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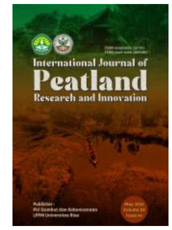


# Analysis of River Water Quality Parameters in the Senepis Peat Forest Area, Riau, Indonesia

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## ABSTRACT

This study examines the water quality of the Senepis Peat Forest in Riau, Indonesia, by analyzing key water quality parameters, including pH, dissolved oxygen (DO), carbon dioxide ($CO_2$), biochemical oxygen demand ($BOD_5$), and chemical oxygen demand (COD). Data collected in 2017 and 2018 show significant variations in these parameters across different locations. pH values ranged from 4.9 to 7.7 in 2017 and from 5.1 to 7.7 in 2018, with lower pH in upstream areas, reflecting the influence of organic acids from decomposing plant matter. DO levels varied from 2.7 mg/L to 17.3 mg/L in 2017 and from 1.2 mg/L to 22.7 mg/L in 2018, with lower concentrations found in rainwater and polluted sites. $CO_2$ concentrations ranged from 19.98 mg/L to 191.44 mg/L in 2017, reflecting significant organic matter decomposition in peatlands. $BOD_5$ levels varied from 2.18 mg/L in rainwater to 14.59 mg/L in Nyamuk Hilir River in 2018, indicating high oxygen demand due to organic pollution. COD values ranged from 6.8 mg/L in rainwater to 114.4 mg/L in Teluk Dalam Hilir in 2017, signaling substantial organic pollution. These findings provide insights into the water quality dynamics in the Senepis Peat Forest, highlighting the effects of natural and anthropogenic factors on the aquatic ecosystem.

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## 1. Introduction

Tropical peatlands are globally important ecosystems that provide critical ecological services, including biodiversity conservation, carbon storage, and water regulation (Girkin et al., 2022; Baird et al., 2017). Indonesia is one of the largest tropical peatland areas in the world, with Riau Province on Sumatra Island being one of the most peat-dominated landscapes. Among these, the Senepis Peat Forest, located in the northern part of Riau, is an ecologically sensitive area that supports a range of biodiversity, including endangered species such as the Sumatran tiger (*Panthera tigris sumatrae*), and provides critical ecosystem services such as water regulation, carbon sequestration, and local climate moderation (Page et al., 2011). However, this ecosystem is under increasing pressure from anthropogenic activities including plantation expansion, canal construction, and forest degradation, all of which threaten the quality of its aquatic systems (Miettinen et al., 2016; Haryani et al., 2021).

Rivers that run through peat forest areas like Senepis show distinct hydrochemical characteristics influenced by high levels of organic matter from decaying vegetation, which contribute to acidic conditions, dark-colored waters due to dissolved humic substances, and typically low oxygen levels (Widodo et al., 2019; Hirano et al., 2021). These characteristics are further modified by anthropogenic inputs that disrupt the natural balance of the ecosystem, often resulting in the deterioration of water quality. Key indicators of such degradation include alterations in pH, dissolved oxygen (DO), carbon dioxide ($CO_2$), biochemical oxygen demand over five days ($BOD_5$), and chemical oxygen demand (COD)—parameters widely used to assess the ecological status and pollution levels of freshwater systems (Sulis et al., 2020; Yulnafatmawita et al., 2020).

Previous studies in peat swamp forests within Riau and other regions of Indonesia provide insight into the expected water quality conditions in Senepis. For example, research conducted in peatland areas of Central Kalimantan highlighted substantial exceedances in BOD and COD levels, with recorded values far surpassing national water quality standards, indicative of significant organic pollution and diminished oxygen availability in these ecosystems (Wahyuni et al., 2021). Moreover, research from Riau's peat swamp streams demonstrated elevated concentrations of dissolved organic carbon directly correlated with high COD values, emphasizing the critical role of organic matter decomposition processes in these waters (Yupi et al., 2016).

Additionally, the naturally low pH characteristic of peat waters significantly affects $CO_2$ dynamics, with recent research showing that acidic conditions influence carbon decomposition rates and regulate greenhouse gas emissions from peat-draining rivers (Klemme et al., 2022). Aligning with it, a prior study has explained that the Giam Siak Kecil–Bukit Batu Biosphere Reserve has been linked to alterations in vegetation and carbon stock dynamics, indirectly impacting water quality by modifying organic matter inputs and hydrological flow patterns (Gunawan et al., 2012). Furthermore, peatland fires, increasingly prevalent due to anthropogenic drainage and deforestation activities, exacerbate water quality deterioration by releasing extensive quantities of carbon and altering water chemistry significantly (Suwarno et al., 2021).

