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Research Paper

The Study of River Water Quality in Water Pollution Control: Case Study of Talawaan River, North Minahasa District, North Sulawesi Province

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Abstract
This research was conducted to assess the quality of river water in the context of controlling water pollution in the Talawaan River in North Minahasa Regency, North Sulawesi Province. This research is a descriptive-quantitative research. The field research was carried out in the Talawaan River, North Minahasa Regency. Water quality measurement includes physical parameters: TSS, and chemical parameters; BOD and COD were carried out at five monitoring points. The results showed that the content of BOD, COD, and TSS in Talawaan River water met the water quality standards (Type B water). The characteristics of the waste (BOD, COD and TSS), the concentration values of BOD, COD and TSS concentration values do not exceed the quality standard according to their designation. The potential for domestic waste pollution load reaches 1,495 kg/day from a total population of 16,040 people. The status of Telawan River water quality is classified as "lightly polluted" based on the studied parameters; there are several other variables that were not included in this study, such as T-P, Total Coli, and Fecal Coli.

Keywords
Water Quality, Pollution, Talawaan River

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1. INTRODUCTION

Water is a natural resource that is needed for the livelihood of many people, even by all living things to carry out their life processes. The use of water for various purposes has led to the importance of considering the sustainability of the benefits of water resources for future generations (Nugroho, 2008; Hering and Ingold, 2012; Megdal et al., 2017). One of the sources of water that is widely used to meet the needs of human life and other living creatures is river water. Rivers are very important ecosystems for humans and are one of the important components of the hydrological cycle. Rivers also provide water for humans for various activities, such as agriculture, fishery, industrial and domestic (Siahaan et al., 2011; Dobriyal et al., 2017). The potential benefits of a river ecosystem are for agricultural irrigation, fisheries, and mineral water raw materials, drainage of rainwater and wastewater, and river tourism objects (McDonnell et al., 2018).

The Watershed System (DAS) functions as a container for water flow to always be in the lowest position in the earth's landscape, so that river conditions cannot be separated from the conditions of the watershed. The quality of river water is influenced by the quality of water supply originating from the catchment, while the quality of water supply from the catchment is related to natural processes and human activities in it (Wiwoho, 2005; Laino-Guanes et al., 2016; Li et al., 2018). The changes in river water quality are usually the result of waste from land use in the watershed (Tafangenyasha and Dzinomwa, 2005; Gichana et al., 2015). The Changes in the natural forest land use pattern into agricultural land and settlements, as well as increased industrial activity have an impact on the hydrological conditions of the watershed (Gashi et al., 2016; Jiao et al., 2020). Besides, the various human activities in fulfilling their daily needs, in the fields of household, agricultural and industrial activities, also produce waste that contributes to the river water quality decrease (Suriawiria, 1996; Sari et al., 2021).

River pollution can be caused from (1) high sediment content which is originating from erosion, agricultural cultivation activities, mining, construction, land clearing and other activities; (2) organic waste from human, animal and plant activities; (3) the rate of addition of chemical compounds originating from industrial activities that dispose of their waste into the water. These three things are the impact of increasing human population, human welfare, economic development and industrialization (Wen et al., 2017). Based on the results of monitoring by the State Ministry for the Environment on 35 rivers in Indonesia, generally the rivers have a moderate to heavily polluted water quality status (Keraf, 2010).

A water quality decrease in river has occurred if the water cannot be used in accordance with the normal water quality status. Water quality status is the level of water quality condition which indicates a polluted or good condition in a water source within a certain time by comparing it with the applicable water quality standard. Determination of water quality status can be done using the Storet Method (The Minister of Environment Decree Number 115 of 2003 concerning Guidelines for Determining Water Quality Status).

The Talawaan River Stream, North Minahasa Regency, North Sulawesi Province, has been used as a disposal site for agricultural, plantation, non-metal and rock mining, domestic waste, solid waste and community activity waste. Based on the pollution load that occurs, it is estimated that it can cause a decrease in the quality of the Talawaan River water. The results of river water quality monitoring carried out by the Environmental Service of North Sulawesi Province from 2012 to 2018 show that the TSS, TDS, E Coli and Total Coli parameters do not meet the Class II water quality criteria (Criteria are in accordance to Government Regulation Number 82 of 2001 concerning Management Water Quality and Water Pollution Control). The latest data is the result of monitoring the water quality of the Domoga River where there are 7 parameters that exceed the quality standard, there are parameters of TSS, TDS, Sulfide, Total Phosphate, Total Chlorine, E. Coli and Total Coliform. The changes in land use in the watershed, marked by increased domestic, agricultural and industrial activities, can affect and have an impact on river water quality conditions (Priyambada, 2008; Santy et al., 2020).

To prevent and overcome industrial waste, the government must play an active role, either through legislation or by other means. The government must promote forward-looking development with the intention of being able to be utilized by present and future generations (Maghfiro, 2013). Based on the problems described above, it is necessary to conduct research on the water quality of the Talawaan River, North Minahasa Regency, North Sulawesi Province in order to support the efforts to control river water pollution.

2. EXPERIMENTAL SECTION

This type of research used in this research is descriptive with a quantitative approach. A quantitative approach was used to describe the condition of the Talawaan River water quality.

