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# The Effort to Improve Water Quality of the Pemandian Alam Tourism in Batu Mbelin Village, North Sumatera

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**ABSTRACT**

The purpose of monitoring the water quality of Deli River at the Pemandian Alam in Mbelin Village, Sibolangit District was an effort to ensure that the Deli River at the meeting point of the Lau Betimus and Lau Petani were a Natural Bath that is safe from pollution. At the confluence point of the Lau Betimus and Lau Petani, it was observed based on the pollution index described by each station from upstream to downstream. The Deli River Pollution Index at the monitoring point of the Lau Betimus and the confluence of the Lau Petani were 0.49 and 0.55, which means the water quality is in good condition index or meets the quality standard. This means that the water quality at the observation station is still natural and has not been polluted by pollutants or waste.

## 1. Introduction

The Pemandian Alam of Baruga in Batu Mbelin Village-Kuala Village is one of the natural baths where the source is the river. The Pemandian Alam of Batu Mbelin Village is located in Sibolangit Deli Serdang, North Sumatra. This area is not so far from the city of Medan, can be reached by two-wheeled vehicles and four-wheeled vehicles. The journey to Tanah Karo and less than 30 minutes from Medan City, on the right side of the road, We could see the flow of a large rocky river. That's why the local people call it Batu Mbelin (meaning Big Stone).


**Figure 1**. The Pemandian Alam in Batu Mbelin Village

The water quality (Wq) of Deli river of the Pemandian Alam in Batu Mbelin Village is one of the most important environmental components and as an indicator of the health of a watershed (DAS). The development of population and community and industrial activities have resulted in changes in environmental functions. This has a negative impact on the sustainability of water resources as indicated by the destructive power of water. The degradation that occurs in the watershed has an impact on changes in land use activities and the ecosystems. Utilization of river functions that are equivalent to water scarcity conditions. The rate of decline in the Wq will affect water resources available for beneficial uses, and will limit productive land use**.** Clean water that can be used to meet human needs is clean water that is colorless, tasteless, free from organics and inorganic pathogens and germs (Sumantri, 2017).

Wq is related to many aspects, so there is a need combines quality indicators into water quality index. Ecological status of water bodies classified based on observations of different biological qualities elements, namely for phytoplankton, aquatic flora, benthic invertebrates and fish (Three Hundred Ways to Assess Europe's Surface Waters: An Almost Complete Overview of Biological Methods to Implement the Water Framework Directive, 2012).

Pollution that occurs in river waters is thought to come from the flow of the waste load from community activities that take place in the indigenous (river water body) and exogenous (outside the river). Waste originating from activities that take place in water bodies comes from industrial and domestic activities.

**Figure 2.** Access road of The Pemandian Alam Location

Wq in general refers to the content of pollutants contained in water and its relation to supporting the life of the ecosystem in it (Fardiaz, 1992; Haslam, 1995).

Wq is the nature of water and the content of living things, substances, energy or other components in water (Sahabuddin H, 2014). Wq is generally indicated by the quality or condition of water associated with a particular activity or purpose. Thus, the quality of water will differ from one activity to another, for example the quality of water for irrigation purposes is different from the quality of water for drinking water purposes (Sari Mukti Rohmawati, Sutarno, 2016; Sudaryono, 2004).

In areas where river water is an important source of water for daily needs, because of these benefits, human activities in agriculture, industry, and household activities can and have been proven to cause a decline in water quality. The adverse impact on river Wq depends on the type, amount and nature of the waste that enters the river. Information on the level of river pollution is needed at any time so that when a problem occurs related to river pollution it can be handled immediately.