The degradation of peat swamp forests, such as those in the Giam Siak Kecil–Bukit Batu Biosphere Reserve in Riau, has been associated with shifts in vegetation structure and carbon stocks, which can indirectly affect water quality by altering organic matter inputs and hydrological regimes (Gunawan et al., 2012). Furthermore, peatland fires, exacerbated by drainage and land-use changes, not only release substantial amounts of carbon but also contribute to the deterioration of air and water quality (Suwarno et al., 2021).

Despite its ecological importance, detailed studies about the water quality in the Senepis Peat Forest remain notably limited. The scarcity of empirical research in this region underscores the necessity and timeliness of the current study. This research aims to analyze the variations in the water quality of Senepis Peat Forest, including pH, dissolved oxygen (DO), carbon dioxide ($CO_2$), biochemical oxygen demand ($BOD_5$), and chemical oxygen demand (COD) by using the data collected in 2017 and 2018. This period is chosen because it aligns with increased anthropogenic activities, such as land-use changes and peatland drainage practices, in northern Riau.

By creating a scientific baseline of water quality conditions, this research is expected to contribute to the sustainable peatland management strategies, support local conservation initiatives, and provide critical input for policymakers in designing effective water quality standards and land use planning in sensitive peatland regions especially in Riau Province.

## 2. Research Significance

This study addresses a critical knowledge gap on river water quality in the Senepis Peat Forest, Riau, providing essential baseline data on parameters such as pH, DO, $CO_2$, $BOD_5$, and COD. The results will directly inform policymakers and conservationists, enabling the development of targeted strategies to mitigate anthropogenic impacts and enhance sustainable peatland management. Additionally, this research benefits local communities by improving awareness of water resource issues, contributes academically by advancing knowledge of peatland ecosystem dynamics, and supports broader goals of biodiversity conservation, climate change mitigation, and sustainable regional development.

## 3. Methods

### Time and Place

The sampling activity was conducted in January 2017 and 2018 to capture representative hydrological conditions within the Senepis Peat Forest area. Water samples were strategically collected from a total of 12 distinct locations, encompassing both upstream (within active concession areas) and downstream points (concession boundary lines) across four primary rivers: Sinepis, Sinaboi, Nyamuk, and Teluk Dalam. Additional samples included groundwater from a well within an active logging block, water from a drainage channel at Km. 11, and rainwater (in both untreated and boiled states) as baseline references. This comprehensive approach ensured that the study effectively examined variations in water quality influenced by forestry practices, drainage activities, and natural ecological processes. The location of research area is shown by the Figure 1.

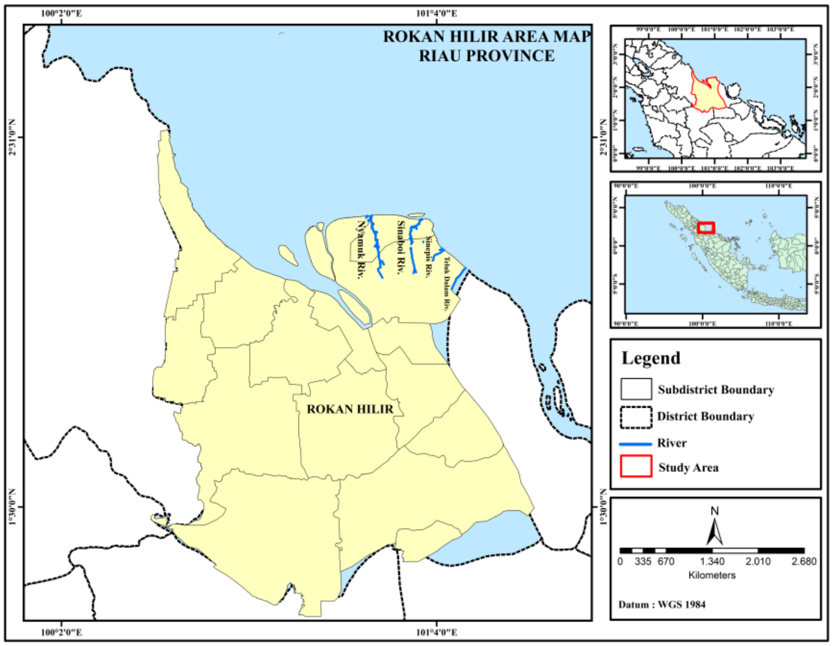


**Fig 1.** Map of research area

## Tools and Materials

In the analysis of water quality parameters, specific tools and reagents are employed for accurate measurements. pH levels are assessed using pH indicator paper. Dissolved oxygen (DO) and biochemical oxygen demand over five days ($BOD_5$) are measured with Winkler bottles, $MnSO_4 \cdot 4H_2O$ solution, 0.5% starch solution, and $Na_2S_2O_3 \cdot H_2O$ solution. Chemical oxygen demand (COD) and carbon dioxide ($CO_2$) concentrations are determined using a COD reactor or water bath, $K_2Cr_2O_7$ solution, concentrated $H_2SO_4$, $Ag_2SO_4$ solution, ferroin indicator, and ferroammonium sulfate (FAS) solution. These instruments and reagents are essential for precise and reliable water quality analysis.

