

Water Quality Assessment of Sisauli Wetland of Morang District, Nepal

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Abstract

Wetlands provide essential ecosystem services, including biodiversity conservation, water purification, nutrient cycling, and hydrological regulation. Assessing their water quality is therefore important for understanding environmental conditions and informing conservation priorities. This study evaluated the post-monsoon water quality of Sisauli Wetland in Morang District, Nepal, using selected physicochemical parameters to characterize aquatic conditions and identify monitoring needs. Water samples were collected from five representative sites following standard sampling procedures. Temperature, pH, total dissolved solids (TDS), and dissolved oxygen (DO) were measured in situ, whereas the remaining physicochemical parameters were analyzed in the laboratory using standard methods. Recorded values included a temperature of 30.2 °C, pH of 8.5, TDS of 92.2 ppm, and DO of 9.64 mg/L. Total alkalinity was 92 mg/L, while nitrate, nitrite, ammonium, and iron concentrations were 6.8, 0.48, 0.02, and 0.26 mg/L, respectively. The results characterized the sampled water as well oxygenated, with low dissolved solids, alkaline conditions, and alkalinity indicating buffering capacity. Nevertheless, the reported nitrite concentration and localized alkaline conditions warrant periodic monitoring to determine their persistence and ecological significance. The measurements provide a baseline for understanding post-monsoon physicochemical conditions, while conclusions about overall ecological health remain limited by the parameters assessed and the seasonal scope of sampling. Continued assessment across seasons, supported by biological indicators, would strengthen the evaluation of wetland condition and potential environmental pressures. The study

recommends regular monitoring of nutrients, pH, and DO, together with effective conservation measures, to detect changes in water quality and support the long-term ecological integrity of Sisauli Wetland.

Keywords: Sisauli Wetland; Water Quality Assessment; Physicochemical Parameters; Dissolved Oxygen; Post-Monsoon Monitoring

INTRODUCTION

Wetlands are among the most productive and ecologically significant ecosystems on Earth, providing a wide range of ecosystem services such as water purification, flood control, nutrient cycling, carbon sequestration, and habitat for diverse flora and fauna (Mitsch & Gosselink, 2015). They play a crucial role in maintaining hydrological balance and supporting livelihoods, particularly in developing countries where communities depend on wetlands for agriculture, fisheries, and domestic water use. However, wetlands are highly sensitive to both natural and anthropogenic disturbances, and their water quality can be rapidly altered by land-use changes, urbanization, agricultural runoff, and climate variability (Wetzel, 2001).

Water quality assessment is a fundamental tool for understanding the ecological health of wetlands and for developing effective management and conservation strategies. Physicochemical parameters such as temperature, pH, dissolved oxygen, total dissolved solids, alkalinity, nutrients, and trace metals are widely used indicators of water quality, as they directly influence biological processes and ecosystem functioning (APHA, 2017; Chapman, 1996). Monitoring these parameters helps in evaluating the suitability of water for various uses and identifying early signs of environmental degradation (WHO, 2017).

In Nepal, wetlands constitute an integral component of the landscape, especially in the Terai region, where numerous natural and man-made wetlands support rich biodiversity and local livelihoods. Despite their importance, many wetlands in Nepal are facing increasing pressure from population growth, agricultural intensification, domestic sewage discharge, and unmanaged resource exploitation (IUCN Nepal, 2004). Scientific data on water quality characteristics of several local wetlands remain limited, particularly seasonal assessments that are essential for understanding temporal variations and pollution dynamics.

Sisauli Wetland, located in Morang District of eastern Nepal, is a typical lowland wetland influenced by monsoonal rainfall and surrounding land-use activities. Several studies

have evaluated surface water quality and ecological conditions of wetlands, lakes, rivers, and ponds in eastern Nepal such as Betna Wetland, Chimdi (Barju) Lake, Fewa Lake, Sanbarish Pond, the Bagmati River and the Triyuga River using water quality indices and physicochemical, microbiological, and ecological parameters (Das, 2017a; Das, 2017b; Das et al., 2018; Das et al., 2020; Das & Sharma, 2025; Pal et al., 2021; Das et al., 2024). Although these investigations have enhanced understanding of surface water pollution in the region, no scientific study has yet been conducted on the water quality of Sisauli Wetland. Therefore, the present study is designed to investigate the physicochemical water quality of Sisauli Wetland across multiple sampling sites and evaluate its ecological health, thereby providing baseline information for future monitoring, management, and conservation planning.

