needed by bacteria to decompose (oxidize) nearly all the dissolved organic matter and some elements of organic material suspended in water.

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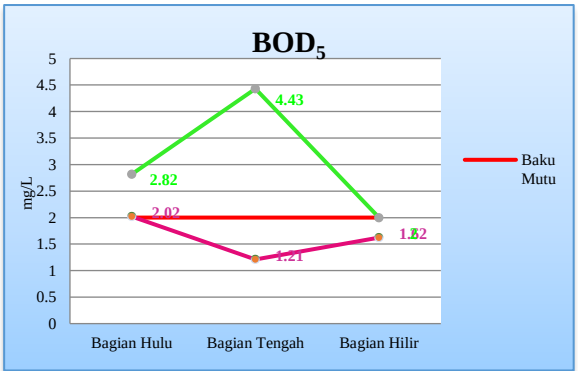

Figure 3. Bengkulu River Basin BOD5

COD

COD indicates the amount of oxygen required to chemically oxidize organic materials, both of which can be degraded biologically (biodegradable) and are difficult to degrade biologically (non-biodegradable). COD measurement results and observations of river water in the research area of the Upper Part, Middle and Lower DAS Bengkulu is as follows

COD parameter measurement results subzone Bengkulu river water downstream in Section Upper, Central and Lower show the COD value ranges between 16-160 mg /l, The COD parameter has exceeded the threshold of river water quality class I to class IV according to Government Regulation No. 82 of 2001 which requires COD in river water quality standard value of 10 mg / l.

COD concentration in the dry season from upstream to downstream tends to increase. The high concentration of COD associated with the presence of organic matter in the water. In Part Downstream segment during the dry season COD concentration increased when compared to the upstream section and the Centre section of the river. This relates to the activities of people who use the river water watershed Bengkulu as domestic waste disposal sites such as bathing, washing waste into water bodies. The community activities led to an increase in organic matter in river water.

In the rainy season, COD concentration was highest in the Upstream section ie 32 mg / l. COD concentration in this segment has exceeded the water quality standard Class II river. This is due to industrial activities that dump waste into the river water containing organic material. There are two rubber raw material processing industry and CPO processing industry and coal mining, which is located around the river has had WWTP but do not meet the technical requirements, so that the wastewater discharged contribute organic matter in river water. For more details, here are presented in graphical form as follows:

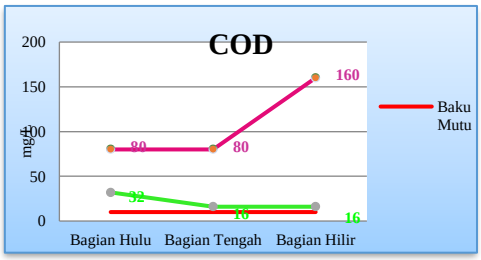

Figure 4. DO COD Air Bengkulu River Basin

According to (Nufus et al., 2017)the presence of organic material in the water can come from natural or household and industrial activity. COD value in uncontaminated waters usually less than 20 mg / l, by COD concentration in river water watershed Bengkulu at the sampling point in the dry season has increased very significantly. This identification is caused by people's activities in the river downstream part of coal mining waste along the river.

These activities besides by COD value of 160 mg/l, the value of which is quite high compared to the value of COD in the other sample points. While the decline during the rainy season due to high river water during the rainy season, causing no mining activities at the banks of the river watershed Bengkulu.

DO

Dissolved oxygen is an important parameter that is used to determine the quality of a body of water (Salmin, 2005).

The results of the measurement of dissolved oxygen waters of the watershed Bengkulu at the point of sampling locations of Part Upper, middle and lower reaches of the river are as follows: The results of measurements of dissolved oxygen River watershed Bengkulu on the location of the sampling part of the Upper, Middle, and Lower show that the value of dissolved oxygen ranges between 5.23 to 7.24 mg / l. The dissolved oxygen concentration still meets the criteria for river water quality class I. The quality standard specified levels of dissolved oxygen is a minimum threshold number. In freshwater, dissolved oxygen levels ranging from 15 mg / l at a temperature of 00C and 8 mg / l at a temperature of 250C. Minimum dissolved oxygen concentration for microbial liFe can not be less than 6 mg / l(Art, Geography, and Gadjah 2011; Sulfikar, 2013). For more details are presented in graphical form as follows:

