Seasonal Dynamics of Physico-Chemical Water Quality Parameters in Dumri Pond, Muzaffarpur (Bihar), India: Implications for Freshwater Ecosystem Health

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Abstract
In the present study, we examined the monthly variations several physicochemical parameters of the Dumri Pond water from January 2025 to December 2025. The parameters included temperature, pH, conductivity, transparency, turbidity, total dissolved solids, dissolved oxygen, biological oxygen demand, chemical oxygen demand, free carbon dioxide, alkalinity, total hardness, chloride, and phosphate concentration. Our finding revealed that temperature, transparency, turbidity, dissolved oxygen, chemical oxygen demand and total hardness exceeded the permissible limit for water intended for human consumption and domestic use. Overall, the results indicate a progressive deterioration in the quality of the pond water. The situation highlights the urgent need for immediate and regular monitoring of water quality for formulation of effective pollution control measures. Additionally, appropriate management interventions are necessary to prevent further ecological decline and to ensure the long-term sustainability of the pond ecosystem.

Keywords: Ecological deterioration, water quality assessment, pond restoration, water resource management, aquatic ecosystem

Introduction

Dumri pond, situated in Muzaffarpur, is a man-made perennial source of water. Nobody living around the pond knows its origin. When it was dug, the surrounding areas were barren, and it was at the outer line of Muzaffarpur city. Nowadays, the bank of the pond and its catchment area is thickly populated. The run-off water, industrial waste, domestic drainage, and detergents disposed of by the washerman are all gradually deteriorating the quality of the pond water. Even after this, the children and adults living around the pond take a bath and wash their clothes in its water. The local inhabitants generally clean their utensils. Further, waste from households and residues of worship materials are all directly dumped in the pond water. All these are causing eutrophication in the pond. One can observe water hyacinth during the rainy season and algal bloom during summer. Mass mortality of fish was reported in July 2023 (Kumar et al. 2023). All these indicated the low level of dissolved oxygen. Keeping all these observations in mind, the monthly variation in selected physicochemical parameters was studied for the entire year in 2025.

Literature survey shows that physicochemical analysis of different pond waters has been done by different workers. Some of them are mentioned here. Mahananda et al. (2005) studied physicochemical parameters of pond water to evaluate the pollution of water. Venkata Subhram and Meenabai (2007) analyzed tank water in Coimbatore. Hazare reported a limnological study of the water. Bhat et al. (2009) reported the water quality status of some urban ponds of Lucknow. Garg et al. (2010) reported that seasonal variations in water quality are major threats to the Ram Sagar reservoir. Arya et al. (2011) reported physicochemical analysis of Laxmi Tal in Jhansi. Parikh and Mankodi (2012) reported the limnology of Sama Pond of Vadodara City. Gangwar et al. (2013) studied the water quality index of the Ram Ganga River water of Bareilly. Chaudhary et al. (2014) reported physicochemical and biological analysis of three rural ponds of Sasaram in Bihar. Dixit et al. (2015) studied physicochemical parameters of different ponds at Bilaspur, Chhattisgarh. Shankar and Chaudhary (2016) analyzed pond water for its quality test at Raipur city in Chhattisgarh. Saha et al. (2017) reported physicochemical analysis of three different ponds of Nadia district, West Bengal. Bhattacharya (2018) reported a physicochemical analysis of pond water in Purva Vardhman, West Bengal. Paul et al. (2019) compared the physicochemical properties of water from different ponds in Raipur. Ara and Jamil (2020) reported physicochemical analysis of two ponds of Madhubani district.

Materials and Methods

Dumri pond is about 5 km south of Muzaffarpur city. The coordinates of the Dumri area in Muzaffarpur, Bihar are 26.107294°N and 85.358841°E. Physico-chemical parameters of Dumri pond were studied at monthly intervals from January to December in 2025. The water was collected in well-cleaned and dried jars. Parameters like temperature, pH, and transparency were determined at the pond site, while other parameters, such as conductivity, turbidity, total dissolved oxygen, biological oxygen demand (BOD), chemical oxygen demand (COD), free carbon dioxide, alkalinity, total hardness, chloride, and phosphate were analyzed in the laboratory following the methodology as

