STUDY IMPACT OF ILLEGAL GOLD MINING ON POTENTIAL POLLUTION TOWARDS TOPO RIVER IN DONGIN VILLAGE CENTRAL SULAWESI

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Abstract

The river is part of the surface water that is vulnerable contaminated by human activities such as mining activities. One of the mining activities that contribute to river water pollution is gold mining. The Topo River is a river that located in Dongin Village which became the recipient water body for illegal gold mining activities. The aims of this study is to determine the impact of illegal gold mining to the waters of the Topo River in efforts to control pollution rate and to prevent the occurrence of potential water quality degradation. This research used survey method. Identification of water quality is done by testing several water pollution parameters compared with those required by Government Act No. 82/2001 on Water Quality Management and Water pollution Control, which includes physics parameters (temperature and TDS); and chemical parameter (pH). The Determination of sampling location is done by purposive sampling that represents the upstream, midstream and downstream Topo River which is divided into six points. According to results from several parameters, it is found that the activity of illegal gold mining in Dongin Village has the potential to contaminate the water of Topo River. Water quality condition from upstream to downstream showed a degradation as proven by pH parameter below the quality thresholds. The pH value ranges from 4-6, where the lowest pH value is 4 at point 6 which is the location of the mine. The highest pH value is 6 at point 1 which is the upstream of the river. TDS values range from 400-650 mg / L, whereas the lowest TDS is in point 6 and the highest TDS at points 4 and 5. Based on the quality standard, all samples are still below the threshold. Temperatures at each point are still within the normal range of river water between 25.7 - 28.4 C. Illegal gold mining activities potentially pollute the waters of the Topo River, therefore

more research is needed with more pollutant parameters so that the pollution index and the water quality status can be determined.

KEYWORDS : illegal gold mining, Topo River, water quality.

INTRODUCTION

Indonesian territory, which consists of several islands, storing the potential of crops are so abundant, both renewable (renewable resources) as well as non-renewable (non-renewable resources). Types of non-renewable natural resources for example are natural resources in the form of mining products. One of the activities in utilizing these natural resources is mining activities of minerals which until now is one of the major contributing sectors of foreign exchange (Yuliana, 2010).

Briefly the definition of mineral is material found in either in the form of chemical elements, minerals, ores or all kinds of rocks. As stipulated in Constitution of the Republic of Indonesia about Mining number 37 year 1960 and the Basic Law of Mining Number 11 year

1967 article 3, there are three classes of excavation materials class A as strategic excavation materials (including: petroleum, natural gas, coal, nickel, Etc.), class B as a vital extract (including: gold, silver, diamond, tin etc.), and class C as non strategic materials (including limestone, marble, sand, etc.) (Sukandarrumidi, 1999).

Gold becomes one of the high attractiveness in the class B excavation material which is an important material for the continuity of state economic activity and controlled by the state by including the people or can be cultivated by State-Owned Enterprises (Sukandarrumidi,

1999). Based on data from Mineral Commodity Summaries 2015 that was launched by the United Stated Geological Survey (2015), found that the amount of gold production Indonesia from 2013 to 2014 has increased, although not significantly, from 61 tons in 2013 to

65 tons in 2014. Based on these data, it is also known that Indonesia has gold reserves as large as the United States gold reserves, which amounted to 3,000 tons, or ranked fifth in the world along with the United States.

Many mining companies use good practices to manage risks that may be generated in an effective and government-controlled manner under applicable regulations. This involves planned practice through all phases of the mine project, including rehabilitation and post- closure management (McIntyre et al, 2016). Though mining is important to be illegal when it is forestry reserves, game reserves or near water resources with a secured permit (World Bank Group Department, 2002).

Illegal mining is a poverty-reduction activity that is practiced in most developing countries with low-educated populations and few employment

opportunities. Globally, about 20 million people are involved in illegal mining with almost a quarter of the world's gold production produced. Although illegal mining can help reduce poverty, it can have a negative impact on forest resources (Boadi et al, 2016).

