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Analysis of water quality and nutrient content in the Belawan River

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Abstract. The goal of this research was to analyze the water quality and nutrient content in the Belawan River. Activities done by the community such as industries, PLTU, PDAM and aquaculture are found in Belawan River area. This action produce waste straightly discharged into river water, emerging several bad effect on water quality and nutrient content. Retrieval of data with Purposive Random Sampling with five analyses the location. Analysis in the form of measurements of water quality that are temperature, pH, depth, light intensity, light penetration, flow speed, dissolved oxygen (DO), BOD₅ and the measurement of nutrient content, which are nitrate, phosphate and nitrogen. The results of water quality measurements indicated that temperature, light penetration, light intensity, flow speed, and depth are still within the water quality standard while pH and BOD₅ have passed the water quality standard. Based on nitrate concentration, it is included as eutrophic and mesotrophic waters (1.18-7.57 mg/L). Based on phosphate concentrations, it is included as hypertrophic (0.14-0.18 mg/L). Based on nitrogen concentration, it is included as eutrophic and mesotrophic waters (1.54-10 mg/L).

1. Introduction

Activities done by the community such as industries, PLTU, PDAM and aquaculture are found in the Belawan River area. Waste produce from these activities is straightly released into the river, emerging in several bad effect on water quality and the contingency of the aquatic biota. The condition of the Belawan river are based on its tributary, the condition of the land and the waters it passes through [1].

Nitrate, phosphate and nitrogen are included as sources of nutrients that are needed by aquatic biota for energy sources by organisms. Organisms need nutrients in the form of phosphate and nitrates. The forms of sediment nutrients are divided into 3 forms that are on the surface of sediments, in sediments and dissolved in sedimentary pore water [2].

The quality of river water determines the condition of the Belawan river. The quality of water that are temperature, pH, depth, light intensity, light penetration, flow speed, dissolved oxygen (DO), BOD₅ and nutrient content which are nitrate, phosphate and nitrogen, are very important to determine the level of Belawan river pollution. This research aims were to analysis the condition of the Belawan river based on water quality and nutrient content with various approaches, i.e to identify the quality of water, temperature, pH, depth, light intensity, light penetration, flow speed, dissolved oxygen (DO), BOD₅, to identify the nutrient content including nitrate, phosphate, and nitrogen, and to determine the condition of the Belawan River based on water quality and nutrient content.



2. Materials and Method

2.1. Sampling sites

The stations were determined based on the community activities different. The sample was done with 3 repetition and the sampling started from upstream to downstream. The number sampling site was five.

Table 1. Description of sampling sites in Belawan River

Station	Activities	Location
I	Control No activity/ Upstream	Deli Serdang District, Salam Tani Village
II	Domestic Habitation	Deli Serdang District Sunggal Kanan Village
III	Hotel, Market	Deli Serdang District Kampung Lalang
IV	Soy Industries, Paper Industries	Deli Serdang District Kelambir 5 Village
V	Downstream (estuary)	Medan Belawan City Sicanang Village

2.2. Water Quality and Nutrient Sampling

The measured water quality and nutrient data can be seen in Table 2.

Table 2. Water Quality and Nutrient Content Parameters

No	Water quality	Tools	Place of Measurement
1.	Temperature	Termometer	In-situ
2.	pH	pH meter	In-situ
3.	Depth (m)		In-situ
4.	Light intensity	Luxmeter	In-situ
5.	Light Penetration	Secchi chip	In-situ
6.	Flow Speed	Stopwath	In-situ
7.	DO	Winkler Method	In-situ
8.	BOD ₅	DO Table	Laboratory
Nutrient			
9.	Nitrate	AAS (Atomic Absorption Spectrophotometer) / Screening	Laboratory
10.	Phosphate	AAS (Atomic Absorption Spectrophotometer) / Ascorbic Acid	Laboratory
11.	Nitrogen	Atomic Absorption Spectrophotometer (AAS)	Laboratory

3. Results and discussion

3.1. Water Quality Analysis

The results of water quality and nutrient content measurements can be seen in Table 3.

Table 3. The value of water quality according to the Water Quality Standard

No	Parameter	St 1	St 2	St 3	St 4	St 5	Quality Standards
1.	Temperature ($^{\circ}\text{C}$)	27	28	28	28	30	Natural
2.	pH	4,0	3,0	4,0	4,0	7,6	6-9
3.	Depth (m)	0,9	1,1	1,2	1,1	1,4	-
4.	Light intensity (Cd)	87	33	26	32	51	-
5.	Light Penetration (cm)	331	611	426	435	535	-
6.	Flow Speed (sec/m)	2,7	5,9	1,7	1,6	3,6	-
7.	DO (Mg/l)	5,3	4,4	3,8	3,8	5,2	3
8.	BOD ₅ (Mg/l)	2,2	2,3	1,3	2,6	4,0	6

The results of water quality measurements indicated that temperature, depth, light intensity, light penetration and flow speed, and were still within the water quality standard while pH and BOD₅ had passed the water quality standard [3].