mentioned in APHA (2015). Water samples for dissolved oxygen determination were collected in a BOD bottle and tested using Winkler's method. The collected water sample was treated with 2 mL of manganese sulphate, 2 mL of alkaline iodised azide, and 2 mL of concentrated H_2SO_4. Temperature was noted with a laboratory thermometer at 100°C, pH with a digital pH meter, and conductivity with a conductivity meter, and the unit was µs/cm. The turbidity was measured with the turbidity meter in Nephelometric turbidity unit (NTU). Transparency was measured with the help of a Secchi disc, and total dissolved solids by the evaporation method. For the rest of the parameters, the trimetric method was used with different indicators. Sample water was collected between 9 am and 10 am. The plastic canes containing the sample water were labelled properly with the date and time of collection. All experiments were done in triplicate, and the mean of the data was calculated and represented by different graphs.

Results and Discussion

The present study includes data obtained through physicochemical analysis of Dumri pond water using different parameters:

Dissolved Oxygen

Free oxygen released during photosynthesis by the aquatic plants and absorbed from the atmosphere is called dissolved oxygen. The solubility of oxygen depends on the temperature of the water. If the temperature of water is very high, the solubility of Oxygen becomes very low. The concentration of oxygen limit is 4.0 mg/L to 5.0 mg/L, below which the water becomes hypoxic, which may cause stress and mass mortality among fish. In the present study, the monthly variation in dissolved oxygen of Dumri pond was studied. The dissolved Oxygen of Dumri pond water ranged between 4.36 mg/L and 8.92 mg/L from January 2025 to December 2025 (Fig. 1A). The lowest value was noted in June, while the highest was in January. This may be due to a change in the temperature of the pond. The present findings are in accordance with the findings of Bist et al. (2013), Sajitha et al. (2016), and Bhagde et al. (2020), respectively.

Biological Oxygen Demand

In water bodies, there are different organic matters and several aerobic bacteria. These bacteria degrade the organic matter and need a considerable amount of dissolved oxygen for aerobic oxidation. The amount of dissolved oxygen needed for such oxidation is called Biological Oxygen Demand (BOD). The value of BOD indicates the amount of organic material as pollutants in the aquatic ecosystem. The BOD of Dumri pond water was studied from January to December 2025. It was noted that the value of BOD varied from 20.62 mg/L to 38.18 mg/L (Fig. 1A). This clearly indicated maximum death and decay of aquatic flora and fauna during summer, due to which the value of BOD was very high. The low value of BOD indicates a lower concentration of organic matter in the pond water. Similar findings were reported by Parikh et al. (2012), Bhattacharya (2018), Sarkar et al. (2020), and Kumar et al. (2021), respectively.

Free Carbon dioxide (CO_2)

Free carbon dioxide is absorbed in water from the air. It is released during respiration of aquatic flora and fauna, and during decomposition of aquatic organic matter, etc. (Abir, 2014). In the present study, free CO_2 was determined from January to December 2025. The values ranged between 3.2 mg/L and 8.5 mg/L. The lowest values were recorded in August, and the highest ones in November. The present value is similar to the data presented by Goswami et al. (2017), Bhattacharya (2018), and Dey et al. (2021). Free CO_2 is utilized by the submerged plants for photosynthesis.

Chemical Oxygen Demand

Organic and Inorganic pollutants in the water bodies are also oxidized chemically, which requires free oxygen. The amount of dissolved oxygen required for this chemical reaction is called chemical oxygen demand. The value of chemical oxygen demand indicates the concentration of organic and inorganic matter responsible for it. A depth between 30 and 45 cm is permissible for aquatic organisms. The transparency of Dumri pond water ranged between 1.20 cm and 50.28 cm in different months of the study year (Fig. 1F). The lowest transparency may be due to runoff of rainwater, which carries different particles along with it. It is proposed that dissolved organic matter absorbs UV light that can harm the aquatic flora and fauna. It also disturbs the visibility of the prey and the predator. Less light can influence the productivity of the aquatic ecosystem. The above findings are in accordance with the findings of Bisht et al. (2013), Dixit et al. (2015), and Mukherjee et al. (2022).

Alkalinity

The alkalinity of pond water acts as a buffer and thus protects the aquatic flora and fauna from sudden fluctuations in the pH of the pond water or aquatic ecosystems. The alkalinity of pond water was studied from January to December 2025. The value ranged between 88.0 mg/L and 156.0 mg/L throughout the year (Fig. 1B). The permissible range is between 50 mg/L and 150 mg/L. Therefore, the alkalinity was within the range throughout the year except in March and April. Shabana and Kumari (2026) reported that in one of the urban ponds, the alkalinity was 323.20 mg/L. However, the present findings corroborate the findings of Bhattacharya (2018).