2.1 Operational Description

- River water quality: These are the biophysical or chemical properties of water which contained in river water and which are measured based on certain parameters and methods. With physical parameters: TSS, and Chemical Parameters; BOD and COD.
- Domestic Waste Pollution Load: the amount of a polluting element contained in domestic wastewater based on parameters of TSS, BOD, COD.

2.2 Sampling Location Points

The research was conducted in the Talawaan River, North Minahasa Regency. The location selection was based on the monitoring point which determined by the North Sulawesi Provincial Environmental Department. Determining the research location takes into account the ease of access, cost and time of research. These are the locations where the river water samplings are taken in the Talawaan River, North Minahasa Regency:

Point I: This location is located next to the Tatelu Freshwater Cultivation Center, under the bridge of Tatelu Village, Dimembe District, North Minahasa Regency, at the coordinates of N 01°30'51,6" E 125°00'49,1". Apart from the Freshwater Cultivation Center around this location there are also residential areas, plantation and fishery activities.

Point II: The location of this sampling point is in Tatelu Village, Dimembe District, North Minahasa Regency, at the coordinates of 01°30'59,9" E 125°00'58.2". This location can be reached by walking about ± 500 m from the Tatelu highway; the access road for motorbikes is only up to ± 400 m from this point due to inadequate road conditions. Based on information obtained from the community around this point, it is a confluence of two tributaries that will eventually end at the Talawaan River, the Walinouw River and the Malupu River. In the upper reaches of the Malupu River was found a Water Supply Company (PDAM). Community activities around this location are settlements, chicken farms, and coconut plantations.

Point III: This point is located in Tatelu Village, Dimembe District, North Minahasa Regency, at the coordinates of N 01°31'55.5" E 124°59'36.1". This location is a meeting point for several tributaries. According to information from the villagers around the the tributary were flows from Rondor and Wasian villages. Around point 3, the residential area is quite crowded, there are small scale chicken farming activities, fish farming ponds and markets.

Point IV: The location of sampling point 4 was at the bridge of Talawaan Village, Talawaan District, North Minahasa Regency, at the coordinates of N 01°31'50,8" E 124°57'37,6". According to vilager information, around the location of sampling point 4 there are gold processing activities. In addition, the main activities that utilize the flow of this river are freshwater fish farming, fishing, rice fields and plantations.

Point V: Was located under the bridge which is the border between Wusa Village and Patokaan Village, administratively located in Wusa Village, Talawaan District, North Minahasa Regency. Around this location there are coconut and corn plantation activities, while river water is used by the local community for bathing and washing.

2.3 Data Analysis

Is an analysis to determine the quality of Talawaan River water by conducting some tests on water pollution parameters which consist of TSS, BOD, COD, and of concentration levels of river water quality measurement parameters. The Test Results of these Parameters are then compared with The Water Quality Standards in Accordance to Government Regulation Number 82 Of 2001 Concerning Water Quality Management and Water Pollution Control.

3. RESULTS AND DISCUSSION

3.1 Talawaan River Water Quality Condition

The Talawaan River Flow is a fertile area for agriculture and plantations, in the Small Scale Gold Mining (PESK) area which is the Talawaan watershed (DAS) area; there are coconut, clove, fruit and seasonal plants which are meaningful to the Villagers economy. As well as the Talawaan river is important for the daily life of the villagers, whether for drinking water, bathing and washing, and also being used for fishery and fish, shrimp and crabs catching. In Talawaan Village, there is a dam that was built during the Dutch era and further enhanced by the Government to irrigate about 500 ha of rice fields and fish ponds. At the estuary in Wori Subdistrict, Talawaan Bajo Village, the villagers use this river flow to catch fish, crabs and various other types of fish. Agro-fishery activities and community activities are disrupted after the degradation of water quality as a result of gold processing with mercury and cyanide technology.

3.2 Talawaan River Water Quality

The quality of Talawaan river water has been degraded due to the existence of Small Scale Gold Mining (PESK) in Dimembe District which has been developing since 1998. This "PESK" business has provided employment and increased villagers' income, especially land owners and gold processing businesses, which use mercury and cyanide.

Employment opportunities are so great, ranging from rambangan (miners in groups to dig and look for reps), rempel (rep pounder workers who are hired by drum owners for a fee per sack of rep), cattle and motorized vehicles, food and service sellers, drum workers also the security section. However, in general it does not have a significant impact in improving the living standards of the surrounding Villagers, because the results of this business are only obtained by land owners, owners of dug holes and owners of mercury drum and cyanide tanks (Anjami and Nurhamlin, 2018).

Evaluation of water quality was carried out to determine the suitability of water for a certain designation compared to the water quality raw materials according to the water class. The parameters used in describing the water quality of the Talawaan River are BOD, COD, and TSS. This parameter is taken because it provides an overview of the natural ability of the river to degrade the organic matter contained in it. Water sampling for analysis was carried out during the rainy season on 26 November 2020 with a time span of 06.00 to 15.00 WITA. The results of the analysis of the water quality of the Talawaan River for each river Segments with parameters of BOD, COD, and TSS are presented in Table 1.