3.2. Belawan River Water Nutrient

The results of analysis on water quality and nutrient content in the Belawan River, the results obtained were described as follows:

Table 4. The value of water nutrients content in the Belawan River

No	Parameter	Station 1	Station 2	Station 3	Station 4	Station 5
1.	Nitrate (NO ₃)	Mg/l	1,18	0,53	4,41	7,57
2	Phosphate	Mg/l	0,15	0,14	0,17	0,18
3	Nitrogen	Mg/l	1,54	1,47	4,9	7,77

The Belawan river nitrate concentrations was ranged from 1.18 to 7.57 (station II had the lowest value and the highest was at station IV). It has passed the environmental quality standard [4] attachment III that nitrate 0,008. Nitrate content is presented in Table 5 [5].

Table 5. Nitrate content based on fertility levels in water.

Category	Nitrate Content
Oligotrophic	0-1 mg/l
Mesotrophic	1-5 mg/l
Eutrophic	5-50 mg/l

Nitrate levels based on fertility levels (Table 4) in The Belawan river, are namely 1.18-7.57 mg/l (eutrophic and mesotrophic). Eutrophic waters have level ranging from 5-50 mg/l., mesotrophic (1-5 mg/l) and oligotrophic (0-1 mg/l) [6]. Belawan river is categorized as eutrophic and mesotrophic waters.

Belawan river phosphate is at the station IV had the highest value (0.18 mg/l) while station II resulted as the lowest one (0.14 mg/l). Stated in MENLH No.51 of 2004 the maximum phosphate concentration of phosphat for marine life is 0.015, has exceeded the Belawan river quality standard. T Phosphate content in the river, namely the range between >0.13 (hypertrophic) 0.04 to 0.13 (eutrophic) 0.015 to 0.04 (mesotrophic) <0.015 (oligotrophic) [7]. Furthermore, fresh water was ranged from >0.06 (hypertrophic), 0.025 to 0.06 (eutrophic), 0.008 to 0.025 (mesotrophic) and <0.008 (oligotrophic). Belawan river phosphate concentration was included as hypertrophic [8]. phosphate content was presented in Table 6. Belawan river phosphate content was ranged from 0.14 to 0.18 (very good fertility).

Table 6. Phosphate based on fertility levels in water

Aquatic Fertility	Phosphate
Low	0,000 – 0,020 mg/l
Adequate	0,021 – 0,050 mg/l
Good	0,051 – 0,100 mg/l
Very Good	0,101 – 0,200 mg/l
Excellent	0,201 mg/l or more

The total concentration of nitrogen in the Belawan river ranges from 1.54-7.77 mg/l. The size of the nitrogen total concentration in the waters caused by organic and inorganic nitrogen contained in the waters [9]. Total nitrogen in the sea is in the range of <0.11 then oligotrophic, 0.11-0.29 then mesotrophic, 0.29-0.94 then eutrophic, >0.94 then hypertrophic. Then for freshwater ranges <0.06 then oligotrophic, 0.06-0.18 then mesotrophic, 0.18-0.43 then eutrophic, and >0.43 then hypertrophic [7]. The total concentration of nitrogen in the Belawan River can be said to be hypertrophic waters.

4. Conclusions

The research analysis of water quality and nutrient content in the Belawan River, it can be concluded that the condition of the Belawan river based on the results of water quality measurements indicated that the temperature, depth, light intensity, light penetration, and flow speed, and are still within the water quality standard while pH and BOD₅ have passed the water quality standard. Based on the nutrient content of nitrates and nitrogen, Belawan river water body is included as eutrophic and mesotrophic waters. Phosphate concentrations is included as eutrophic.

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References

- [1] Yeanny, M.S (2018) *Phytoplankton community as bioindicator of fertility in belawan river*. IOP Conference Series: Earth and Environmental Science 130 (1), 012030
- [2] Firmansyah, N, Ihsan Y.N, Permatasari L, 2016. *Dynamics of Nutrients with Macrozoobenthos Distribution in the Segara Anakan Laguna*. Journal of Marine Fisheries Vol. VII No. 2
- [3] Government Regulation no. 82 of 2001. *Water Quality Standard class III*
- [4] Decree of the Minister of Environment (MENLH) No. 51 of 2004. Appendix III. About Sea *Water Quality Standards for Marine Biota*.
- [5] Effendi, H. 2003. *Review of Water Quality for Management of Aquatic Resources and Environment*. Cetakan Kelima. Yogyakarta : Kanisius
- [6] Wetzel, R.G. (2001). *Limnology; lake and River Ecosystem* 3rd ed. Academic Press New York 1006 pp.
- [7] Håkanson, L. (2006), *A dynamic model for suspended particulate matter (SPM) in rivers*. Global Ecology and Biogeography, 15: 93–107. doi: 10.1111/j.1466-822X.2006
- [8] Hartoko, A. 2010. *Oceanography and Fisheries Resources - Marine in Indonesia*. Undip Press, Semarang
- [9] Nybakken, J. W. 1992. *Biologi Laut Suatu Pendekatan Biologis*. PT Gramedia. Jakarta