WATER QUALITY ASSESSMENT OF PONDS IN KANPUR NAGAR

[1]Dheerendra Kamal and [1]Shraddha Sahu*,

[1]Department of Biotechnology, Faculty of Engineering and Technology,
Rama University, Kanpur, Uttar Pradesh - 209217, India

***Corresponding author e-mail_id: drshraddha.fet@ramauniversity.ac.in**

ABSTRACT

Water quality data paints a grim picture of this degradation. Researchers consistently find high levels of total dissolved solids and electrical conductivity within these stagnant pools. Low dissolved oxygen levels prevent aquatic life from thriving. Oxygen depletion stems directly from the massive organic load constantly flowing into the systems. Higher readings of biochemical oxygen demand and chemical oxygen demand confirm that the water is actively suffocating. Beyond mere oxygen starvation, nutrient loading creates a different kind of disaster. Nitrates and phosphates surge into the ponds through runoff, triggering rapid, suffocating algal blooms. People often add to the problem through cultural practices or dumping trash during religious festivals. While algae look harmless on the surface, their decay strips every remaining bit of oxygen from the water beneath. Fish die off, foul odours fill the air, and the entire pond ecosystem collapses into a state of total imbalance.

Keywords- TDS, BOD, COD, Pond water, Heavy metals, Charcoal

I. INTRODUCTION

Kanpur Nagar remains a densely populated urban centre within Uttar Pradesh, India, where its numerous ponds serve as essential reservoirs for ecological health and local survival. Villagers rely on these basins for irrigation, livestock watering, and various domestic chores every single day. Rapid urbanization, unchecked industrial growth, and messy human habits now threaten these vital water bodies, creating significant environmental misery. Truth be told, the damage to our local water is already quite extensive. We need a comprehensive water quality assessment to map out the current pollution levels and find actionable ways to save these disappearing natural resources (Singh et al., 2026). Evaluating the fitness of water for diverse purposes remains a primary goal for environmental health. Experts define water quality through specific chemical, physical, and biological lenses. These measurements gauge how well a water body meets the biological requirements of species and the harsh demands of human utility. Fresh water ponds function as small yet ecologically mighty hubs that support biodiversity while regulating local microclimates for the surrounding community. Such ponds act as critical social-ecological resources in peri-urban landscapes, yet they face constant danger from runoff, organic debris, and chemical detergents flowing from nearby settlements. Even minor human interference disrupts the pond balance, shifting nutrient levels or microbial activity to a state of dysfunction (Das et al., 2026). Poor water quality renders a pond useless for both human consumption and animal health. Physical, chemical, and biological factors constantly interact within these systems to provide early warning signals regarding overall ecosystem stress. Researchers track physiochemical indicators like pH levels, electrical conductivity, total dissolved solids, temperature, dissolved oxygen, and free carbon dioxide to evaluate the current health of these ponds. These metrics reflect the ionic content, the surrounding buffering capacity, and the metabolic processes governing water health. Dissolved oxygen stays at the top of the priority list because it sustains aerobic aquatic life while shifting based on organic decay or photosynthesis. Furthermore, free carbon dioxide rises when respiration is high, specifically under the weight of organic loading or restricted aeration (Bouelet et al., 2024). Monitoring these specific indicators serves the dual purpose of keeping the ecosystem alive and preventing severe health hazards in surrounding residential areas. Scientists utilize benchmark frameworks established by the Bureau of Indian Standards and the World Health Organization to confirm if a pond is fit for use. Rigid adherence to these specific guidelines helps prevent disaster before it begins. Monitoring these small bodies of water is the only way to ensure they continue to serve humanity and wildlife alike without constant failure. Protecting these fragile networks requires sustained effort, consistent data, and public awareness. Without active oversight, our urban ponds will likely vanish entirely, leaving us with dry, dead pits where life used to thrive. Simply ignoring these red flags is a mistake we cannot afford to repeat. (Ermadani et al., 2023).

II. MATERIALS AND METHODS

2.1 Sampling

Proper wastewater classification is dependent on good sampling. Constant variations in flow rate and wastewater quality may inhibit a wastewater's ability to consistently undergo biological changes. Composite sampling over three to four hours is a good sampling technique. This will minimize the time the sample is held and provide data that can be considered indicative of typical wastewater properties during the day. Samples are collected from the wastewater stream in 500 ml bottles. The wastewaters are sampled at the time of maximum flow of a day. Collected samples were transported to the laboratory in an ice box for further analysis (Radenkovic et al., 2025).