The contents of BOD, COD, and TSS of Talawaan River water indicate that the waste content of the Talawaan River are generally meets the water quality standards in the BOD and TSS parameters. But the maximum pollution load on BOD is less than the threshold value according to the designation for class II Rivers, which is about 3 mg/L per day. The river water BOD pollution load in Segment 1 is about 2 mg/L, in Segment II it is about 2 mg/L, in Segment IIII it is about 2 mg/L, in Segment IV it is about 2 mg/L, and in Segment V it is about 2 mg/L, with an IP range value of 0.524-2.599. So it can be said that the status of Telawan River water quality is lightly polluted.

The maximum pollution load on COD does not exceed the normal limit set if was averaged at 4 mg/L per day, which means that it is less than the threshold value according to the designation for class II, which is about 25 mg/L. The COD pollution load of river water in Segment 1 River is about 4 mg/L, in Segment II it is about 4 mg/L, in Segment III it is about 4 mg/L, in Segment IV it is about 5 mg/L; and in Segment V is about 4 mg/L. With a range of IP values, it is vulnerable from 0.524 to 2.599. So it can be said that the quality status of Telawan water is lightly polluted.

The maximum pollution load on TSS does not exceed the normal limit, which is about 50 mg/L per day. The TSS load of river water in Segment I River is about 10, Segment II is about 16, Segment III is about 16, Segment IV is about 24; and in Segment V are about 19. The TSS content tends to fluctuate; even in Segment IV it almost reaches the maximum threshold. Then the value of the IP range is in the vulnerable of 0.524-2.599. So it can be said that the quality status of Telawan water is lightly polluted.

Based on the test results, the quality status of lightly polluted Telawan water was obtained based on the pollutant index category, namely $1.0<2.0\leq 0.5$. This value was obtained not only based on COD, BOD and TSS but there were also several other variables that were not included in this research such as TP, Total Coli, and Fecal Coli. According to Uyun (2020), the high water pollution index caused a decrease in water quality so that it can interfere with the health of living things. As according to WQI water classification standards Mandalika (2018), the quality status of Telawan water is lightly polluted. Not suitable for drinking and agriculture, if there is no choice, it is necessary to process both needs before consumption. It does not require processing if

Table 1. Talawaan River Water Quality

No	Segment	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	PI	Water quality status
1	Segment I	2	4	10	1.77	Light
2	Segment I	2	4	16	0.524	Good
3	Segment II	2	4	16	2.599	Light
4	Segment IV	2	5	24	2.09	Light
5	Segment V	2	4	19	2.253	Light

used for animal husbandry, recreation and sporting purposes. So that the status of the polluted Telawan water quality cannot be used for consumption purposes.

Talawaan River is a river with class II water quality, this is stated in Government Regulation Number 81 of 2001 concerning Water Quality Management and Water Pollution Control. Therefore, this river water is intended for facilities and infrastructure, recreational facilities, and the cultivation of freshwater biota, and for gardening irrigation. The range of BOD values from the measurement of each segment was obtained 2 mg/L, the COD value from the measurement of each segment was obtained 4 mg/L and the TSS from the measurement of each segment was obtained 10 mg/L - 24 mg/L, it seems that it tends to fluctuate. The contents of BOD, COD, and TSS of Talawaan River water have met the threshold according to their designation based on Government Regulation Number 81 of 2001 concerning Water Quality Management and Water Pollution Control for water with class II status. The COD and BOD values are in the range of class 1 river quality standards.

BOD for class II is based on the quality standard value of Government Regulation Number 81 of 2001, which is about 3 mg/L, but the BOD value of the measurement for each river segment is about 2 mg/L. BOD or often called by Biological Oxygen Demand is the amount of dissolved oxygen needed by microorganisms to decompose organic matter under aerobic conditions (Santoso, 2018). The greater the BOD value of a water, it means that the organic matter content in the waters is also higher (Yudo, 2010; Dewa, 2016). The high BOD value will directly and indirectly affect the life and productivity of aquatic animals, consisting of fish (Sharma and Gupta, 2014; Pawar, 2017). Several attempts can be made to control the BOD value of wastewater before it is discharged into open waters so as not to endanger the lives of aquatic animals.

Previous research results were related to the BOD values of river water Mahyudin et al. (2015), it was found that the BOD value of Metro river water at monitoring point 1 was about 3.20 mg/L, monitoring point 2 was about 4.98 mg/L and at point 3 was 5.65 mg/L. The BOD concentration values of the Metro river ranged from 3.2 to 5.65 mg/L. These values have exceeded the threshold for class II river water quality criteria of 3 mg/L, so that river water cannot be used for recreational facilities, freshwater fish farming, livestock and agriculture. The greater the BOD concentration indicates that the decomposition has been polluted, the BOD concentration which has a low level of pollution and can be categorized as good waters has BOD levels ranging from 0 - 10 mg/L, while waters that have a BOD concentration of more than 10 mg/L are considered has been polluted.

