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Water Quality Status of the Rivers in Tembilahan City Based on Physical-Chemical Parameters and Storet Index

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Abstract: Tembilahan city has several tidal-type rivers flowing into the Indragiri river which encountered a waste pollution problem. This research aims to obtain insight into the water quality of the rivers in Tembilahan City. Characteristics of rivers that flow in urban areas are vulnerable to water quality degradation and environmental pollution due to high anthropogenic activities. Water quality data, which includes physical and chemical properties of water, were obtained from monitoring four rivers as sampling stations representing several rivers in Tembilahan city. The sampling location was determined based on the representativeness of the human activity area. The river water quality status was analysed by using Storet Index. The results showed that the water quality of the rivers in Tembilahan City has a score of -31 which indicates that the rivers are categorised as polluted rivers. Therefore, there is a need for river revitalisation management with the participation of the public sector and the community in Tembilahan City.

Key words: Indragiri river, revitalisation river, Storet index, water quality status, Tembilahan city's rivers.

Highlight: The water quality of Tembilahan City's rivers has a score ≥ -31 categorised as a polluted river.

- The physical and chemical parameters of the rivers in Tembilahan City are no longer suitable for activities like fisheries, farms, irrigation, or other utilsation, which require high-quality water.
- A decrement in the clarity level of the river is occurred along with the water flow downstream caused by the existence of organic material drifted by the river flow.
- Most parts of the rivers in Tembilahan City have phosphate concentration that violates the maximum threshold.
- The salinity values tend to be below when the waters are in low tide due to the decrement of salt water concentration and automatic increase in the concentration of freshwater.

Introduction

Tembilahan City is known by the nickname "The Land of a Thousand Ditches" because this area consists of waters, rivers, swamps and coconut plantations separated by thousands of ditches (DPMPT Indragiri District, 2019). Unfortunately, several tidal-type rivers in Tembilahan City have waste pollution problem. The growth of Tembilahan City's population in line with the regional development leads to the riverbanks' functional shift. Nowadays, the riverbanks in Tembilahan City are becoming a settlement, trade market, workshop, hospitality area, and even a hospital. Those activities on the riverbanks generate waste which is directly thrown away to the river and cause water pollution. Direct input of pollutants into rivers will cause a decrease in water quality in the form of changes in the physical, chemical and biological parameters of river waters (Masykur et al., 2018).

One of the indicators of water quality degradation is the change in the value of the water quality parameters. Those changes are led by waste disposal into the rivers.

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Those wastes were from industrial waste, agricultural waste, or domestic waste by citizen activities. The open water area, including a river, is a unification of physical, chemical, and biological components interacting with each other. Therefore, the change that occurred in one element would affect other elements (Rudiyanti, 2011).

Provincial level Environmental Council in 2015 reported that some of the physical and chemical parameters of water quality in Tembilahan City's rivers surpassed the water quality standard IV based on Regulation No. 82 of the Year 2001. Those parameters are Total Dissolved Solid (TDS), TSS, Biological Oxygen Demand (BOD), NO_3, NH_3, Fecal and total Coliform (Provincial level Environmental Council, 2015). Hence, this research tried to describe the water quality condition of Tembilahan City's rivers from the perspective of water physics and chemistry parameters. The main objective of this research is the observations of water quality in Tembilahan City's rivers, which have specific characteristics. The river characteristic of Tembilahan City is a combination of a tidal-type river and a river originating from peatland.

Following the regulation issued by the Ministry of Environment No. 15 Year 2003 as guidance to determine the water quality status, Storet Index was used to measure the river condition, whether in a proper condition or vice versa. Hence, this research aims to determine the water quality value of Tembilahan City's rivers by using that index. Therefore, the results of this observation will give valuable insight to the authority of Tembilahan City so that they can make necessary efforts to revitalize the rivers.

Methods

Time and Location

Purposive sampling was used to acquire a sample water monitoring station for data acquisition purposes, with an upstream and downstream approach to overlook the distinction between river segmentation characteristics. Then, the observation was conducted on four water monitoring stations spread over four rivers in Tembilahan City. Those selected stations were then divided into four sub-stations located in the headwaters, the middle part of the river, the river's downstream, and the point at which the river flow meets the Indragiri river. On each of the substations, the sample water was acquired three times in different areas. Each of those areas represented different types of related human activities. Hence, each of the water monitoring stations was expected to have distinct waste characteristics. The acquisition of water samples was conducted two times iteratively to obtain a clear snapshot of water characteristics based on tidal conditions (high tide and low tide). Figure 1 depicts the location of sample data acquisition at each water monitoring station.

Quality Measurement of Physical and Chemical Properties of River Water

The river water sample for physical and chemical quality measurement was acquired on each substation within three iterations when the river water was at a low level (low tide). Table 1 outlines the parameters of physical and chemical properties, methods, and equipment used in this research.

