Eco. Env. & Cons. 31 (4) : 2025; pp. (1527-1531)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2025.v31i04.030
Website: www.envirobiotechjournals.com

Monitoring and Assessment of Water Quality of Surajpur Wetland, Uttar Pradesh, India

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(Received 10 August, 2025; Accepted 4 October, 2025)

ABSTRACT

The present study evaluates the seasonal and inter-annual variations in physicochemical and biological water quality parameters across two consecutive years. Parameters including temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), turbidity, hardness, alkalinity, and nutrients (nitrate, sulphate, phosphate) were analyzed seasonally (summer, monsoon, winter). Results demonstrated that Year 1 values were within or near acceptable limits, whereas Year 2 exhibited drastic deterioration in multiple parameters, with critically low DO (1.2 mg/l in winter), elevated BOD (62.5 mg/l, COD (230 mg/l), turbidity (46.3 NTU), and high nutrient enrichment. Seasonal trends revealed that summer was driven by evaporation-induced concentration, monsoon by runoff and turbidity, and winter by severe stagnation and organic pollution. The findings highlight increasing anthropogenic pressures, nutrient enrichment, and eutrophication risk. Recommendations include stricter effluent regulation, seasonal monitoring, and nutrient load management.

Keywords: *Water quality, Seasonal variation, DOES, BOD, COD, Eutrophication, Pollution*

Introduction

Wetlands are among the most productive ecosystems, providing essential ecosystem services such as water purification, flood control, nutrient cycling, and habitat for biodiversity (Mitsch and Gosselink, 2015). In India, wetlands are under severe threat due to rapid urbanization, agricultural expansion, and industrial development (Prasad *et al*., 2017). The large proportion of the earth's biodiversity resides in aquatic environments (Groombridge and Jenkins, 1998). The health of wetlands and their ecological functioning are directly related to survival of aquatic organisms (Ramesh *et al.*, 2007). However, in recent decades, Surajpur has been increasingly influenced by untreated sewage discharge, solid waste dumping, agricultural runoff, and industrial effluents from nearby Noida and Greater Noida (Singh and Sharma, 2018). Assessing its water quality is critical for evaluating ecological health and formulating management strategies. Management of an aquatic ecosystem is aimed for the conservation of its habitat by suitably maintaining the physicochemical quality of water within acceptable levels (Garg *et al*., 2010). This study aims to evaluate seasonal and year-wise variations in key physicochemical parameters of Surajpur Wetland to understand the impact of anthropogenic pressures and and to suggest ways and means for its conservation.

Materials and Methods

Surajpur Lake (28°31′425′′N; 77°29′714′′E) is an important urban wetland located in Gautam Budh

Nagar district, Uttar Pradesh. This area comes under Upper Gangetic Plains biogeographic zone of northern India, at an elevation of approximately 184.7 m above mean sea level. The landscape is characterized by fine alluvium and clay rich swamps, fertile soil and high water retention capacity (Manral *et al.*, 2013). The wetland, encompassing an area of about 308 hectares, has been designated as a Reserve Forest, thereby ensuring its ecological protection. Hydrologically, the lake is predominantly rain-fed, although it also receives supplementary recharge from the Hawaliya drain, which connects to the Hindon River, as well as from the Tilapta irrigation canal. Climatic conditions in the region exhibit considerable variability, with minimum air temperatures dropping to approximately 18.7 °C during January and maximum values reaching 45.6 °C in June. Seasonality is distinctly defined, with summer spanning from March to June, the monsoon period extending from July to October, and winter occurring between November and February.

Methods

Water samples were collected from Surajpur Wetland during three seasons (summer, monsoon, and winter) over two consecutive years. Standard sampling and analytical procedures recommended by the American Public Health Association (APHA, 2017) were followed for analysis of physicochemical parameters. The parameters studied included water temperature (WT, °C), pH, electrical conductivity (EC, ìS/cm), total dissolved solids (TDS, mg/L), total suspended solids (TSS), dissolved oxygen (DO , mg/l), biochemical oxygen demand (BOD , mg/l), chemical oxygen demand (COD , mg/l), carbonate (CO_3, mg/l), bicarbonate (HCO_3, mg/l), total alkalinity (TA, mg/l), total hardness (TH, mg/l), calcium (Ca, mg/l), turbidity (NTU), sulphate (SO_4, mg/l), nitrate (NO_4, mg/l), phosphate (PO_4, mg/l). For collection of water samples, wide mouth sterile transparent plastic jars of half liter capacity used and 10 20cm depth of water surface were considered for collection during 0800 – 1000 hr., brought to the laboratory and preserved under refrigerated condition for analysis (Mishra *et al.*, 2008). Preservation of samples and estimation of various water quality parameters were done as per standard procedures reported in APHA, (2006) and Golterman *et al.*, (1978). Preservation of samples and estimation of various water quality parameters were done as per standard procedures reported in APHA, (2006) and Golterman *et al.* (1978). Seasonal averages were compared year-wise to evaluate temporal and spatial variation in water quality.

