

Water quality assessment using the STORET method and formulation of pollution control strategies in the Sangatta River, East Kutai Regency, Indonesia

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ABSTRACT

The Sangatta River, located in East Kutai Regency, East Kalimantan, is a vital water resource that plays a significant role in supporting both local communities and ecosystems. However, the increasing pressure on this river necessitates regular monitoring to assess its water quality status. This study aims to assess and analyze the water quality of the Sangatta River, determine its water quality status, and identify potential measures for controlling water pollution in the river. The research employed the STORET method. Based on this method, the results were as follows: -22 (upstream 1), -34 (upstream 2), -50 (downstream 1), -54 (downstream 2), and -40 (downstream 3). These findings indicate that the Sangatta River is classified as heavily polluted, with an overall score of -40 according to the STORET method. Efforts to control river water pollution should focus on social and institutional aspects, particularly by enhancing community participation in pollution control efforts for the Sangatta River.

INTRODUCTION

The Sangatta River, located in East Kutai Regency, East Kalimantan, is a crucial water resource that plays an important role in supporting both human livelihoods and ecosystem functions. Human activities such as mining, palm oil industry operations, agriculture, and domestic waste disposal have the potential to cause significant pollution in this river (Akhtar et al., 2021). Such pollution leads to a decline in water quality, rendering it non-compliant with environmental standards for various uses, including drinking water, fisheries, and other domestic needs.

This pollution issue is becoming increasingly concerning due to the large volume of domestic and industrial waste, as well as unregulated land-use changes (Jordao et al., 2002; Shiddamallayya & Pratima, 2008). These waste sources contain pollutants such as organic and chemical substances, which negatively impact aquatic ecosystems and pose risks to human health. It is estimated that key water quality parameters such as BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand) in the Sangatta River have exceeded the quality standards set by government regulations.

This study aims to analyze the current water quality condition of the Sangatta River using the STORET method, a widely adopted approach for evaluating water quality status. In addition, the research

seeks to identify pollution control strategies that can be implemented to ensure the sustainability of the river's ecological and social functions.

METHODOLOGY

Research tools and materials

The tools used in this study included a pH meter, water sampler, current meter, sample bottles, measuring tape, rope, thermometer, GPS (Global Positioning System), 5-liter jerry cans, and a cool box. In addition to the equipment, supporting materials were also used, including Whatman filter paper (0.45 µm), distilled water (aquadest), hydrochloric acid (HCl), sulfuric acid (H₂SO₄), KH₂PO₄, potassium antimony tartrate, ammonium molybdate, ascorbic acid powder, manganese sulfate (MnSO₄), sodium hydroxide (NaOH), potassium hydroxide (KOH), sodium iodide (NaI), potassium iodide (KI), starch, salicylic acid, sodium thiosulfate pentahydrate (Na₂S₂O₃·5H₂O), potassium dichromate, sulfuric acid–silver sulfate solution, ferrous ammonium sulfate (FAS) solution, potassium hydrogen phthalate (KHP) standard solution, ferroin indicator, and mercury sulfate (HgSO₄) powder.

Research location

This study was conducted on the Sangatta River in East Kutai Regency, East Kalimantan Province, particularly in river segments known to be affected by mining activities or other pollution sources. These areas were selected to facilitate sample collection and the assessment of river water quality. The research was carried out over a period of six months, from **June to November 2024**.

Data collection

Water samples from the Sangatta River were collected at various sampling segments: Upstream 1, Upstream 2, Downstream 1, Downstream 2, and Downstream 3. Water samples were collected in 5-liter jerry cans, stored in cool boxes, and labeled accordingly. The samples were preserved using sulfuric acid (H₂SO₄). pH measurements were conducted using a pH meter. Water temperature was measured with a thermometer, and Streamflow velocity was measured using a current meter. The parameters assessed under the STORET method included: Temperature, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), pH, Ammonia, Nitrite, BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), Phosphate, Nitrate, Oil and Grease, and Total Coliforms.

Data analysis

Data analysis was conducted using the STORET method, starting with laboratory testing of water samples at an accredited laboratory of the Global Environmental Laboratory, and then followed by analysis of the laboratory results. The data analysis was carried out in July, August, and September 2024.

The STORET method is based on comparing water quality data with the established water quality standards according to designated water uses, in order to determine water quality status. This approach aligns with the implementation of Government Regulation No. 22 of 2021 concerning water quality management and pollution control, and refers to Minister of Environment Decree No. 115 of 2003.