## Sample Collection and Handling

Effective sample collection and handling are important to ensure the integrity and accuracy of analytical results. Proper procedures help prevent contamination, preserve sample composition, and maintain representativeness.

### *Sample Collection*

1. *Preparation:*
   - *Use clean, contaminant-free containers appropriate for the specific analysis.*
   - *Label each container with relevant information, such as sample ID, date, time, and location.*
2. *Collection Procedure:*

- *Rinse the container with the sample water three times before final collection to minimize contamination.*
- *Submerge the container below the water surface, facing upstream, to avoid debris and surface contaminants.*
- *For dissolved oxygen (DO) analysis, use specialized DO bottles, filling them to overflow and capping underwater to prevent air bubbles.*
- *For carbon dioxide ($CO_2$) analysis, collect samples in airtight glass containers to prevent atmospheric exposure.*

***Sample Handling***

1. *Preservation:*
    - *Store samples in a cooler with ice packs to maintain a temperature at or below 4°C, protecting them from direct sunlight*
    - *Use appropriate preservatives as required for specific analyses*

2. *Delivery:*
    - *Ensure samples reach the laboratory as soon as possible, ideally within 24 hours of collection, to minimize potential alterations and maintain the integrity of the sample for accurate analysis.*
3. *Analysis:*
    - *After the arrival, refrigerate samples designated for biochemical oxygen demand ($BOD_5$) and chemical oxygen demand (COD) analyses at 4°C and analyze them within 48 hours to ensure data integrity.*

## Data Analysis

***Dissolved Oxygen (DO)***

Dissolved oxygen (DO) is a crucial indicator of aquatic ecosystem health, representing the amount of oxygen dissolved in water. Its solubility is influenced by temperature and pressure, with colder water holding more oxygen. Henry's Law quantifies this relationship, stating that at a constant temperature, the amount of a gas that dissolves in a liquid is directly proportional to the partial pressure of that gas above the liquid (Bok et al., 2023). To calculate the DO, we use the formula as follows:

$$DO\left(\frac{mg}{L}\right) = \frac{Vx\ N\ x\ 8000x\ F}{50} \tag{1}$$

Where:
V = mL of Sodium Thiosulfate
N = Normality of Sodium Thiosulfate
F = Factor calculated by dividing the volume of the Winkler bottle by the result of subtracting the volume of the bottle with the volume of the Manganese Sulfate and Potassium Azide reagents.

***Biochemical Oxygen Demand ($BOD_5$)***

Biochemical Oxygen Demand (BOD) is defined as the amount of oxygen required by microorganisms to decompose organic matter under aerobic conditions. This parameter serves as an indicator of the degree of organic pollution in water bodies, reflecting the impact of effluents from industrial and domestic sources on oxygen levels when discharged into aquatic environments (Sawyer at al., 2003). To calculate $BOD_5$, we use the formula as follows:

$$BOD\left({}^{mg}/_{L}\right) = \frac{(A1-A2)-(B1-B2)-(1-P)}{P} \quad (2)$$

Where:
$BOD_5$ = $BOD_5$ value of the test sample (mg/L)
A1 = DO of the test sample on day 0 (mg $O_2$/L)
A2 = DO concentration of the test sample after 5 days of incubation (mg/L)
B1 = DO concentration of the blank sample on day 0 before incubation (mg/L)
B2 = DO concentration of the blank sample after 5 days of incubation (mg/L)
P = Ratio of the volume of the test sample (V1) to the total volume (V2)

***Chemical Oxygen Demand (COD)***

Chemical Oxygen Demand (COD) is a parameter used to measure the amount of oxygen required to oxidize organic and inorganic substances found in water. COD analysis is generally performed to assess water or wastewater quality. The COD value serves as an indicator of water pollution caused by biodegradable organic substances, which can naturally be oxidized through microbial processes, and also non-biodegradable organic substances that cannot be degraded by microorganisms, potentially leading to a decrease in dissolved oxygen in the water (Alaerts & Santika, 1987). To calculate COD, we use the formula as follows:

$$COD\left(\frac{mg}{L}\right) = \frac{(A-B)x\ N\ x\ 8000}{V} \quad (3)$$

Where:

A = Volume of FAS solution used for titrating the blank (mL)
B = Volume of FAS solution used in the titration
N = Normality of the FAS solution
V = Volume of the sample used (mL)
8000 = Conversion factor
*FAS: Ferroammonium Sulfate

## 4. Results and Discussion

The analysis of water quality parameters from various locations within the Senepis Peat Forest and surrounding areas in 2017 and 2018 reveals important insights into the environmental condition of these water bodies. The key parameters measured include pH, carbon dioxide ($CO_2$), dissolved oxygen ($O_2$), chemical oxygen demand (COD), and biochemical oxygen demand over five days ($BOD_5$), which are indicative of the ecological health and pollution levels in these water bodies.