Chloride concentration

The source of chloride is the fertilizers used in the nearby lands and septic tank leakage. Use of bleaching powder in the water tank and release of such water in drainage also adds chloride to the pond water. Even animal wastes from

the nearby farms can add chloride to the pond water. In the present study, the concentration of chloride was analyzed from January to December 2025. It can be noted from the table that the amount of chloride ranged between 84.0 mg /L to 168.0 mg/L (Fig. 1B). It may be noted that, except for a few months of the year, the concentration of chloride was higher than the permissible limits, that is, 100mg/L. This higher concentration of chloride would reduce the dissolved oxygen content of the pond water; this would harm the aquatic life. Sajitha et al. (2016) reported a higher limit of 250 mg/L. The above findings are similar to the findings of Sajitha et al. (2016), Kumar et al. (2021), and Bhargavi and Aruna (2023).

Total dissolved Solids

Small fragments of matter may be organic or inorganic, mineral soil particles, and all are considered dissolved solids. Dissolved solids differ in size from the suspended solids. They are thus mainly dissolved anions and cations such as calcium, magnesium, potassium, sodium, sulphate, chloride, carbonates, and bicarbonates, etc. Salinity is a good indicator of dissolved solids. It can cause osmotic stress, toxicity and breeding failure among fish. It can reduce dissolved oxygen and decrease the rate of Photosynthesis and therefore affects the productivity of an aquatic ecosystem. The TDS ranged between 354.48 mg/L and 589.65 mg/L (Fig. 1C). The lower value was found in November, which may be due to heavy rainfall and dilution, while the higher value was noted in June. It may be due to a reduction in water and an increase in the Concentration of TDS.

Total Hardness

It is the measure of divalent ions in the water, such as Calcium and Magnesium. Their carbonates are the common cause of hardness. Hard water can inhibit the growth of certain algae and aquatic plants. It can also limit the growth of plankton. All this affects the aquatic ecosystem and food chain. It also reduces the pH of the water. The mineral reacts with the soap to form a sticky layer called scum. Both fish and plants are affected by hard water. The optimum limit for it is (75 – 150) mg/L. However, exceeding 300 mg/L is lethal for the fish. In the present study, the hardness of Dumri pond water ranged between 505.0 mg/L and 656.0 mg/L from January to December 2025 (Fig. 1C). As the permissible limit of pond water hardness, the pond water hardness was found to be higher. This may reduce the photosynthetic capability. The runoff rainwater from the surrounding fields and areas may be the cause of this hardness. The above findings are supported by Goswami et al. (2017), Paul et al. (2019), Ara and Jamil (2020), Kumar et al. (2021), Mukherjee et al. (2022), Bhargavi and Aruna (2023), and Shabana and Kumari (2026), respectively. Hardness of the pond water may also cause different problems.

Conductivity

Conductivity of pond water indicates the presence of ions of different salts in the form of cations (potassium, calcium, magnesium, and sodium, etc.) and anions (Sulphate, chloride, and bicarbonate, etc.). The value of conductivity directly depends on the concentration of these cations and anions. Electrical conductivity is a useful tool to evaluate the purity of water (Sajitha et al. 2016). The source of electrical conductivity may be the concentration of dissolved salts due to poor irrigation management, minerals from rainwater or other discharges of wastewater. The conductivity of Dumri pond water ranged between 542.6 µs/cm and 756.7 µs/cm (Fig. 1D). However, the desirable limit of electrical conductivity of drinking water has been prescribed as 1500. Shrivastava and Kanungo (2013), Chaudhary et al. (2014), and Swanker and Chaudhary also reported the same in different pond waters. Electric Conductivity indicates salinity and concentration of dissolved solids. Here, dissolved ions like Calcium and Magnesium are essential for the growth of Flora and Fauna. But a higher concentration of these cations indicates a polluted condition of the pond water. So, its regular evaluation is important.