Based on the BOD value, it turns out that the Talawaan River water is not polluted, although based on IP calculations the river water is categorized as "lightly polluted". It should be noted that the IP calculation is not only based on organic matter content, but there are several other parameters that are used as indicators. This BOD value cannot be used as a determination that the river water is not polluted. However, the low BOD value indicates that further treatment is needed to prevent an increase in the BOD value. Treatment or treatment of wastewater that is rich in organic matter is considered an effective way to control BOD in river water (Shon et al., 2006; Krasner et al., 2009). As well as the habits of throwing garbage into waterways must be avoided, because this can have an impact on the high BOD value of river water (Yulida et al., 2016; Nwaneri et al., 2018).

The highest COD value was found in Segment IV, which was 5 mg/L, this value did not exceed the predetermined threshold of 25 mg/L per day. The results also illustrate that in each river flow segment, the COD value fluctuates, but overall the COD value is still below the class I water quality standard. A high COD value indicates a greater level of river water pollution (Yudo, 2010; Dewa, 2016). The results of research conducted by researchers in various river flows indicate that polluted river water usually has COD values that exceed the quality standard according to the class designated for river water (Pohan et al., 2016; Christiana et al., 2020).

The threshold used in this study is the Quality Book of Government Regulation Number 81 of 2001, which divides the river water class so that the COD concentration of Talawaan River has met the quality standard in accordance with the designated river area category, namely class II. However, the conditions of fluctuation in COD values are very low, even below the class II river quality standard, therefore it needs attention and prevention so that COD in Talawaan River does not change and exceeds the threshold.

Limiting community behavior dumping waste rich in organic matter into waterways and river flows is an effective way to control river water COD values (Mukharomah, 2020; Alfiyansyah, 2020; Wulandari, 2021).

The largest TSS concentration value of Talawaan River water was found in the upstream river flow segment; 24 mg/L, this value is lower than the threshold, which is 50 mg/L per day. Although in each segment the river flow experiences different concentrations, if on average it is in the range of 10-112 mg/L per day. This value also does not exceed the threshold specified in the Regulation, the value has also exceeded the predetermined threshold was 50 based on Government Number 81 of 2001, as a class II designation for Talawaan River water (Effendi, 2003).

Total Suspended Solid (TSS) is an important parameter in wastewater which caused by the presence of clay particles, microorganisms, dust and fine sand, all of which have a size of <1 μm (Asmadi et al., 2012). TSS can cause silting in water bodies and cause the growth of certain aquatic plants, and can be toxic to other living things. The above statement was then strengthened by Effendi (2003), that the range is 25 - 80 mg/L. High turbidity values can interfere with the osmoregulation system of aquatic organisms.

Based on the values of BOD, COD and TSS in Talawaan River water, counter measures and prevention are needed to maintain the quality of river water from being further contaminated. At this time the status of Telawan River water quality is lightly polluted, based on COD, BOD and TSS parameters that do not pass the predetermined quality standards.

3.3 Calculation of Existing Pollutant Load

The determination of the pollutant load of the Talawaan River will be carried out in 2020. The parameters used in this calculation include BOD, COD, and TSS. The Talawaan River is insufficient to obtain N-total due to data limitations, so BOD, COD, and TSS parameters are used which represent the determination of the pollutant load of the Talawaan River (Andika et al., 2020). Biological indicators are correlations of community behavior in nature with their environment. Meanwhile, chemical indicators are carried out by analyzing BOD, COD and DO. The formula used to calculate the potential pollution load from household sources was developed by the Center for the Environment of the Water Resources Research and Development Center, Ministry of Public Works. :

$$\text{PBP} = \text{Population x Emission Factor x ek ratio x alpha} \quad (1)$$

The results of the calculation are described as follows.

Tetelu Village with a population of 3,354 people has a BOD pollutant load in river water of 109 kg/day. In the second position is Talawaan village with a population of 3,094 people, having a BOD pollutant load in river water

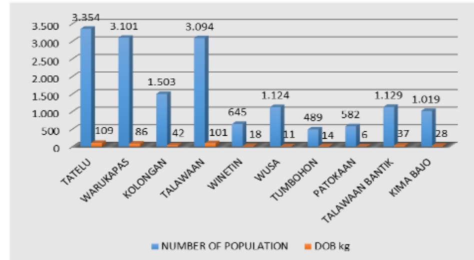

Figure 1. BOD Pollutant Load for Talawaan River

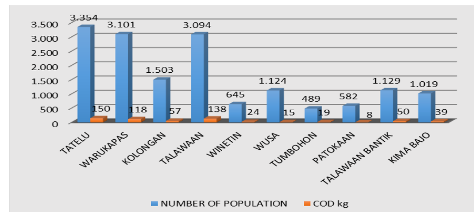

Figure 2. COD pollutant load of Talawaan river

which reaches to 101 kg/day. Furthermore, in the second position, warukapas village with a population of 3,109 people has a BOD pollutant load in Talawan river water reaching 86 kg/day. BOD or often mentioned as Biological Oxygen Demand is the amount of dissolved oxygen needed by microorganisms to decompose organic matter in waters under aerobic conditions (Santoso, 2018).