### *pH Levels*

The pH of water samples from the Senepis Peat Forest ranged from 4.9 to 7.7 in 2017 and from 5.1 to 7.7 in 2018 (it can be seen in Table 1). The observed low pH values, particularly in the upstream areas of Senepis River and Teluk Dalam, suggest the presence of organic acids, a common characteristic of peatland waters due to the accumulation and decomposition of organic material. Peatlands are naturally acidic environments due to the high content of humic substances, which can lower the pH of water. The presence of organic acids in water is often associated with high concentrations of dissolved $CO_2$, a byproduct of organic matter decomposition (Tiemann et al., 2017).

Table 1. pH values in Senepis Peat Forest during a year of 2017 and 2018.

| Parameter | Senepis Hulu R. | Senepis Hilir R. | Nyamuk Hulu R. | Nyamuk Hilir R. | Sinaboi Hulu R. | Sinaboi Hilir R. | Teluk Dalam Hulu R. | Teluk Dalam Hilir R. | Petak RKT | Camp Canal | Raw Rainwater | Mature Rainwater |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2017** | | | | | | | | | | | | |
| **pH** | 5.1 | 7.7 | 6 | 6.8 | 6.7 | 6.9 | 5.4 | 6.4 | 5.2 | 5.2 | 6.7 | 7 |
| **2018** | | | | | | | | | | | | |
| **pH** | 4.9 | 5.5 | 5.9 | 6.2 | 5.4 | 6.1 | 5.4 | 5.6 | 5.7 | 5.1 | 6.4 | 6.2 |

The comparison between pH values over each year is displayed in Figure 2. The figure shows that slightly acidic water, with pH values ranging from 4 to 6, can influence the solubility and bioavailability of various nutrients and metals, which may have significant implications for the aquatic organisms that inhabit these waters (LaHaye et al., 2014). While the pH values in this study were within the acceptable range for freshwater ecosystems, the consistently low pH in some locations could potentially affect aquatic biodiversity, especially for species sensitive to pH fluctuations (Hajek et al., 2016). The higher pH values recorded in certain areas, such as Sinaboi Hilir River, where the pH reached 7.7 in 2017, suggest a more neutral or slightly alkaline condition. This could be attributed to natural buffering processes, such as the presence of minerals that neutralize acidity, or the effects of dilution from rainwater or groundwater inputs. However, these higher pH values may also reflect human-induced changes in water chemistry due to agricultural runoff or the alteration of water flow regimes (Naiman et al., 2018). Therefore, while the pH values in the Senepis region are within a range conducive to aquatic life, continued monitoring is necessary to understand the long-term trends and potential impacts on the ecosystem.

