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# Assessment of quarterly variations in Oxygen demanding parameters (DO and COD) in Nandan Pahar Pond, Deoghar, Jharkhand, India.

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**Abstract:-**

Freshwater ecosystems play a crucial role in maintaining ecological balance and supporting human livelihoods. Among various water quality indicators, dissolved oxygen (DO) and chemical oxygen demand (COD) serve as key parameters reflecting the biological health and organic pollution status of aquatic systems. The present investigation assessed quarterly variations in oxygen-demanding parameters**,** specifically **Dissolved Oxygen (DO)** and **Chemical Oxygen Demand (COD)**, in**NandanPahar Pond**, a semi urban pond located at Deoghar district, Jharkhand, over four successive seasons from **July 2024 to April 2025**. The observed DO values ranged from **5.15–6.80 mg/L**, while COD varied between **9.8–39.6 mg/L**, indicating moderate organic loading with seasonal fluctuations. Higher DO concentrations were recorded during winter, whereas elevated COD values were observed during the monsoon season due to surface runoff and organic influx. The inverse relationship between DO and COD highlights biological oxidation processes and seasonal biogeochemical dynamics. Systematic water sampling and analysis following standard methods (APHA, 2017) revealed dynamic seasonal fluctuations in both DO and COD, reflecting the influence of **hydro-meteorological cycles and organic matter load**. The monthly data indicate that DO concentration was highest during **January 2025 (6.8 mg/L)**and lowest in**October 2024 (5.70 mg/L)**, illustrating a clear inverse relationship with temperature and supporting patterns observed in similar pond studies where DO peaks in cooler seasons due to enhanced solubility and reduced biological oxygen demand (e.g., studies in Kerala pond systems. Conversely, COD values exhibited a **marked decline**from **39.6 mg/L in July 2024 to 9.8 mg/L in April 2025**, indicating lower organic pollutant load in later seasons, possibly due to natural attenuation and reduced runoff inputs during dry periods. These results align with findings in freshwater reservoirs where seasonal changes significantly affect COD distribution.

Statistical examination using appropriate seasonal analysis confirmed significant temporal variability in both oxygen-demand parameters. Elevated COD in the monsoon quarter underscores the input ofallochthonous organic matter from surface runoff and increased biological activity, while relatively higher DO in winter reflects favorable aeration and reduced

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biochemical consumption processes. The contrasting patterns of DO and COD highlight the **interplay between physical conditions and biochemical oxygen demand**, crucial for understanding the ecological health of shallow pond ecosystems. These seasonal trends emphasize the need for continuous water quality monitoring to inform sustainable management strategies, particularly in semi-urban ponds influenced by both natural and anthropogenic factors. The findings suggest that NandanPahar Pond remains moderately impacted but ecologically stable, requiring continuous monitoring to prevent future degradation. This study contributes baseline information essential for sustainable freshwater management and environmental conservation planning in the region.

**Keywords:** Dissolved Oxygen, Chemical Oxygen Demand, Seasonal Variation, Freshwater Ecology, NandanPahar Pond, Water Quality Assessment.

**Introduction:**

Freshwater resources constitute one of the most vital natural assets for ecological stability, biodiversity conservation, and human survival. Water makes up around 70% of the Earth's surface, with 97.5% of it being salty and 2.5% being fresh. Of this 2.5%, less than 1% is accessible (Mishra 2023).Small freshwater bodies such as ponds and lakes play a significant role in groundwater recharge, nutrient cycling, and supporting aquatic biodiversity. However, increasing anthropogenic pressures—urbanization, agricultural runoff, domestic waste discharge, and climatic variability—pose serious threats to the ecological integrity of such water bodies. Leachates from waste dumps, partially treated or untreated wastewater, pollution from human settlements without proper sanitary infrastructure, and pollution from land use activities like agriculture are the key sources of ground water pollution in less industrialized areas, Sale et al.,(2019). Among the various physico-chemical parameters used for evaluating water quality, **dissolved oxygen (DO)**and**chemical oxygen demand (COD)**are considered critical indicators of aquatic health. DO reflects the amount of oxygen available for aquatic organisms, whereas COD indicates the concentration of oxidizable organic and inorganic matter present in water. It can determine the level of water contamination based on the lack of oxygen in the water and also can indicate the increased use of oxygen by organic substances in the water, Cantor (2009).Variations in these parameters directly influence metabolic processes, biodiversity, and trophic interactions within aquatic ecosystems.Algal vegetation adds green color to water, but water with too many slits appears brown. The presence of organic debris and iron causes the water to turn yellow, Nayar(2020). In the Indian state of Rajasthan, Mahesh Kumar and G. V. Mishra et al. (2024) investigated the causes and effects of water pollution on a variety of water bodies.Researchers like Verma et al. (2025) , Sharma P. et. al., (2025) etc., have also done research on Physicochemical parameters and Limnology of water bodies. NandanPahar Pond, located in Deoghar district of Jharkhand, is a culturally and ecologically important freshwater body exposed to seasonal climatic fluctuations and moderate anthropogenic pressure. Despite its significance, systematic scientific studies evaluating its oxygen-demanding parameters remain limited. Therefore, the present investigation aims to assess seasonal changes in DO and COD and interpret their ecological implications.