In Indonesia, Illegal mining locally known as "PETI", and it has been given a lot of media publicity, and has created public concern on the perceived extensive damage it has caused to environment. PETI in Indonesia have a very long history. It is a traditional mining by an individual or a group of people who are not well organized. Symptoms of PETI arise when the community has not requested or have not been able to apply the legislation, especially if any rules and provisions do not yet exist. Gold, tin and diamond and various industrial minerals have long been mined from generation to generation by local people using simple equipment (Department of ESDM, 2009).

The illegal gold mining has been proven to cause severe environmental problems. The most obvious impact of the mining activities are draining resources on a large scale without regard to environmental aspects, and not applied by mining is good (good mining practice). The miners did not hesitate to use mercury to catch gold, so the river was polluted. The use of sand pumps has also resulted in erosion on river walls (Winarno, 1997).

Traditional gold mining activities and small-scale gold mining are linked to decreasing water quality and aquatic ecosystems. These activities reduce the water quality through 4 (four) ways: (a). contamination due to flowing water (run-off) from mine wastes in the form of solids or liquids from the tailings pond; (B). Pollution caused by unauthorized waste disposal into rivers, waterways or other water systems (drainage channels); (C). Pollutant source from the leaking management site; and D). increase in soil carried away by erosion related to land use (land-use change).

Similarly, the case occurred in the area of small scale gold mining or gold mine of the people in the village of Dongin, Central Sulawesi. Most of these communities use a traditional way called "dulang" to take gold at the mine site. Not only that method, people who have greater capital using mining methods commonly called "dompeng". This mining method uses the method of dredger (Dredging) and boat or barge by using a dompeng machine. In this method, the mud containing gold seeds in the bottom of the river is sucked from a dumping machine located on a boat or barge, then it is equipped with a sluice box that serves as a filter.

Subanri (2008) states that uncontrolled dumping can cause river water pollution from upstream to downstream. If mine wastes are dumped into the river then the potential impacts are:

1. Siltation of the river because the sand of mining waste is dumped in the river body
2. Changes in river flow and river cover
3. Flooding around the exile site during the rainy season

4. Turbidity in the river basin, especially downstream areas
5. The decline in water quality due to the content of harmful compounds used in the mining process carried by the river flow.

As a whole, the impacts caused by PETI not only cause damage to land / natural in mining areal itself but also can lead to environmental pollution as a result of mining techniques that are not environmentally friendly. Therefore, this study aims to determine the potential pollution of Topo River waters that can cause water quality degradation due to illegal gold mining activities in Dongin Village, Central Sulawesi.

MATERIALS AND METHOD

This research was carried out in Sungai Topo, Dongin Village in June until July 2017. Administratively, this research location is located in Kecamatan Toili Barat Sub-district, Banggai District, Central Sulawesi Province. Location of the study are presented in Figure 1

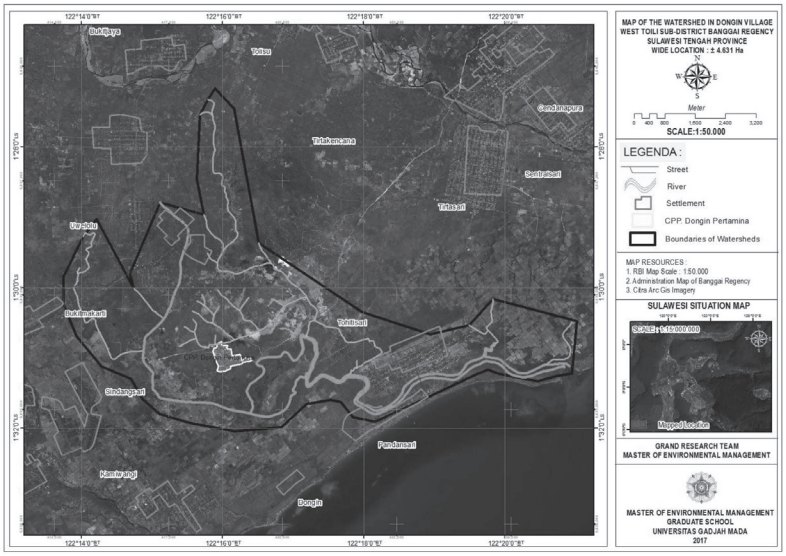

Figure 1. The map of Research Location

The method that used in this research is survey. This method is used to collect data related to water parameters in both physical and chemical parameters. Determination of sampling points is done by purposive sampling, the method of determining the sample to see consideration of the condition of a state of the research areas of direct observation in the field. Several parameters analyzed were physics water parameters (temperature and TDS) and chemical parameter (pH). Evaluation of water quality is done by referring to Government Regulation Number 82 of 2001 on water quality standards.