Quality Analysis of Waters Phyisco Chemical using Storet Index

The procedure of using Storet Index for water quality measurement in the river area obeying the regulation from the Indonesian Ministry of Environment Number 115, 2003 about the Guidance of Water Quality Determination (Ministry of Environment, 2003). The measurement procedure consists of the aggregation of chemical quality parameters and physical quality parameters. The first phase of analysis calculates the

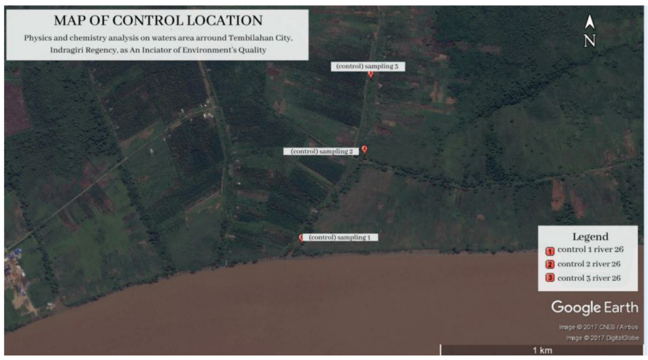

Figure 1A: Map of research sites onTembilahan City's rivers, Indragiri: A. map of research control location.

Figure 1B: Map of research sites on Tembilahan City's rivers, Indragiri: B. map of sampling location.

Table 1: Parameters, equipment and waters physicochemical analysis method

Parameters	*Measurement unit*	*Equipment/ Analysis method*	*Additional information*
Physical			
Colour	PtCo	*Spectrophotometric*	Laboratory
Clarity	Cm	Secchi disk	In situ
Turbidity	NTU	*Tubridy meter*	Laboratory
Temperature	°C	*Thermometer*	In situ
Current Speed	m/dtk	*Current drogue*	In situ
TSS	mg/L	*Gravimetric*	Laboratory
Chemistry			
Ph	-	*Horiba waterquality*	In situ
Salinity	PSU	*Hand refractometer*	In situ
DO	mg/L	*Horiba waterquality*	In situ
BOD_5	mg/L	*titrimetric*	Laboratory
COD	mg/L	*titrimetric*	Laboratory
Organic Materials	mg/L	*titrimetric*	Laboratory
Nitrate (NO_3)	mg/L	*Spectrophotometric*	Laboratory
Phosphate (PO_4)	mg/L	*Spectrophotometric*	Laboratory

average value, maximum value, and minimum value of every parameter. Afterwards, those calculation results are compared to the common value of water quality to determine the final score. The determination process of the final score was following the scoring system depicted in Table 2. In this research, the final score calculation employed the scoring system for a total sample of less than 10. The final score was then evaluated to determine the water quality status following the United States Environmental Protection Agency (US-EPA) (Table 3).

Results and Discussion

Parameters of Waters Physics

Colour

Table 4 outlined the measurement results of the colour parameter on the rivers in Tembilahan City. From the measurement results in Table 4, there are three levels of colour gradation from four monitoring stations. Those gradation levels are brown, muddy brown, and dark brown. Compared to the watercolour in the control station, the monitoring station's colour has naturally changed from clear brown to muddy brown in station 1 and dark brown in stations 2 and 3. The turbidity of water can be influenced by organic matter and inorganic sludge and effluent from a certain surface which causes the water to become cloudy (Supriyono et al., 2019). The manganese oxide could change the water colour to dark brown or black (Rasmito et al., 2019). The more human activities in the river, the darker the colour will be.

Table 2: Scoring system with Storet Index

Number of Sample[a]	*Score*	*Parameters*	
		Physical	*Chemical*
< 10	Maximum	-1	-2
	Minimum	-1	-2
	Average	-3	-6
>10	Maximum	-2	-4
	Minimum	-2	-4
	Average	-6	-12

Source: Canter within Regulation from The Ministry of Environment Number 115, 2003(Ministry of Environment 2003); [a]number of samples from each water quality parameter.

Table 3: Classification of waters area quality status based on Storet Index value

Class	*Criteria*	*Score*	*Water Contamination Level*
A	Very Good	0	Per quality standard
B	Good	-1 s/d -10	Lightly contaminated
C	Moderate	-11 s/d -30	Moderately contaminated
D	Bad	≥ -31	Heavily contaminated

Source: Regulation from The Ministry of Environment Number 115, 2003 (Ministry of Environment, 2003).

Clarity and Turbidity

The measurement result of water clarity on each monitoring station when the water is on high tide is 6.0 cm – 11.50 cm and 2.5 cm – 14.5 cm when the water is on low tide. Alamanda et al. (2012) classified a clarity level below 100 cm as low clarity. Hence, those measurement results were categorised as low. When the water is at high tide, the lowest level of water clarity has occurred in the downstream part of Station 2 (river 11), and the highest level occurred on upstreams of station 2 (river 11) and Station 3 (River 13). Figure 2 depicts the water clarity fluctuation in each monitoring station.

