Turnitin 2

by Feb Ulb

Analysis Of Water Quality From Bio-Physical-Chemical Factors of The Asahan River North Sumatra

Arman Harahap[1]*, Budianto Bangun[2], Chairul Insani Ilham[3], Doharman Lumban Tungkup[4]

[1,2]Universitas Labuhanbatu, Sumatera Utara, Indonesia
[3,4]Lecturer of the Inland Water Transportation Management Study Program at Inland ate and Ferries Transportation Polytechnic Palembang, Indonesia

Corresponding author:
e-mail: armanhrahap82@gmail.com

Abstract

Asahan River is one of the rivers that pass in North Sumatra Regency with a length of 147 km which empties into the Malacca Strait. The Asahan River is classified as a class I (one) river. The conversion of land functions is quite large around the Asahan watershed, for the stone mining sector, the oil and gas sector, the industrial sector, plantations and agriculture. This number of activities causes the Asahan river to have a large potential to experience a decline in quality. Field observations indicate that several activities have the potential to introduce pollutants into the Asahan River which may dispose of production waste directly or run off production waste into the river. The purpose of this study was to analyze the quality of the Asahan River by determining the Water Quality Status of the Asahan River. The research area was carried out on the Asahan River as far as 45 Km. River water quality was measured and observed at 3 sampling points for physical, chemical and biological parameters. Quality analysis and determination of water quality status used the Storet method and the pollution index method. The results are (1) DO, BOD, COD, Fecal coliform and Total Coliform parameters have exceeded the Class I river water quality standard according to South Kalimantan Governor Regulation No. 5 of 2007 which states that the water quality of the Asahan river has decreased (2) There has been a shift in the status of the water quality of the Asahan river from upstream to downstream which is indicated by the Storet value and the pollution index value (IP) which tends to increase based on river criteria according to Government Regulation number 82 of 2001. However, these waters can still be inhabited by various animals including Gastropods, Fish, Paramecium, Plankton and other microorganisms.

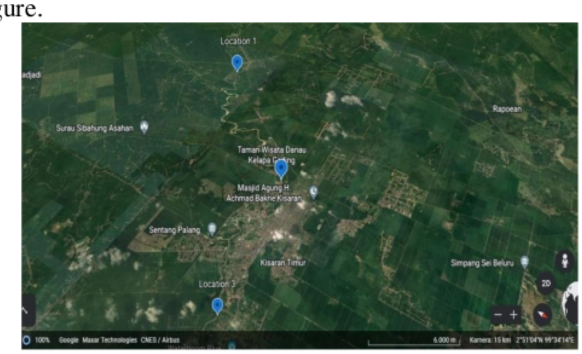
Keywords: Pollution index, water quality and quality status.

Introduction. The fairly large population growth rate goes hand in hand with the rapid development in all fields in Asahan Regency, North Sumatra. This has a fairly large impact, both positive and negative impacts. Rivers become the medium that receives these impacts as a result of intensive development and exploration of natural resources. Anthropogenic activities, such as sand mining, agricultural and urban runoff, domestic and industrial effluents, have been identified as potential threats to freshwater ecosystems (J. Heisler, PM Glibert, 2018). Under the availability of excessive nutrients and lack of proper nutrients and sediment cycle, phytoplankton can grow abundantly leading to conditions of reduced light penetration and oxygen depletion in water bodies or eutrophication (VH Smith, SB Joye, 2017). In addition, direct disposal of xenobiotic-contaning waste can contaminate freshwater ecosystem health and limit it. Carrying capacity of biodiversity (Y. Lu, H. Xu, Y. Wang, 2017). Preserving a healthy aquatic environment is still undergoing the process of following the rapid development of urban and industrial locations for certain freshwater areas in Indonesia (MC Acreman, 2010 and T. Garg, SE Hamilton, 2018). The distribution and species composition of benthic macroinvebra can be monitored to assess river water quality (BA Badea, 2017 and K. Kubosova, 2010). Macroinvebral is sensitive to water quality and therefore, is used as a bioindicator of the most frequently natural and polluted streams (JC Morse, 2009). Sahabuddin et al (2014) stated that the input of waste into the environment from human activities without considering the carrying capacity and carrying capacity of the environment causes a bad influence on the quality of the ecosystem, both physical, chemical and biological as well as the preservation of the aquatic environment. Rivers are open waters, flowing and have great potential to get input from all discharges originating from human activities such as agriculture, industry and domestic waste from surrounding settlements. Identification of macroinvebral diversity and community will help in determining the overall species richness and abundance in the aquatic environment, especially for suspected polluted rivers (K. Sirisinthuwanich, 2016).

The life of the people of Tabalong Regency cannot be separated from the existence of rivers, most of them use river water as a source of clean water. Asahan River is one of the rivers that pass through Tabalong Regency with a length of 39 km which empties into the Tabalong River. The Asahan watershed has an area of 147 km2. The Asahan River is classified as a class I (one) river, namely a river that is designated as a source of raw water for drinking water and other designations that require the same quality, therefore this river water is used as raw water (intake) and also other designations such as fishery infrastructure. rivers, livestock and agriculture (Environmental Service 2017).