METHODS

The study area is situated at Belbari municipality of Morang District in Koshi province of Eastern Nepal. Sisauli Wetland covers an area of 292.4 ha, encompassing the entire Sisauli community forestry in Belbari Municipality ward no. 1. It is situated at an elevation of 125 m above sea level and is located at Lat. 26°39' N and Long. 87°26'E (Coordinates: 26.67°N 87.43°E). It is located 26 kilometers from Biratnagar and 600 meters north of the East West Highway (Adhikari & Thapa Chhetry, 2017). A tiny fragment of Char-Koshe-Jhadi is present. The area filled with water is surrounded by a dense sal forest and little bushes. Sisauli wetland is surrounded by dense tropical forests. Belbari municipality lies at terai belt of Eastern Nepal hence, experiences tropical savannah climate type with dry winters and hot summers.

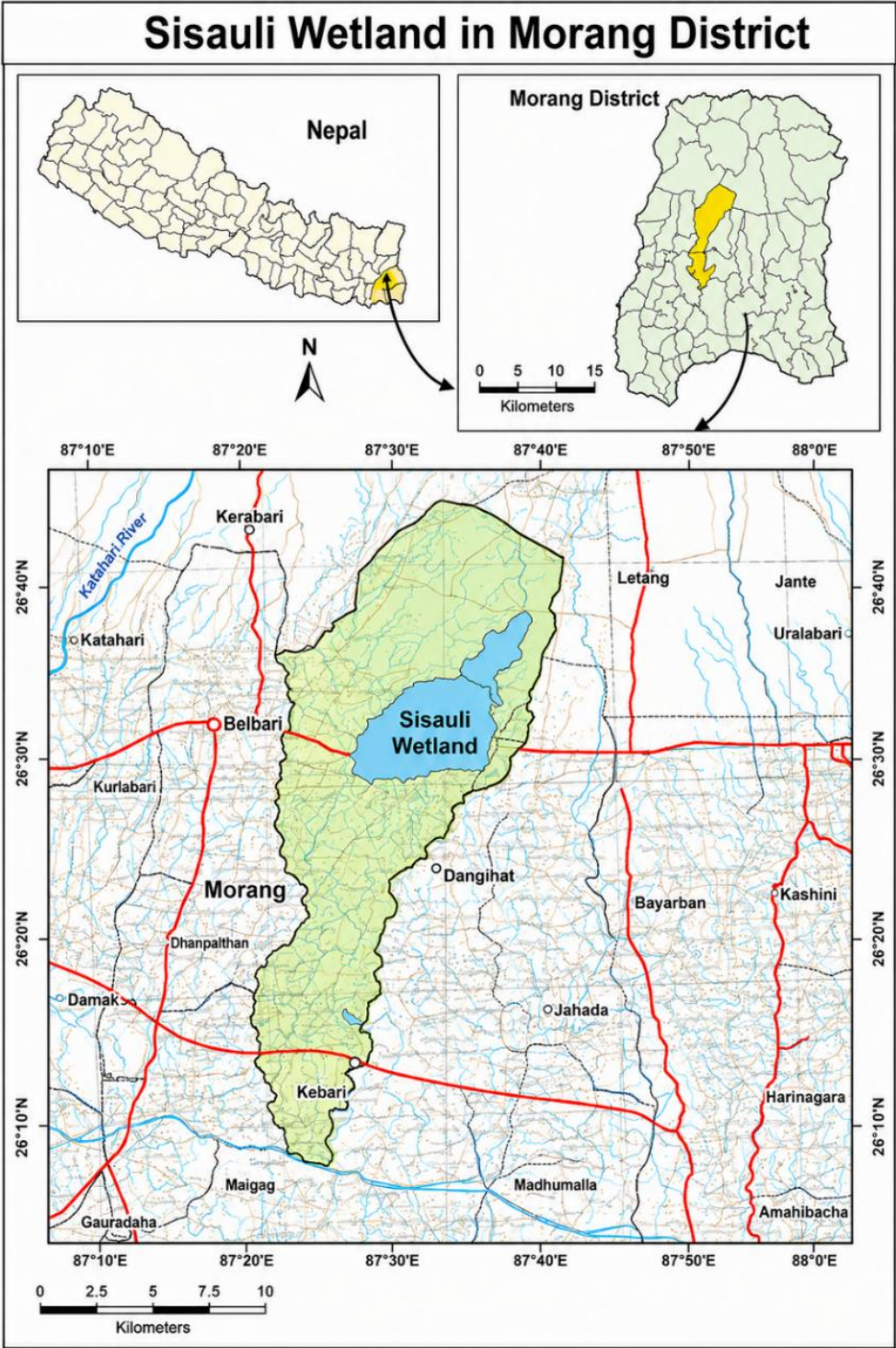


Figure1. Sisauli Wetland at Belbari municipality, Morang.

RESULTS

The present study was conducted at five sites (I, II, III, IV and V) along the Sisauli wetland as shown in the table 1.

Table 1: Sampling site, GPS and observations

Site No.	Geo-coordinates	Observations
Site I	26°39'58.549"N 87°25'17.046"E	Water surface was nearby the human residence.
Site II	26°39'59.037"N 87°25'18.114"E	Some of the anthropogenic activities were observed near the water body.
Site III	26°40'01.989"N 87°25'17.314"E	Water surface was covered with some floating aquatic plants.
Site IV	26°40'05.012"N 87°25'22.661"E	Some of the non-degradable wastes could be seen.