Temperature

The temperature of pond water depends on the temperature of the air. It is one of the important physical parameters. In the present study, the temperature of the pond water ranged between 10.5 °C and 34.60 °C from January to December 2025 (Fig. 1E). From June to December, there is a gradual decrease in the temperature because of the rainy and winter seasons. High water temperatures reduce the solubility of atmospheric oxygen, resulting in a lower concentration of dissolved oxygen in June. In addition, high temperatures also influence other physiological processes of the aquatic organism. The above findings are also in agreement with the findings of Chaudhary et al. (2014) and Sajitha et al. (2016), respectively.

Transparency

It indicates the depth of water up to which Sunlight can reach in the water. The presence of inorganic and organic matter influences the entry of light inside water. Concentrations of dissolved and suspended matter are responsible for it. A depth between (30 – 45) cm is permissible for aquatic organisms. The transparency of Dumri pond water ranged between (1.20 - 50.28) cm in different months of the study year (Fig. 1F). The lowest transparency may be due to runoff of rainwater, which carries different particles along with it. It is proposed that dissolved organic matter absorbs UV light that can harm the aquatic flora and fauna. It also disturbs the visibility of prey and predators. Less light can influence the productivity of the aquatic ecosystem. The above findings are in accordance with the findings of Bisht et al. (2013), Dixit et al. (2015), and Mukherjee et al. (2022).

Phosphate concentration

Phosphate concentration is another important parameter of the chemical analysis of pond water. The sources of phosphate in pond water are the degradation of dead fish and other aquatic animals, debris of plants and runoff rainwater carrying residues of chemical fertilizers. The concentration of phosphate is responsible for the algal bloom in the pond water. The concentration of phosphate ranged between 0.38 mg/L and 0.78 mg/L from January to December (Fig. 1G). The higher concentration was found in June, which was most likely caused by the evaporation of water. Phosphate is essential for aquatic organisms, but higher concentrations may cause eutrophication. The above findings are supported by Pandey and Chandra (2016), Bhattacharya (2018), Bhargavi and Aruna (2023), and Shabana and Kumari (2026).

Turbidity

The amount of light blocked by suspended particles of the water body was studied. Cloudy water can be easily seen due to suspended particles during the rainy season. It may be due to deposition of clay and soil particles along with runoff water. Organic and inorganic matter, along with an excess amount of nutrients and phosphates, can cause turbidity. On one hand, it blocks the entry of sunlight; on the other hand, it lowers the concentration of dissolved oxygen. Both of these can influence aquatic life. The turbidity of Dumri pond water ranged between 34.60 NTU and 68.16 NTU from January to December 2025 (Fig. 1H). The permissible value for turbidity is 20-50 NTU. In this respect, the turbidity of Dumri pond is high. Higher turbidity may be caused by plankton and an algal bloom. Excessive turbidity is caused by soil particles and salt, which may damage the pond ecosystem. The above findings are in accordance with the findings of Paul et al. (2019).

pH

pH of pond water refers to its hydrogen ion activity, and is expressed as the logarithm of the reciprocal of the hydrogen ion activity at a given temperature. (Sajitha et al. 2016). The pH of Dumri pond water ranged between 7.4 and 8.9 from January to December (Fig. 1H). The lowest value was noted in January, and the highest one in June. As per the Bureau of Indian Standards (BIS), the permissible range of drinking water is 6.5 to 8.5. The pH of the water body depends on the presence of free CO_2. During summer, most of the dissolved CO_2 is used by aquatic plants and algae, while it is used in less amount during winter due to slow photosynthesis. pH also influences different enzymatic activities. The above findings are parallel with the findings of Gupta et al. (2011).

Conclusions and Recommendations

In the present study, most of the physicochemical parameters were within the acceptable limits. However, temperature, turbidity, dissolved oxygen, chemical oxygen demand (COD), and total hardness exceeded the permissible limits. Elevated turbidity reduces light penetration and adversely affects the growth and abundance of phytoplankton and zooplankton. Excessively high dissolved oxygen causes supersaturation of the water body, increasing the risk of gas bubble disease in fish. High COD is an indicator of high organic load in water, reflecting increased pollution from organic matter and deteriorating water quality. Field observations revealed that domestic solid waste was frequently dumped into the pond by residents. Additionally, surface runoff during the rainy season carried animal farm wastes into the pond, further degrading its quality. These conditions may accelerate eutrophication, which adversely affects the aquatic ecosystem and renders the pond water unsuitable for household use. Therefore, regular monitoring of pond water is strongly recommended. Public awareness programmes should be undertaken to discourage the disposal of domestic solid and liquid waste in the pond. Appropriate measures should be taken to control the inflow of contaminated runoff from animal farms during the rainy season and otherwise.