Measurement of Water Quality

Samples of water were taken using Water Sampler, then the physics and chemical parameters were measured in the field. The quantity of Total Dissolved Solid (TDS) was determined by using conductivity meter CD-4301 series. The water temperature was measured using Digital Thermometer. The water acidity was estimated using pH universal paper.

RESULT AND DISCUSSION

Data collection was done by taking samples to obtain water quality data in the study area. The selection of water sampling sites is done based on the analysis of river water flow on Topo River through remote sensing. Based on the analysis on the image and objectives of water quality testing requirements, it is determined 6 (six) water sampling points, with the method of taking water once at each point. The selection of the sampling sites is based on the difference of the river order and the differences in river morphology appearance indicating the type of activity that takes place around the river. Six sample points are presented in Figure 2. Sampling Point Distribution Map.

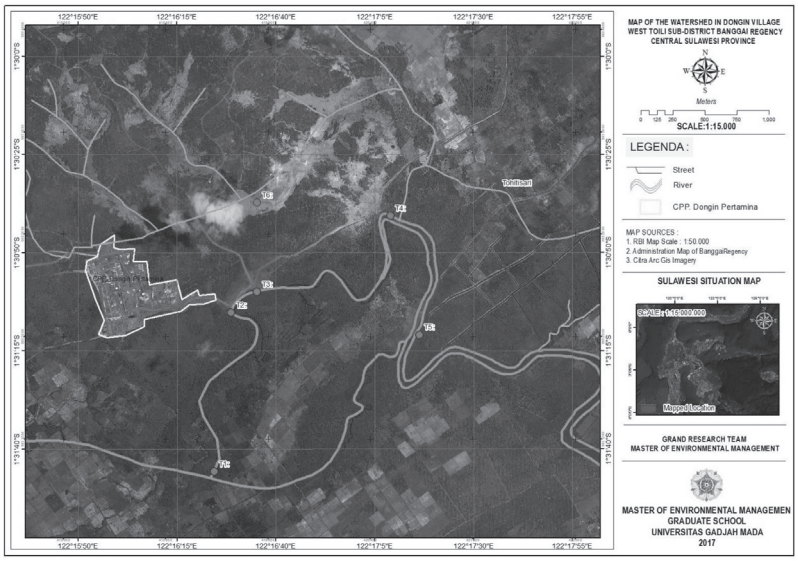

Figure 2. Sampling Points Distribution Map

Measurement of water quality aims to determine the value of water quality based on the parameters. Comparison of water quality parameter values at each research point with numbers allowed in the waters as it designation based on Government Regulation No. 82/2001. The measurement of the physical

and chemical factors of the Topo River waters at each point during the study can be seen in Table 2.

Table 1. Criteria for selecting the location of the water sample.

No	Sample Point	Coordinate	Information
		122□16'24.361 "E	
1	Point 1	1□31'45.765 "S	Before mining area
		122□16'28.655 "E	
2	Point 2	1□31'5.297 "S	Near the CPP area of Pertamina
		122□16'35.207 "E	
3	Point 3	1□31'0.000 "S	Near the CPP area of Pertamina
		122□17'9.000 "E	
4	Point 4	1□30'40.563 "S	After mining area
		122□17'16.311 "E	
5	Point 5	1□31'10.936 "S	Before the settlement
		122□16'35.223 "E	
6	Point 6	1□30'37.213 "S	Gold mining location

Table 2. Results of measurement parameters temperature, TDS and pH at any point

Parameter	**Sampling Points**						**Quality standards**
	1	2	3	4	5	6	
Temperature (□C)	25.7	27.2	28.4	28	26.3	28.1	Water temperature is normal
TDS (mg /L)	500	500	550	650	650	400	1000
pH	6	5	5	5	5	4	6.0-9.0

Physics and chemical parameters of the waters are the most important part in the management of public waters (rivers, reservoirs and lakes) because these common waters whose overall contents are water. Every life in it depends on the quality of water. Aquatic organisms can live well when influencing factors such as physical and chemical parameters of water are within the limits of tolerance desired by the organism (Johan and Edirmawan, 2011).