The River water that has experienced heavy metal pollution and decreased quality, if used as household water or for irrigation, especially for food crops, will have a very dangerous impact on consumers. The heavy metals contained in the irrigation water will in turn accumulate in plants, and through these plants in the end these heavy metals will enter the bodies of animals and humans which can cause various types of diseases, especially cancer (Briffa et al., 2020; Malikula et al., 2022). Heavy metals are environmental pollutants because toxicity, persistence and bio accumulative properties. Examples of this heavy metal including zinc (Zn), copper (Cu), iron (Fe), manganese (Mn), cadmium (Cd), chromium (Cr), and others. Although some of them are also important for plants for their growth, in on the other hand, they mostly become harmful at high concentrations. However, some Heavy metals, namely cadmium (Cd), lead (Pb), and chromium (Cr), are even dangerous at low temperature concentrations. Heavy metals are not the only water pollution problem, as they may also contain phosphates, nitrates, and pathogens.

Nitrates and phosphates are also needed nutrients for plant growth; However, this high concentration on the surface and groundwater is harmful to the environment and can cause serious problems for waters life (Alagha et al., 2020; Letshwenyo & Sima, 2020).

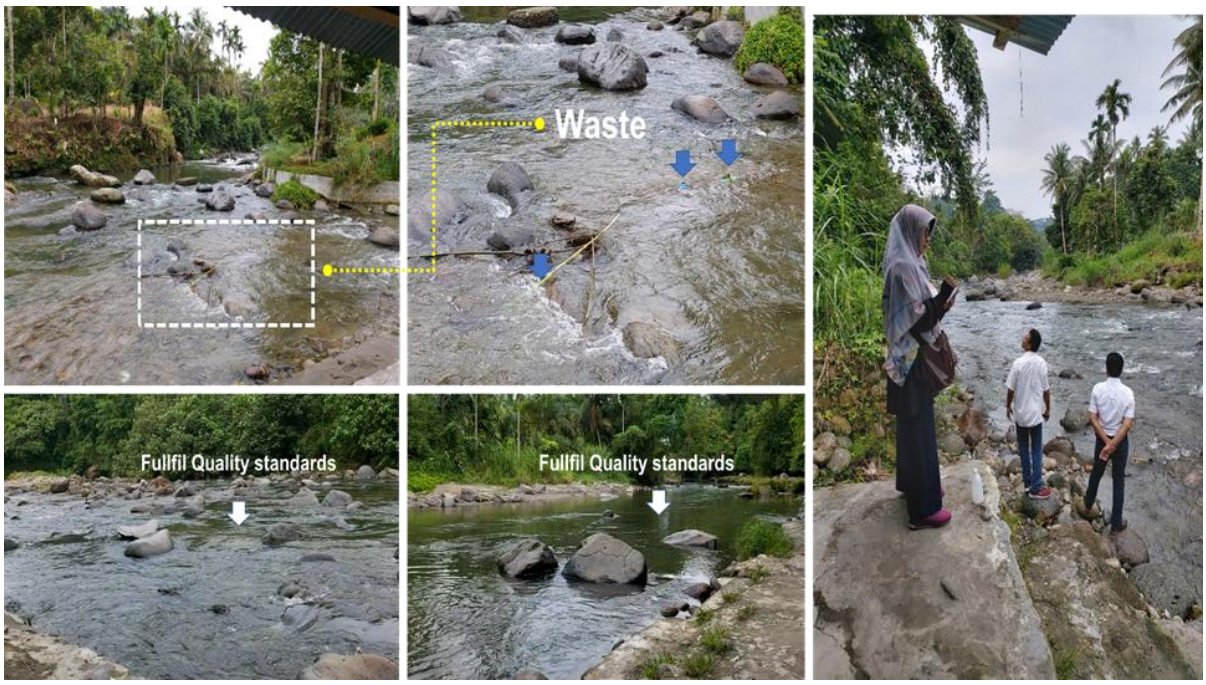


**Figure 3.** Sampling Point

The increasing burden of pollution that enters river waters is also caused by the habits of the people who live around the river. Generally, people around rivers dispose of their domestic waste, both liquid waste and solid waste, directly into the river water. This will put pressure on the river water ecosystem. This condition will result in all dissolved pollutants in the form of liquid waste entering the river flow. The amount of pollutants that enter the river will affect the quality of the river water. At some point it will cause pollution.