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Conflict of Interest

There is no conflict in the publication of this paper.

References

1. Abir, S. (2014) 'Seasonal variations in physico-chemical characteristics of Rudrasagar wetland, a Ramsar site, Tripura, N.E., India', *Research Journal of Chemical Sciences*, 4(1), pp. 31–40.
2. American Public Health Association (APHA) (2005) *Standard Methods for the Examination of Water and Wastewater*. 21st edn. Washington, DC: American Public Health Association.
3. Ara, N. and Jamil, S. (2020) 'Analysis of selected physico-chemical parameters of two ponds of Madhubani', *Indian Journal of Scientific Research*, 10(2), pp. 85–91.
4. Arya, S., Kumar, V., Rajkumar, M. and Dhaka, A. (2011) 'Physico-chemical analysis of selected surface water of Laxmi Tal (Pond) in Jhansi City, Uttar Pradesh, Bundelkhand Region', *Journal of Experimental Life Sciences*, 2(8), pp. 1–6.
5. Bhagde, R.V., Pingle, M.R., Bhoye, S.S., Pansambal, S. and Deshmukh, D.R. (2020) 'A comparative study of physico-chemical parameters of pond water from Sangamner Taluka of Ahmadnagar, India', *International Journal of Biological Innovations*, 2(2), pp. 137–142.