In general, the decrement of the clarity level of the river occurs alongwith the waterflow down stream caused by the existence of organic material drifted by the riverflow. Figure 3 shows the turbidity level of river water in Tembilahan City. When the observation was performed, the high turbidity level of the downstream

Table 4:Water colour gradation on Tembilahan City's rivers

Station	*Sub-Station*	*Waters Colour*	
		Sampling 1	*Sampling 2*
1	1	Brown	Brown
	2	Brown	Muddy Brown
	3	Muddy Brown	Muddy Brown
2	1	Brown	Brown
	2	Muddy Brown	Brown
	3	Dark Brown	Dark Brown
3	1	Muddy Brown	Muddy Brown
	2	Dark Brown	Dark Brown
	3	Dark Brown	Dark Brown
4	1	Brown	Brown
	2	Brown	Brown
	3	Brown	Brown

Source: Primary Research Data (2017); Additional Information: Station 1 = River 10; Station 2 = River 11; Station 3 = River 13; Station 4 = Kontrol (River 26; Sub Station 1 = representsheadwaters; Sub Station 2 = representsmiddlepartoftherivers; Sub Station 3 = representsdownstreampartoftheriver; the waters color sdetermined by visual observation.

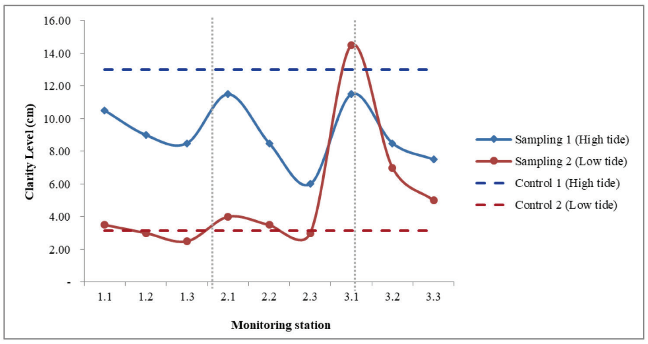

Figure 2: Water clarity level distribution on Tembilahan City's rivers.

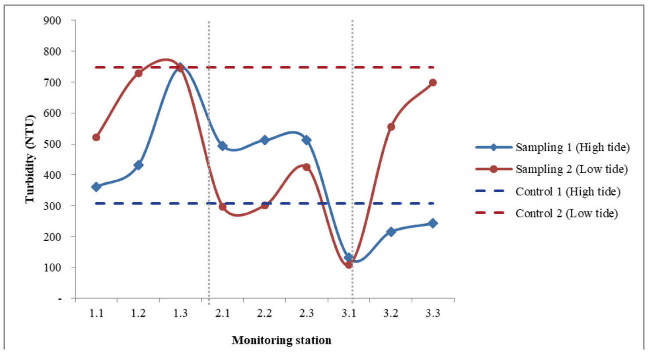

Figure 3:Turbidity level distribution on Tembilahan City's river.

river was caused by the heavy rain upstream that lead to a runoff. The occurrence of the runoff will increase the intensity of organic materials on the river (Rustiah et al., 2019). Alongside those natural factors, the increment in turbidity level probably comes from anthropogenic activity throughout the riverside, which generates waste and contaminates the river.

The high level of turbidity can block light penetration into the waters. Thus, it can lead to a negative impact on the number and distribution of plankton organisms because they are heavily dependent on sunlight (Chen et al., 2012; Edward et al., 2016; Effendi, 2003).

Current Speed

The measurement results of current speed on Tembilahan City's river is ranging from 2.0 to 8.0 m/s when the river is at high tide and 0.5 – 4.0 m/s at low tide. Based on those results, the current speed of Tembilahan City's river was categorised as very slow. The categorisation is following the research conducted by Yu et al. (2017), which classified the current speed below 10 m/s as very slow. The lowest current speed on high tide conditions was recorded upstream of station 3 (river 13), whereas the highest current speed occurred upstream of station 2 (River 11). Figure 4 shows the fluctuation of the current speed on each monitoring station.