Site V	26°40'03.876"N 87°25'22.155"E	Water surface was moving and looked fresh.

Water samples from different sampling sites of different locations of wetland were collected between 03:30 PM – 04:30 PM in the day hour since all the physicochemical parameters of water are likely to be in their natural conditions. The samples were gathered in distilled water-rinsed plastic bottles. The bottles were dipped into the water body slowly without disturbing its surface and progress of any air bubbles. Temperature, Total dissolved solid and pH were measured on the spot by using TDS meter and pen type pH meter. Geo-coordinates for groundwater selected for the study were recorded with the help of Global Positioning System (GPS). Experimental works were carried out within a couple of weeks of sample collection and DO was carried out on the spot. For the analysis of other parameters, water samples were taken to the Department of Botany, MMAMC Campus, Biratnagar, Nepal.

Table 2: Physicochemical parameters in Sisauli Wetland, Morang (Post monsoon 2023)

S.N.	Parameters	Units	Post Monsoon (2023)					Average
			Site I	Site II	Site III	Site IV	Site V	
1.	Temperature	°C	31	32	31	29	28	30.2
2.	TDS	ppm	99	98	95	86	83	92.2
3.	pH		8.6	8.3	9	8.4	8.2	8.5
4.	Dissolved oxygen	mg/l	13.2	8.8	8.8	8.6	8.8	9.64
5.	Total alkalinity	mg/l	125	90	80	105	60	92
6.	Nitrate	mg/l	4	10	7	8	5	6.8
7.	Nitrite	mg/l	0.1	0.5	0.6	0.5	0.7	0.48

S.N.	Parameters	Units	Post Monsoon (2023)					Average
			Site I	Site II	Site III	Site IV	Site V	
8.	Ammonium	mg/l	0	0.1	0	0	0	0.02
9.	Iron	mg/l	0.5	0.2	0.1	0	0.5	0.26

