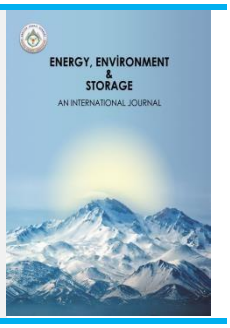
Research Article *Energy, Environment and Storage (2025) 05-01:25-28*

Energy, Environment and Storage

Journal Homepage: www.enenstrg.com



Evaluation of Cikapundung River Water Quality Based on Upstream, Middle, and Downstream Characteristics: A Comparative Approach

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ABSTRACT. This study evaluates the water quality of the Cikapundung River based on upstream, midstream, and downstream characteristics using a comparative approach. The water quality data include parameters such as dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), and total dissolved solids (TDS). The analysis revealed that DO, BOD, COD, and TSS parameters in certain river segments did not meet the surface water quality standards set forth in Government Regulation No. 22 of 2021, Class II. The high pollution levels were mainly attributed to domestic, industrial and other human activities. This study provides important insights into the water quality conditions of the Cikapundung River and their implications for environmental management in the region.

Keywords: Cikapundung, water quality, evaluation, and comparative

Article History: Received: 13.12.2024; Accepted: 15.01.2025; Available Online: 31.01.2025
Doi: https://doi.org/10.52924/ KRVA9089

1. INTRODUCTION

The Cikapundung River, a tributary of the Citarum River, is approximately 28 km in length and traverses West Bandung Regency upstream, Bandung City in the middle, and Bandung Regency downstream before discharging into the Citarum River. The confluence area of these two rivers is prone to flooding, particularly during the rainy season. The most significant impacts are observed in Baleendah, Dayeuhkolot, and Bojongsoang.

The Cikapundung River catchment area encompasses 111.3 km² in its upstream region, 90.4 km² in the central portion, and 76.5 km² in its downstream reach. The Cikapundung watershed area is home to approximately 750,559 individuals, with an average population density of 122 people per hectare. At 2004, the riparian area is home to 1,058 buildings, with a total population of 71,875. This has resulted in significant pollution due to the presence of domestic, household, and industrial waste.

As reported by the West Java Regional Environmental Management Agency (BPLHD) in 2016, the high concentration of settlements adjacent to the Cikapundung River results in the direct discharge of approximately 90% of domestic waste into the river. Consequently, the Cikapundung River receives in excess of 2.5 million liters of waste on a daily basis, in addition to waste from the industrial sector. This finding aligns with the conclusions by Rahayu et al. [1], who determined that the river, which traverses West Bandung Regency, Bandung City, and Bandung Regency, is particularly susceptible to contamination from domestic sewage.

Some cases of pollution include domestic waste in Babakan Siliwangi and Babakan Ciamis, textile waste in Bojongsoang, and pollution in the Cikapundung watershed [2]. In fact, the upstream part of the Cikapundung watershed shows an increase in pollution if there are no early preventive measures [3]. Based on field studies and chemical analysis, water quality in the upper Cikapundung watershed (Bukti Tunggul) continues to decline compared to previous studies (Surtikanti, 2004; Surtikanti & Priyandoko, [2] [4].

2. MATERIALS AND METHODS

2.1 Study Area

This research was conducted in the Cikapundung River area, with the research site divided into three main segments: upstream, middle, and downstream. The upstream segment was situated at Dago Pakar, the middle segment at Viaduct Road, and the downstream segment at Soekarno-Hatta Road. The objective of this segmentation was to observe variations in water quality at each location based on geographical conditions and human activities along the river.

2.2 Water Quality Analysis

This research was conducted through a comparative analysis of the surface water quality of the Cikapundung river, encompassing the upstream, middle, and downstream segments. The analysis employed secondary data of water Quality Cikapundung River at 2022 sourced from Saeful and Artiningrum's research [5]. The parameters utilized as constraints in this investigation encompass dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, total suspended solids, and total dissolved solids. The suitability of the water quality was then evaluated in accordance with the surface water quality standards outlined in Government Regulation Number 22 of 2021, Class II, and a comparative approach to water quality was undertaken for each river segment.

3. MATERIALS AND METHODS

3.1 Dissolved Oxygen (DO)

DO plays a vital role as an indicator of water quality due to its involvement in the oxidation and reduction of both organic and inorganic substances [6]. It is crucial for various biochemical processes in aquatic ecosystems, supporting the breakdown of organic materials and the respiration of aquatic organisms. Consequently, the level of dissolved oxygen is often used to assess the health of water bodies and the extent of potential pollution.

