Assessing Environmental Health Through Physicochemical Analysis of the Sabangan River in Barangay Can-ayan, Malaybalay City, Bukidnon

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ABSTRACT

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| This study aimed to assess the physicochemical water quality of the Sabangan River in Barangay Can-ayan, Malaybalay City, Bukidnon. Specifically, it evaluated total dissolved solids (TDS), turbidity, dissolved oxygen (DO), pH, and total alkalinity in upstream, midstream, and downstream sections of the river to determine compliance with the Department of Environment and Natural Resources (DENR) Class C standards for recreational waters. This study employed a qualitative descriptive research design to characterize the physicochemical properties of the river water based on observed and measured parameters. Water samples were collected and analyzed ex-situ at F.A.S.T. Laboratories to determine key physicochemical parameters using standard laboratory methods. pH was assessed using the 4500 H+B electrometric method, turbidity was measured through 2130 B Nephelometry, TDS was determined via 2540 C Gravimetry, DO was analyzed using the 4500 oC Azide modification method, and total alkalinity was tested through 2320 B Titrimetry. The analysis revealed that TDS was 146.67 mg/L, turbidity was 0.413 NTU, DO was 8.47 mg/L, pH was 8.26, and total alkalinity was 112 mg/L. All measured parameters were within the DENR Class C standards for recreational waters, indicating low levels of dissolved impurities, high water clarity, and a well-buffered aquatic system. The findings suggest that the Sabangan River maintains good water quality for recreational use. However, continuous monitoring is recommended to prevent potential contamination from tourism and local activities. Future research should examine additional water quality indicators such as biochemical oxygen demand (BOD), fecal coliform levels, nutrient concentrations, and heavy metal contamination to provide a more comprehensive assessment of the river's ecological health. |

***Keywords:*** *dissolved oxygen, pH, total alkalinity, total dissolved solids, total alkalinity, turbidity, physicochemcial analysis, Sabangan River, water quality*

1. INTRODUCTION

Water quality in river ecosystems is crucial for ecological stability, biodiversity conservation, and human well-being, especially for recreational activities such as swimming, fishing, and boating (Doi et al., 2013). Healthy river systems support biodiversity, regulate nutrient cycles, and provide safe human and aquatic life environments. However, poor water quality threatens the environmental balance and public health, as pollution introduces harmful substances such as chemicals, heavy metals, and microorganisms into river systems (Cheng et al., 2023; Jennings et al., 2023; Ezekiel et al., 2023; Ruan et al., 2023). Assessing water quality is essential for monitoring physicochemical properties such as pH, dissolved oxygen, total dissolved solids, turbidity, and alkalinity, ensuring compliance with environmental regulations and safeguarding public health (Adelagun et al., 2021).

Several studies have assessed river water quality in Malaybalay City and surrounding areas, but key tributaries remain underexplored. Damasco et al. (2024) conducted a physicochemical assessment of Kalawaig Creek, analyzing parameters such as dissolved oxygen, pH, total dissolved solids, and alkalinity. Similarly, Bete et al. (2024) studied the Tagoloan River, evaluating temperature, conductivity, salinity, nitrates, phosphates, and fecal coliforms. Their findings indicated high salinity from wastewater and excessive fecal coliform levels, classifying the river as marginal for primary contact use. While these studies provide valuable insights, the Sabangan River, which the Kibalabag River feeds before merging with the Tagoloan River, has still not been thoroughly studied. Given its importance in recreation and ecology, assessing its physicochemical properties is essential for understanding its current state and implementing effective water management strategies.

The Sabangan River is crucial in maintaining ecological balance and supporting livelihoods, tourism, and biodiversity. It is a popular recreational site, but human activities such as tourism, land use changes, and potential agricultural runoff may introduce pollutants that could compromise water quality and long-term sustainability. Aside from its environmental importance, the river has cultural and historical significance; it has long been a meeting place for tribal leaders and is regarded as a site of ancestral heritage. Additionally, the Kibalabag River, which flows into the Sabangan River, is the primary water source for Malaybalay City, further emphasizing the need for continuous water quality monitoring. Given increasing environmental pressures, assessing the Sabangan River's physicochemical properties is necessary to safeguard local livelihoods, inform future management decisions, and support conservation efforts.