6. Bhargavi, R. and Aruna, M. (2023) 'Analysis of physico-chemical parameters of a freshwater lake in Nizamabad District, Telangana State, India', *World Journal of Biology Pharmacy and Health Sciences*, 16(1), pp. 21–30.
7. Bhat, M.M., Yazdani, T., Narain, K., Yameen, M. and Shukla, R.N. (2009) 'Water quality status of some urban ponds of Lucknow, Uttar Pradesh', *Journal of Wetland Ecology*, 2, pp. 67–73.
8. Ghosh,B.B(Nee). (2018) 'Physico-chemical analysis of pond water in Purba Bardhaman, West Bengal, India', *International Research Journal of Environmental Sciences*, 7(2), pp. 54–59.
9. Bisht, A.S., Ali, G., Rawat, D.S. and Pandey, N.N. (2013) 'Physico-chemical behaviour of three different water bodies', *Journal of Ecology and the Natural Environment*, 5, pp. 387–395.
10. Bureau of Indian Standards (2012) *Indian Standard: Drinking Water Specification (IS 10500:2012)*. New Delhi: Bureau of Indian Standards.
11. Chaudhary, P., Dhakad, N.K. and Jain, R. (2019) 'Studies of physico-chemical parameters of Bilawali Pond (Tank), Indore, Madhya Pradesh, India', *Journal of Environmental Science, Toxicology and Food Technology*, 8(1), pp. 37–40.
12. Chaudhary, J., Singh, S.N. and Singh, S. (2014) 'Physico-chemical and biological parameters of three rural ponds of Sasaram, Bihar', *International Journal of Applied Science and Biotechnology*, 2(1), pp. 206–210.
13. Dey, S.S., Botta, R., Kallam, A., Angdal, R. and Andugala, J. (2021) 'Seasonal variations in water quality parameters of Gudlavalleru Engineering College pond', *Current Research in Green and Sustainable Chemistry*, 10, pp. 1016–1024.
14. Dixit, A.K., Pandey, S.K., Mehta, R., Ahmad, N.G. and Pandey, J. (2015) 'Study of physico-chemical parameters of different pond waters of Bilaspur District, Chhattisgarh, India', *Environmental Skeptics and Critics*, 4(3), pp. 89–95.
15. Gang, R.K., Rao, R.J., Venchariya, D., Shukla, G. and Saksena, D.N. (2010) 'Seasonal variations in water quality are major threats to Ramsagar Reservoir, India', *African Journal of Environmental Science and Technology*, 2, pp. 61–76.
16. Gangwar, R.K., Singh, J., Singh, A.P. and Singh, D.P. (2013) 'Assessment of Water Quality Index: A case study of River Ramganga, Bareilly, Uttar Pradesh, India', *International Journal of Scientific and Engineering Research*, 4(9), pp. 2325–2329.
17. Goswami, S.N., Trivedi, R.K., Saha, S. and Mandal, A.J. (2017) 'Seasonal variations of water characteristics in three urban ponds with different management practices at Kolkata, West Bengal, India', *International Journal of Entomology and Zoology Studies*, 5(6), pp. 149–154.
18. Gupta, A., Mishra, K.K., Kumar, P., Singh, C. and Srivastava, S. (2011) 'Impact of religious activities on the water characteristics of prominent ponds at Varanasi, Uttar Pradesh, India', *Plant Archives*, 11(1), pp. 297–300.
19. Hajare, M.S. (2008) 'Limnological studies of the perennial water body Attigre Tank, Kolhapur, Maharashtra', *Nature Environment and Pollution Technology*, 7(1), pp. 43–52.
20. Kumar, R., Ayush, M. and Kumar, S. (2023) 'Study of physico-chemical parameters and pond water quality analysis at Panipat, Haryana, India', *World Journal of Pharmaceutical Research*, 12(9), pp. 1020–1030.
21. Kumar, S., Jain, V. and Raghuvanshi, S.K. (2021) 'Physico-chemical characteristics of Akshar Vihar Pond in Bareilly, Uttar Pradesh, India', *International Journal of Advanced Research in Biological Sciences*, 8(3), pp. 30–36.
22. Mahananda, H.B., Mahananda, M.R. and Mohanty, B.P. (2005) 'Study on the physico-chemical and biological parameters of a freshwater pond ecosystem as an indicator of water pollution', *Ecology, Environment and Conservation*, 11(3–4), pp. 537–541.
23. Mukherjee, P., Kumar, P., Gupta, S.K. and Kumar, R. (2022) 'Seasonal variations in physico-chemical parameters and suitability for various uses of Bouli Pond water, Jharkhand', *Water Science*, 36(1), pp. 125–135.
24. Parikh, A.N. and Mankodi, P.C. (2012) 'Limnology of Sauna Pond, Vadodara City, Gujarat', *Journal of Environmental Science*, 5, pp. 1424–1436.
25. Paul, J.S., Beliya, E., Tiwari, S., Gupta, N., Verma, D. and Yadav, S.K. (2019) 'Comparative studies of physico-chemical properties of water from various ponds in Raipur', *New Bio World*, 1(2), pp. 23–27.
26. Radhika, S.A. (2022) 'Physico-chemical parameters of pond waters from Sankarankovil Oorkulam and Seevalaraya Pond, Tenkasi District, Tamil Nadu, India', *International Journal of Current Science*, 12(1), pp. 125–130.
27. Saha, S., Mandal, A. and Sahoo, D. (2017) 'Study of physico-chemical parameters of three different urban ponds of Nadia District, West Bengal, India', *International Journal of Fisheries and Aquatic Studies*, 5(6), pp. 23–27.
28. Sajitha, V. and Smitha Ashok Vijayamma (2016) 'Study of physico-chemical parameters and pond water quality assessment using Water Quality Index at Athiyannoor Panchayath, Kerala, India', *Emergent Life Sciences Research*, 2(1), pp. 46–51.
29. Sarkar, R., Ghosh, A.R. and Mondal, N.K. (2020) 'Comparative study on physico-chemical status and diversity of macrophytes and zooplanktons of two urban ponds of Chandannagar, West Bengal, India', *Applied Water Science*, 10(2), pp. 1–8.
30. Shabana Begum and Kumari, N. (2026) 'A comparative study of physico-chemical parameters of urban and rural pond water at Muzaffarpur to assess the pollution load of these ponds', *Journal of Emerging Technologies and Innovative Research*, 13(6), pp. 73–79.
31. Srivastava, S. and Kanungo, V.K. (2013) 'Physico-chemical analysis of pond water of Surguja District, Chhattisgarh, India', *International Journal of Herbal Medicine*, 1(4), pp. 35–43.
32. Swankar, A.K. and Chaudhary, S. (2016) 'Testing and analysis of pond water in Raipur City, Chhattisgarh, India', *International Journal of Science and Research*, 5, pp. 1962–1965.
33. Tiwari, S. (2015) 'Water quality parameters: A review', *International Journal of Engineering Science Invention Research and Development*, 1, pp. 319–324.

34. Venkatasubramani, R. and Meenambal, T. (2007) 'Study on subsurface water quality in Mettupalayam Tank of Coimbatore District, Tamil Nadu', *Nature Environment and Pollution Technology*, 6(2), pp. 307–310.