Research Methods. Place and time of research

The research area was carried out on the Asahan River as far as 45 km by dividing it into 3 (three) segments, namely upstream, middle and downstream. The sampling location can be seen in the following figure.



Pig 1. Sampling Location on Asahan River

The implementation time of this research is 3 (three) months, namely from February to April 2022 and the river water sampling period is carried out 3 (three) times. The analyzed parameters include physical, chemical and microbiological parameters with the analytical method used adjusted to The parameters studied are as shown in the following table.

2.1. Water Quality Analysis and Determination of River Water Quality Status

The methods used to determine the water quality of the Asahan river and determine the status of water quality are the Storet method and the Pollution Index (IP) method (Ministry of Environment, 2003)

2.1.1. STORET method

The stages of determining the status of water quality using the STORET method are carried out by looking at the negative number of all parameters calculated and determining the quality status from the total score obtained using the value system in Table 4 below.

Table 3. Determination of the Value System to Determine the Status of Water Quality with the STORET Method

Amount Example 1)	Score	Parameter		
		Physics	Chemical	Biology
< 10	Maximum	-1	-2	-3
	Minimum	-1	-2	-3
	Average	-3	-6	-9
> 10	Maximum	-2	-4	-6
	Minimum	-2	-4	-6
	[illegible]	[illegible]	[illegible]	[illegible]

Notes: 1) the number of parameters used to determine the quality status

Table 4. Water Quality Status Determination Value System

No	Category		Score	Quality Status
1	Class A	Very well	0	Meet Quality Standard
2	Class B	Well	-1 to -10	Light Pollution
3	Class C	Currently	-11 to -30	Medium Polluted
4	Class D	Bad	> -31	Heavy Polluted

2.1.2. Pollution Index Method

Referring to the Decree of the Minister of the Environment Number 115 of 2003, if Lij states the concentration of water quality parameters listed in the Quality Standard of a Water Designation (j), and Ci states the concentration of water quality parameters (i) obtained from the analysis of water samples at a location. taking a sample from a river channel, then Pij is the Pollution Index for the allotment (j) which is a function of Ci/Lij. This Pij price can be determined by selecting parameters, if the parameter price is low, the water quality will improve. Select the concentration of quality standard parameters that do not have a range. Calculate the Ci/Lij value for each parameter at each sampling location. If the parameter concentration value decreases, the level of pollution increases, for example DO.

The assessment of the PI value is shown in the following table.

Table 5. Pollution Index (IP) Assessment

Index	Evaluation
0 Pij 1.0	Fulfill Quality standards
1.0 < Pij 5.0	Blackened Light
5.0 < Pij 10	Blackened Currently
Pij > 10	Heavy Polluted

Results And Discussion. Asahan River Water Quality Analysis

Mentioning the quality of the Asahan River means the quality or level of the river's good and bad. The Asahan River is an object that is the target of very close or direct impacts and the most sensitive impact on industrial activities or businesses and or exploitation of natural resources around its banks.

The width of the flow, depth and speed of the current from the Asahan river fluctuate in the upstream, middle to downstream parts, this of course affects the amount of discharge from the Asahan river. Discharge is the volume per unit time, the time required for concentration from the farthest point to a measurement point (Neno et al. 2016). The average data from the measurement of current velocity, flow width, depth and discharge from the Asahan river are shown in Table 23 below.

Table 6. Average Current Velocity, Flow Width, Depth and Discharge of the Asahan River

No	Parameter	Unit	Point Measurement		
			Hulu	Middle	Downstream
1.	Flow Width	m	8.70	30.12	35.23
2.	Depth	M	0.36	2.76	3.14
3.	Current Speed	m/sec	0.75	0.80	0.95
4.	debit	M2/sec	3766	1633	15.48

Table 23 shows the Asahan river is classified as a river with a discharge between 0 m3/second to 15.48 m3/second. In the upper part of the Asahan river, the current velocity is quite large with a narrow flow width and a small or shallow depth, so that the resulting discharge is still < 5 m3/second, which is 3.766m3/second. In contrast to the middle part, the flow velocity of the Asahan river is the smallest than the upstream or downstream segments, but has a large flow width and depth, so that the discharge in this segment is 1633 m3/second. Likewise in the downstream, the flow velocity of the Asahan river in this segment is the largest and has a large flow width and depth so that the discharge in this segment is maximized compared to other segments of the Asahan river, which is 15.48 m3/second.