Given the fundamental role of water quality in sustaining both ecological balance and human health, numerous studies have assessed the physicochemical properties and pollution levels of rivers in the region. For instance, Lubos et al. (2020) examined the Sawaga River, a tributary of the Tagoloan River that serves as a critical water source for Malaybalay. Their findings revealed alarming pollution levels, emphasizing the need for ongoing water quality monitoring in local water sources. Their study found alarming pollution levels, such as high concentrations of ammonia, nitrite, and total coliforms, which have raised concerns about water safety for domestic use and local fisheries. Similarly, research by Opiso and Alburoa (2014) on the Sawaga River highlighted elevated nitrate levels, moderately acidic pH, and high total suspended solids, indicating the impacts of agricultural runoff and nearby settlements on water quality. In other parts of the country, studies on rivers like the Sindangan River (Laranjo et al., 2023) and the Pagbanganan River (Villarmino & Quevedo, 2021) have also identified concerning trends, including rising total suspended solids and phosphate levels, pointing to the need for ongoing monitoring and pollution control. In addition, Rahman et al. (2021) examined seasonal variations in physicochemical parameters on the Turag River, showing how changes in water quality can vary with the seasons, affecting the overall ecosystem. These studies underscore the importance of assessing and managing river systems to ensure water quality and mitigate the impact of anthropogenic activities, which is particularly relevant to our study of the Sabangan River.

This study aimed to conduct a comprehensive physicochemical assessment of the Sabangan River, specifically focusing on parameters such as total dissolved solids (TDS), dissolved oxygen (DO), turbidity, total alkalinity, and pH. This study seeks to provide valuable insights into the river's water quality and potential hazards by addressing the existing research gap. The findings will support policymakers and stakeholders in developing effective management strategies to preserve the Sabangan River's ecological and cultural value for present and future generations.