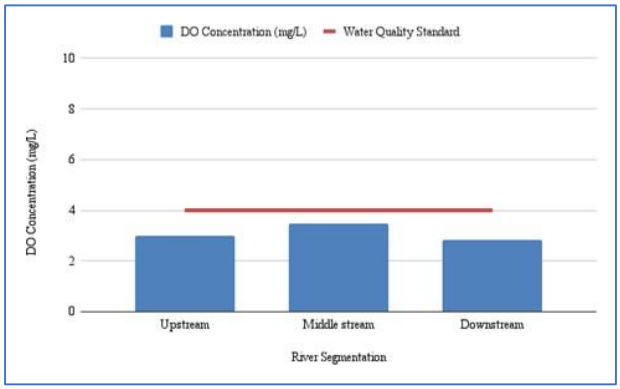

Fig. 1. DO concentration profile in the Cikapundung River

As illustrated in the Figure 1, the graph depicts the DO concentration profile across three segments of the Cikapundung River, namely the upstream, middle, and downstream regions. The data indicates that the DO concentration in these segments falls below the quality standards, with a range of 3.07 to 3.47 mg/L. This suggests that the DO concentration levels in the Cikapundung River do not align with the established quality standards across all segments. The highest concentration of dissolved oxygen is observed in the middle segment of the Cikapundung River, while the lowest concentration is found in the downstream segment.

The observed decline in DO levels suggests the potential influence of industrial or human- related activities in the surrounding residential areas, as reported by Effendi [7]. This finding aligns with the hypothesis that a reduction in DO concentration can be attributed to the decomposition of organic and inorganic materials.

3.2 Biochemical Oxygen Demand (BOD)

BOD, is a parameter used to assess water quality. It represents the amount of dissolved oxygen required by aerobic biological microorganisms to decompose organic matter present in water samples at a specific temperature over a defined period of time.

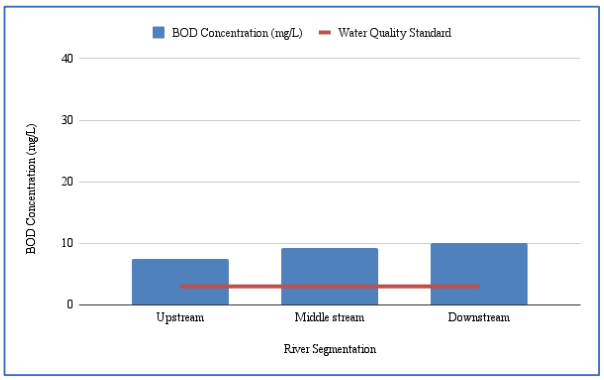

Fig. 2. BOD concentration profile in the Cikapundung River

As illustrated in Figure 2, the graph depicts the concentration profile of biochemical oxygen demand (BOD) across three segments of the Cipundung River, namely the upstream, middle, and downstream regions. The data demonstrate that the BOD concentration in these segments exceeds the quality standards, with a range of 7.52 to 10 mg/L. This indicates that the BOD concentration levels in the Cikapundung River do not correspond with the established quality standards across all segments. The highest concentration of BOD is observed in the downstream segment of the Cikapundung River, while the lowest concentration is found in the upstream segment. This is potentially because the condition of settlements in the downstream area of the Cikapundung River is very dense, and the sanitation conditions of the surrounding communities are not very good, especially in the management of garbage and domestic wastewater.

3.3 Chemical Oxygen Demand (COD)

COD is a parameter utilized to assess the quality of water. It quantifies the quantity of oxygen necessary to decompose the total organic matter present in the water through chemical processes. A high concentration of COD indicates a high content of organic matter in the water.

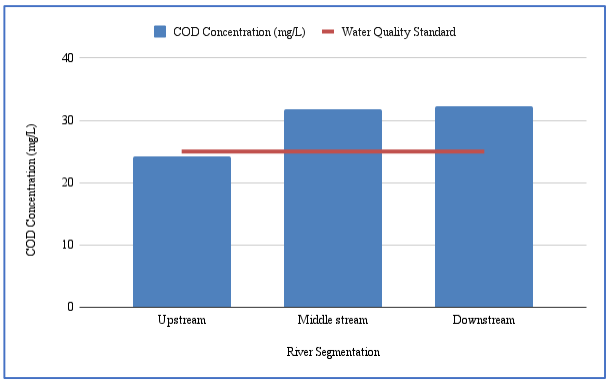

Fig. 3. COD concentration profile in the Cikapundung River

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As illustrated in Figure 3, the graph depicts the concentration profile of chemical oxygen demand (COD) across three segments of the Cipundung River, namely the upstream, middle, and downstream regions. The data demonstrate that the concentration of chemical oxygen demand (COD) in the middle and downstream segments exceeds the quality standards, with a range of 24.27 to 32.26 milligrams per liter (mg/L). This indicates that the concentration levels of COD, particularly in the middle and downstream segments of the Cikapundung River, are not in accordance with the established quality standards. The highest concentration of COD is observed in the downstream segment of the Cikapundung River, while the lowest concentration is found in the upstream segment. The industrial activities conducted in the downstream area of the Cikapundung River are a significant contributing factor to the elevated concentration of chemical oxygen demand (COD) observed in the region.