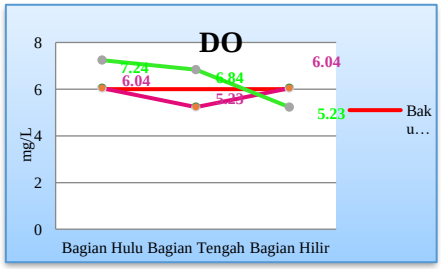

Figure 5. DO Bengkulu River Basin

Based on the levels of dissolved oxygen in the water, river water quality conditions Bengkulu DAS can still be used to support aquatic liFe (> 6 mg / l). DO value from the graph above it can be seen that a decline in value at the point of sample Do River Middle Section. This indication can be seen in the Central Section polluted rivers by sewage plant BAM Company, ITS BBP, AST and Company Company CREW that throw waste in the dry season to the value of Do is 5.23 mg / l. This indication in accordance with (Harianja et al., 2018)DO low value due to the abundance of industrial waste into the river. Decreased levels of dissolved oxygen in water is a strong indication of contamination. This resulted in the difficulty of living marine organisms in the water because it has exceeded the tolerance levels of DO aquatic organisms, even though there are a Few organisms that can live in it.

Iron (Fe)

The results of measurements and observations Fe in the research area of Part Upper, Middle and Lower River watershed Bengkulu is following the results of measurements of the iron (Fe) river watershed Bengkulu on the location of the sampling part of the Upper, Middle, and Lower shows that the value of the ranges from 0, 45 to 4.52 mg / l. Fe concentration exceeds the criteria for river water quality class I. The quality standard specified Fe is a number that is the maximum limit of 0.3 mg / l..

From the picture above Fe value has increased drastically in the river sample points upstream section both in the rainy season and dry season. This identification shows Fe high value in the dry season it identifies that the coal plant wastewater pollution in the river area Bengkulu River watershed. Fe value in the dry season to 4.23 mg / l, while in the rainy season of 1.2 mg / l exceeded the water quality standard of 0.3 mg / l.

High levels of Fe is caused by land clearing land uncovers topsoil layer, thus causing mineral content Fe exposed upward. Then when washing waste directly coal washing wastewater flowing into the river watershed agency Bengkulu.

Manganese (Mn)

From the table above it can be concluded that increasing the Mn Vilain caused by mining activity mine located in the upper river. Identification is seen in the rainy season in the river section upstream sample point Mn value of 0.8 and in the dry season the river downstream section 0.4.

From the graph below Cu, values have increased dramatically in the river sample points upstream section both in the rainy season and dry season. This identification indicates a high Cu value in the rainy season it identifies that the coal plant wastewater pollution in the river in Bengkulu River watershed. High levels of Cu is caused by land clearing land uncovers layers of topsoil, causing the minerals Cu exposed upward.

Then, when the rainy season the runoff that carries soil and outcrop coal washing waste directly drain wastewater into the river watershed Agency Bengkulu. This identification line. Copper heavy metal suspected to come from the coloring process in industrial processes and the accumulation of the original sites. Cu originating from industrial production processes.

Nature of Water Microbiology

Results of measurement of total coliform bacteria in river water sampling locations of the Upper Part, Middle DAS Bengkulu shows that the number of total coliform bacteria per 100 ml of water of the river ranges between 16000-24000 cells. Parameters of total coliform bacteria in the river at the location of the sampling point upstream section, Middle and Lower has exceeded the water quality criteria for class I but the numbers still meet the criteria for river water quality class II.

The highest number of total coliform bacteria is shown in Part upstream during the rainy season, reaching 24,000 cells. The content of total Coliform obtained at the intake is proportional to the content of total coliform in the river water that is> 1100, because in the daytime has occurred because of community activities around the river,

Air Pollution Levels

Results of analysis of water quality in the dry season of the results of research supported by secondary data in the rainy season and then used as the determination of water quality status with *Storet* method. Calculation of water quality status attached. While the results are presented in the table below are divided into divisions according to samples taken at the river watershed Bengkulu. The determination is based on samples taken river representing the Upper Part, Middle and Lower. *Storet* index Analysis according to Decree 115 of 2003 on water quality standards following table:

Value Index Storet River upstream section

Table 3. Water Quality Section River Upstream

Parameter	Unit	standard quality	Measurement results			Score			Ket.
			Mak *	Min *	price *	Mak *	Min *	price *	
Physics									
Temperature	^{O}C	D3 *	25.00	24,00	24.83	0	0	0	0
Smell	-	-	-	-	-	-	-	-	-
Color	-	-	-	-	-	-	-	-	-
TSS	Mg / l	50	175.5	154.9	165.3	-1	-1	-3	-5
pH	-	6-9	6.81	6.73	6.77	0	0	0	0
Chemistry									
DO	Mg / l	6	7,24	6.04	6,64	-2	-2	-6	-10
BOD5	Mg / l	2	2,82	2.02	2.42	-2	-2	-6	-10
COD	Mg / l	10	80	32	56	-2	-2	-6	-10
Fe	Mg / l	0.3	4.52	1.20	2,86	-2	-2	-6	-10
M N	Mg / l	0.1	0.80	0.20	0.50	-2	-2	-6	-10
Cu	Mg / l	0.02	1.33	0.24	0.78	-2	-2	-6	-10
Biology									
total Coly	Tot / 100 ml	1000	24000	16000	20000	-3	-3	-9	-15
Total score									-80

Source: Data Processing, 2015
* Max = Maximum, Man = Minimum, Average = Average, D3 = Deviation 3 means a temperature of 20-30 0C

From the table above that shows that the index value indicates *storet* upstream section of the river is heavily polluted. The indication in accordance with the Ministerial Decree 115 of 2003 which states that the value of the index *storet* > -30. The high value is due to several parameters measured experiencing a significant increase in TSS, DO, COD, and metal content (Fe, Mn, and Cu) and biological parameters, namely total coliform. The high value of the parameter is indicated by the coal mining upstream. Coal mining, which directly disposes of waste into water bodies both the rainy season and dry season.

Value Index Storet River Middle Section

Table 4. River Water Quality Status Midsection

Parameter	Unit	standard quality	Measurement results			Score			Ket.
			Mak *	Min *	price *	Mak *	Min *	price *	
Physics									
Temperature	^{O}C	D3 *	25.00	24,00	24.83	0	0	0	0
Smell	-	-	-	-	-	-	-	-	-
Color	-	-	-	-	-	-	-	-	-
TSS	Mg / l	50	219.2	24.5	121.8	-1	0	-3	-4
pH	-	6-9	6,52	6,38	6.45	0	0	0	0
Chemistry									
DO	Mg / l	6	6,84	5.23	6.03	-2	-2	-6	-8
BOD5	Mg / l	2	4.43	1.21	2,82	-2	-2	-6	-8
COD	Mg / l	10	80	16	48	-2	-2	-6	-10
Fe	Mg / l	0.3	1.57	0.45	1.01	-2	-2	-6	-10
M N	Mg / l	0.1	0.5	0.2	0.3	-2	-2	-6	-10
Cu	Mg / l	0.02	0.16	0.07	0,115	-2	-2	-6	-10
Biology									
total Coly	Tot / 100 ml	1000	16000	16000	16000	-3	-3	-9	-15
Total score									-75

Source: Data Processing, 2015
* Max = Maximum, Man = Minimum, Average = Average, D3 = Deviation 3 means a temperature of 20-30 0C

From the table above that shows that the index value indicates *storet* upstream section of the river is heavily polluted. The indication in accordance with the Ministerial Decree 115 of 2003 which states that the value of the index *storet* > -30. The high value is due to several parameters measured experiencing a significant increase in TSS, BOD5, COD, and metal content (Fe, Mn, and Cu) and biological parameters, namely total coliform. The high value of the parameter is indicated by the coal mining upstream. Coal mining, which directly dispose of waste into water bodies both the rainy season and dry season. And indications were allegedly also had no direct impact as a result of factory activity in the river Midsection. The industries that dispose of industrial waste directly into water bodies, disregarding the quality standard of wastewater discharged into the river.