2. material and methods

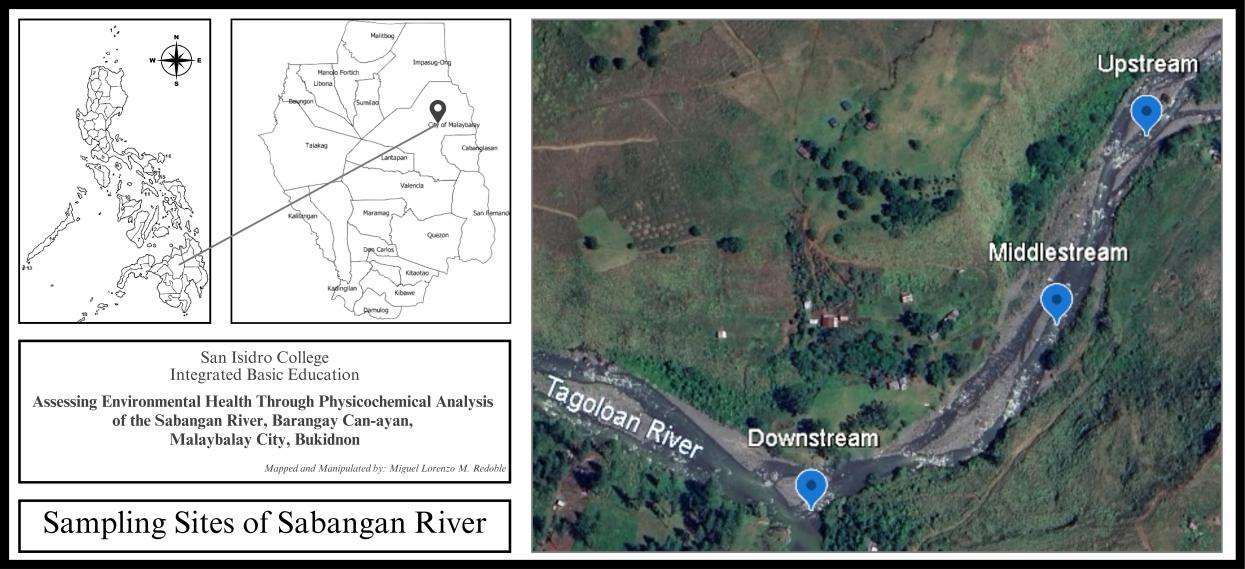
**2.1 Research design**

This qualitative study used a descriptive research design to examine the physicochemical parameters of the Sabangan River in Barangay Can-Ayan, Malaybalay City, Bukidnon. The study aimed to assess key parameters such as turbidity, total dissolved solids (TDS), dissolved oxygen (DO), hydrogen ion concentration (pH), and total alkalinity, providing a detailed examination of these variables. Field research techniques were utilized to collect data directly from the river's ecosystem, ensuring accuracy and reliability. Additionally, qualitative analysis methods were applied to interpret the collected data, comprehensively describing the river's physicochemical characteristics. The study also assessed spatial variations across upstream, downstream, and midstream locations to provide insights into the Sabangan River's ecological conditions.

**2.2 Entry Protocol**

All necessary permissions were obtained from the relevant authorities to conduct research outside San Isidro College and in all designated study sites. Formal letters outlining the study’s objectives, scope, and duration were submitted to ensure compliance with institutional and regulatory requirements. Approval from the principal of the Integrated Basic Education Department (IBED) authorized off-campus research, while parental consent was secured to uphold ethical standards and ensure the safety of the student researchers. Additionally, authorization from the City Environment and Natural Resources Office (CENRO) of Malaybalay City permitted field studies and sample collection at the Sabangan River, enabling the successful execution of the study.

Figure 1. Map of Study Site Sabangan River



**2.3 Study Site**

Three sampling stations were established along the Sabangan River: the upstream location at 8°12'27.7"N and 125°09'01.4"E, the midstream location at 8°12'22.0"N and 125°08'57.6"E, which is the most popular recreational site for tourists, and the downstream location at 8°12'20.3"N and 125°08'53.8"E, where the Can-Ayan River meets the Sabangan River, forming the Tagaloan River. Sampling was conducted on April 8, 2024, with the upstream sample collected at 6:37 am, the midstream sample at 6:44 am, and the downstream sample at 6:49 am.

**2.4 Collection and Analysis of Physicochemical Parameters**

Sampling points were strategically selected along the river to capture water quality variations across upstream, midstream, and downstream locations, adapting Igloria et al. 2024 with modifications for this study. Transect walks were conducted, and grab samples were taken from the mid-depth of each stream. The sampling distance between the upstream and midstream stations was approximately 170.28 meters, while the distance between the midstream and downstream stations was 165.69 meters. Water samples were collected in sterile polyethylene bottles, labeled, and transported in a cooler maintained at 4°C to F.A.S.T. Laboratories for analysis. Key physicochemical parameters including pH, turbidity, dissolved oxygen, total dissolved solids, and total alkalinity were tested using standardized methods. Quality control measures ensured data reliability, and results were compared to the Department of Environment and Natural Resources Class C water quality standards.

3. results and discussion

**3.1 Physicochemical Properties**

**Table 1. Physicochemical Analysis Results**

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| **Parameter** | **Upstream** | **Midstream** | **Downstream** | **Average** | **Standard** |
| Total Dissolved Solids (mg/L) | 178 | 168 | 94 | 146.67 | >1,000 mg/L |
| Turbidity (NTU) | 0.42 | 0.41 | 0.41 | 0.413 | >5 NTU |
| Dissolved Oxgen (mg/L) | 8.5 | 8.4 | 8.5 | 8.47 | <5 mg/L |
| pH | 8.30 | 8.26 | 8.22 | 8.26 | 6.5-8.5 |
| Total Alkalinity (mg/L) | 112 | 112 | 112 | 112 | 5-500 mg/L |

Table 1 presents the physicochemical parameters of the Sabangan River, including Total Dissolved Solids (TDS), turbidity, Dissolved Oxygen (DO), pH, and total alkalinity. The data, collected from upstream, midstream, and downstream locations, indicate that all measured values fall within the permissible limits set by the DENR Class C water quality standards. These findings suggest that the Sabangan River maintains good water quality, supporting aquatic life and potential domestic use.