The size of the discharge value of a river is very dependent on the flow velocity and the cross-sectional area of the river. According to Soebarkah (1978) in Neno et al. (2016) many factors affect the size of the river discharge value, including:

1. Rainfall, rainfall intensity and duration of rain greatly affect the amount of infiltration, groundwater flow and surface runoff. The length of time it rains is very important in relation to the length of time the rainwater flows into the river.
2. The topography, shape and slope of the slope affect the length of flow time. Areas with large slopes cause heavy surface runoff when compared to areas with flat and small slopes.
3. Geological characteristics, structure and soil characteristics affect the infiltration capacity.
4. The condition of plants or vegetation cover, affecting more and more trees will cause more water to disappear through evapotranspiration and infiltration, causing the run off of rainwater to decrease so that the water discharge can be reduced. The Quality Data from the Asahan River is shown in Table 7 below.

Table 7. Asahan River Quality Data

No	Parameter	Unit	Raw Quality	Point Measurement		
				Hulu	Middle	Downstream
1.	DO	mg/L	6	5.31	4.10	4.54
2.	BOD_5	mg/L	2	2.56	3.55	3.76
3.	COD	mg/L	10	13.37	12.57	21.37
4.	TSS	mg/L	50	5.17	20.33	15.33
5.	Total Phosphate	mg/L	0.2	0.07	0.03	0.05
6.	*Fecal Coliform*	Quantity/100 mL	100	1123.33	956.67	1081.01

3.1.1. DO (Dissolved Oxygen)

According to Wetzel (2001) in Muriasih (2012) states that dissolved oxygen is an essential compound needed for the metabolism of all aquatic organisms. Dissolved oxygen in waters fluctuates over time according to the intake and utilization by organisms and the decomposition of microorganisms. Based on the Regulation of the Governor of South Kalimantan No. 5 of 2007 concerning Designation and River Water Quality Standards, the tolerated DO value in class I (one) rivers is 6 mg/L. The DO concentration of the Asahan river for 3 (three) measurement periods at each sampling point is shown in Graph 1 below.

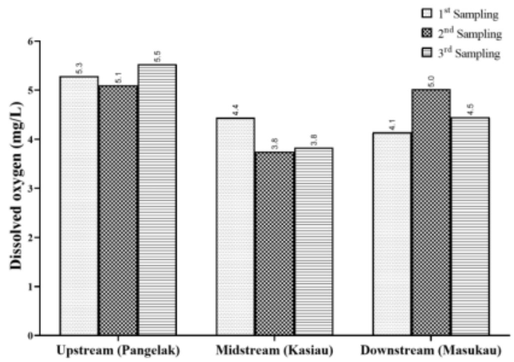


Figure 1. DO Concentration in Asahan River

In Graph 1 above, it can be seen that the minimum DO concentration is at the center sampling point at the second sampling time, which is 5.31mg/L, while the maximum DO concentration is at the upstream sampling point at the third sampling time, which is 4.10mg/L. . The DO concentration from upstream to downstream fluctuates, this is because dissolved oxygen levels in water are highly dependent on temperature, atmospheric pressure in the area around the measurement and the flow velocity of the river flow (Muriasih, 2012).

Dissolved oxygen levels also fluctuate daily (diurnal) and seasonally, depending on the mixing (mixing) and movement (turbulence) of water masses, photosynthetic activity, respiration and waste (effluent) entering water bodies. Dissolved oxygen is used for the degradation of organic compounds in water (Simanjuntak, 2012).

Dissolved oxygen levels are an indicator of whether the water is polluted or not. Based on the results of dissolved oxygen analysis, the Asahan River is still good for various aquatic animals including macrozoobentos, gastropods, plankton and various other animals.

3.1.2. TSS (Total Suspended Solids)

Total Suspended Solids are suspended materials having a diameter > 1 m retained on a millipore sieve with a pore diameter of 0.45 m. The total value of suspended solids in water generally represents the content of organic matter in water because organic matter shows the total substances in the form of suspended dissolved and in the form of colloidal particles.

Based on Governor Regulation No. 5 of 2007 concerning Designation and River Water Quality Standards, the TSS value that is tolerated in class I (one) rivers is 50 mg/L.

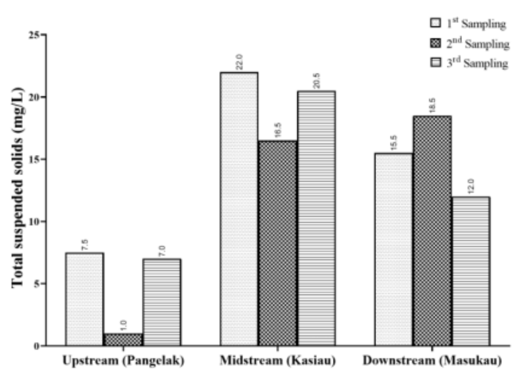


Figure 2. TSS Concentration in Asahan River

In Figure 2 shows the TSS concentration of the Asahan river fluctuates from upstream, middle and downstream. The maximum TSS value is only 22 mg/L at the center sampling point at the first sampling time and the minimum TSS value is only 1 mg/L at the upstream sampling point at the second sampling time. TSS is strongly influenced by land erosion activities around the watershed in addition to current velocity and high rainfall which is also one of the driving factors for erosion.