Several environmental factors like dissolved oxygen, water clarity, temperature, aquatic organism characteristics, and the level of sedimentation and pollution were affected by the current speed of the river (Fisesa et al., 2014). Tembilahan City's rivers generally

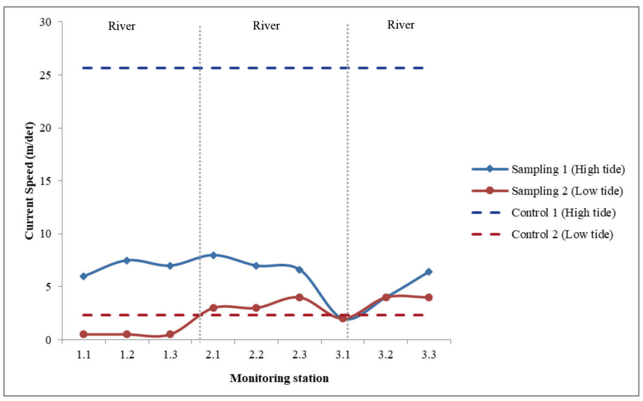

Figure 4: Fluctuation and distribution of the current speed of the rivers in Tembilahan City.

have base sediment, which consists of mud. River with low current speed leads to the difficulties of organic and inorganic materials assimilation. Thus, aquatic organisms have a high possibility of accumulating polluted materials.

Temperature

During the observation, the water temperature at each station is around 29.48 - 32.27°C when the tide is high and 28.64 – 32.19°C when the tide is low. The lowest temperature when the water is on high tide has occurred on the headwaters of station 3 (River 13), and the highest one is downstream of station 1 (River 10). Meanwhile, when the water is on low tide, station 1 (river 11) has the highest water temperature, and the lowest one belonged downstream of station 3 (Sungai 13). The water temperature distribution on every monitoring station is depicted in Figure 5.

The ideal temperature of the aquatic area is around 25–31°C. Those range of temperatures forms a suitable environment for the growth of benthic animals that are beneficial to the river's ecosystem. Another kind of organism like plankton has the ideal water temperature ranging from 22°C to 30°C (Stuart-Smith et al., 2013). The water temperature plays a significant role in the life of an organism because it affects the oxygen solubility within the water, which is crucially needed by the organism for its metabolism (Soliha et al., 2016). In addition, the oxygen solubility level goes against the water temperature. Hence, the non-standard water temperature can geographically hinder the spread of that kind of organism (Stuart-Smith et al., 2017).

Total Dissolved Solid (TDS) and Total Suspended Solid (TSS)

TDS value of river water on each monitoring station is around 489.00–2,147.00 mg/L when the water is on high tide and 107.00–647.00 mg/L on low tide. The highest value of TDS occurred downstream of station 3 (River 13) in both high and low tide. Meanwhile, station 3 (River 13) records the lowest TDS values in both high and low tide. The high level of TDS value mainly comes from the contamination of liquid waste such as detergent, surfactant, and soap molecules that are readily soluble in the water (Effendy, 2013). Hence, the high TDS value on the rivers in Tembilahan City is presumably because of household and small industry waste like laundry services. Figure 6 shows the distribution of TDS values across the monitoring station.

TSS concentration on each monitoring station during the observation period has a similar condition to the TDS value. That situation follows the TSS value's general pattern similar to TDS in which the river flow goes downstream, and the TSS value tends to rise. The TSS value on each monitoring station was recorded at 72.0 – 438.0 mg/L on high tide and 64.0 – 696.0 on low tide. Station 3 (river 13) records the highest TSS value both on high and low tide. On the high tide, the lowest TSS value was recorded at station 1 (river 10), and the lowest TSS value on the low tide belonged to station 2 (river 11). The observation results of TSS values on each monitoring station are shown in Figure 7. Refers to the government regulation number 82, 2001 and the rules of environmental protection 2003, as well as

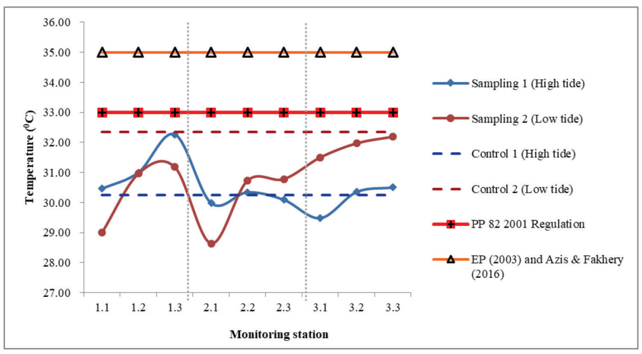

Figure 5: Distribution of water temperature on the rivers in Tembilahan City.

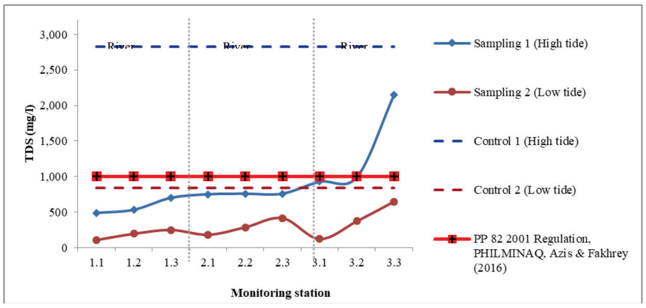

Figure 6: Distribution of TDS value on the rivers in Tembilahan City.