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**Study Area:**

NandanPahar Pond is situated in Deoghar district, Jharkhand, characterized by a subtropical monsoon climate. The region experiences hot summers, a monsoon season with moderate to heavy rainfall, and relatively cooler winters. The pond receives water from precipitation, surface runoff, and limited anthropogenic discharge from nearby settlements and recreational activities.The hydrological regime and shallow depth make the pond sensitive to seasonal changes, influencing temperature, oxygen solubility, and organic matter decomposition.

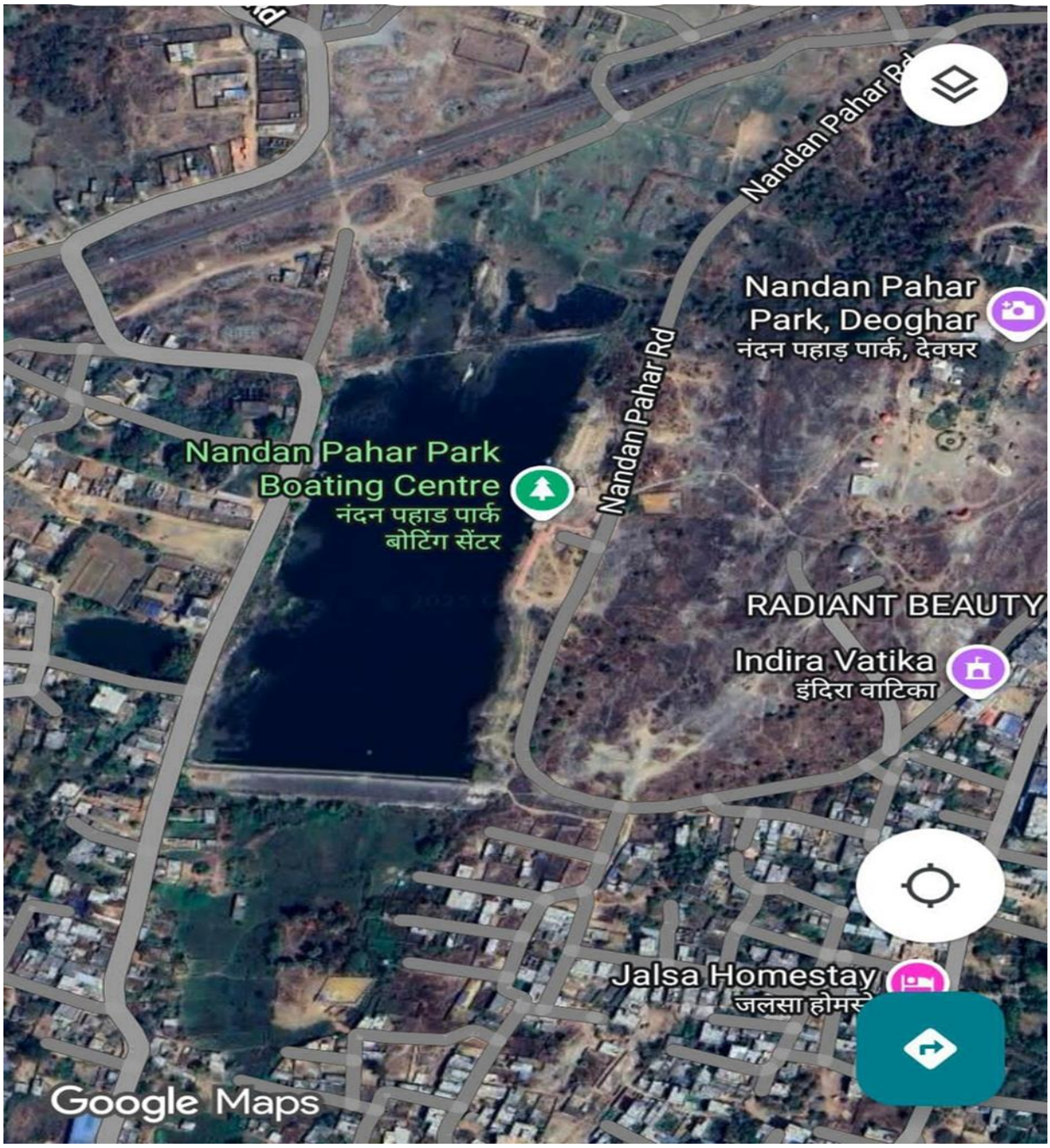


**Fig1: Google Map view of Nandanpahar Pond, Deoghar, Jharkhand, India.**

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**Materials and Methods:**

**Sampling Design**

Water samples were collected quarterly representing four seasons -**July 2024 (Monsoon), October 2024 (Post-monsoon), January 2025 (Winter) and April 2025 (Pre-monsoon).**Sampling was carried out during morning hours using clean, sterilized polyethylene bottles following standard sampling protocols.

**Analytical Methods**

**Table-1: Process of measurement of oxygen demanding parameters -**

| Sl No | Parameters | Method follow (APHA, 2017, 23RD Edition |
|---|---|---|