Value Index Storet River Downstream Section

Index value indicates *storet* upstream section of the river is heavily polluted. The indication in accordance with the Ministerial Decree 115 of 2003 which states that the value of the index *storet* > -30. The high value for some measured parameters had significant improvement in COD and metal content (Fe and Cu) and biological parameters, namely total coliform. The high value of the parameter is indicated by the coal mining upstream. Indications are allegedly no direct influence due to the coal mining activities along the river. The coal waste collection economically makes a new livelihood to the surrounding community, but ecologically led to pollution of river water watershed Bengkulu.

Based *storet* index value indicates that the rivers in the watershed of Bengkulu, which is heavily polluted from the upstream section of the river until the river downstream section. The river pollution caused by the high parameters of physical, chemical and biological river water exceeds the threshold value of river water quality standard. Pollution of the river upstream to -80 *storet* index value that is high enough numbers to the average pollution index if heavily polluted river water according to MOE Decree 115 of 2003 is -11 through -30.

Decline in water quality caused by sediment derived from erosion and industrial waste (pollution) and increased mining activity that is not followed by the conservation techniques. River water pollution in the upstream section is indicated by mining coal by the Company There are four coal firms in the upstream areas of Bengkulu River watershed that DMH Company, IPB Company, Company BS and Company ETA. The coal mining activities less all operating since the 1990s until now. This is in accordance with Parake JJ (2014) The mine sites operate in Air Kandis the South Hill Village Sunur Penanjung Tabak Central Bengkulu District in the area of 800 ha. And high rates of rainfall in the watershed area Air Bengkulu is 3118 mm.

Such conditions lead to frequent rains and correlated with the flow of run-off on the former minelayer, so that the water quality decreases. Indicators of pollution caused by the high value of significant TSS, DO, COD, and metal content (Fe, Mn, and Cu) and biological parameters, namely total coliform. River water pollution in the Central Section is indicated by industrial activity is along the River watershed Bengkulu namely BAM Company factory, BBP Company, the Company, and the Company AST KRU. The Company Activities throw waste into the river, the pollution indicators caused by the high value of significant TSS, BOD5, COD, and metal content (Fe, Mn and Cu) and biological parameters, namely total coliform.

The waste company could not be readily decomposed by water directly, because when the waste disposal does not pay attention to the aspects of environmental sustainability. The company alleged waste and overflow or exceeds the carrying capacity of the waste bin during the rainy season. So it flows into the river Bengkulu unnoticed levels of water quality standards must turn waste dumped into the river. The following spatial visualization Company's presence through googles earth. River water pollution in the downstream section of society industrial activity indicated by the mining of coal along the river. According to the Environment Agency Bengkulu Province (2008) the number of miners was approximately 500 people. The mining activities resulted in eroded soil sediment from upstream to light and cause the water to become contaminated. Indicators of pollution caused by the high value of significant TSS, BOD5, COD, and metal content (Fe and Cu) and biological parameters, namely total coliform. Following visualization of the presence of coal mining along the river downstream subzone Bengkulu

4. CONCLUSION

Based on exposure to the above results it can be concluded that the water quality in the watershed physically Bengkulu river water during the rainy season and dry season condition with variations in color and turbidity pollution is murky brownish with no difference significant changes in temperature. Chemical and Biological water quality is a significant change in the elements of the TSS, BOD5, COD, and metal content (Fe, Mn, and Cu) which exceeds the limit

of the watershed water quality standard Bengkulu. So it can be seen that the river water biota disrupted by the changes in the water. Indications are several companies in the mining and company throw their waste in the river. The quality of water exceeds the water quality standards in the segment of river watershed upstream section that is affected by the mining activities and encroachment of forests due to agricultural extension *ie* oil palm plantations by the community. Then the arithmetic results in Bengkulu watershed-level water contamination, that the river is heavily polluted with a value that exceeds the quality standards of water pollution. Pollution caused by the exploitation of mining and agricultural extension in DAS Bengkulu gives clear results that the Bengkulu river is heavily polluted with an indicator that the water turbidity never is above normal during the rainy season and dry season river segments and regions. So, this study provides a great recommendation on county and city governments need integrase unified and integrated watershed. Thus the need for clean water and the preservation of the river in the watershed can Bengkulu intended. Steps were taken to create a plan that sits along for stakeholder cross-sector on governance and areas of the watershed, the Ministry of Environment, NGOs so as to produce a clear on watershed governance Bengkulu.

5. SUGGESTION

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