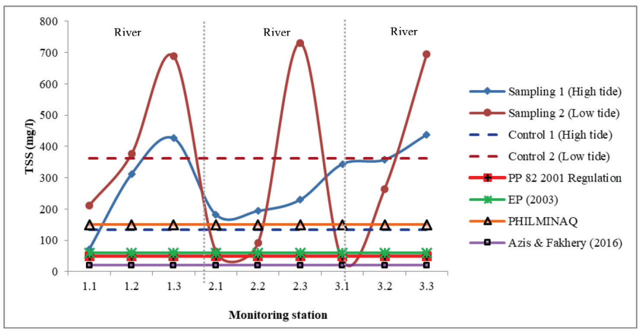

Figure 7: Distribution of TSS values on the rivers in Tembilahan City.

research by Kustiyaningsih and Irawanto (2020), Aziz and Fakhrey (2016), TDS and TSS value during this observation was observed to be violating the standard of water quality.

Parameter of Waters Chemical

pH

The pH value on each station at the high tide is recorded from 6.23 to 7.10, while the low tide is from 6.41 to 7.68. The upstream of station 1 (river 10) has the lowest pH value both at the high and the lowtide. Meanwhile, the highest pH value at the high and the lowtide belonged to the middle stream and the upstream of station 3 (river 13), respectively. The ideal pH value suitable for organisms' living environment ranges from 7 to 8.5 (Ratzke and Gore, 2018). Waters that have too high pH value can disturb the metabolism and respiration of organisms. Hence, it may damage the life of organisms within the rivers. Figure 8 depicts the distribution of pH values on each monitoring station.

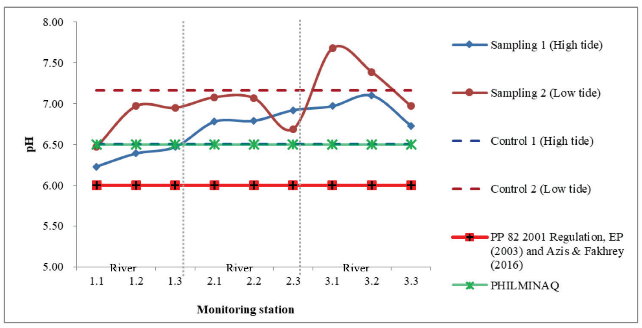

Figure 8: Distribution of pH value on the rivers in Tembilahan City.

According to government regulation number 82, 2001 about water quality standard level II, the law of environmental protection 2003, and observation by Aziz and Fakhrey (2016), the range of pH level during the observation period (around 6 -9) are still tolerable. However, the Center for the Development of Freshwater Cultivation Sukabumi (2016) defines a slightly different standard that determines the ideal pH value to be < 6.5 that is in line with the research by Hanisa et al. (2017) that determined the ideal pH value of waters area is from 6.5 to 8.5.

Salinity

The salinity value recorded on each monitoring station is around $0.40 - 0.80\,^{0}/_{00}$ and $0.10 - 0.50\,^{0}/_{00}$ when the tide is high and low, consecutively. The lowest salinity value recorded on high tide occurred upstream of station 1 (river 10), and the highest one occurred downstream of station 3 (river 13). Meanwhile, on the low tide condition, the lowest salinity occurred in four distinct places, specifically the middlestream of station 1 and upstream of station 1, 2 and 3. Afterward, the highest salinity when the water is at lowtide occurred downstream of station 3. Figure 9 shows the distribution of salinity value on each monitoring station.

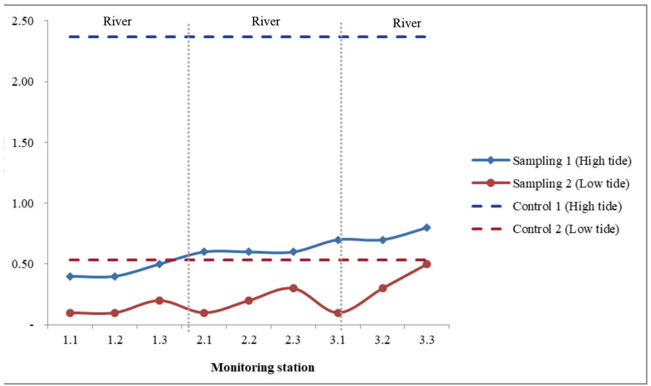

Figure 9: Distribution of salinity value on the rivers in Tembilahan City.

Salinity values on the estuary is highly dependent on the tidal condition of the waters. When these tides recede, the discharge of freshwater increases and reduces the salinity level (Sari et al., 2013). Hence, during the observation, the salinity values tend to be low when the waters are in low tide due to the decrement of saltwater concentration and automatically increase the concentration of freshwater.