| 1. | DO (mg/L) | 4500-O-C :Oxygen (Dissolved) Determination By Azide Modification Of Winkler Method |
| 2. | COD (mg/L) | 5220-b :Chemical Oxygen Demand (COD) Determination By Open Reflux Method |

All analyses were performed in triplicate to ensure accuracy and reproducibility.Research was conducted at CSIR Institute, Durgapur recognised by West Bengal pollution control board.

**Results**

**Table 2: Quarterly variation of oxygen demanding properties of Nandanpahar Pond from July – 2024 to April – 2025.**

| Parameters | Units | Jul-24 | Oct-24 | Jan-25 | Apr-25 |
|---|---|---|---|---|---|
| DO | mg/L | 5.8 | 5.70 | 6.8 | 5.15 |
| COD | mg/L | 39.6 | 15 | 9.72 | 9.8 |

DO concentrations remained within permissible limits for freshwater ecosystems, with maximum values recorded during winter due to lower temperatures and enhanced oxygen solubility.COD showed a clear declining trend from monsoon to winter and pre-monsoon periods, indicating dilution effects and reduced organic load during dry seasons.However, most of the values obtained for the physico-chemical parameters fell within the prescribed limit for tropical water bodies (McCaffrey, 2018)

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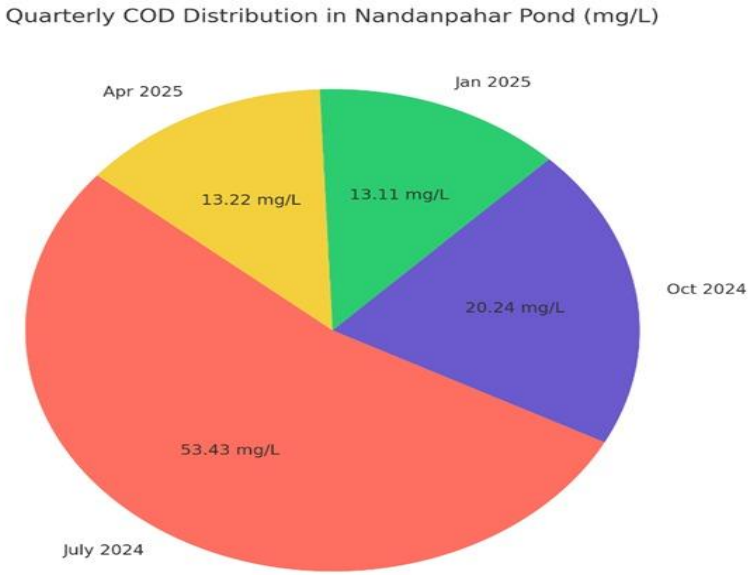


Fig. 2. Pie Chart Showing Quarterly COD distribution in Nandanpahar pond, Deoghar, Jharkhand