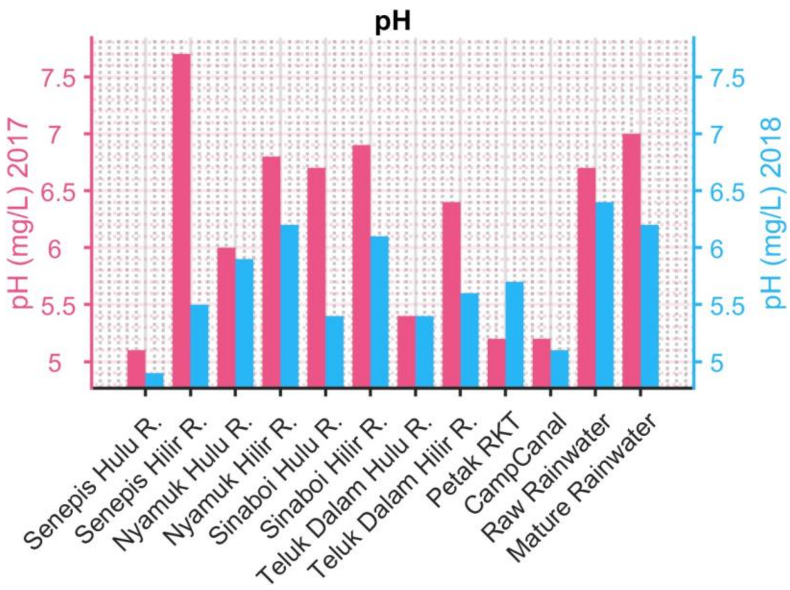


**Fig 2.** Comparison of pH values in the Senepis Peat Forest area during 2017 and 2018.

### *Dissolved Oxygen (DO)*

Dissolved oxygen ($O_2$) is a key indicator of water quality, as it reflects the oxygen availability required for the survival of aquatic organisms. The $O_2$ concentrations in the samples collected during the study ranged from 5.2 mg/L to 17.3 mg/L in 2017, and from 1.2 mg/L to 22.7 mg/L in 2018 (it is shown in Table 2). The lowest $O_2$ concentrations were observed in rainwater samples, consistent with expectations, as rainwater generally contains low dissolved oxygen levels due to minimal interaction with the atmosphere. In contrast, the higher $O_2$ concentrations recorded at sites such as Sinaboi Hilir River (22.7 mg/L in 2018) reflect more favorable conditions for aquatic life, where oxygen is available in sufficient quantities for aerobic organisms. This variation in $O_2$ levels emphasize the influence of both natural processes, such as photosynthesis and gas exchange, and anthropogenic factors, such as organic matter decomposition and nutrient enrichment, on oxygen dynamics in aquatic environments (Liu et al., 2018).

Table 2. $O_2$ values in Senepis Peat Forest during a year of 2017 and 2018.

| Parameter | Senepis Hulu R. | Senepis Hilir R. | Nyamuk Hulu R. | Nyamuk Hilir R. | Sinaboi Hulu R. | Sinaboi Hilir R. | Teluk Dalam Hulu R. | Teluk Dalam Hilir R. | Petak RKT | Camp Canal | Raw Rainwater | Mature Rainwater |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2017** | | | | | | | | | | | | |
| **$O_2$ (mg/L)** | 5.6 | 5.8 | 5.6 | 5.7 | 6.2 | 6.6 | 6.4 | 6.8 | 4.7 | 5.8 | 4.4 | 2.7 |
| **2018** | | | | | | | | | | | | |
| **$O_2$ (mg/L)** | 17.3 | 8.2 | 6.4 | 10.5 | 15.2 | 22.7 | 10.7 | 14.59 | 5.2 | 5.9 | 5.2 | 1.2 |

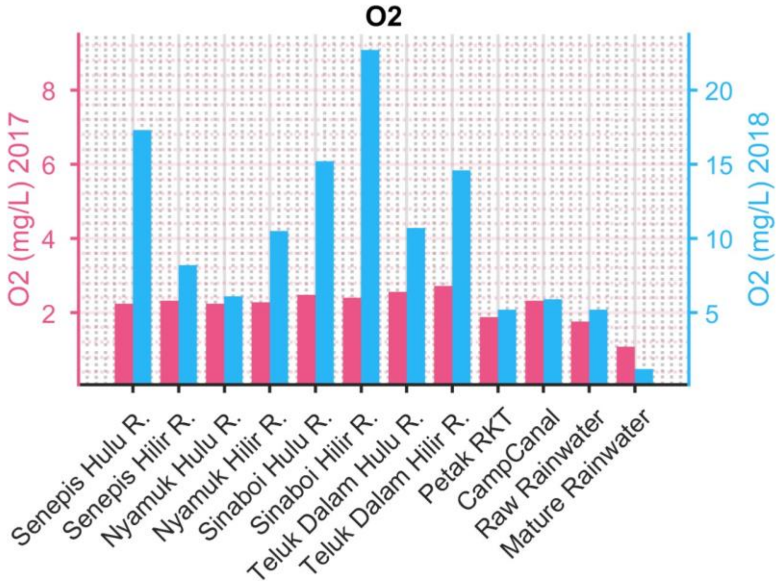


**Fig 3.** Comparison of dissolved oxygen values in the Senepis Peat Forest area during 2017 and 2018.

Low $O_2$ concentrations, particularly in areas like Petak RKT 2016 and Kanal Camp Pemda, can be indicative of oxygen deficiency due to the higher organic matter load and microbial decomposition. Such conditions can result in hypoxia or even anoxia, leading to fish kills and the disruption of aquatic ecosystems. The $BOD_5$ analysis, which measures the oxygen demand for the decomposition of organic matter, further supports these observations, with higher $BOD_5$ values correlating with areas of lower $O_2$ availability (Santos et al., 2017). This highlights the importance of understanding the factors that influence oxygen levels in peatland waters, as it directly affects the biodiversity and ecological functions of these freshwater systems. The data shows that the Senepis Peat Forest area may be vulnerable to oxygen deficiency, especially during periods of high organic load or microbial activity, and requires effective strategies to maintain water quality and ecosystem health.