These phenomena indicate that the pollution that occurs in river waters is increasingly worrying because it can threaten the sustainability of river functions. This is a problem that needs to be taken seriously so that it doesn't spread and get worse in the future.

To prevent the occurrence of river water pollution, it is necessary to control efforts. One of the efforts to prevent the river water pollution is to maintain the river so that it still has the ability to reduce and clean up the pollutants that enter it. These efforts include regulating the amount of pollutant that may be discharged into the river.

One solution to overcome the water problem is the water quality index. The Water Quality Index appears to measure the effects of pollution and waste control. Indices related to chemical parameters have long been used to communicate water quality in aggregate scores that represent quality degradation (Rubio-Arias et al., 2013; Tyagi et al., 2020). In general, any index is obtained by applying the procedure. Parameters selected that represent Wq. Each parameter, sub-index is created, in where this parameter is weighted. Finally, the sub-indexes are combined into a single index with multiple: function (Alexandre Borges Garcia et al., 2019; Tyagi et al., 2020).

Wq includes all physical, chemical, and biological factors where these factors affect the benefits of using water (Nelson Fernández, 2004; Spellman, 2008). Wq is important for drinking water supply, irrigation, fish production, recreation and other purposes. Some of the most important physical factors and the chemical characteristics of the reservoir water include temperature, turbidity, conductivity, dissolved oxygen, pH, nitrogen, and phosphorus (Daniel N A & Elliot H A, 2021).

The government based on Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning Implementation of Environmental Protection and Management has determined Wq

standards for various types of water use. Wq is determined, among others, by several physical properties of water such as temperature, color, water turbidity and total dissolved solid (TDS); the level of air in a body of water identified through several characteristics, i.e. dissolved oxygen (DO) and chemical oxygen demand (COD); microbial life standard of water biological oxygen demand (BOD), and also based on the content of some heavy metals As, Hg, Cr, Pb.

## 2. Method

Primary data came from direct measurements and sampling at the meeting point of the Lau Betimus and Lau Petani. Samples were directly measured to temperature and pH at the meeting point of the river and samples were also taken to the laboratory for checking the quality of river water with physical, chemical and biological parameters. The measured water sample was mainly based on class 2 Wq parameters, namely water whose designation could be used for water recreation infrastructure/facilities, freshwater fish farming, animal husbandry.