Wastewater samples are collected from the kitchen, bathroom, and laundry through the use of sterile bottles and combined to form a composite sample. Activated charcoal is prepared by subjecting washed coconut shells to a process of carbonization at temperatures between 600-700°C, activation with 10% phosphoric acid followed by drying and grinding. Batch adsorption tests are performed by exposing wastewater samples to various quantities of charcoal, stirring and letting them interact. The samples are then filtered to determine TDS, COD, BOD, heavy metals, and organic compounds. During column filtration, a glass column packed with charcoal is used; effluent samples are collected while controlling the flow rate. The charcoal is regenerated after treatment of 200 l by soaking it in 0.1 M NaOH. mixing the pond water samples collected within a period of two days into one big container (Adekunle et al., 2020).

Lack of information on particular samples since it becomes difficult to determine the unknown waste variances. As an example, suppose that the samples collected were analysed individually, then you would come up with a very high reading and a very low reading. From those few extreme readings, it could be concluded that the waste is non-homogeneous and contains hot spots in its composition. Here, you lose the information. Already pre-determined averages are obtained. As an illustration, four different samples are put together to create a homogenous sample instead of analysing each sample individually. All these samples are averaged to obtain the homogenized sample (Tonmoy et al., 2024).

2.2 Sample Analysis

Colour of the water samples was observed using naked eyes, whereas other physiochemical properties of samples were analysed through computerized means. Specifically, pH, electrical conductivity and total dissolved solids TDS were measured by the Hanna Portable pH and TDS, Dissolved oxygen DO concentrations, together with temperature, were determined with the aid of the DO Meter. The level of phosphorus in lab was determined by means of Solution A made up of H_2SO_4, antimony potassium tartrate, ammonium molybdate, and water; and Solution B constituted of both solutions A and ascorbic. The use of DO and TDS is the easiest way to determine temperature, pH, and dissolved oxygen DO of water samples (Hemprabha et al., 2025).

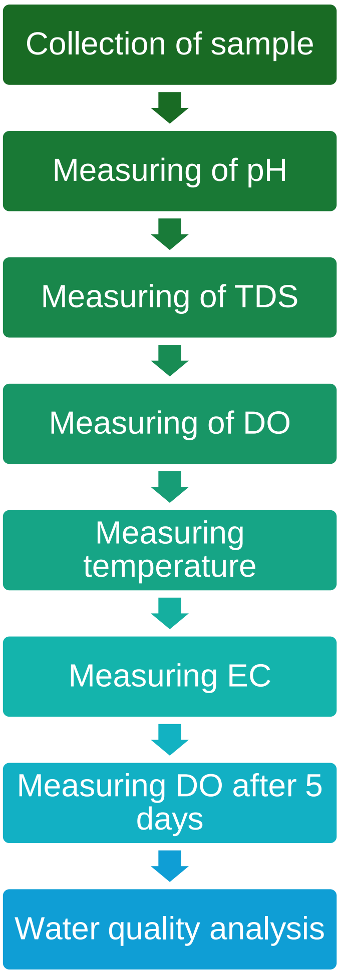

Figure 1: Flowchart of water quality test

2.3 Physicochemical Parameters

The pond water samples were analysed for the physicochemical parameters such as pH, electrical conductivity, total hardness, bicarbonate, carbonate, chloride, sulphate, calcium, magnesium, sodium and all molecules. pH is one of the most important parameters in water quality because it influences nearly all chemical and biological processes. It affects ammonia toxicity, the solubility of metals, and the functioning of enzymes in fish. For testing, water samples should be collected in clean plastic or glass bottles of about 100 ml. No preservative is required, but the sample should ideally be tested within two hours. If there is a delay, it can be stored at 4°C and tested within six hours. To understand daily variation, measurements should be taken at consistent times, preferably early morning 6-7 AM and late afternoon 4-5 pm), as pH fluctuates due to photosynthesis (Po et al., 2023).

There are two main methods for pH measuring. A pH meter provides accurate readings ±0.1 and should be calibrated daily using standard buffer solutions of pH 4.0, 7.0, and 10.0. Colorimetric kits are simpler but less accurate ±0.2, using indicators like bromothymol blue or phenol red. Fish culture such as carp and catfish, the suitable pH range is 6.5 to 8.5, with an ideal range of 7.5 to 8.0. Shrimp require slightly higher pH, and values below 7 can cause moulting problems. According to CPCB guidelines, discharge water should have a pH between 6.0 and 9.0. In natural ponds, especially in Uttar Pradesh, pH usually ranges from 7.0 to 8.5, but algae can increase it during the day. Low pH below 5.5 indicates acidic conditions, often due to acid sulphate soils or mining discharge, which can be harmful to fish and increase aluminium toxicity. High pH (9–10) is usually caused by dense algal blooms, where pH rises in the evening due to photosynthesis, increasing the risk of ammonia toxicity. Large daily fluctuations (greater than 1 unit) suggest excessive plant or algal growth. pH also affects ammonia toxicity. At pH above 8.5, a significant portion of ammonia becomes toxic (NH_3), whereas at pH below 7, it remains mostly in the safer ammonium form NH_4^+ (Ermadani et al., 2023).