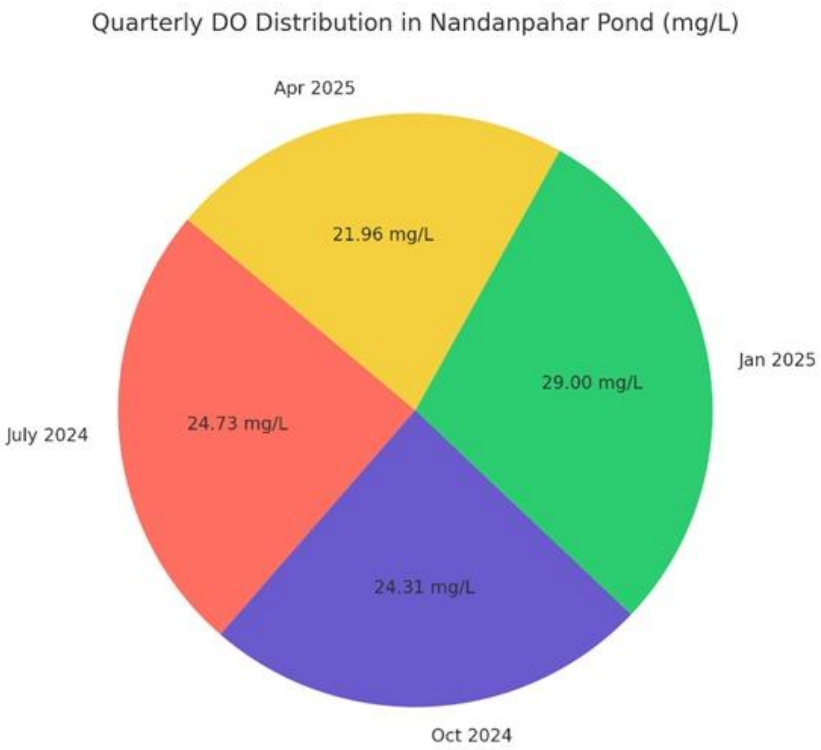


Fig. 3. Pie Chart Showing Quarterly DO distribution in Nandanpahar pond, Deoghar, Jharkhand.

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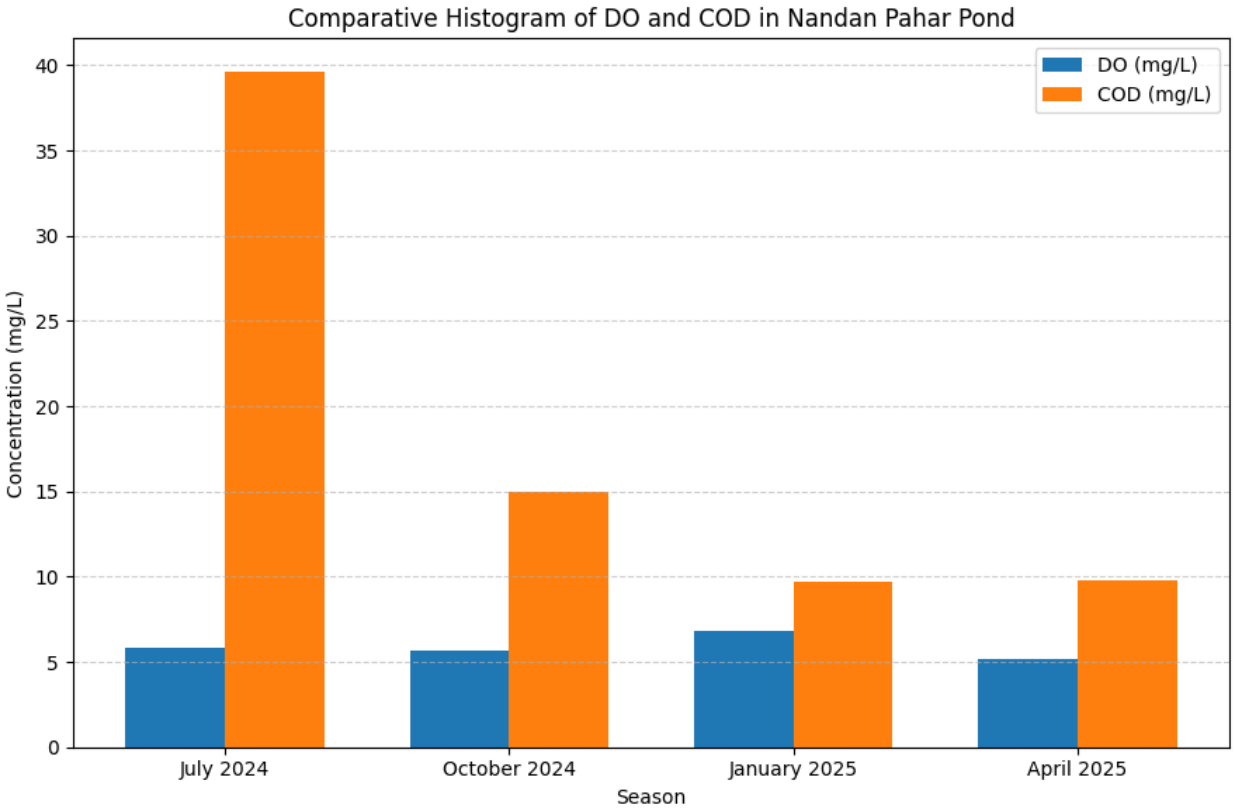