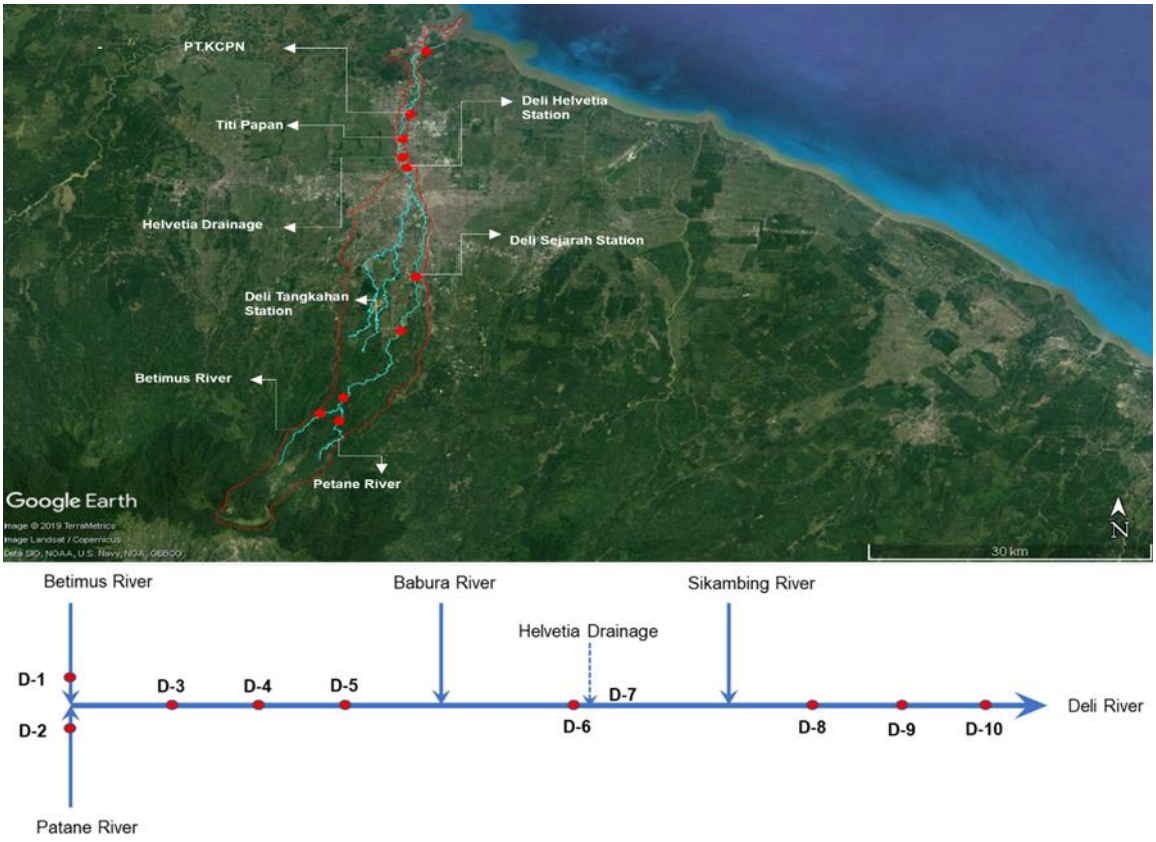


**Figure 4.** Schematic of location of Deli River water quality monitoring point

Wq testing was carried out at the Village of Batu Mbelin of the Pemandian Alam location. The activity was carried out by conducting a physical test of the river water, namely measuring pH and temperature which were directly measured at the location of the Pemandian Alam. Assessing the quality of river water pollutant in terms of the content of TSS (Total Suspended Solid), Biological Oxygen Demand (BOD), dissolved oxygen (DO), COD (Chemical Oxygen Demand), pH, and microbiological parameters (Total *ColIform*, *E.ColIform*). The results of laboratory testing obtained parameters that have exceeded the quality standard.

**Table 1.** Water Quality Status of Pollution Index Method

| No | Value | Status of Water Quality |
|---|---|---|
| 1 | $0 \leq PIj \geq 1,0$ | Fullfil Quality standards (Good condition) |
| 2 | $1,0 \leq PIj \geq 5,0$ | Light Polluted |
| 3 | $5,0 \leq PIj \geq 10$ | Medium Polluted |
| 4 | PIj > | Heavily Polluted |

*Source: KepMen LH No. 115, 2003*

**Figure 5.** Sampling Point Location

## 3. Results and Discussion

Primary Data Analysis for the quality status of the Deli River (Table 3) (the meeting point of the Lau Betimus and Lau Petani) could be calculated using the pollution index method. The study of river water quality and pollutant concentration reviewed in the content of TSS, organic matter BOD, DO, COD, pH, and Total *Colyform*, *E. Coliform*. Monitoring of Wq in the Deli River based on the pollution index was described for each station from upstream to downstream. The Deli River Pollution Index at the monitoring point of the Lau Betimus and the confluence of the Lau Betimus and Lau Petani river were 0.49 and 0.55, which means that Wq is in good condition index or meets the quality standard. This means that the Wq at the observation station is still natural and has not been contaminated with pollutants or waste.