Table 1. Water Quality Status Classification System

No.	Category	Score Range	Status
1	Class A	0	Meets Quality Standards
2	Class B	-1 to -10	Lightly Polluted
3	Class C	-11 to -30	Moderately Polluted
4	Class D	Less than -31	Heavily Polluted

Source: Government Regulation No. 22 (2021)

RESULT AND DISCUSSION

Water quality status based on the STORET method

According to the Decree of the State Minister for the Environment No. 115 of 2003 concerning Guidelines for Determining Water Quality Status, one of the methods commonly used to evaluate river water quality is the STORET method, which helps identify which parameters meet or exceed the applicable water quality standards.

Table 2. STORET score calculation results for the Sangatta River

No.	Location	STORET Score	Water Quality Status
1	Upstream 1	-22	Moderately Polluted
2	Upstream 2	-34	Heavily Polluted
3	Downstream 1	-50	Heavily Polluted
4	Downstream 2	-54	Heavily Polluted
5	Downstream 3	-40	Heavily Polluted
Average		-40	Heavily Polluted

The average STORET score calculation indicates that the Sangatta River is generally categorized as heavily polluted. This high score is due to several parameters exceeding the Class II river water quality thresholds as stipulated in Government Regulation No. 22 of 2021 and East Kalimantan Provincial Regulation No. 02 of 2011.

Identification of potential water pollution control measures

Efforts to control river water pollution involve various strategies aimed at maintaining water quality in accordance with environmental and public health standards. The following actions can be implemented:

1) Pollution prevention

Domestic Waste Management: Treating household wastewater through Wastewater Treatment Plants (WWTPs) to remove harmful substances before discharge (Purwatiningrum, 2018). **Industrial Waste Management:** Requiring industries to install and operate WWTPs in compliance with standards to prevent toxic waste discharge (Belladona et al., 2020). **Reducing Hazardous Chemical Use:** Substituting toxic chemicals in industrial and household activities with environmentally friendly alternatives.

2) Water quality restoration

River and Lake Rehabilitation: Conducting cleanup, sediment dredging, and replanting vegetation around water bodies to restore ecological functions (Hadi et al., 2019). **Aeration:** Adding oxygen to the water to improve quality degraded by organic pollutants (Yuniarti et al., 2019). **Bioremediation:** Using microorganisms to degrade organic and inorganic pollutants in water (Priadie, 2012).

3) Regulation and law enforcement

Implementation of Water Quality Standards: Governments set pollutant thresholds for water quality compliance. **Legal Sanctions:** Enforcing strict penalties for individuals or companies that violate pollution regulations. **Monitoring and Supervision:** Regularly monitoring water quality in areas vulnerable to pollution (Rusli & Harvelina, 2015).

4) Public education and participation

Environmental Awareness Campaigns: Educating the public on the importance of maintaining clean water through outreach and education programs (Fajarwati et al., 2024). **Community Involvement:** Encouraging community participation in activities such as river clean-ups and pollution monitoring.

5) Application of environmentally friendly technologies

Rainwater Harvesting: Utilizing rainwater as an alternative clean water source to reduce reliance on groundwater (Dentry et al., 2023). Integrated Sanitation Systems: Implementing technologies that support wastewater recycling into usable water. Eco-Friendly Infrastructure: Constructing biofilters for natural water filtration.

6) Addressing agricultural pollution sources

Sustainable Agriculture: Minimizing the excessive use of fertilizers and pesticides that can contaminate water through surface runoff. Waste Management: Ensuring proper waste disposal practices to prevent dumping into rivers and waterways. A comprehensive combination of these actions, implemented consistently, can help safeguard water quality while protecting aquatic ecosystems and public health.

CONCLUSION

The average STORET score indicates that the Sangatta River is heavily polluted, primarily due to several parameters exceeding the Class II water quality standards as stipulated in Government Regulation No. 22 of 2021 and East Kalimantan Provincial Regulation No. 02 of 2011.

Efforts to control river water pollution require a strategic, multi-faceted approach, including preventive, restorative, regulatory, educational, and technological measures. Pollution prevention involves proper management of domestic and industrial waste, and reducing the use of hazardous chemicals. Water quality restoration can be achieved through ecosystem rehabilitation, aeration, and bioremediation. The government plays a key role through the enforcement of regulations and regular monitoring. Furthermore, community education and participation enhance public awareness and engagement in river conservation. The adoption of environmentally friendly technologies and sustainable agricultural practices offers innovative solutions to address diverse pollution sources. The synergy of these integrated actions is crucial to ensuring the long-term sustainability of aquatic ecosystems and the health of surrounding communities.

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