3.1.3. BOD (Biological Oxygen Demand)

According to Effendi (2003) Biological Oxygen Demand shows the amount of dissolved oxygen needed by microorganisms, especially bacteria to decompose or decompose organic materials under aerobic conditions. River Water Quality Standards, the BOD value that is tolerated in class I (one) rivers is 2 mg/L. The BOD concentration of the Asahan river for 3 (three) measurement periods at each sampling point is shown in Graph 3 below. In Figure 3 the BOD concentration at all points has exceeded the quality standard. The highest BOD concentration value was at the downstream sampling point at the third sampling time of 5.96 mg/L, while the lowest BOD concentration value was at the upstream sampling point at the first sampling time of 2.24 mg/L. BOD concentration fluctuates, this is caused by residential activities around the Asahan river watershed. The high value of BOD concentration in the waters shows the high level of water pollution originating from organic materials (Noprianti et al., (2013) cited by Djoharam, Riani, and Yani 2018).

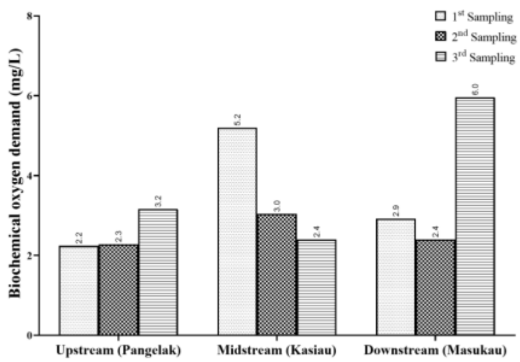


Figure 3. Concentration of BOD

3.1.4. COD (Chemical Oxygen Demand)

According to Effendi (2003), COD is describing the total amount of oxygen needed to chemically oxidize organic materials, both those that can be degraded biologically and those that are difficult to degrade biologically into CO2 and H2O. Based on Governor Regulation No. 5 of 2007 concerning Designation and Quality Standards for River Water, the value of COD that is tolerated in class I (one) rivers is 10 mg/L. The COD concentration of the Asahan river for 3 (three) measurement periods at each sampling point is shown in Graph 5 below.

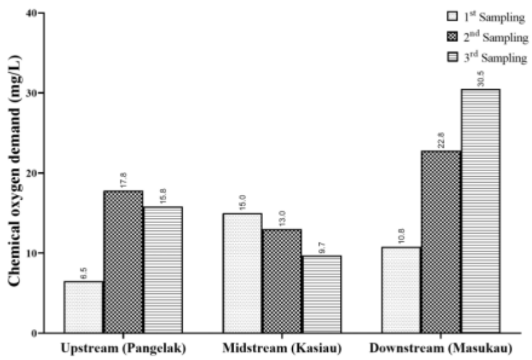


Figure 4. COD concentration in Asahan River

Figure 4 shows that the highest COD concentration value is at the downstream sampling point at the third sampling time of 30.50 mg/L, while the lowest COD concentration value is at the upstream sampling point at the first sampling time of 6.50 mg/L, This is due to residential and domestic industrial activities located around the Asahan River Basin which are suppliers of large quantities of organic materials. Similar to the BOD concentration, the high value of COD concentration in the waters shows the high level of water pollution originating from organic materials Saksena et al., (2008) cited by Djoharam, Riani, and Yani (2018). These organic waste materials will increase the concentration of COD because in the form of waste that is discharged into the water is chemically degraded by anaerobic microorganisms. In general, a high concentration of COD in water indicates the presence of large amounts of organic pollutants. The value of a high COD concentration in waters is directly proportional to the value of the BOD concentration and is an indicator of the contamination of a waters (Trilaksono et al. 2001)

3.1.5. Phosphate

According to Effendi (2003) phosphorus in the form of orthophosphorus comes from fertilizers for agricultural and plantation activities that enter the river through runoff of rainwater and drainage.