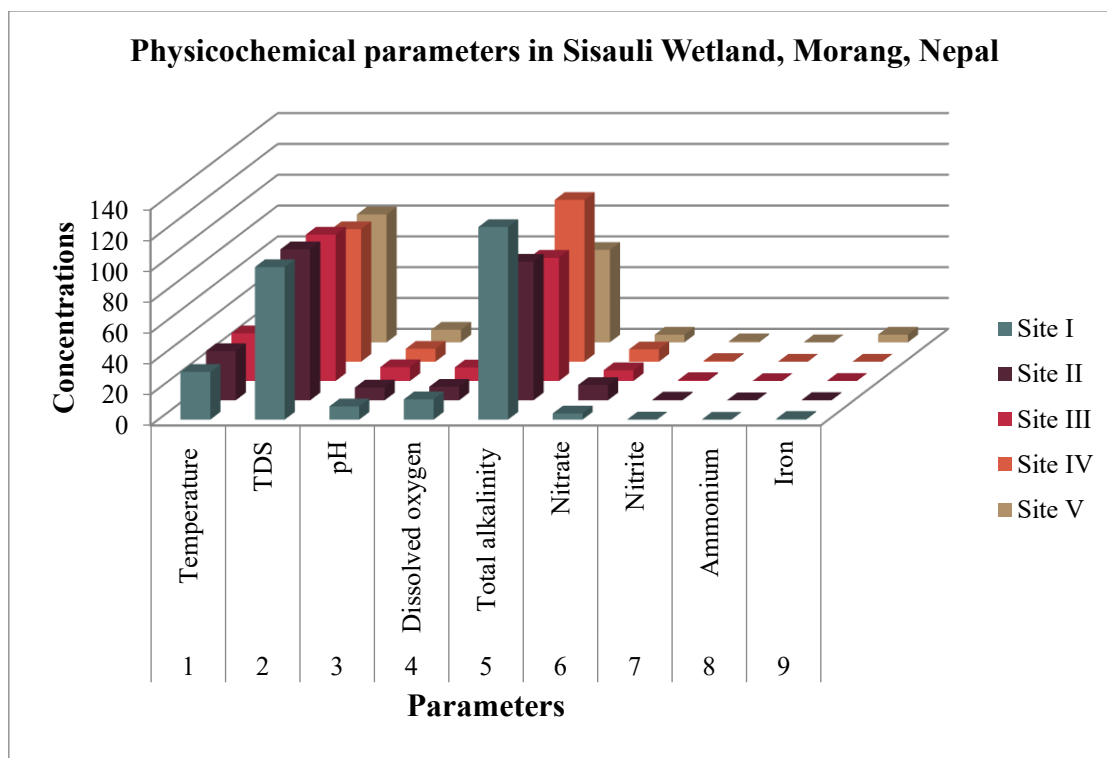


Figure 2. Physicochemical parameters in Sisauli Wetland, Morang (Post monsoon 2023)

DISCUSSION

Water is component upon which all the life forms depend for different activities of their life. The Physicochemical parameter shows change due to various factors like climate, pollutants, chemicals, etc. Different Physicochemical parameters found during the study are discussed below.

Temperature: Water temperature across the five sites of Sisauli Wetland during the post-monsoon season ranged from 28–32 °C, with an average of 30.2 °C. Elevated temperature in wetlands during post-monsoon periods is generally influenced by ambient climatic conditions, shallow water depth, and increased solar radiation. Higher temperatures can accelerate biochemical reactions and reduce oxygen solubility, thereby affecting aquatic life and water quality (Wetzel, 2001; WHO, 2017).

Total Dissolved Solids (TDS): TDS values varied between 83 and 99 ppm with a mean of 92.2 ppm. Such low TDS concentrations indicate minimal dissolved salts and low inorganic pollution, suggesting limited anthropogenic disturbance in the wetland catchment during the study period (WHO, 2017; Chapman, 1996).

pH: The pH of water ranged from 8.2 to 9.0, with an average value of 8.5. Alkaline pH in wetlands is often attributed to bicarbonate and carbonate buffering, photosynthetic activity, and geological characteristics of the basin. Slightly alkaline conditions can influence nutrient availability and metal solubility in aquatic systems (WHO, 2017; Wetzel, 2001).

Dissolved Oxygen (DO): Dissolved oxygen concentrations ranged from 8.6 to 13.2 mg/L, with a mean value of 9.64 mg/L, which is well above the minimum requirement of 4–6 mg/L for aquatic life. High DO values indicate good aeration and active photosynthesis by aquatic macrophytes and phytoplankton, reflecting favorable ecological conditions within the wetland (APHA, 2017; Chapman, 1996).

Total Alkalinity: Total alkalinity values varied from 60 to 125 mg/L with an average of 92 mg/L. Alkalinity reflects the buffering capacity of water against sudden pH changes and is primarily controlled by bicarbonates, carbonates, and hydroxides. Moderate alkalinity values indicate stable water chemistry suitable for sustaining aquatic biota (WHO, 2017; Sawyer et al., 2003).