Dissolved Oxygen (DO)

Dissolved Oxygen (DO) values on each station when the rivers at a high tide are around 1.12 – 2.50 mg/L and 1.35–4.89 mg/L when the rivers at a lowtide. The downstream of station 3 (river 13) records the lowest DO value at high and lowtides. On the contrary, the upstream of station 1 (river 10) records the highest point of DO level both at high and low tide. Figure 10 depicts the distribution of DO concentration in each monitoring station.

According to government regulation number 82, 2001, about water quality standard level II, the DO value of the rivers in Tembilahan City measured during the observation is below the quality standard. An exception belonged to the upstream of station 1 (river 10) and station 3 (river 13) which have a DO value of 4 mg/L. However, if the terms of quality refer to the regulation of PHILMINAQ and research by Aziz and Fakhrey (2016) that determine the minimum DO level is 5 mg/L and 6.5 mg/L, respectively, then all of the water

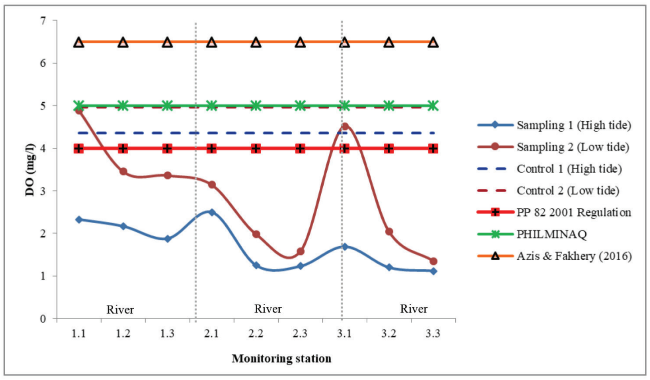

Figure 10: Distribution of DO value on the rivers in Tembilahan City.

on each monitoring station is below the quality standard.

COD

COD values of river water on each monitoring station when the river is at high tide is around 30.34 – 65.73 mg/L, and around 16.80 – 64.80 mg/L at lowtide. Station 2 (river 11) has both the lowest and highest COD value on its middle stream and downstream at high tide conditions, respectively. When the river is on lowtide, the highest COD value was recorded on the middle stream of station 3 (river 13), while the lowest value is recorded in two places, specifically the downstream of station 1 (river 10) and the middle stream of station 2 (river 11). Figure 11 shows the distribution of COD concentration in each monitoring station.

Water areas with high COD concentrations are not suitable for fishery activities (Pamungkas, 2016). COD concentration on the river comes from domestic waste and industrial waste, including agricultural and farming industries (Agustira et al., 2013). The COD concentration level on the rivers in Tembilahan City is mostly violating the threshold of water quality standards. Government regulation number 82, 2001, about water quality standard level II determined the maximum value of COD concentration is 25 mg/l. During the observation, only two places have an ideal COD concentration, specifically the downstream of station 1 (river 10) and the middle part of station 2 (river 11) when the river is in high tide condition.

BOD

BOD values of the river in Tembilahan City on each monitoring station are 0.13 – 0.92 mg/L and 10.92 – 42.12 mg/L when the river is on a high and low tide. Station 3 (river 13) has the highest BOD value on its upstream when the tide is high and its middle stream when the tide is low. The upstream of station 1 (river 10) has the lowest BOD value both at high and lowtide. Another lowest BOD concentration at the low tide occurred in the middle part of station 2 (river 11). Figure 12 depicts the BOD concentration on each monitoring station.

On government regulation number 82, 2011 about water quality standard level II and research conducted by Azis and Fachery (2016), the ideal value of BOD concentration is 3.0 mg/l. Hence, the BOD concentration on the rivers in Tembilahan City at the high tide condition is still within the threshold. However, when the rivers are at a lowtide, the BOD concentration is far above the threshold, especially on station 3. Station 3 has a very high BOD value when the river is at lowtide, indicating that the waters on station 3 contain more organic materials compared to waters on another station. Those organic materials presumably form households and traditional market waste. On the contrary, the BOD value on the head waters of the rivers is relatively low. The head waters area is usually far from settlement and has a less human activity that can generate any organic waste. The high BOD concentration can decrease the intensity of dissolved oxygen within the waters which disturb the metabolism process of waters biota (Patty et al., 2015).

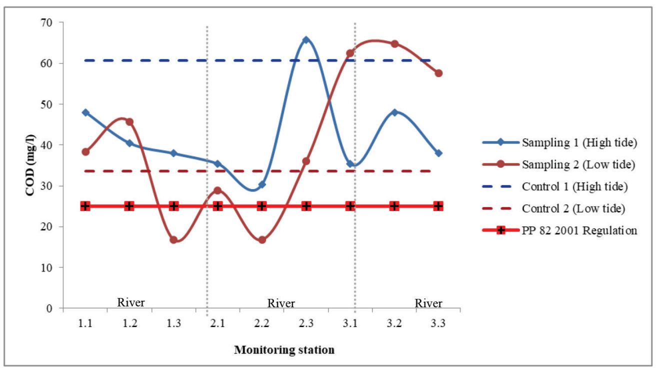

Figure 11: COD value distribution on the rivers in Tembilahan City.