A high BOD value cannot be identified with the large population, although it can be seen that the population is directly proportional to the BOD value of river water. Wusa Village with a large population but does not provide significant BOD pollutants. However, population is one of the considerations in seeing the potential for BOD pollutants in the river flow (Mahyudin et al., 2015; Rahayu-Yushi, 2018; Setianto and Fahritsani, 2019). The matter of concern is the distance of the settlement to the river flow; the average polluter load contributor is in an area ranging from 0-100 meters from the river flow (Wijaya et al., 2017; Darmawan and Fatchiya, 2018). The following is the pollutant load of Talawan river COD in Figure 2.

Tetelu Village with a population of 3,354 people has a COD pollutant load in river water of 150 kg/day. In second place is Talawaan Village with a population of 3,094 people having a COD pollutant load in river water reaching 138 kg/day. Furthermore, in third place, Warukapas Village with a population of 3,101 people, has a COD pollutant load in Talawan River water of 118 kg/day. COD reflects the amount of oxygen needed to chemically oxidize the organic matter present in water, possibly the higher the organic matter content in river water, the higher the COD value (Lumaela et al., 2013). Most of the organic material in river water comes from organic waste from various activities that take place around the river, including household waste (Lee et al., 2019; Liu et al., 2020).

Based on the picture above, the high COD value cannot be identified with the number of people, although it can be seen that the number of residents is proportional, because the Wusa Village has a large population but does not provide significant pollutants from COD. Despite the population, it is taken into consideration in seeing the potential for COD pollutants in the watershed area. The thing that is of concern is the distance because the average contributor to the load of applicants is in an area that is 0-100 meters from the watershed (river basin).

Thus the calculation of the Existing Pollutant Load parameters which covering BOD, COD, and TSS of Talawaan River, it is known that the area that contributes to the pollutant load is an area that has a large population then geographically is 0-300 meters from the Talawaan River watershed.

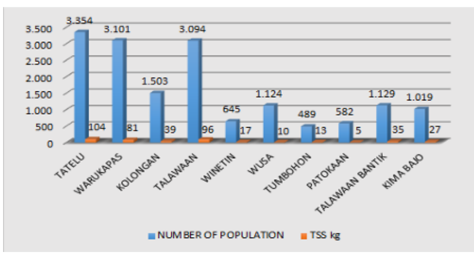

Figure 3. TSS Pollutant Load for Talawaan River

Tetelu village with a population of 3,354 people has a TSS pollutant load in river water of 104 kg/day. In the second position, Talawaan village with a population of 3,094 people has a TSS pollutant load in river water reaching to 96 kg/day. Furthermore, in the third position, warukapas village with a population of 3,101 people has a TSS pollutant load in Talawan river water reaching to 81 kg/day.

Based on the picture above, the high TSS value cannot be identified with the amount of population even though it can be seen that the population has a proportional number, because the village of Wusa has a large population but does not provide significant pollutants from TSS. Although the population, it is taken into consideration in seeing the potential for TSS pollutants in the watershed area. The thing of concern is the distance because the average contributor to the burdens of the importer is in an area ranging from 0-100 meters from the watershed.

3.4 Calculation of Potential Domestic Pollutant Load

Based on the measurement results of the Talawaan River from 10 villages which consists of Tatelu, Warukapas, Kolongan, Talawaan, Winetin, Wusa, Tumbohon, Patokaan, Talawaan, Bantik and Kima Bajo villages with a distance of 0-100 meters from the river will be described as in Figure 4. The Potential Domestic Pollutant Load is described below:

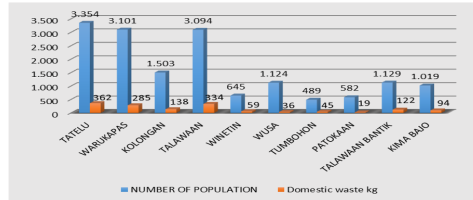

Figure 4. Potential Domestic Pollutant Load

Based on the picture above, it can be seen that the total potential of domestic waste reaches 1,495 kg/day from a total population of 16,040 people. Tatelu Village is seen by the largest population, which amount to 3,354 people, contributing to the potential for domestic waste of 365 kg/day. Then, it followed by Talawaan Village with a population of 3,094 people, contributing a potential domestic waste of 334 kg/day. Warukapas Village, with the second largest population of 3,101 people, contributes a potential domestic waste of 285 kg/day. Part of this domestic waste is generated from household activities, in the form of solid waste (rubbish) from food scraps, packaging, yard waste, and waste water from water used for bathing, washing, cooking and other activities. This household waste enters the sewerage and eventually enters the river flow and becomes a burden of river pollution (Mantaya et al., 2016; Suharto et al., 2019).

The pollution load from the domestic sector comes from human activities, such as black water waste (human waste) and gray water waste (water used for bathing, washing and kitchen). The factors that influence the contribution of the pollution load from domestic activities include the number of residents, the number of households, the distance between settlements or residents' houses and the Cikapundung River Flow. In this case it is assumed that the closer the distance between the house and the river flow is, the greater its contribution to the pollution load. Most of the residents who live along the riverbanks dispose of their waste into the river directly (Rahayu-Yushi, 2018; Alhassan et al., 2020). This suggests the importance of efforts to be able to change household behavior in disposing of their waste directly into the river stream. Household perceptions of waste (rubbish) must be able to be changed towards the understanding that the household's "garbage" or "waste" is an object that has added economic value if it is properly managed (Padilla and Trujillo, 2018; Tweneboah-Koduah et al., 2020).