**Fig.4. Quarterly comparative Histogram bar graph of DO and COD in Nandanpahar pond, Deoghar, Jharkhand, India.**

**Discussion:-**

The DO concentration exhibited noticeable seasonal variation, with the highest value during winter (6.8 mg/L) and lowest during pre-monsoon (5.15 mg/L). This pattern aligns with temperature-dependent oxygen solubility, where cooler conditions enhance oxygen retention in water.DO was recorded as adequate generally above 4.0 in the present assessment, which is suitable for fish culture as a similar study reported in Panchobhvillage,Darbhanga district (Rani, 2019). The chief oxygen producers in ponds are phytoplanktons and aquatic plants. Temperatures are usually high during the pre monsoon season (May) allowing plants to synthesize oxygen through photosynthesis and release it into the Pond's water. The dynamic oxygen cycle of ponds has a higher DO during the day since phytoplanktons performs photosynthesis and respiration, Baxa et al., (2021). As a result of increased energy expenditure when feeding fish and swim the oxygen demand increases it is also known as specific dynamic action, McGaw and Whiteley, (2012).Additionally, reduced microbial activity during winter contributes to higher DO levels.The relatively stable DO values throughout the year indicate moderate ecological stability, supporting aerobic aquatic life. Temperature plays an important role in determining the DO in the water. The amount of oxygen that the water can hold depends on the temperature of the salinity and the water flow pressure, Kale (2016).The higher the DO valuethe betterthe quality of the water. On the other hand, the lower the value of DO obtained

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then the lower the water quality will be, Arief(2017).Since we know that oxygen has a direct effect on feed intake metabolism and disease resistance, maintaining proper DO levels in the water is important for adequate production of fish (Begum,Mondal, Ferdous, Zafar and Ali, 2014 ). A sub- optimal level was very traumatic for fish and shrimp (Qian et al., 2012), so it is important to keep DO levels at optimum of above 4.0 ppm.Comparable seasonal trends have been reported in freshwater ponds across eastern India. Satya et al. (2018) investigated the physicochemical, and bacteriological characteristics of Ganga water in Patna, India. His findings revealed that untreated sewage is having a growing impact on the Ganga.Chemical oxygen demand is a test performed to determine the rate of oxygen consumption in water for the process of oxidising a solution that can dissolve in water and also oxidizing the particles or combinations of more than one particle called particulateJaffar A. et al.,(2020).Compared to BOD tests that take up to 5 days or more, COD tests take between two and three hoursTintometer(2015) and Ghalimath (2025).Like the BOD parameter, COD can provide an index to see the effects of discharges on the environment, Li.J et al. ,(2018) .COD values were highest during the monsoon (39.6 mg/L), reflecting increased runoff carrying organic debris, soil particles, and biodegradable matter into the pond. A marked decrease during winter and pre-monsoon seasons suggests natural self-purification processes, sedimentation, and reduced external input.The inverse relationship between DO and COD observed in the present study indicates enhanced microbial oxidation of organic matter during warmer and wetter periods, which consumes dissolved oxygen.Chemical Oxygen Demand is the oxygen content of a sample that is equal to amount of organic matter that strong chemical oxidants like potassium dichromate aur potassium permanganate may oxidise,Torrejon et al.(2023).