Nitrate: Nitrate concentrations ranged from 4 to 10 mg/L, with an average of 6.8 mg/L. These moderate nitrate levels may originate from natural decomposition of organic matter and limited agricultural runoff. Although acceptable, continuous nutrient enrichment may promote eutrophication in wetlands if concentrations increase over time (WHO, 2017; Wetzel, 2001).

Nitrite: Nitrite levels ranged from 0.1 to 0.7 mg/L, with an average of 0.48 mg/L. Nitrite usually occurs as an intermediate product in the nitrogen cycle and its presence in low concentrations indicates ongoing nitrification and denitrification processes within the wetland ecosystem (Chapman, 1996; WHO, 2017).

Ammonium: Ammonium concentrations were very low (0–0.1 mg/L), with an average of 0.02 mg/L. Low ammonium levels suggest minimal contamination from domestic sewage or agricultural sources and efficient biological oxidation of ammonia to nitrate in the wetland system (APHA, 2017; Wetzel, 2001).

Iron: Iron concentration ranged from 0 to 0.5 mg/L with an average value of 0.26 mg/L. Iron in wetlands is often derived from soil and sediment under reducing conditions. Elevated iron concentrations may affect water taste, color, and aquatic organisms (WHO, 2017; Chapman, 1996).

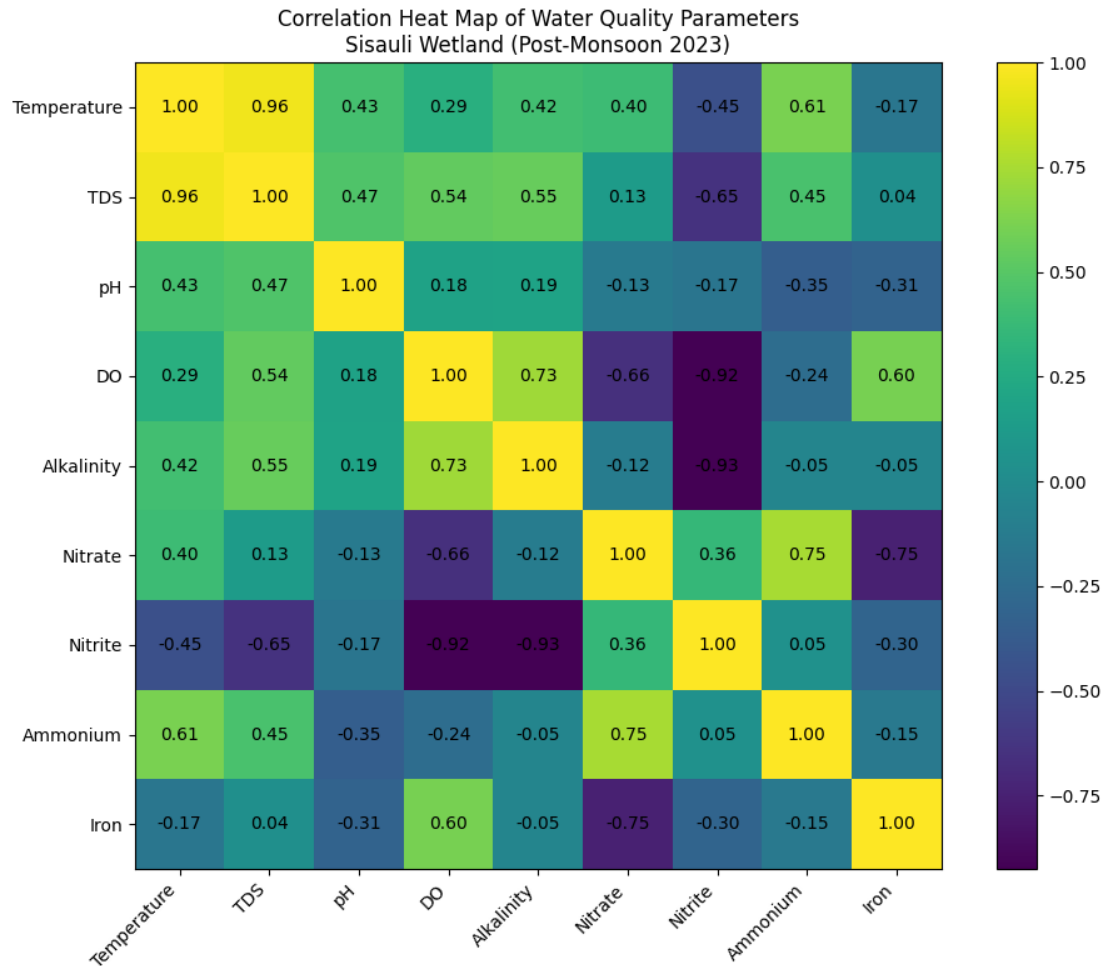


Figure3. Correlation heat map showing interrelationships among physicochemical parameters

The correlation heat map (Figure 3) for post-monsoon water quality parameters of Sisauli Wetland (2023) revealed several significant interrelationships among the measured physicochemical variables. Water temperature showed a strong positive correlation with total dissolved solids ($r = 0.96$) and moderate positive relationships with alkalinity ($r = 0.42$) and ammonium ($r = 0.61$), indicating the influence of seasonal warming on solute concentration and biogeochemical processes. Dissolved oxygen exhibited a strong positive correlation with alkalinity ($r = 0.73$) and iron ($r = 0.60$), suggesting enhanced oxygenation and mineral interactions under favourable environmental conditions. In contrast, dissolved oxygen

showed strong negative correlations with nitrate ($r = -0.66$) and nitrite ($r = -0.92$), reflecting the inverse relationship between oxygen availability and reduced nitrogen species.