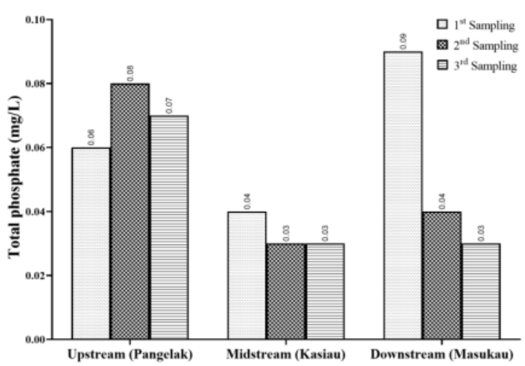


Figure 5. Phosphate Concentration in Asahan River

Based on Governor Regulation No. 5 of 2007 concerning Designation and Quality Standards for River Water, the phosphate value that is tolerated in class I (one) rivers is 0.2 mg/L. Figure 5 above shows that the largest phosphate concentration is only 0.09 mg/L at the downstream point at the first sampling time and the smallest phosphate concentration value is 0.03 mg/L at the middle and downstream points at the second and third sampling times. Fluctuations in the value of the phosphate concentration due to the basic stirring process of the water flow and the circulation process from the surface will greatly affect the concentration (Handoko, 2013 cited by Woelansari, et al. 2017). Patty (2013) in Woelansari., et al. (2017) explained that the large number of organic substances containing phosphate levels carried by currents into the waters caused high phosphate levels in the waters, it was suspected that land had a major influence on phosphate concentrations. Phosphate is a pollutant agent that can cause eutrophication in waters, which makes algae or water hyacinth appear and multiply. This Algae boom, if accumulated in large quantities, reduces the solubility of oxygen in the water because it is used by algae or water hyacinth plants, so that the value of phosphate concentration can be an indicator of the contamination of waters. which makes algae or water hyacinth arise and multiply. This Algae boom, if accumulated in large quantities, reduces the solubility of oxygen in the water because it is used by algae or water hyacinth plants, so that the value of phosphate concentration can be an indicator of the contamination of waters. which makes algae or water hyacinth arise and multiply. This Algae boom, if accumulated in large quantities, reduces the solubility of oxygen in the water because it is used by algae or water hyacinth plants, so that the value of phosphate concentration can be an indicator of the contamination of waters.

3.1.6.Fecal Coliform

According to Kuswandi (2001) cited by Sutiknowati (2016), 'fecal' E. coli bacteria enter the waters through river flows and rainwater runoff so that the abundance of bacteria will be higher when it rains. Based on Governor Regulation No. 5 of 2007 concerning Designation and River Water Quality Standards, the value of Fecal coliform that is tolerated in class I (one) rivers is 100 jml/100 mL.

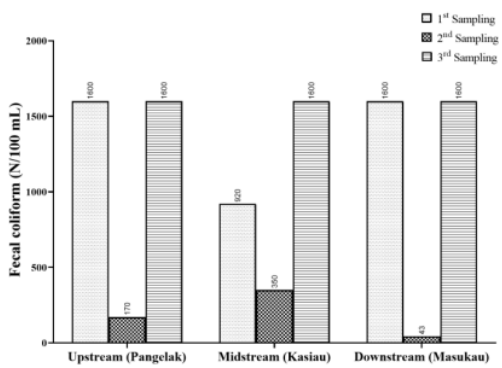


Figure 6. Number of Fecal coliforms in Asahan River

Figure 6 above shows that the largest number of fecal coliforms is 1600 mg/L at the upstream point, while the smallest number of fecal coliforms is 43 jml/100 mL at the downstream point. The high number of fecal coliforms is associated with the level of pollution, this is influenced by seasonal factors and the intensity of domestic waste from land (Lewerissa 2014). Kunarso (1989) cited (Lewerissa 2014) stated that the presence of coliform bacteria in the waters can be an indicator of the entry of fecal contaminants in the environment. Fecal coliform bacteria in conditions of high temperature, salinity levels and high light intensity such as in the middle area of large waters have a small number. In addition, fecal coliforms will always be found in nutrient-rich water, soil, and decaying plants (Jumaidi, 2010).

3.1.7. **Total Coliform**

Total coliform or coliform density is an early indicator of bacteria used to determine whether or not a water source is safe for human consumption (Khotimah, 2013). Based on the Regulation of the Governor of South Kalimantan No. 5 of 2007 concerning Designation and River Water Quality Standards, the value of Total Coliform that is tolerated in class I (one) rivers is 1000 jml/100 mL. The number of fecal coliforms in the Asahan river for 3 (three) measurement periods at each sampling point is shown in Graph 7 below.

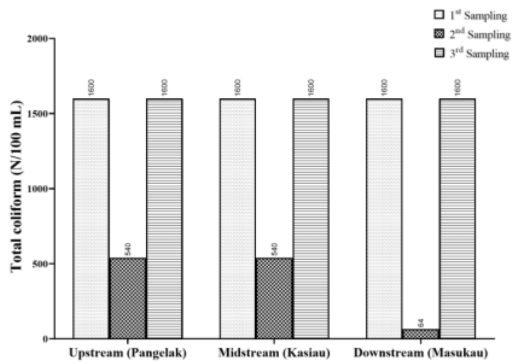


Figure 7. Total Coliform Count in Asahan River

Figure 8 above shows that the largest number of coliform bacteria is 1600 mg/L at the upstream, middle and downstream points at the first and third sampling times, while the smallest number of coliform bacteria is 64 jml/100 mL at the downstream point at that time. second sampling. The results of the examination showed that the Asahan river was contaminated with coliform bacteria that had passed the threshold for drinking water and domestic use (1000 jml/100 mL). Locations with a high density of coliform bacteria are residential locations at the upstream and downstream points as well as the rubber industry and residential areas around the factory at the center point.