PHYSICS PARAMETERS

Temperature

Water temperatures at each point during the Topo River water survey ranged from 25.7

- 28.4 ºC. The highest temperature is at point 3 that is 28.4 ºC while the lowest temperature at point 1 is 25,7 ºC. The highest temperature is at point 3 that is 28.4 º C, this is because the measurement at point 3 is done around 12.00 WITA, and it is an open area so that the surface of the water is directly

exposed by the sun. The low temperature at point 1 is caused by the difference in altitude, where point 1 is upstream and covered by vegetation. The water temperature difference between one point and the other is not so significant. The small difference in the temperature of the waters of the Topo River is due to the waters being a lotic water, so that water agitation can occur at any time, thus the temperature of Topo River waters is still within normal limits for the life of aquatic organisms.

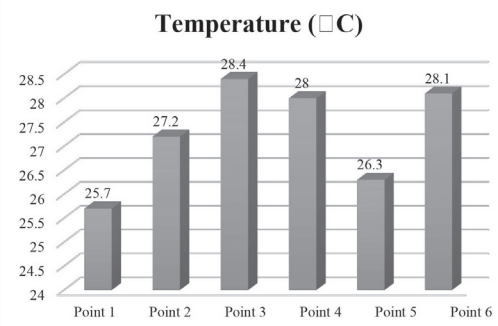

Figure 3. The Graph of Temperature Parameter

According to Bishop (1973) the temperature of the aquatic environment greatly affects the spread of the organism and also determines the speed of its growth, because all metabolic processes of aquatic organisms are highly temperature dependent. Temperature can raise the maximum rate of photosynthesis, while the indirect influence that can change the hydrological structure of the water column that can affect the distribution of phytoplankton. Boyd (1979) states that the temperature of waters in the tropics ranging from 25 - 32 ºC is still feasible for the life of aquatic organisms. Based on the temperature measurement during the research, the temperature of Topo River waters is quite normal and still meets the criteria of water quality standard in Government Regulation No.82 / 2001.

Total Dissolved Solid (TDS)

Total dissolved solids (TDS) is a measure of the combined content of all inorganic substances and organic contained in a liquid as: molecules, ionized or form mikrogranula (colloidal sol) were trapped. In general the operational definition is that the solid must be small enough to pass from filtration through a 2 μm (micrometer).

Total soluble solids are normally discussed only for freshwater systems, since salinity includes some of the ions that are the definitions of TDS. The basic application of TDS is the study of the quality of water for streams, rivers and lakes, although TDS is not generally regarded as a major pollutant (eg, TDS is not considered to be associated with health effects) TDS is used as a

characteristic aesthetic of drinking water characteristics and As an aggregate indicator of the existence of extensive measurements of chemical contaminants.

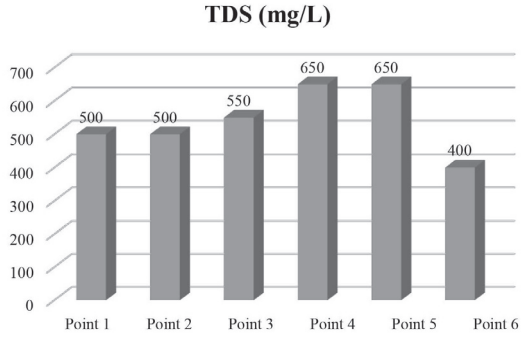

Figure 4. The graph of TDS Parameter

TDS or Total Dissolved Solid in Sungai Topo-range 400-650 mg / L. All TDS value for each sample of water at any point meet water quality standard that is <1000 mg / L.The highest TDS is present at point 4 and point 5. Overall, all points meet water quality standards for TDS in accordance with Government Regulation No. 82 of 2001.