Nitrate displayed a strong positive correlation with ammonium ($r = 0.75$), indicating active nitrogen transformation within the wetland, while a strong negative correlation was observed between nitrate and iron ($r = -0.75$), possibly due to redox-controlled iron–nitrogen interactions. Nitrite showed strong negative correlations with alkalinity ($r = -0.93$) and dissolved oxygen ($r = -0.92$), emphasizing the sensitivity of nitrite to oxygen-rich and well-buffered conditions. Overall, the correlation pattern suggests that temperature-driven processes, oxygen dynamics, and nitrogen cycling play a major role in regulating the post-monsoon water chemistry of the Sisauli Wetland. A strong negative correlation between dissolved oxygen (DO) and nitrite ($r = -0.92$) indicates that as nitrite concentrations increase, dissolved oxygen decreases. Ecologically, this suggests that elevated nitrite is associated with oxygen depletion caused by microbial decomposition of organic matter and nitrification, which consume oxygen. Such conditions can stress aquatic organisms, reduce biodiversity, and indicate deteriorating water quality.

CONCLUSION

The physicochemical characteristics indicate that Sisauli Wetland is in generally good ecological condition during the post-monsoon season. Water temperature (28–32°C; mean 30.2°C) is suitable for tropical freshwater biota, while the TDS values (83–99 ppm; mean 92.2 ppm) are low, indicating minimal dissolved solid pollution. The water is slightly alkaline (pH 8.2–9.0; mean 8.5), which is favorable for most aquatic organisms, although the pH value of 9.0 at one site suggests the need for periodic monitoring. Dissolved oxygen concentrations (8.6–13.2 mg/L; mean 9.64 mg/L) are high, reflecting well-oxygenated water capable of supporting diverse aquatic life. Total alkalinity (60–125 mg/L; mean 92 mg/L) indicates good buffering capacity against sudden pH fluctuations. Nutrient concentrations were generally low to moderate, with nitrate (4–10 mg/L; mean 6.8 mg/L), nitrite (0.1–0.7 mg/L; mean 0.48 mg/L), and ammonium (0–0.1 mg/L; mean 0.02 mg/L) suggesting limited nitrogen pollution and no evidence of severe eutrophication. Iron concentrations (0–0.5 mg/L; mean 0.26 mg/L) were within acceptable levels for natural freshwater systems. Overall, the measured parameters suggest that Sisauli Wetland is in good ecological health, with no strong evidence of significant nutrient enrichment, organic pollution, or physical

degradation. However, the relatively elevated nitrite concentrations at some sites and the high pH at Site III warrant periodic monitoring to ensure that water quality remains suitable for sustaining aquatic biodiversity.

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