An inverse correlation between DO and COD was evident throughout the study period. Higher COD values during monsoon months corresponded with relatively lower DO, indicating increased microbial respiration. Conversely, lower COD during winter resulted in higher DO levels. Such interactions are widely reported in lentic ecosystems and serve as reliable indicators of water quality status.. For survival, fish require 3-5 mg/L of DO. Direct and indirect information, such as bacterial activity, photosynthesis, nutrient availability, stratification, etc., are provided by its association with water bodies, Halim et al.,(2018).

The observed DO and COD ranges in NandanPahar Pond are comparable with studies conducted in freshwater ponds of Jharkhand, West Bengal, and central India. Previous studies by reported DO ranges of 4.5–7.2 mg/L and COD values between 10–45 mg/L in semi-urban ponds, supporting the present findings.

Moderate DO levels support fish survival and microbial balance, while elevated COD during monsoon suggests periodic organic stress. Although current levels do not indicate severe pollution, continued anthropogenic activities could elevate organic loading over time. Preventive management is therefore essential to maintain ecological integrity.

**Conclusion and Recommendations:-**

The present study demonstrates clear seasonal variation in oxygen-demanding parameters of NandanPahar Pond. Dissolved oxygen remained within acceptable ecological

limits, while COD exhibited seasonal enrichment during monsoon months. The results indicate that the pond is moderately impacted but not critically polluted. Continuous monitoring, controlled anthropogenic activity, and sustainable watershed management are essential to preserve water quality and ecological stability. Sharma and Kumar (2025) suggested thatanthropogenic activity in freshwater ponds can trigger eutrophication a process where increased nutrients promote the growth of algae and other microorganisms. As these microorganisms decompose they consume oxygen leading to low DO levels. The microbial breakdown of organic matter consumes Oxygen and this process could lead to A reduction in COD overtime. A reduction in COD suggest that the organic pollution in the water decreases. A study on the physical and chemical characteristics of wastewater effluents from industrial regions in Jaipur, Rajasthan, India, was conducted by Dhingra, P. Singh, et al. in 2015. and his findings showed that, if waste water from industrial areas is dumped directly into the ground, its temperature may have an impact on the texture of the soil .Regular seasonal monitoring of DO and COD should be implemented.Control of surface runoff and organic waste inflow is necessary during monsoon.Public awareness programs should be initiated to prevent dumping of waste.Long-term ecological assessment including biological indicators is recommended.

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**Competing interests:-**

Authors have declared that no competing interests exist.

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**References:-**

- Aguilar-Torrejón, J.A., Balderas-Hernández, P., Roa-Morales, G., Barrera-Díaz, C.E., Rodríguez-Torres, I. and Torres-Blancas, T., 2023. Relationship, importance, and development of analytical techniques: COD, BOD, and, TOC in water—An overview through time. SN Applied Sciences, 5(4), p.118.
- APHA (2017). *Standard Methods for the Examination of Water and Wastewater*. 23rd Ed. American Public Health Association, Washington, DC.
- Baxa, M., Musil, M., Kummel, M., Hanzlík, P., Tesařová, B., &Pechar, L. (2021). Dissolved oxygen deficits in a shallow eutrophic aquatic ecosystem (fishpond)– Sediment oxygen demand and water column respiration alternately drive the oxygen regime. Science of the Total Environment, 766, 142647. doi:10.1016/j.scitotenv.2020. 142647
- Begum, A., Mondal, S., Ferdous, Z., Zafar, M. A., & Ali, M. M. (2014). Impact of water quality parameters on monosex tilapia (Oreochromisniloticus) production under pond condition. International Journal Animal Fish Science, 2(1), 14–21.
- Cantor, "Water Quality Parameters," Water Distrib. Syst. Monit., ,pp. 113–128, 2009