Results and Discussion

Spatially, water temperature represents no significant difference among various stations throughout the study period, whereas temporally, lower water temperature was observed from December to February and higher temperature was recorded from March to June. In Year 1, water temperature ranged from 25 °C in winter to 33.7 °C in summer, while in Year 2 it increased slightly in summer (35 °C) and decreased in winter (23.5 °C). These seasonal fluctuations are expected as temperature is directly influenced by climatic conditions, solar radiation, and atmospheric interaction (Patel *et al.*, 2018). The higher summer temperatures reflect enhanced solar heating and evaporation, while lower winter temperatures are due to reduced solar intensity. Such variation influences dissolved oxygen solubility, with higher temperatures generally reducing oxygen retention (Sharma *et al.*, 2021).

Table 1. Permissible limits of physicochemical parameters of water samples

S. No.	Physicochemical parameters	Permissible limits*
1.	EC (microS/cm)	300
2.	pH	6.5-8.5
3.	TDS	500
4.	Total Alkalinity as CaCO3 (mg/l)	200
5.	DO	4
6.	BOD	10
7.	COD	250
8.	Turbidity (Transparency, NTU)	5
9.	Total Hardness as CaCO3 (mg/l)	300
10.	Calcium	75
11.	Sulphate	250
12.	Nitrate	45

*As per Indian Standards Institution (IS 10500-1989), Bureau of Indian Standard (BIS), World health Organization WHO, Union Health Ministry and Central Pollution Control Board (CPCB)

Year 1 water was consistently alkaline (8.25-8.49), whereas Year 2 showed a marked shift toward neutrality (6.57-7.13). The decline suggests increased organic matter decomposition and carbon dioxide accumulation, leading to acidification (Gupta *et al*., 2019). The alkaline condition of Year 1 is typical of low-pollution waters with carbonate buffering, while the near-neutral pH of Year 2 reflects heavy organic load and wastewater influence. Sahu *et al.* (1995) and Ramadas *et al*. (2005) also reported variations in pH level due to inflow of waste as also seasonal changes. According to WHO (2017), acceptable drinking water pH ranges from 6.5 to 8.5, which indicates that Year 2 winter values were borderline.

EC in Year 1 was relatively low (100–240 µS/cm), whereas Year 2 recorded much higher values (1100–1886 µS/cm), particularly in winter. A similar trend was observed for TDS, which rose from 410 mg/l (Year 1 winter) to 918 mg/l (Year 2 winters). These increases indicate significant ionic enrichment, likely from domestic sewage, industrial effluents, and leaching of salts during runoff (Singh and Chandra, 2017). Higher EC and TDS reduce water usability for drinking and irrigation and may cause scaling in distribution systems. The WHO guideline limit for TDS is 500 mg/l, suggesting that Year 2 samples, especially winter, exceeded safe limits.

Dissolve oxygen (DO) is a very important parameter of a water body's ability to support aquatic life. DO was consistently high in Year 1 (7.5-9 mg/l), suggesting good oxygenation and self-purification potential. In contrast, Year 2 exhibited drastic oxygen depletion, with winter recording only 1.2 mg/l. Simultaneously, BOD rose from 18–21 mg/l (Year 1) to as high as 62.5 mg/l (Year 2 winter), while COD increased from ~80 mg/l (Year 1) to 230 mg/l (Year 2 winter). This inverse relationship highlights organic pollution, where microbial decomposition consumes oxygen (Patel *et al*., 2018). The critical DO decline in Year 2 indicates heavy organic load and possible discharge of untreated sewage. Both BOD and COD far exceed permissible limits (BIS, 2012), suggesting that Year 2 water was unsuitable for aquatic life.

Turbidity (transparency) is an optical property of the water body; it is due to suspended matter in water and it was fluctuated temporally across the study period. Year 1 turbidity values were negligible (0.9-1 NTU), but in Year 2, monsoon and winter values surged (40-46 NTU). TSS similarly rose from ~30-42 mg/l in Year 1 to 75 mg/l in Year 2 winter. In general, the high turbidity values were recorded in monsoon season and low in summer season due to highest suspended matter in water in monsoon season as it receives maximum rainfall. This suggests enhanced soil erosion, runoff, and wastewater discharge during monsoon, with further accumulation in winter due to stagnation (Sharma *et al*., 2021). Elevated turbidity reduces light penetration, negatively impacting photosynthesis and aquatic biodiversity. WHO (2017) prescribes turbidity <5 NTU for drinking water, which Year 2 values far exceeded.