2.4 Water Temperature

Water temperature refers to the kinetic energy of water and is measured using either Fahrenheit (°F) or Celsius (°C). The physical property refers to the hotness or coldness of the water. Hotness and coldness are subjective terms, and temperature may be explained as the average thermal energy of any substance. Thermal energy refers to the kinetic energy of atoms and molecules; hence, the kinetic energy of atoms and molecules can be measured using temperature. Heat transfer may occur among substances (Po et al., 2023).

2.5 Biological parameters

Biological oxygen demand BOD the pond water samples were analysed for BOD for detection of pollution, total coliform count for focal contamination and bacteriological assessment of water samples was also done. Biological oxygen demand BOD is an index of the physical and biochemical processes that occurs in water and is a very important parameter of water quality (Adekunle et al., 2020).

It is applied in ecology, environmental science and water quality management and assessment. Coliform detection by MPN method the probable or total coliform count was determined by a multiple tube fermentation test which involved diluting the sample in different concentrations of the medium Lactose broth. The sample colour changed after 48 h of incubation because of the formation of gas and acid indicating the presence of total coliforms (Radenkovic et al.,2025).

2.6 Bacteriological assessment

The water samples were assessed for other bacterial flora present in the water samples by serial dilution and pour plate method. Identifications of the Bacterium The identification of the bacteria was performed by Gram staining. Further confirmation was done by biochemical methods (Savita et al., 2025).

2.7 Dissolved Oxygen (DO)

Dissolved oxygen is the most critical factor for fish survival. It is also essential for aerobic bacteria that decompose organic matter. If oxygen levels drop too low, harmful gases like hydrogen sulphide and methane can form, leading to fish deaths. Water samples for DO are collected in 300 mL BOD bottles, ensuring no air bubbles are trapped. In the Winkler method, the sample must be fixed immediately at the site using specific reagents. For DO meters, the probe is dipped into the water and gently moved until a stable reading is obtained (Wanek et al., 2021).

The Winkler titration method is highly accurate (±0.05 mg/L) and considered the standard method. DO meters are faster and suitable for field use but require daily calibration. Optical DO meters are more advanced, with less maintenance and suitable for continuous monitoring. At 30°C, the maximum oxygen saturation in water is about 7.5 mg/L. Healthy fish require more than 5 mg/L for normal growth. Levels between 3–5 mg/L cause stress and reduced feeding, while levels below 1 mg/L can lead to fish death within hours. CPCB recommends a minimum of 4 mg/L for fisheries (Antsiferova et al.,2023). A typical pattern in ponds is low oxygen levels in the early morning and high levels in the evening due to photosynthesis during the day and respiration at night. Constant low oxygen indicates high organic pollution or overstocking. Extremely high oxygen levels above 15 mg/L in the evening suggest severe algal blooms, which can lead to gas bubble disease and high pH. Temperature also affects oxygen levels significantly; colder water holds more oxygen than warm water. For example, at 20°C, water can hold about 9.1 mg/L, while at 35°C, it drops to around 7.0 mg/L (Kumar et al., 2026).

2.8 Biological oxygen demand (BOD)

BOD measures the amount of oxygen required by microorganisms to break down organic matter over five days. It indicates the level of biodegradable pollution in water. Samples are collected in BOD bottles without air bubbles and stored at 4°C in the dark. Testing should begin within six hours, or at most within 24 hours. If chlorine is present, it must be neutralized before testing. The test involves measuring initial dissolved oxygen, diluting the sample with oxygen-rich water, and incubating it at 20°C for five days. After incubation, the final oxygen level is measured, and BOD is calculated from the difference (Tulus et al.,2025). Clean water typically has BOD values below 2 mg/L. For fish culture, values should be below 6 mg/L. Water with BOD above 15 mg/L is considered polluted and likely to cause oxygen depletion. Low BOD (below 4 mg/L) indicates clean water, while moderate levels (5–10 mg/L) are manageable if oxygen levels remain sufficient. High BOD suggests pollution from sources like sewage, uneaten feed, or decaying algae. However, the test takes five days, and toxic substances may interfere by reducing microbial activity, leading to underestimated values (Kumar et al., 2021).