***Biochemical Oxygen Demand ($BOD_5$)***

Biochemical Oxygen Demand ($BOD_5$) is another key parameter used to assess the organic pollution in water, specifically the amount of oxygen consumed by microorganisms during the decomposition of organic matter (Santos et al., 2017). The $BOD_5$ values in the research area is shown in Table 3. From the data, it can be seen that the numbers of BOD5 varied and ranged from 2.18 mg/L in rainwater to 14.59 mg/L in Nyamuk Hilir River in 2018. In 2017, the $BOD_5$ levels were generally higher, particularly in areas impacted by human activities, such as Petak RKT 2016 and Kanal Camp Pemda (the comparison of $BOD_5$ in each year is attached in Figure 4). Elevated $BOD_5$ levels indicate that significant organic matter is being decomposed by microorganisms, leading to an increased oxygen demand. This is concerning, as high $BOD_5$ values are associated with oxygen depletion in water, which can lead to hypoxic conditions that are harmful to aquatic organisms (Santos et al., 2017).

In 2018, $BOD_5$ values decreased across most of the study sites, with lower concentrations in the rainwater samples and relatively stable values in other locations. This decrease could indicate improvements in the quality of water, possibly due to reduced organic pollution or changes in land use and water management practices. However, areas with consistently high $BOD_5$ values, such as Sinaboi Hilir River, still indicate a need for targeted interventions to reduce organic pollution. Continued monitoring of $BOD_5$ is essential, as it provides insight into the microbial decomposition processes and the overall health of aquatic systems, especially in peatland environments where organic material decomposition is a significant driver of water quality dynamics (Liu et al., 2018).

Table 3. $BOD_5$ values in Senepis Peat Forest during a year of 2017 and 2018.

| Parameter | Senepis Hulu R. | Senepis Hilir R. | Nyamuk Hulu R. | Nyamuk Hilir R. | Sinaboi Hulu R. | Sinaboi Hilir R. | Teluk Dalam Hulu R. | Teluk Dalam Hilir R. | Petak RKT | Camp Canal | Raw Rainwater | Mature Rainwater |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2017** | | | | | | | | | | | | |
| **$BOD_5$ (mg/L)** | 4.6 | 5.4 | 6.4 | 6.4 | 4.3 | 5.4 | 5.4 | 5.9 | 5.9 | 5.3 | 5.9 | 5.9 |
| **2018** | | | | | | | | | | | | |
| **$BOD_5$ (mg/L)** | 9.83 | 12.92 | 6.91 | 14.59 | 11.90 | 30.72 | 6.91 | 11.14 | 3.14 | 11.90 | 2.18 | 1.54 |

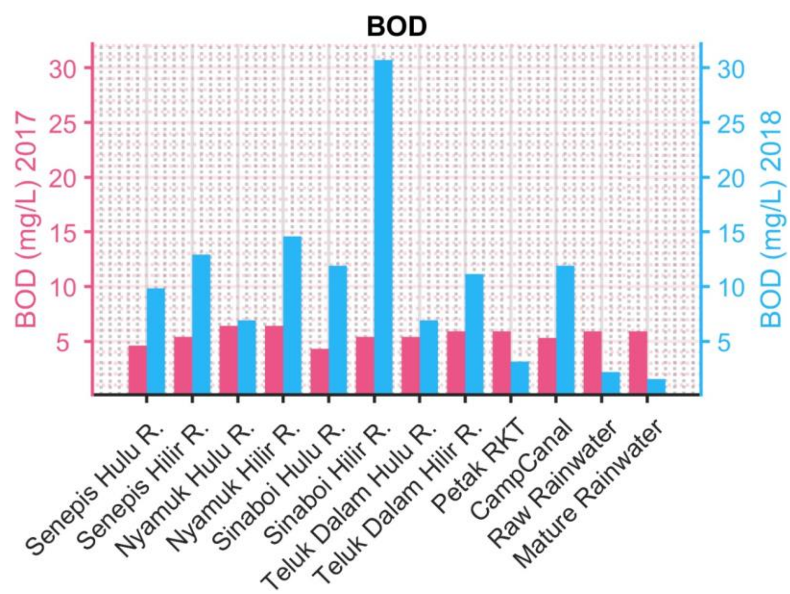


**Fig 4.** Comparison of $BOD_5$ values in the Senepis Peat Forest area during 2017 and 2018.

***$CO_2$ Concentrations***

Carbon dioxide ($CO_2$) concentrations in the study area also exhibited significant variations across different sampling points in both 2017 and 2018 (attached in Table 4). In 2017, $CO_2$ levels ranged from 19.98 mg/L to 191.44 mg/L, with the highest concentration found at Teluk Dalam Hilir (191.44 mg/L).