This illustrates that the problem of water polluted by domestic waste is greater due to the coliform present in the waste and the unhealthy lifestyle of the community. High human activity around the river causes the entry of organic wastes such as domestic waste into water bodies. According to Feliatra (2002) cited by Khotimah (2013), the factors causing water pollution are dominated by the influence of household waste such as feces or other food waste. The location is near a densely populated settlement with a high population density, the distance from one house to another is very close,

2.2. Determination of Asahan River Water Quality Status

The assessment of the water quality status of the Asahan river was carried out using the Storet Method and the Pollution Index Method on the results of the analysis of the water quality of the Asahan river, namely the parameters DO, TSS, BOD, COD, Phosphate, Fecal coliform and Total Coliform, so that the following results were obtained.

2.2.1. Storet method

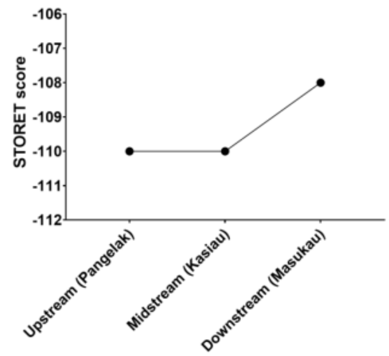


Figure 8. Determination of the Water Quality Status of the Asahan River with the STORET Method in 2019

Graph 8 shows that the upstream, middle and downstream parts of the Asahan river score between (–108) to (-110) are heavily polluted for class I (one) rivers. This is due to chemical and biological parameters whose values exceed the class I quality standard. The parameters are DO, BOD, COD, Fecal coliform and Total Coliform. Referring to the parameters that exceed the quality standard, it illustrates that the cause of the contamination of the quality status of the Asahan river comes from residential activities that produce domestic waste and garbage. However, these waters can still be inhabited by various animals including gastropods, fish, paramecium, plankton and other microorganisms.

2.2.2. Pollution Index (IP) Method

According to Saraswati et al (2014), the Pollution Index is used to determine the status of river water quality from only one water quality sampling. The water quality status of instantaneous water quality monitoring is useful for the study of the control of effluent entering the river (off stream).

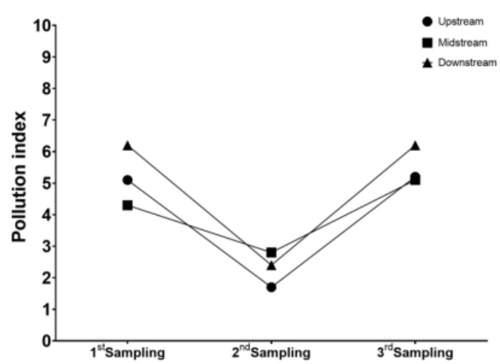


Figure 9. Determination of Water Quality Status of Asahan River Pollution Index (IP) Method

The Asahan River Pollution Index (IP) value from upstream, middle and downstream has increased. The increase in the value of this index indicates that the water quality status of the Asahan river has also decreased. The water quality status of the Asahan river from upstream to downstream is lightly polluted. This states that the water quality of the Asahan river from the upstream, middle and downstream parts has shifted from the quality of Class I (One) river water, where the allotted water can be used for drinking water, and or other uses that require the same water quality as that use. as stipulated in the Governor's Regulation Number 5 of 2007 the quality of river water is Class II (Two), namely water whose designation can be used for water recreation infrastructure or facilities, freshwater fish cultivation, animal husbandry, water for irrigating crops,

This shift in the water quality status of the Asahan river, of course, has many causes, the first to be highlighted is the considerable land conversion that occurs in the area along the Asahan river. The Tabalong Regency Environmental Service stated data on coal mining land, oil and gas activities, the Crumb Rubber Industry and other businesses such as agriculture, plantations and settlements. The second is household activities. Every activity carried out by humans will certainly produce waste, as well as human activities in watersheds. A total of 1790 thousand residents living on the banks of the Asahan river watershed produce waste such as bath residue, toilets, plastic waste, detergent and food waste with a potential pollution load of 3,094.43 kg/day (Environmental Service). The third is industrial waste that is discharged into the river with a pre-processing process or from rain run-off and drainage, even industrial waste with a permit to dispose of waste water or liquid waste and without a disposal permit. Another source of causes is the waste of fertilizers and pesticides from agricultural and plantation activities carried by run-off of rainwater that enters the river.

9

Conclusion. Based on the results of research and analysis conducted, the following conclusions can be drawn:

The water quality of the Asahan River has decreased from the results of the analysis of parameters DO, BOD, COD, Phosphate, TSS, Fecal coliform and Total Coliform. This happens because of various activities around the waters such as mining, agriculture, domestic waste and industrial waste as well as other human activities. which produces pollution.