Chemical Parameters

Degree of Acidity (pH)

In addition to the physical parameters, the most influential chemical parameters in the waters of the Topo River during the study were acidity (pH) values. The value of degree of acidity (pH) of the waters of the Topo River at each point during the study ranges from 4 - 6. The highest pH is 6 at point 1, where point 1 is upstream of the Topo River whereas the lowest pH is 4 at point 6 which is close to the center Location of PETI. This indicates that the activity of gold mining at point 6 leads to a decrease in pH parameter of river water.

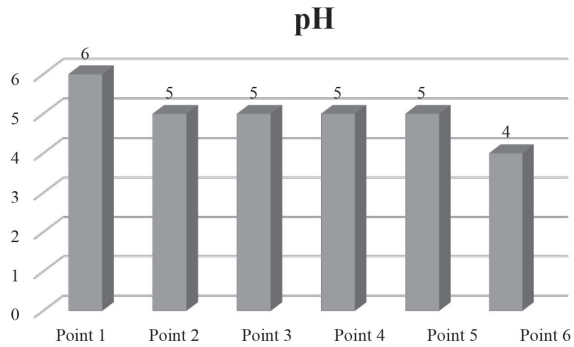

Figure 5. The graph of pH Parameter

The low pH value of the waters of the Topo River is caused by the high turbidity value, besides the gold mining activity around the Topo River potentially decreasing the water pH value. Johan and Edimawan (2011) stated that the degree of acidity of water is one of the chemical properties of water that affect the growth of plants and aquatic animals so often used as a guide to state the good of a water environment as the environment. The degree of acidity of the waters also affects the resistance of the organism, where low pH will cause the absorption of oxygen by the organism will be disrupted.

The pH value found at each research point is low so it can be concluded that the waters are classified into unfavorable waters for the life of phytoplankton organism. Banerjea in Lamury (1990) categorize the level of fertility waters based on the range of pH: 1) pH 5.5 - 6.5, unproductive, 2) pH 6.5 - 7.5 prolific and 3) pH 7.5 - 8, 5 is very productive. Boyd (1979) suggested that the pH range suitable for the life of aquatic organisms is 6.5 - 9. According to PP. 82 in 2001, in the criteria of water quality class III is 6 - 9. Based on the above opinion, the pH value of the waters of the Topo River is less supportive for the life of aquatic organisms.

Water pollution according to the Decree of the Minister of State for Population and Environment Regarding the stipulation of the Environmental Quality Standard shall be the entry of living creatures, energy substances, or other components into water or the change of the water order by human activities or natural processes So that the water quality decreases to a certain level that causes the water is not working anymore in accordance with the allocation (article 1).

According to Wardhana (2004), water is polluted if it has deviated from its normal state of dependence on determinants, such as the ait itself and the source of water. An indicator or a sign that the environmental water has been polluted is a noticeable change through:

1. There is a change in water temperature
2. The change in pH or Hydrogen ion concentration
3. The change of color, smell, and taste of water
4. The emergence of precipitate, colloidal, dissolved material
5. The existence of microorganisms
6. Increase environmental water radioactivity.

The occurrence of pH change and discoloration in the waters of the Topo River indicate the potential of pollution. Therefore, further research is needed to prove the extent of pollution that occurs in the waters of the Topo River.

Conclusion

The results showed that the acidity level of Topo River is quite high and below the criteria of quality standard according to Government Regulation No. 82

Year 2001. This indicates potential pollution in the waters of the Topo River caused by illegal gold mining activities. Therefore, there is a need for further research on the water quality of the Topo River by using more parameters such as DO, COD, BOD and heavy metal content that may contaminated the waters of the Topo River. In addition, the Regional Government should be more assertive in issuing policies and rules related to Illegal Gold Mining conducted by the society of Dongin Village. The government should supervise the implementation of illegal mining activities and conduct consultations with miners to make policy on how illegal gold mining activities can take place without causing negative impacts for the people and the environment, especially for the waters of Topo River.

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