**Figure 6.** Sampling and Measurement of Temperature and pH

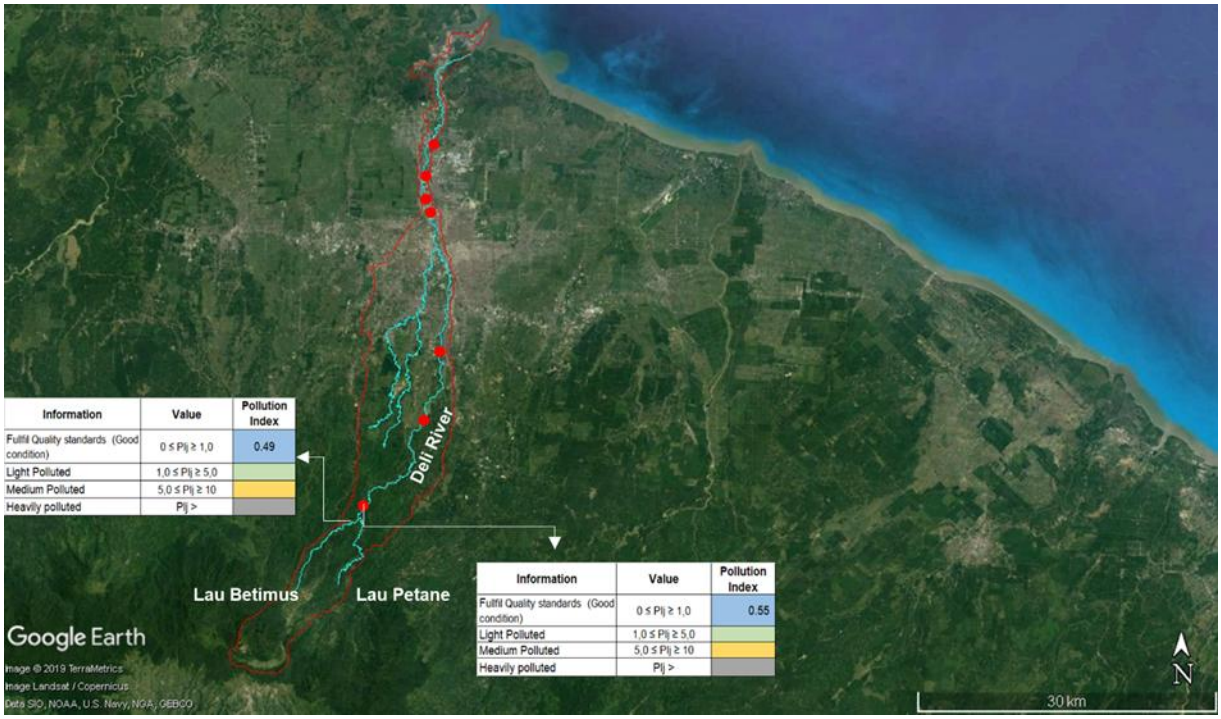


**Figure 7.** Pollution Index of Deli River at Lau Betimus and Lau Petani

**Table 2.** Status of Water Quality

| **Meeting Point Lau Betimus and Lau Petani** | | |
|---|---|---|
| **Information** | **Value** | **Pollution Index** |
| Fullfil Quality standards (Good condition) | 0 ≤ PIj ≥ 1,0 | 0.55 |
| Light Polluted | 1,0 ≤ PIj ≥ 5,0 | |
| Medium Polluted | 5,0 ≤ PIj ≥ 10 | |
| heavily polluted | PIj > | |