The water quality status of the Asahan River shows moderately polluted according to the Storet method and light pollution according to the Pollution Index (IP) method. However, these waters can still be inhabited by various animals including gastropods, fish, paramecium, plankton and other microorganisms.

References

A. Harahap, P. Hrp, NKAR Dewi, Macrozoobenthos diversity as an bioindicator of the water quality in the Sungai Kualuh Labuhanbatu Utara, International Journal of Scientific & Technology Research, 9(4), 2020, pp. 179-183.

J. Heisler, PM Glibert, JM Burkholder, DM Anderson, W. Cochlan, WC Dennison, Q. Dortch, CJ Gobler, E. Humphries, A. Lewis, R. Magnien, HG Marshall, K. Sellner, DA Stockwell, DK Stoecker, M. Suddleson, Eutrophication and harmful algal blooms: a scientific consensus, Harmful Algae, 8(1), 2008, pp. 3-13.

VH Smith, SB Joye, RW Howarth, Eutrophication of freshwater and marine ecosystems, Limnology and Oceanography, 51, 2006, pp. 351-355.

Y. Lu, H. Xu, Y. Wang, Y. Yang, Evaluation of water environmental carrying capacity of city in Huaihe River Basin based on the AHP method: a case in Huai'an city, Water Resources and Industry, 18, 2017 , pp. 71-77.

MC Acreman, AJD Ferguson, Environmental flows and the European Water Framework Directive, Freshwater Biology, 55, 2010, pp. 32-48.

T. Garg, SE Hamilton, JP Hochard, EP Kresch, J. Talbot, (Not so) gently down the stream: river pollution and health in Indonesia, Journal of Environmental Economics and Management, 92, 2018, pp. 35-53.

BA Badea, A. Gagyi-Palffy, LC Stoian, G. Stan, Preliminary studies of quality assessment of aquatic environments from Cluj suburban areas, based on some invertebrates bioindicators and chemical indicators, AACL Bioflux, 3(1), 2010, pp. 35-41.

K. Kubosova, K. Brabec, J. Jarkovsky, V. Syrovatka, Selection of indicative taxa for river habitats: a case study on benthic macroinvertebrates using indicator species analysis and the random forest methods, Hydrobiologia, 651, 2010, pp. 101-114.

JC Morse, YJ Bae, G. Munkhjargal, N. Sangpradub, K. Tanida, TS Vshivkova, B. Wang, L. Yang, CM Yule, Freshwater biomonitoring with macroinvertebrates in East Asia, Frontiers in Ecology and the Environment, 5(1), 2007, pp. 33-42.

RC Sharma, JS Rawat, Monitoring of aquatic macroinvertebrates as bioindicator for assessing the health of wetlands: a case study in the Central Himalayas, India, Ecological Indicators, 9, 2009, pp. 118-128.

K. Sirisinthuwanich, N. Sangpradub, C. Hanjavanit, Development of biotic index to assess the Phong and Cheon Rivers' healths based on benthic macroinvertebrates in Northeastern Thailand, AACL Bioflux, 9(3), 2016, pp. 680-694.

A. Harahap, TA Barus, MB Mulya, S. Ilyas, Macrozoobenthos diversity as bioindicator of water quality in the Bilah River, Rantauprapat, Journal of Physics: Conference Series, 1116(5), 2018, Article Number: 052026.

Djoharam, Veybi, Etty Riani, and Mohamad Yani. (2018). Analysis of Water Quality and Pollution Load Capacity of Pesanggrahan River in DKI Jakarta Province." Journal of Natural Resources and Environmental Management. Journal of Natural Resources and Environmental Management. Vol 8 (1): 127–33.

Effendi, H. (2003). Study of water quality for the management of aquatic environmental resources. Canisius Publisher. Yogyakarta

Jumadi, Ahmad. (2016). The Effect of Water Discharge on Water Quality Improvement in the Recirculation System and Its Relationship with Survival and Seed Growth of Gouramy Fish (Oshpronemus Gouramy). Junal Engineering and Aquaculture Technology 5 No. 1.

Ministry of Environment. (2001). Government Regulation Number 82 of 2001 concerning Water Quality Management and Water Pollution Control. Ministry of Environment. Ministry of Environment Republic of Indonesia : Jakarta.

Khotimah, Siti. (2013). Density of Coliform Bacteria in the Kapuas River, Pontianak City. In the Proceedings of SEMIRATA 2013 1 (1): 339–49.

Lewerissa, Frijon and Martha Kaihena. (2014). Qualitative Analysis of Coliform and Fecal Coliform Bacteria in the Springs of Saparua Village, Saparua District, Central Maluku Regency. At the National Seminar on Basic Science VI F-MIPA UNPATI.

Muriasih, W. (2012). "Distribution of Dissolved Oxygen from the Cicendo River in Cirata Reservoir, West Java," 1–43.