The Total Dissolved Solids (TDS) concentrations in the Sabangan River averaged 146.67 mg/L, well below the DENR Class C threshold of 1,000 mg/L. This suggests minimal dissolved salts and organic matter, confirming the river’s suitability for aquatic life and domestic use (Muchanga & Sichingabula, 2021; Mathur et al., 2024; Paudel et al., 2024).. Similarly, turbidity levels remained low, averaging 0.413 NTU, far below the 5 NTU standard. This indicates good water clarity, reducing risks of microbial contamination and ensuring safe conditions for recreational activities (Muchanga & Sichingabula, 2021; Malaki et al., 2024). Studies on the Ganga and Yamuna Rivers in Prayagraj also analyzed similar physicochemical parameters, revealing that while most values were within permissible limits, DO levels were slightly lower than ideal, highlighting the importance of continuous monitoring in different river systems (Minz & Nath, 2023).

Dissolved Oxygen (DO) levels averaged 8.47 mg/L, exceeding the DENR standard of 5 mg/L. This indicates a well-oxygenated river system, essential for sustaining aquatic organisms (Auta et al., 2023; Mathur et al., 2024).. The swift-moving waters likely facilitate oxygen dissolution, promoting a biologically stable environment (USGS, 2019). Compared to other Philippine rivers, such as the Meycauayan River, which recorded lower DO levels averaging 3.34 mg/L, the Sabangan River demonstrates superior water quality (Pleto et al., 2020).

The pH of the Sabangan River averaged 8.26, remaining within the DENR Class C range of 6.5 to 8.5, ensuring a stable aquatic environment. This slight alkalinity is typical of carbonate-buffered river systems, which help neutralize acidic inputs (Mathur et al., 2024; Paudel et al., 2024). Similarly, total alkalinity was consistently measured at 112 mg/L, well within the acceptable range of 5 to 500 mg/L. This buffering capacity prevents sudden pH shifts, maintaining favorable conditions for aquatic life (Lawson, 1995).

Comparisons with other Philippine rivers further emphasize the Sabangan River’s water quality. The Labo and Clarin Rivers recorded lower TDS levels averaging 59 mg/L, while the Meycauayan River exhibited significantly higher levels (351.98 mg/L), indicating more dissolved contaminants (Labajo-Villantes & Nuñeza, 2014). Similarly, turbidity in the Sabangan River (0.413 NTU) remains much lower than that of the Sapangdaku River (22–35 NTU), which suffers from urban runoff and mining activity (Sanchez et al., 2020). These comparisons highlight the Sabangan River’s relatively unpolluted state, reinforcing its importance for sustaining aquatic ecosystems and human use.

4. Conclusion

The physical parameter results revealed consistently low levels of Total Dissolved Solids (TDS) and turbidity throughout the Sabangan River. Regular monitoring is recommended to maintain these favorable conditions and address any potential sources of contamination promptly. The chemical parameter analysis indicates healthy levels of dissolved oxygen, pH, and total alkalinity, suggesting the need for continued monitoring to detect fluctuations due to seasonal variations or anthropogenic activities, ensuring the river's long-term sustainability. Further investigation into parameters such as nutrient levels, heavy metal concentrations, and microbial contamination could inform ongoing monitoring efforts to safeguard water quality and ecosystem integrity. Additionally, conducting the study during the wet season is recommended, as this study was done during the dry season.

**Ethical approval:**

Approval from the principal of the Integrated Basic Education Department (IBED) authorized off-campus research.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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