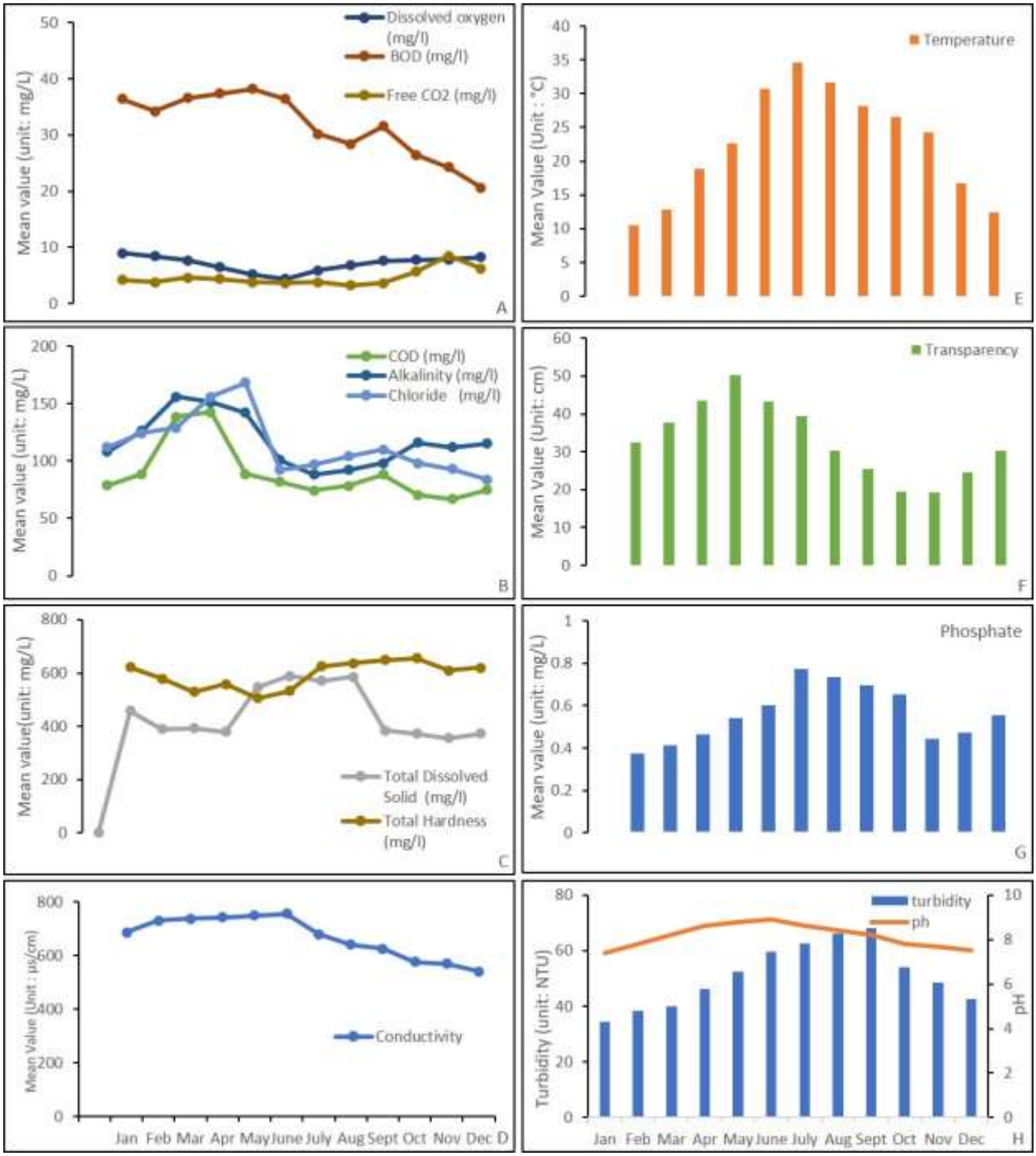

Figure 1. Monthly fluctuations in the physicochemical characteristics of Dumri Pond water during the study period (January–December 2025): (A) dissolved oxygen (DO), biological oxygen demand (BOD), and free CO_2; (B) chemical oxygen demand (COD), alkalinity, and chloride; (C) total dissolved solids (TDS) and total hardness; (D) electrical conductivity; (E) temperature; (F) transparency; (G) phosphate concentration; and (H) turbidity and pH.