Noprianti, R. (2013). Status of Water Quality Using the Polluttan Index Method in the Lemo River, North Barito Regency, Central Kalimantan Province. Special Issues. Lambung Mangkurat University: Banjarbaru.

Neno, Abd Kamal, Herman Harijanto. (2016). Relationship between water discharge and water level in the Lambagu River, Tawaeli District, Palu City. Warta Jungle, Vol. 4 Number 2 December 2016 4:1–8.

South Kalimantan Provincial Government. (2007). South Kalimantan Governor Regulation Number 5 of 2007 concerning Designation and Quality Standards for River Water. South Kalimantan Provincial Government : Banjarmasin.

Saraswati, SP, Sunyoto, Bambang A. K and S. Hadisusanto. (2014). Assessment of the Forms and Sensitivity of the Index Formula PI, Storet, CCME for The Determinat ion of Water Quality Status of A Tropical Stream in Indonesia). Journal of Humans and the Environment, Vol.21, No.2:129-142.

Simanjuntak, Marojahan. (2012). Dissolved Oxygen and Apparent Oxygen Utilization in Klabat Bay Waters, Bangka Island. Marine Sciences: Indonesian Journal of Marine Sciences 12 (2): 59–66.

Sutiknowati, LI, (2016). “Bioindicators of Pollutants, Bacteria.” Oceana XLI: 63–71.

Trilaksono. Ginanjar., Ing S. Dwi., and S. Handayani., (2001). “Qual2e And Method *Mass Balance (Case Study: Sungai Garang, Central Java),” no. 82*.

Woelansari, Emmy, Mahmiah and Supriyatno W. (2017). "Distribution of Forfat And Dissolved Oxygen In The Waters Of The East Coast Of Surabaya." National Marine Seminar XII Faculty of Marine Engineering and Science Hang Tuah University : Surabaya. B-98.

Turnitin 2

ORIGINALITY REPORT

8%	5%	4%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.itp.edu.pl Internet Source	1%
2	ojs3.unpatti.ac.id Internet Source	1%
3	Effendi, Hefni. "River Water Quality Preliminary Rapid Assessment Using Pollution Index", Procedia Environmental Sciences, 2016. Publication	1%
4	pt.scribd.com Internet Source	1%
5	Submitted to Sriwijaya University Student Paper	<1%
6	Ilham, Djoko M. Hartono, Emirhadi Suganda, Muhammad Nurdin. "How Land Stripping Affects Quality of River in Pomalaa Nickel Mining, South East Sulawesi, Indonesia", Asian Journal of Water, Environment and Pollution, 2018 Publication	<1%

7	journalppw.com Internet Source	<1%
8	Submitted to Universitas Diponegoro Student Paper	<1%
9	jimf-bi.org Internet Source	<1%
10	Rojacques Mompremier, Jorge Ramírez-Muñoz, Kebreab Ghebremichael, Jersain Gómez Nuñez et al. "Prediction of chlorine concentration of flows exiting pipe in cross junctions: experimental and numerical study", Water Supply, 2022 Publication	<1%
11	id.scribd.com Internet Source	<1%
12	docshare.tips Internet Source	<1%
13	repozitorij.veleri.hr Internet Source	<1%
14	Submitted to Universitas Indonesia Student Paper	<1%
15	innspub.net Internet Source	<1%
16	download.atlantis-press.com Internet Source	<1%

17 Hadiwijaya L. Salim, Dini Purbani, Agustin Rustam, Yulius -, Devi D. Suryono, Joko Prihantono. "Spatial Pattern of Water Quality on Coral Reef Area Around Kaledupa Island", Jurnal Segara, 2016
Publication
<1%

---

18 Hung-Nien Sung, Evina Katsou, Evangelos Statiris, Lorna Anguilano, Simos Malamis. "Operation of a modified anaerobic baffled reactor coupled with a membrane bioreactor for the treatment of municipal wastewater in Taiwan", Environmental Technology, 2018
Publication
<1%

---

19 Mereta, Seid Tiku, Pieter Boets, Luc De Meester, and Peter L.M. Goethals. "Development of a multimetric index based on benthic macroinvertebrates for the assessment of natural wetlands in Southwest Ethiopia", Ecological Indicators, 2013.
Publication
<1%

---

20 N Listyaningrum, A K Nisa, L Hidayatullah, M M M Ihsanjaya et al. "Water quality as a base of water treatment with appropriate technology in Girikerto Village, Sine Subdistrict, Ngawi Regency", IOP Conference Series: Earth and Environmental Science, 2019
Publication
<1%

---

21 neptjournal.com
Internet Source

<1%

22	smujo.id Internet Source	<1%
23	www.eco-nomic.com Internet Source	<1%
24	www.tandfonline.com Internet Source	<1%
25	H Purwati, M F Fachrul, D I Hendrawan. "The study on the self-purification based on BOD parameter, Situ Gede Tangerang City, Banten Province", Journal of Physics: Conference Series, 2019 Publication	<1%

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		