2.9 Chemical Oxygen Demand (COD)

COD measures the total amount of oxygen required to chemically oxidize both organic and some inorganic substances. Unlike BOD, it provides results within a few hours, making it useful for monitoring industrial pollution. Samples are collected in glass bottles and preserved with sulfuric acid if not analysed immediately. The test involves digesting the sample with strong oxidizing agents at high temperature, followed by titration to determine oxygen demand. In clean ponds, COD ranges from 10 to 30 mg/L. Well-managed fish ponds may have values between 30 and 70 mg/L. Values above 100 mg/L indicate pollution. CPCB allows discharge up to 250 mg/L. The ratio of BOD to COD helps assess biodegradability. A ratio above 0.6 indicates easily biodegradable waste, while values below 0.3 suggest the presence of toxic or non-biodegradable substances. High chloride or nitrite concentrations can interfere with COD results, causing overestimation (Tulus et al., 2025).

2.10 Total Dissolved Solids (TDS)

The abbreviation TDS stands for "Total Dissolved Solids," which refers to the total amount of solids dissolved in water. TDS is made up of organic material and inorganic salts like potassium, sodium, calcium, magnesium, and many more. Total Dissolved Solids (TDS) in water is an indicator of the quantity of minerals, metals, organic matter, and salts, more precisely ions like magnesium, calcium, sodium, and potassium. The presence of ions is an indicator of water quality (Nachchach et al., 2025).

2.11 Complete assessment of pond water

A proper pond assessment begins with an early morning field visit around 6 AM. At this time, parameters like dissolved oxygen, pH, temperature, and water transparency should be measured. Low oxygen combined with large pH fluctuations usually indicates algal problems. Samples should then be collected for laboratory analysis. One bottle is used for BOD, another for COD (with acid added for preservation), and a general sample for other parameters. Each sample must be labelled with date, time, depth, and location, and stored in an icebox. Laboratory analysis should be performed within six hours. BOD testing should begin on the same day, while COD can be delayed if properly preserved (Blaustein et al., 2025)

Water parameter	Optimum level
Temperature	26-32°C
Salinity	15-25 ppt
DO	>0.4 ppm
pH	7.5-8.5
Total ammonium nitrate	<0.5 ppm
Nitrite nitrogen	<0.01 ppm
BOD	<10 ppm

Figure 2: Standard parameters of water

III. CONCLUSION

Water quality assessment in ponds is not based on a single parameter but on the combined understanding of pH, dissolved oxygen, biochemical oxygen demand, and chemical oxygen demand. These parameters are deeply interconnected, and together they provide a complete picture of the pond's health, productivity, and suitability for aquatic life, pH acts as a controlling factor influences chemical reactions and biological processes in the water. Even small changes in pH can significantly affect ammonia toxicity, nutrient availability, and the overall metabolic activity of fish and microorganisms. A stable pH within the recommended range ensures a balanced aquatic environment, while large fluctuations often indicate underlying issues such as excessive algal growth or pollution. Dissolved oxygen is the most immediate indicator of life-supporting conditions in a pond. Adequate oxygen levels are essential not only for fish survival but also for beneficial microbial activity that helps break down organic waste. When oxygen levels drop, the entire ecosystem becomes stressed, leading to poor fish growth, reduced feeding, and in extreme cases, mass fish mortality. The daily fluctuation of oxygen levels, especially the difference between early morning and evening, provides valuable insight into biological activity such as photosynthesis and respiration.

Biochemical oxygen demand reflects the amount of biodegradable organic matter present in the water. It essentially indicates how much oxygen will be consumed by microorganisms as they decompose waste materials. A low BOD suggests clean water with minimal organic pollution, whereas a high BOD signals the presence of excessive organic waste, which can deplete oxygen levels and create unfavourable conditions for aquatic life. However, since this test requires several days, it is more useful for understanding long-term trends rather than immediate providing a rapid estimate of the total oxidizable matter in the water, including both biodegradable and non-biodegradable substances. This makes it particularly useful for detecting industrial pollution or toxic compounds that may not be captured by BOD analysis alone. The comparison between BOD and COD values further helps in determining the nature of pollution, whether it is easily biodegradable or resistant to biological treatment.

When these parameters are analysed together, they allow for accurate diagnosis of pond conditions. For example, a combination of low dissolved oxygen and high BOD typically points to organic pollution such as sewage inflow or excess feed. On the other hand, high pH along with large daily oxygen fluctuations is a clear sign of algal blooms. Similarly, high COD with relatively low BOD may indicate the presence of industrial or chemical contaminants. Effective pond management depends on regular monitoring, timely sampling, and correct interpretation of these parameters. Early morning measurements are especially important because they reveal the most critical stress conditions, particularly low oxygen levels. Proper sample handling and timely laboratory analysis ensure reliable results, which are essential for making informed decisions.

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