**Table 3.** Parameter of The Water Quality of Deli River

| No | Parameter | Parameter Value | Level of class | Information |
|---|---|---|---|---|
| **A. PHYSICS** | | | | |
| 1. | Temperature | 25 – 30.6 | Class -1- 4 | Temperature water of Deli river was the water quality criteria class 1-3. For locations in KIM, the water temperature is in class 4 category |
| 2. | Suspended Residue (TSS) | 7 - 265 | Class - 3 | The TSS value of the Deli River downstream has exceeded the water quality criteria for class 3 of 50 mg/l, especially in the Deli Tua and KIM areas. |
| **B. INORGANIC CHEMISTRY** | | | | |
| 1. | pH | 5.9 – 8.62 | Class 1 - 3 | pH of the water was at normal conditions. |
| 2. | BOD | 2 – 94.2 | Class 1- 4 | The concentration of BOD in the upstream area (Namorambe) of Deli River water was below the upper threshold for water quality requirements. The BOD value was above the water quality standard from the Helvetia area to the downstream, which was > 12 mg/l. This means that river water cannot be used for recreation, freshwater fish farming, animal husbandry and agriculture. |
| 3. | COD | 7.75 – 0.12 | Class 1-4 | COD in the upstream area (Namorambe) of Deli River water was below the upper threshold for water quality requirements, while in the downstream area (Helvetia to KIM) it is already above the water quality threshold for rivers. |
| 4. | DO | 5.9 – 20.1 | Class 1 and Class 4 | The DO parameter was still high in water. The role of DO is very important to help reduce the burden of water pollution due to discharge from industrial and domestic waste, both naturally and by aerobic treatment. The lowest DO on the Deli river was in the Helvetia and KIM areas with values close to zero. |
| 5. | $NO_3$ as N (Nitrate) | 0.1-4.6 | Class 1 | Nitrate is needed as a nutrient for life in river water but if it is in excess it will reduce the quality of river water. |
| 6. | Chrome (VI) | 0.02 | Class 1 | The water quality in the upstream and in the middle of the Deli river (Namorambe to Deli Tua) was still relatively safe from heavy metal elements, while the river area that was polluted by heavy metals is in the Deli Helvetia river to the KIM area. |
| 7. | Free chlorine | 0.01 – 0.24 | Class 1 | Chloride analysis results of 0.01 mg/L were still reserved for Government Regulations, Chloride was a corrosive parameter that can corrode iron pipes. |

| No | Parameter | Parameter Value | Level of class | Information |
|---|---|---|---|---|
| | | | | |
| 8. | Cyanide | 0.001 -0.02 | Class 1 | Deli river water quality was still relatively safe to cyanide element along the river except in the KIM area |
| 9. | Fluoride | 0.01 – 0.13 | Class 1 | Deli river water quality was still relatively safe to fluoride element. |
| 10. | Nitrite as N | 0.01 – 0.05 | Class 1 | Deli river water quality was still relatively safe to the element Nitrite as N. Except in Deli Tua (PDA Deli History) |
| 11. | Sulfate | 4 -10 | Class 1 | Belawan river water quality was still relatively safe for sulfate elements |
| **C. MICROBIOLOGY** | | | | |
| 1. | *Fecal coliform* | 11 - 20 | Class 1 | Deli River was not polluted and not contaminated with pathogenic bacteria |
| 2. | Total *coliform* | 50 - 240 | | |
| **D. ORGANIC CHEMISTRY** | | | | |
| 1. | Oil and fat | 1 | Class 1 | Deli river water quality was still safe to the element of Oil and Fat |
| 2. | Phenol Compound | 0.001 –0.003 | Class 4 | Deli river water quality was still relatively unsafe for Phenol compounds |

## 4. Conclusion

Monitoring the Wq of the Pemandian Alam in Mbelin Village, Sibolangit District on the Deli river were at the meeting point of the Lau Betimus and Lau Petani, where based on the pollution index, each station is described from upstream to downstream. The Deli River Pollution Index at the monitoring point of the Lau Betimus and the confluence of the Lau Petani were 0.49 and 0.55, which means that the Wq is in a good condition index or meets the quality standard. This means that the Wq at the observation station is still natural and has not been contaminated with pollutants or waste. The Pemandian Alam in Mbelin Village is one of the water tourism destination, therefore a commitment or regulation from the Regional Government is needed to maintain water quality.

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