Water is a natural resource that fulfills the lives of many people, so it must be managed appropriately and must be protected from the degradation variation so that it can help human life and life as well as other living things in a sustainable manner (Putra, 2017; Larson and Santelmann, 2007). Management of river water quality is carried out by controlling water pollution, in order to maintain the quality of water in order to meet quality standards (Azwir, 2006; Pohan et al., 2016). To keep the Talawaan River water from degrading its quality, all stakeholders must synergistically work together in managing the waste that is discharged into the river every day (Butterworth et al., 2010; Dobriyal et al., 2017)

4. CONCLUSIONS

Based on the results and discussion described above, the conclusions and suggestions that can be used in this study are the characteristics of the waste, the BOD, COD and TSS concentration values do not exceed the quality standard according to their designation with the potential for domestic waste pollution load reaching to 1,495 kg/day from a total population of 16,040 people and with the status of Telawan water lightly polluted quality but several other variables which are not included in this study such as T-P, Total Coli, and Fecal Coli which must be further observed so that the status of Talawaan's sharia does not experience heavier pollution.

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REFERENCES

Alfiyansyah, A. A. (2020). Perubahan Perilaku Budaya Mburi Omah Masyarakat Pinggir Sungai. *Biokultur*, **9**(1); 63–82

Alhassan, H., P. A. Kwakwa, and E. Owusu-Sekyere (2020). Households' source separation behaviour and solid waste disposal options in Ghana's Millennium City. *Journal of environmental management*, **259**; 110055

Andika, B., P. Wahyuningsih, and R. Fajri (2020). Penentuan Nilai BOD Dan COD Sebagai Parameter Pencemaran Air Dan Baku Mutu Air Limbah Di Pusat Penelitian Kelapa Sawit (PPKS) Medan. *QUIMICA: Jurnal Kimia Sains dan Terapan*, **2**(1); 14–22

Anjami, T. and N. Nurhamlin (2018). Dampak Sosial Penambangan Emas tanpa Izin (Peti) di Desa Sungai Sorik Kecamatan Kuantan Hilir Seberang Kabupaten Kuantan Singingi. *Jurnal Online Mahasiswa FISIP*, **4**(2); 1–13

Asmadi, S., M. Si, S. Suharno, and M. Kes (2012). Dasar-Dasar Teknologi Pengolahan Air Limbah. *Yogyakarta: Gosyen Publishing*

Azwir (2006). *Analisa Pencemaran Air Sungai Tapung Kiri Oleh Limbah Industri Kelapa Sawit PT. Peputra Masterindo di Kabupaten Kampar*. Ph.D. thesis, Program Pascasarjana Universitas Diponegoro

Butterworth, J., J. Warner, P. Moriarty, S. Smits, and C. Batchelor (2010). Finding practical approaches to integrated water resources management. *Water alternatives*, **3**(1); 68–81

Christiana, R., I. M. Anggraini, and H. Syahwanti (2020). Analisis Kualitas Air dan Status Mutu Serta Beban Pencemaran Sungai Mahap di Kabupaten Sekadau Kalimantan Barat. *Jurnal Serambi Engineering*, **5**(2); 941–950

Darmawan, R. and A. Fatchiya (2018). Analisis Perilaku Ibu Rumah Tangga Bantaran Sungai Citampian dalam Mengelola Sampah Rumah Tangga. *Jurnal Sains Komunikasi dan Pengembangan Masyarakat [JSKPM]*, **2**(4); 431–440

Dewa, R. P. (2016). Penanganan Baku Mutu Kualitas Air Limbah Produksi Atc Dari Rumput Laut Eucheuma Cottonii. *Majalah BIAM*, **12**(2); 34–40

Dobriyal, P., R. Badola, C. Tuboi, and S. A. Hussain (2017). A review of methods for monitoring streamflow for sustainable water resource management. *Applied Water Science*, **7**(6); 2617–2628

Effendi, H. (2003). *Telaah kualitas air, bagi pengelolaan sumber daya dan lingkungan perairan*. Kanisius

Gashi, F., S. Frančišković-Bilinski, H. Bilinski, and L. Kika (2016). Assessment of the effects of urban and industrial development on water and sediment quality of the Drenica River in Kosovo. *Environmental Earth Sciences*, **75**(9); 801

Gichana, Z., M. Njiru, P. O. Raburu, and F. O. Masese (2015). Effects of human activities on benthic macroinvertebrate community composition and water quality in the upper catchment of the M ara R iver B asin, K enya. *Lakes & Reservoirs: Research & Management*, **20**(2); 128–137

Hering, J. G. and K. M. Ingold (2012). Water resources management: what should be integrated? *Science*, **336**(6086); 1234–1235

Jiao, D., D. Wang, and H. Lv (2020). Effects of human activities on hydrological drought patterns in the Yangtze River Basin, China. *Natural Hazards*, **104**(1); 1111–1124