Table 4. $CO_2$ values in Senepis Peat Forest during a year of 2017 and 2018.

| Parameter | Senepis Hulu R. | Senepis Hilir R. | Nyamuk Hulu R. | Nyamuk Hilir R. | Sinaboi Hulu R. | Sinaboi Hilir R. | Teluk Dalam Hulu R. | Teluk Dalam Hilir R. | Petak RKT | Camp Canal | Raw Rainwater | Mature Rainwater |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2017** | | | | | | | | | | | | |
| **$CO_2$ (mg/L)** | 55.93 | 191.44 | 19.98 | 19.98 | 15.98 | 19.98 | 47.94 | 59.93 | 27.97 | 15.98 | 23.97 | 15.980 |
| **2018** | | | | | | | | | | | | |
| **$CO_2$ (mg/L)** | 10.02 | 20.04 | 15.03 | 15.87 | 13.36 | 18.37 | 19.20 | 21.71 | 6.68 | 18.37 | 10.02 | 1.70 |

The comparison of $CO_2$ values in 2017 and 2018 (Figure 5) shows the elevated of $CO_2$ concentrations, particularly in peatland areas like Senepis Hulu River, Senepis Hilir River, Teluk Dalam Hilir, and Teluk Dalam Hulu, which are likely due to the high rates of organic matter decomposition occurring under anaerobic conditions in the peat soils (Mohan et al., 2017). Peatlands are recognized for their high organic carbon content, and when these areas are disturbed or when water levels drop, the organic material decomposes, releasing significant amounts of $CO_2$ into the water (Bastien et al., 2019). The high $CO_2$ levels in 2017 indicate that the study sites were experiencing significant microbial activity, which can influence the oxygen balance and overall water quality.

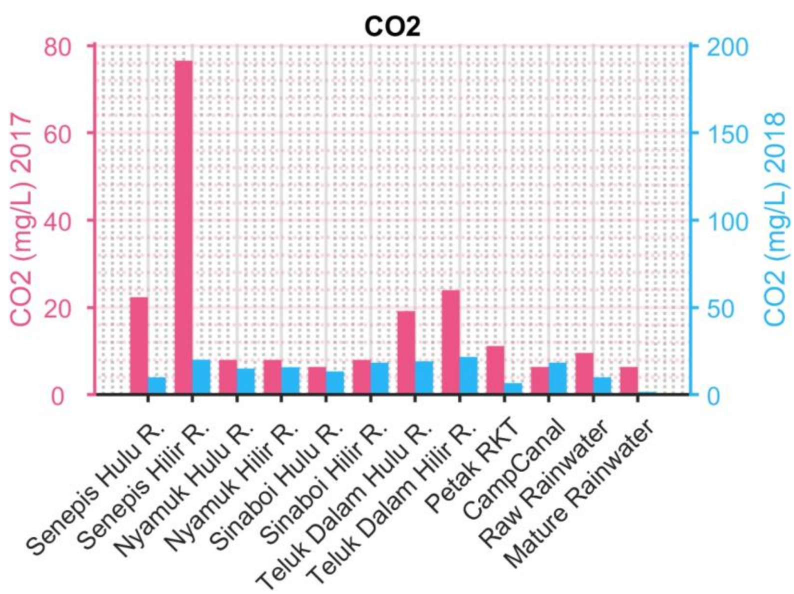


**Fig 5.** Comparison of $CO_2$ values in the Senepis Peat Forest area during 2017 and 2018.

In 2018, $CO_2$ levels decreased, ranging from 1.7 mg/L in rainwater to 21.71 mg/L in Teluk Dalam Hilir. The reduction in $CO_2$ concentrations could reflect seasonal changes, such as reduced microbial activity during drier periods, or alterations in land-use practices that may have reduced organic material inputs into the water bodies (Hirano et al., 2021). The difference in $CO_2$ levels between the two years highlights the complex interplay of environmental factors such as temperature, organic matter availability, and microbial dynamics. Elevated $CO_2$ concentrations, if left unmanaged, can contribute to acidification of water, reducing oxygen availability for aquatic organisms and altering the aquatic food web (Bastien et al., 2019).

***Chemical Oxygen Demand (COD)***

Chemical Oxygen Demand (COD) is a measure of the total oxygen required to chemically oxidize both organic and inorganic substances in water. In this study, COD values found in 2017 ranged from 6.8 mg/L in rainwater to 114.4 mg/L in Teluk Dalam Hilir (shown in Table 5). The elevated COD levels in the Senepis Peat Forest area, especially in locations like Teluk Dalam Hilir, indicate significant organic pollution. Peatland waters are naturally rich in organic matter due to the accumulation of decomposed plant material, and the high COD values in these areas suggest that substantial organic material is available for oxidation (Almeida et al., 2016). The presence of high COD values is concerning, as it indicates that substantial amounts of organic material are being oxidized by microorganisms, leading to oxygen depletion and potential impacts on water quality.