- Dhingra, P., Singh, Y., Kumar, M., Nagar, H., Singh, K. and Meena, L.N., 2015. Study on Physico–Chemical Parameters of Waste Water Effluents from Industrial areas of Jaipur,Rajasthan, India. Int. J. Innov. Sci. Eng. Technol, 2(5), pp.874-876.
- G. Tintometer, "The importance of biochemical oxygen demand BOD in the water analysis sector",Aet, no. May,pp. 12- 13, 2015.
- P.A.G.Ghalimath, "An overview of phenomena of BOD and COD," Int.Res.J.Eng.Technol.,vol.4, no.8,pp.264-266,2017.
- Halim, A., Sharmin, S., Rahman, H., Haque, M., Rahman, S. and Islam, S., 2018. Assessment of water quality parameters in baor environment, Bangladesh: A review. International Journal of Fisheries and Aquatic Studies, 6(2), pp.269-263.
- J. Li, G. Luo, L. J. He, J. Xu, and J. Lyu, "Analytical Approaches for Determining Chemical Oxygen Demand in Water Bodies: AReview," Crit. Rev. Anal. Chem., vol. 48, no. 1, pp. 47–65, 2018.
- Jaffar, A., ThamrinN.M., Ali M.S.A.M., Misnan M.F., Yassin A.I.M., " The influence of physical chemical parameters to determine water quality: A review". Journal of electrical and electronic systems research ,2020.https://doi.org/10.24191/jeesr.v17i1.016.
- Kumar, M. and Mishra, G.V., 2024. Causes and Impacts of Water Pollution on Various water bodies in the State of Rajasthan, India: A Review. Environ. Ecol, 42, pp.645-654.
- M. Arief, "Development of Dissolved Oxygen Concentration Extraction Model Using Landsat Data Case Study: Ringgung Coastal Waters," Int. J. Remote Sens. Earth Sci., vol. 12, no. 1, p. 1, 2017
- McCaffrey, S. (2018). Water quality parameters and indicators [Waterwatch Coordinator, Namoi Catchment Manage-ment Authority Ph: 6764 5961]. Retrieved 12 May 2018 fromhttps://www.sswm.info/sites/default/files/reference_attachments/DFID%201998%20Guid
- McGaw, I. J., &Whiteley, N. M. (2012). Effects of acclimation and acute temperature change on specific dynamic action and gastric processing in the green shore crab, Carcinusmaenas. Journal of Thermal Biology, 37(8), 570–578. doi:10.1016/j.jtherbio.2012.07.003
- Mishra, R.K., 2023. Fresh water availability and its global challenge. British Journal of Multidisciplinary and Advanced Studies, 4(3), pp.1-78.
- Nayar, R., 2020. Assessment of water quality index andmonitoring of pollutants by physico-chemical analysis in water bodies: a review. International Journal of Engineering Research and Technology, 9(01).
- Ni, M., Yuan, J. L., Liu, M., &Gu, Z. M. (2018). Assessment of water quality and phytoplankton community of Limpenaeusvannamei pond in intertidal zone of Hangzhou Bay, China. Aquaculture Reports, 11, 53–58.doi:10.1016/j.aqrep.2018.06.002
- Qian, Z., Liu, X., Wang, L., Wang, X., Li, Y., Xiang, J., &Wang, P. (2012). Gene expression profiles of four heat shock proteins in response to different acute stresses in

shrimp, Litopenaeusvannamei. Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology, 156(3–4), 211–220.

- Rani, S. (2019). Physico-chemical properties of fresh water fish pond in relation to fish farming in Darbhangadistrict. Journal of Emerging Technologies and Innovative Research, 6(6), 541–544.
- Satya, Kumari, and Chanavir Narayan. "Study of physico-chemical and biological characteristics of the water of river Ganga at Patna, India." Current World Environment 13, no. 3 (2018): 374.
- Sale, J.F., Yahaya, A., Ejim, C.C. and Okpe, I.W., 2019. Physicochemical assessment of water quality in selected borehole in Anyigba Town, Kogi State, Nigeria. Journal of Applied Sciences and Environmental Management, 23(4), pp.711-714.
- Sharma,P. and Kumar, N. “ShravaniMela and its consequences on the limnology of Shivganga pond ,Deoghar,Jharkhand”. Bihar research journal. ISSN : 0975-4288
- V. S. Kale, “Consequence of Temperature , pH , Turbidity andDissolved Oxygen Water Quality Parameters.,” Int. Adv. Res. J. Sci. Eng. Technol. ISO, vol. 3, no. 8, pp. 186–190, 2016.
- Verma,S., Verma,S., Ramakant., Pandey, V. and Verma, A., 2025. “Comprehensive assessment of physical chemical and biological parameters in water quality monitoring: A review of contaminants, indicators and health impacts”. International Journal of horticulture, Agriculture and Food Science (IJHAF) ISSN: 2456-8635 [Vol-9, Issue-2, Apr-Jun, 2025].

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