Keraf, S. (2010). *Etika lingkungan hidup*. Jakarta: PT. Kompas Media Nusantara

Krasner, S. W., P. Westerhoff, B. Chen, B. E. Rittmann, S.-N. Nam, and G. Amy (2009). Impact of wastewater treatment processes on organic carbon, organic nitrogen, and DBP precursors in effluent organic matter. *Environmental science & technology*, **43**(8); 2911–2918

Laino-Guanes, R., M. González-Espinosa, N. Ramírez-Marcial, R. Bello-Mendoza, F. Jiménez, F. Casanoves, and K. Musálem-Castillejos (2016). Human pressure on water quality and water yield in the upper Grijalva river basin in the Mexico-Guatemala border. *Ecohydrology & Hydrobiology*, **16**(3); 149–159

Larson, K. L. and M. V. Santelmann (2007). An analysis of the relationship between residents' proximity to water and attitudes about resource protection. *The Professional Geographer*, **59**(3); 316–333

Lee, M.-H., Y. K. Lee, M. Derrien, K. Choi, K. H. Shin, K.-S. Jang, and J. Hur (2019). Evaluating the contributions of different organic matter sources to urban river water during a storm event via optical indices and molecular composition. *Water research*, **165**; 115006

Li, S., H. Yang, M. Lacayo, J. Liu, and G. Lei (2018). Impacts of land-use and land-cover changes on water yield: A case study in Jing-Jin-Ji, China. *Sustainability*, **10**(4); 960

Liu, D., Y. Du, S. Yu, J. Luo, and H. Duan (2020). Human activities determine quantity and composition of dissolved organic matter in lakes along the Yangtze River. *Water research*, **168**; 115132

Lumaela, A. K., B. W. Otok, and S. Sutikno (2013). Pemodelan chemical oxygen demand (cod) sungai di Surabaya dengan metode mixed geographically weighted regression. *Jurnal Sains dan Seni ITS*, **2**(1); D100–D105

Maghfiro, I. (2013). Analisis Peran Pemerintah dalam Mengatasi Limbah Industri Pabrik Gula Tjoekir (Studi pada Badan Lingkungan Hidup Kabupaten Jombang). *Jurnal Administrasi Publik*, **1**(3); 94–102

Mahyudin, M., S. Soemarno, and T. B. Prayogo (2015). Analisis kualitas air dan strategi pengendalian pencemaran air Sungai Metro di Kota Kepanjen Kabupaten Malang. *Indonesian Journal of Environment and Sustainable Development*, **6**(2); 105–114

Mandalika, B. A. (2018). *Studi Penentuan Status Mutu Air Dengan Menggunakan Metode Indeks Pencemaran Dan Metode Water Quality Index (WQI) Di Sungai Dodokan Lombok, Nusa Tenggara Barat*. Ph.D. thesis, Universitas Brawijaya

Mantaya, S., M. Rahman, and Z. Y. Yasmi (2016). Model Storet Dan Beban Pencemaran Untuk Analisis Kualitas Air Di Bantaran Sungai Batu Kambing, Sungai Mali-Mali Dan Sungai Riam Kiwa Kecamatan Aranio Kalimantan Selatan. *Fish Scientiae*, **6**(1); 35–52

McDonnell, J., J. Evaristo, K. Bladon, J. Buttle, I. Creed, S. Dymond, G. Grant, A. Iroume, C. Jackson, J. Jones, et al. (2018). Water sustainability and watershed storage. *Nature Sustainability*, **1**(8); 378–379

Megdal, S. B., S. Eden, and E. Shamir (2017). Water governance, stakeholder engagement, and sustainable water resources management. *Water*, **9**(3); 190

Mukharomah, E. (2020). Analisis faktor-faktor yang mempengaruhi pola perilaku masyarakat membuang sampah di sungai musi (studi kasus kelurahan 10 ulu). *UNBARA Environmental Engineering Journal (UEEJ)*, **1**(1); 1–6

Nugroho, S. (2008). Analisis Kualitas Air Danau Kaskade Sebagai Sumber Imbuhan Waduk Resapan di Kampus UI Depok. *Jurnal Sains dan Teknologi Indonesia*, **10**; 99–105

Nwaneri, O., M. Nwachukwu, N. Ihua, and C. Nwankwo (2018). The effect of solid waste disposal on Nworie river. *Journal of Environment & Biotechnology Research*, **7**(2); 23–29

Padilla, A. J. and J. C. Trujillo (2018). Waste disposal and households' heterogeneity. Identifying factors shaping attitudes towards source-separated recycling in Bogotá, Colombia. *Waste management*, **74**; 16–33

Pawar, S. (2017). Analysis of some physicochemical parameters and their effect on the productivity of fishes in two different types of aquatic bodies of Unamgaon and Seipargaon of Patharkandi block of Karimganj district, Assam, India. *International J. of Life Sciences*, **5**(4); 587–592

Pohan, D. A. S., B. Budiyono, and S. Syafrudin (2016). Analisis kualitas air sungai guna menentukan peruntukan ditinjau dari aspek lingkungan. *Jurnal Ilmu Lingkungan*, **14**(2); 63–71