Table 5. COD values in Senepis Peat Forest during a year of 2017 and 2018.

| Parameter | Senepis Hulu R. | Senepis Hilir R. | Nyamuk Hulu R. | Nyamuk Hilir R. | Sinaboi Hulu R. | Sinaboi Hilir R. | Teluk Dalam Hulu R. | Teluk Dalam Hilir R. | Petak RKT | Camp Canal | Raw Rainwater | Mature Rainwater |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2017** | | | | | | | | | | | | |
| **COD (mg/L)** | 114.4 | 114.4 | 114.4 | 114.4 | 114.4 | 114.4 | 114.4 | 114.4 | 114.4 | 114.4 | 79.2 | 70.4 |
| **2018** | | | | | | | | | | | | |
| **COD (mg/L)** | 30.72 | 40.38 | 21.60 | 45.60 | 37.29 | 96.00 | 21.60 | 34.89 | 9.8 | 37.20 | 6.80 | 4.80 |

From the table above, it can be seen that the COD values in 2018 decreased across most of the research area, with a maximum value of 96.00 mg/L observed in the Sinaboi Hulu River. This decrease in COD levels could indicate a reduction in organic matter inputs or improvements in the management of water quality, such as less organic pollution from domestic and industrial sources. The high COD values observed in 2017, however, underscore the ongoing challenges posed by organic pollution in the Senepis Peat Forest area. These pollutants, if left unchecked, can lead to long-term degradation of water quality, affecting both the physical and biological health of the ecosystem (Boyd, 2015).

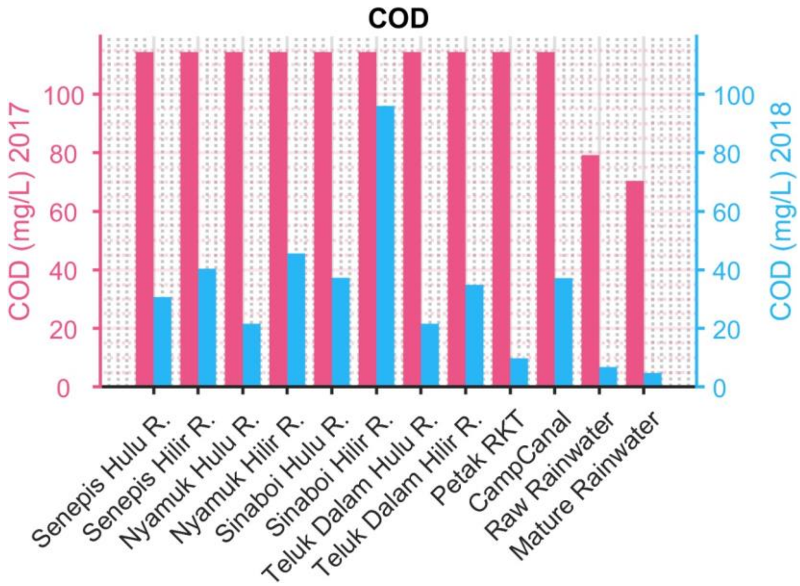


**Fig 6.** Comparison of COD values in the Senepis Peat Forest area during 2017 and 2018.

## 5. Conclusions

The results of this study provide valuable insights into the water quality of the Senepis Peat Forest region. The findings highlight significant variability in key water quality parameters, including pH, dissolved oxygen ($O_2$), carbon dioxide ($CO_2$), biochemical oxygen demand ($BOD_5$), and chemical oxygen demand (COD). These variations reflect both natural processes, such as organic matter decomposition, and the potential influence of human activities. Areas with lower pH and higher $CO_2$ levels suggest the ongoing natural processes in peatlands, where organic material breaks down under low-oxygen conditions. On the other hand, fluctuations in oxygen levels and BOD indicate the pressures exerted by anthropogenic activities on the aquatic ecosystem, which can lead to oxygen depletion and water quality deterioration.

The implications of these findings are clear: the health of aquatic ecosystems in peatlands is sensitive to both natural cycles and human influence. Managing water quality in such regions requires addressing both organic pollution and the impacts of land-use changes. Moving forward, it is crucial to conduct long-term studies that explore the effects of climate change, land conversion, and restoration efforts on water quality. Further research will help refine management strategies and enhance our understanding of how peatland ecosystems respond to environmental pressures, ensuring that effective conservation and restoration measures can be implemented.

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