3.4 Total Suspended Solid (TSS)

As defined by Effendi [7], TSS, or Total Suspended Solids, represents a water quality parameter comprising materials or substances that are suspended in water and contribute to turbidity. The TSS component of water comprises mud, fine sand, and microscopic organisms, which are primarily derived from soil erosion and sedimentation transported by water flow.

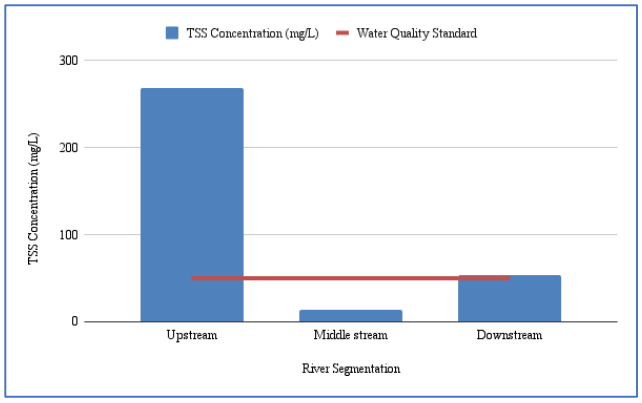

Fig. 4. TSS concentration profile in the Cikapundung River

As illustrated in Figure 4, the graph depicts the total suspended solid (TSS) concentration profile across three segments of the Cikapundung River, namely the upstream, middle, and downstream regions. The data demonstrate that the TSS concentration in the upstream and downstream segments exceeds the quality standards, with a range of 14 to 269 mg/L. This indicates that the TSS concentration levels in the upstream and downstream regions of the Cikapundung River are not in accordance with the established quality standards. The highest concentration of TSS is observed in the downstream segment of the Cikapundung River, while the lowest concentration is found in the middle segment. The condition of the river channels in the Cikapundung River Basin area has relatively little pavement construction, so the potential for sediment erosion is very high, which can contribute to increasing TSS concentrations in water bodies. In addition, livestock activities in the upstream area also contribute to the high TSS content in the upstream river. Cikapundung, because the management of livestock waste by the community is not optimal.

3.5 Total Dissolved Solid (TSS)

Total Dissolved Solids (TDS) represents the content of dissolved materials with a diameter of 10^{-6} mm, as well as colloids between 10^{-6} and 10^{-3} mm in diameter, and is one of the water quality parameters. The materials in question consist of chemical compounds and other materials that cannot be filtered using filter paper with a pore diameter of 0.45 µm [7]. The high TDS value also indicates the presence of dissolved sediment and turbidity [8].

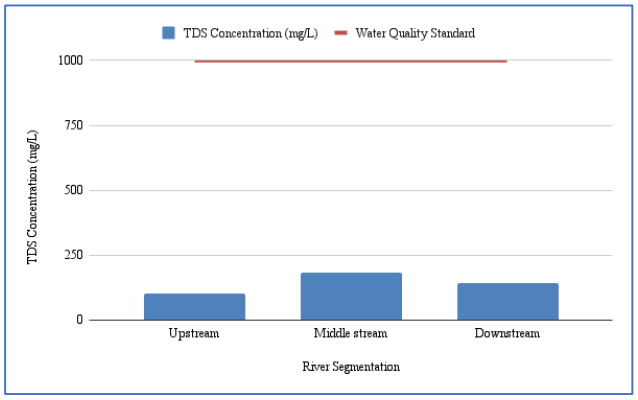

Fig. 5. TDS concentration profile in the Cikapundung River

As illustrated in Figure 5, the graph depicts the total dissolved solid (TSS) concentration profile across three segments of the Cikapundung River, namely the upstream, middle, and downstream regions. The data indicate that the dissolved oxygen (DO) concentration in these segments falls below the quality standards, with a range of 104 to 182 milligrams per liter (mg/L). This indicates that the TDS concentration levels in the Cikapundung River are consistent with the established quality standards across all segments. The highest concentration of TSS is observed in the middle segment of the Cikapundung River, while the lowest concentration is found in the uppermost segment.

4. CONCLUSION

The study shows that the water quality of the Cikapundung River varies among its segments, DO levels are consistently low in all river segments, with the highest concentration observed in the middle segment and the lowest in the downstream segment, reflecting the impact of human activities. BOD and COD parameters exceed quality standards in the downstream segment, indicating high levels of organic material from domestic and industrial waste. TSS levels are high in the upstream and downstream segments due to soil erosion and livestock activities, while TDS is within acceptable limits in all segments. These results highlight the need for improved waste management, especially in the downstream segment, to improve the water quality of the Cikapundung River and support environmental sustainability in the region

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