Priyambada, O. W. . S. R., I. B. (2008). Analisa pengaruh perbedaan fungsi Guna Lahan Terhadap Beban Pencemaran BOD Sungai (Studi Kasus Sungai Serayu Jawa tengah). *Jurnal Presipitas*, **5**(2); 55–62

Putra, A. S. . N. E., T. P. (2017). Analisis perilaku masyarakat bantaran sungai martapura dalam aktivitas membuang sampah rumah tangga di kelurahan Basirih kecamatan Banjarmasin Barat. *JPG (Jurnal Pendidikan Geografi)*, **3**(6); 23–35

Rahayu-Yushi, J. . D. M., Iwan (2018). Kajian Perhitungan Beban Pencemaran Air Sungai Di Daerah Aliran Sungai (DAS) Cikapundung dari Sektor Domestik. *Jurnal Rekayasa Hijau*, **2**(1): 61-71

Santoso, A. D. (2018). Keragaan Nilai DO, BOD dan COD di Danau Bekas Tambang Batubara Studi Kasus pada Danau Sangatta North PT. KPC di Kalimatan Timur. *Jurnal Teknologi Lingkungan*, **19**(1); 89–96

Santy, S., P. Mujumdar, and G. Bala (2020). Potential impacts of climate and land use change on the water quality of Ganga River around the industrialized Kanpur region. *Scientific Reports*, **10**(1); 1–13

Sari, Y. S., D. D. Anggoro, H. R. Sunoko, and C. Ozel (2021). Disposal of Waste Communal in Region of Flow River on Settlement Solid Population. In *IOP Conference Series: Materials Science and Engineering*, IOP Publishing, 1053: 012078

Setianto, H. and H. Fahritsani (2019). Faktor Determinan Yang Berpengaruh Terhadap Pencemaran Sungai Musi Kota Palembang. *Media Komunikasi Geografi*, **20**(2); 186–198

Sharma, P. and S. Gupta (2014). Study of amount of Oxygen (BOD, OD, COD) in water and their effect on fishes. *American International Journal of Research in Formal, Applied and Natural Sciences*, **7**(1); 53–58

Shon, H., S. Vigneswaran, and S. A. Snyder (2006). Effluent organic matter (EfOM) in wastewater: constituents, effects, and treatment. *Critical reviews in environmental science and technology*, **36**(4); 327–374

Siahaan, R., A. Indrawan, D. Soedharma, and L. B. Prasetyo (2011). Kualitas Air Sungai Cisadane, Jawa Barat-Banten. *Jurnal Ilmiah Sains*, **11**(2); 268–273

Suharto, B., L. Dewi, A. N. Mustaqiman, and T. Marjo (2019). The Study of Water Quality Status in The Ngebrong River with Physical and Chemical Parameters in The Tawangsari Barat Region, Pujon District, Malang Regency. *Indonesian Journal of Urban and Environmental Technology*, **2**(2); 164–180

Suriawiria, U. (1996). Air dalam kehidupan dan lingkungan yang sehat. Bandung: Alumni

Tafangenyasha, C. and T. Dzinomwa (2005). Land-use impacts on river water quality in lowveld sand river systems in south-east Zimbabwe. *Land Use and Water Resources*

Research, **5**(1732-2016-140251)

Tweneboah-Koduah, E. Y., M. Adams, and K. M. Nyarku (2020). Using theory in social marketing to predict waste disposal behaviour among households in Ghana. *Journal of African Business*, **21**(1); 62–77

Uyun, S. (2020). Pengembangan Sistem Pemetaan Status Mutu Air Sungai Berbasis Web Menggunakan Extreme Programming. *JISKA (Jurnal Informatika Sunan Kalijaga)*, **4**(3); 173–184

Wen, Y., G. Schoups, and N. Van De Giesen (2017). Organic pollution of rivers: Combined threats of urbanization, livestock farming and global climate change. *Scientific reports*, **7**(1); 1–9

Wijaya, K., A. Y. Permana, and N. Swanto (2017). Kawasan Bantaran Sungai Cikapundung Sebagai Permukiman Masyarakat Berpenghasilan Rendah (Mbr) Di Kota Bandung. *Jurnal Arsitektur ARCADE*, **1**(2); 57–68

Wiwoho, W. (2005). *Model Identifikasi Daya Tampung Beban Cemaran Sungai dengan Qual2E (Study Kasus Sungai Babon)*. Ph.D. thesis, Program Pascasarjana Universitas Diponegoro

Wulandari, R. A. A. (2021). Upaya Meminimalisir Pencemaran Sampah Di Sungai Jenes Kelurahan Laweyan Kota Surakarta. *Jurnal Pengabdian Barelang*, **3**(01); 14–19

Yudo, S. (2010). Kondisi kualitas air Sungai Ciliwung di wilayah DKI Jakarta ditinjau dari paramater organik, amoniak, fosfat, deterjen dan bakteri coli. *Jurnal Air Indonesia*, **6**(1): 34-42

Yulida, N., A. Suwarni, and S. Sarto (2016). Perilaku masyarakat dalam membuang sampah di aliran sungai batang bakarek-karek Kota Padang Panjang Sumatera Barat. *Berita Kedokteran Masyarakat*, **32**(10); 373–378