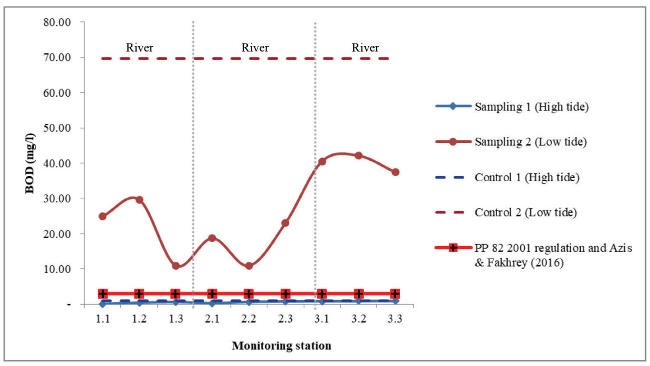

Figure 12: Distribution of BOD values on the rivers in Tembilahan City.

Phosphate

The phosphate concentration on the river on each monitoring station was around 0.11–0.37 mg/L and 0.14 – 2.28 mg/L at the high and lowtide, consecutively. The lowest phosphate concentration is recorded on the upstream of station 1 (river 10), either at the hightide or lowtide. The highest phosphate concentration occurred downstream of station 2 (river 11) and station 3 (river 13) when the rivers are at high and lowtide, respectively. Figure 13 depicts the distribution of phosphate concentration in each monitoring station.

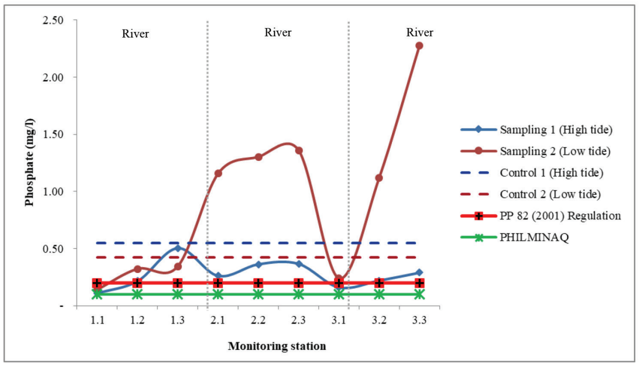

Figure 13: Distribution of phosphate concentration on the rivers in Tembilahan City.

One of the significant causes of phosphate contamination on rivers is detergent materials from domestic and industrial waste. Another source of phosphate contamination includes drifting fertiliser, organic materials, and other kinds of phosphate minerals. The maximum value of phosphate materials is 0.10 mg/L (Patty et al., 2015) or 0.2 mg/L, determined by government regulation number 82, 2001 about water quality standard level 2. Hence, most parts of the rivers in Tembilahan City have phosphate concentration that violates the maximum threshold except the upstream of station 1 (river 10). Station 3 (river 13) also has a tolerable phosphate concentration but only when the river is at high tide.

Nitrate

Nitrate concentration on the rivers in Tembilahan City is around 0.52–0.67 mg/L at the high tide and 0.08–01.2 mg/L at the low tide. The upstream of station 1 (river 10) has the lowest nitrate concentration in any water condition. The highest nitrate concentration occurred downstream of station 2 (river 11) and station 3 (river 13) when the waters are at high and low tide, consecutively. Figure 14 depicts the distribution of nitrate concentration in each monitoring station.

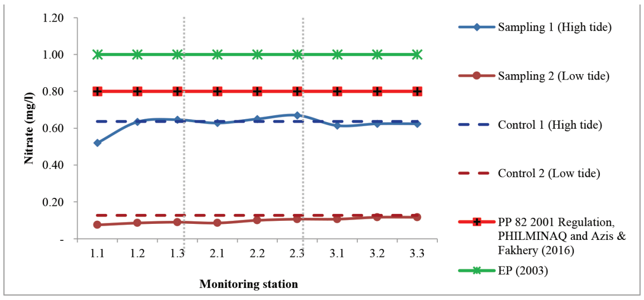

Figure 14: Distribution of nitrate concentration on the rivers in Tembilahan City.

Nitrate is a representation of the final product from the oxidation process of nitrogenous materials. In the waters, nitrogen can be in the form of gasses (N_2), nitrite (NO_2^-), nitrate (NO_3^-), ammonia (NH_3), and ammonium (NH_4^+) as well as N that bonded within complex organic material (Mayani, 2020). Nitrate concentration on the rivers in Tembilahan City is still below the threshold determined either by government regulation number 82, 2001, the law of environmental protection 2003, or the research by Aziz and Fakhrey (2016).