Total hardness increased from ~250–410 mg/l in Year 1 to 316–484 mg/l in Year 2, with calcium lev-

Table 2. Results of water quality analysis of various physico-chemical parameters

Parameter	Year 1				Year 2			
	Summer	Monsoon	Winter	Mean	Summer	Monsoon	Winter	Mean
Temperature	33.7	28	25	28.9	35	29	23.5	29.17
EC (microS/cm)	200	100	240	180	1446	1100	1886	1477
pH	8.49	8.25	8.49	8.41	6.57	7	7.13	6.9
TDS	442	850	410	567.3	728	550	918	732
TSS	42	30	40	37.33	15.6	15.63	75	35.41
Total Alkalinity	260	550	259	356.3	528	475	460	487.7
DO	9	7.5	8.1	8.2	3.2	6.2	1.2	3.533
BOD	21	18	20.9	19.97	14	22	62.5	32.83
COD	88	81	84.5	84.5	104	135	230	156.3
Turbidity (NTU)	1	0.9	1	0.967	11.6	40	46.3	32.63
total hardness	250	410	243.8	301.3	316.46	265	484	355.2
calcium	88	108	88	94.67	181.44	150	104.2	145.2
Nitrate	12	15	11	12.67	26	16.7	12	18.23
Sulphate	10	13.6	11.6	11.73	27.5	24	17	22.83
phosphate	3	3	3	3	12	18	14.7	14.9
Carbonate	24	60	23	35.67	6.4	0	0	2.133
Bicarbonate	305	305	306	305.3	637.7	475	560	557.6

els rising from ~88 mg/l (Year 1) to as high as 181 mg/L (Year 2 summer). Alkalinity also increased, especially in Year 2 summer (528 mg/l). These values reflect higher carbonate, bicarbonate, and calcium salt dissolution, possibly due to industrial and agricultural effluent discharge (Gupta et al., 2019). Hardness above 300 mg/l (WHO guideline) causes scaling and taste issues, suggesting Year 2 waters were less suitable for domestic use.

Nitrate levels increased from 12–15 mg/l (Year 1) to 26 mg/l (Year 2 summer), likely from fertilizer runoff. Sulphate doubled, reaching 27.5 mg/l in Year 2, also reflecting anthropogenic inputs. The most critical change was phosphate: stable at 3 mg/l in Year 1 but elevated to 12-18 mg/L in Year 2. This enrichment signals high eutrophication risk, as excess phosphate promotes algal blooms and oxygen depletion (Singh and Chandra, 2017). According to WHO (2017), phosphate should not exceed 5 mg/l, suggesting Year 2 values were unsafe.

Year 1 recorded moderate carbonate (23-60 mg/l) and bicarbonate (~305 mg/l), reflecting natural alkalinity. However, Year 2 showed carbonate depletion (0–6.4 mg/l) with significantly higher bicarbonate (up to 637 mg/l). This shift indicates stronger acid-neutralizing capacity from wastewater-derived bicarbonate salts, altering buffering mechanisms and reducing water stability (Sharma *et al*., 2021).

Conclusion

Summer: Elevated temperatures and ionic concentration due to evaporation.

Monsoon: High turbidity, TSS, and nutrient inflow from runoff.

Winter: Maximum deterioration, with extremely low DO, high BOD/COD, turbidity, and TDS, reflecting stagnant conditions.

The study reveals significant seasonal and year-wise variation in the water quality of Surajpur Wetland, Uttar Pradesh. Year 2 exhibited greater deterioration with higher organic load, increased BOD and COD, reduced dissolved oxygen, and elevated nutrient levels, particularly during winter. These changes are attributed to anthropogenic pressures such as sewage discharge, agricultural runoff, and urbanization around study area. Immediate conservation efforts, including wastewater treatment, pollution regulation, and ecological monitoring, are urgently required to safeguard the wetland's ecological integrity.

Acknowledgement

I express my gratitude to concern authority of Surajpur wetland for allowing to do work in research area and to Prof. (Dr.) Antony Joseph Raj Dean of College of Forestry and to my advisor Dr. Satyendra Nath, Associate Professor, Department of Environmental Science and Natural Resource management for his valuable advice and helpful suggestion in writing this review paper. His vast knowledge and experience helps me a lot in writing this context.

Conflict of Interest- None

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