Water Quality Status Based on Parameter of Waters Physics and Chemistry

The water quality status of the rivers in Tembilahan City has been measured using Storet Index. Table 5 shows the measurement results of each physical and chemical quality parameter.

Storet index was employed to describe the level of contamination in the observation area comprehensively. Hence, every measurement result of the water's physical and chemical parameters was then benchmarked to the water quality standard level II determined within the government regulation number 80, 2001. The result of water quality measurement is then classified into three categories and depicted in Figure 15.

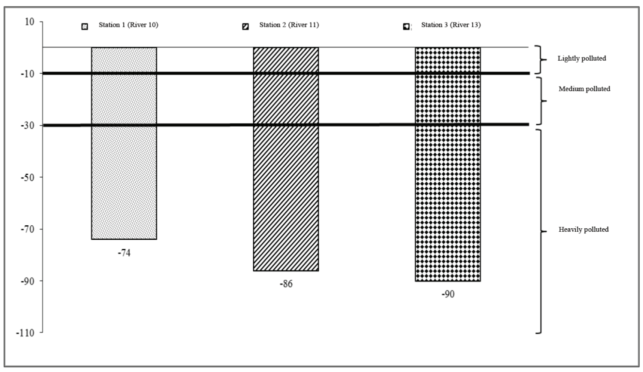

Figure 15: Classification of waters quality status on the river in Tembilahan City based on Storet Index.

Table 5:Storet index of physical and chemical water quality parameters

Parameters	*Measurement Units*	*Quality Standard**	*Station*	*MeasurementResults*			*Score***	*Average*
				Max	*Min*	*Average*		
Physical								
Temperature	^0C	Deviation 3	1	31.73	29.73	30.81	0	0
			2	30.54	29.31	30.09	0	
			3	31.35	30.49	31	0	
TSS	mg/L	50	1	557	142	347.67	-10	10
			2	480.5	123	248.83	-10	
			3	567	190	356	-10	
Chemistry								
pH	-	6-9	1	6.71	6.35	6.58	0	0
			2	6.93	6.81	6.89	0	
			3	7.33	6.86	7.14	0	
BOD	mg/L	3	1	15.04	5.78	11.12	-20	20
			2	11.93	5.79	9.08	-20	
			3	21.15	19.18	20.47	-20	
COD	mg/l	25	1	43.22	27.36	37.87	-20	20
			2	50.87	23.57	35.51	-20	
			3	56.42	47.76	51.02	-20	
DO	mg/L	4	1	3.61	2.62	3.01	-8	14.66
			2	2.82	1.41	1.95	-16	
			3	3.11	1.24	1.99	-20	
Phosphate	mg/L	0,2	1	0.42	0.13	0.27	-16	18.66
			2	0.86	0.71	0.8	-20	
			3	0.67	0.37	0.72	-20	
Nitrate	mg/L	10	1	0.37	0.3	0.34	0	0
			2	0.39	0.36	0.37	0	
			3	0.36	0.37	0.37	0	

Source: Processed data (2017)
Information:Station 1 = river 10; Station 2 = river 11; Station3 = river 13; * = Qualitystandardongovernmentregulationnumber 82, 2001;** = regulationoftheminisitryofenvironmentsnumber 115, 2001.

The classification results depicted in Figure 15 shows that most of the rivers in Tembilahan City are heavily polluted, indicated by a Storet Index score ≥ -31. More specifically, station 3 (river 13) has the highest Storet Index (-90), followed by station 2 (river 11) and then station 1 (river 10) with Storet indices of -86 and -74, respectively.

River revitalisation is the right step to restore the river's function as flood control, utilisation of water resources in the coconut plantations, rice fields, fisheries, and livestock sectors. In a previous study, the initial step of river revitalisation can also be done by selecting several parts of the river to be revitalised (Idajati, 2014), for example, in this study, the locations with poor water quality from the results of the research above with clear coordinates. The interaction between the government and the community can be demonstrated in socialisation programmes. Socialisation will be more targeted if the government invites the cooperation of local traditional leaders. These figures are chosen and nurtured to help increase awareness of river sustainability, especially among the people who live on the banks of the river (Angriani, 2018). Therefore, coordination, cooperation and consultation between stakeholders in every policy-making related to rivers is very necessary. Community involvement with the river revitalisation programme is also important for the integrated and sustainable management of the Indragiri River in Tembilahan City

Conclusion

The measurement results of physical and chemical parameters and the calculation result of Storet Index score ≥ -31 show that the rivers in Tembilahan City are heavily polluted. The rivers in Tembilahan City are no longer suitable for activities like fisheries, farms, irrigation, or other utilization, which require high-quality water. River revitalsation is the right step to restore the river's function. Coordination, cooperation and consultation between stakeholders in every policy-making related to rivers are very necessary.

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