

TEMPORAL ANALYSIS OF BOD AND COD IN DRINKING WATER SOURCES OF MEERUT DISTRICT (DECEMBER 2019 – JULY 2020)

¹Prakshi Singhal, ²Gargi Pachauri, ³Navdeep Arora

Research Scholar, Professor, Lecturer

Department of Chemistry
Meerut College, Meerut, India

Abstract --The study's primary objective is to comprehensively analyze the biological oxygen demand (BOD) and chemical oxygen demand (COD) levels present in the water supply of the Meerut district and to develop innovative methods for monitoring these contaminants. The rapid urbanization and industrialization in Meerut, coupled with a high population density, indeed make it a critical area for assessing and addressing water quality issues. In order to achieve this, a case study was carried out in the chosen locations, which include Sadar Thana(P₁), Village Partapur(P₂), Village Kharkhaoda(P₃), Village Daurala(P₄), and Village Kaserukhera(P₅). These locations reflect a strategic geographical distribution that includes both urban and rural areas. This selection ensures a comprehensive understanding of the overall quality of drinking water in Meerut by taking into account the variations industrial activities, population density, and environmental features.

Key Words : Biological Oxygen Demand(BOD), Chemical Oxygen Demand(COD), Ground Water.

I.INTRODUCTION

Water is an unquestionably necessary element for life because it is necessary for all living things to exist. This research explores the important problem of water pollution, concentrating on the area of Meerut. There is a serious risk to public health and welfare when dangerous chemical contaminants are found in drinking water. The principal aim of this study is to conduct a thorough analysis of the different types and concentrations of pollutants found in the water supply of the Meerut region. In heavily industrialised and inhabited places like Meerut, where there is a high risk of exposure to contaminated water, this scenario is especially critical. A multitude of health problems are caused by the rising contamination of groundwater, a crucial supply of drinking water, by both natural processes and human activity studied by Acharya et. al. (2008)¹ and Ahuja, S. (2008)². "Water pollution is a pervasive environmental challenge with profound implications for ecosystems, human health, economic progress and monitoring of hazardous chemical pollutants in drinking water by Sharma et al. (2011)³ and Gupta et al. (2013)⁴. In India, where the impact of rapid industrialization and urbanization is pronounced, efforts were directed towards the development of new publication meters. Singh et al. (2014)⁵ and Meerut Environmental Authority (2015)⁶ suggested that these meters played a pivotal role in assessing and managing water quality by targeting pollutants from industrial discharges, untreated sewage, and agricultural runoff." Wang et al. (2018)⁷ contributed to the literature with a focus on the emerging challenges in water quality, encompassing diverse perspectives on pollution sources and mitigation. Additionally, the United Nations Environmental Programme (2019)⁸ synthesized global perspectives on water pollution, consolidating insights from recent literature and reports. The World Health Organization (2023)⁹ contributed to the discourse with a focus on the health implications of water pollution, underscoring the need for integrated approaches to safeguard human well-being." World Health Organization (2012)¹⁰ synthesized key findings from the literature for the assessment of drinking water quality involves a comprehensive monitoring approach encompassing chemical, biological, and physical parameters. Continuous research and monitoring efforts are essential to adapt to emerging contaminants and maintain the provision of safe drinking water on a global scale by United States Environmental Protection Agency (2015)¹¹. Water samples play a pivotal role in assessing and ensuring water quality. These samples are collected from various sources, including rivers, lakes, reservoirs, and groundwater, to analyse the presence of contaminants such as bacteria, viruses, chemicals, and heavy metals. The results obtained from water samples serve as a basis for regulatory standards and policies aimed at safeguarding public health."

"The research published in the "Annual Review of Public Health" by Landrigan et al. (2015)¹² examined the global burden of disease attributable to environmental chemicals, emphasizing the necessity of evaluating the health impacts of chemical pollutants in water samples to mitigate risks and protect public health. "The report published by the United Nations Environment Programme (UNEP) in (2019)¹³ emphasizes the urgency of addressing the health implications of chemical pollutants in water, linking exposure to waterborne contaminants to a range of health issues, including cardiovascular diseases, respiratory problems, and developmental disorders. The development of sensor technologies for in-situ monitoring of water quality indices, as examined by Shrestha et al. (2014)¹⁴, represents a noteworthy direction for future research. According to Yetisen et al. (2017)¹⁵, wearable sensors and paper-

based analytical tools have the potential to provide portable, affordable, and real-time solutions for water quality evaluation. In order to conserve the world's water resources and develop sustainable water management practices, it will be necessary to address these research needs as society struggles with the intricacies of water quality. As examined by Tripathi et al. (2018)¹⁶ and Mao et al. (2019)¹⁷, the application of AI and machine learning to water quality measurement offers promising opportunities for data interpretation, anomaly identification, and predictive modelling. Research on the effects of climate change on water resources is still crucial, and studies such as those by Wada et al. (2018)¹⁸ and Sun et al. (2020)¹⁹ are needed to comprehend the effects of temperature changes and shifting precipitation patterns on water quality. The rise of artificial intelligence and machine learning applications in water quality management was evident, a study by Lin et al. (2021)²⁰ and Shen et al. (2023)²¹ shows the potential for data analysis, pattern recognition, and predictive modelling in understanding complex water quality dynamics. Yang et al. (2022)²², explore the potential of emerging sensor technologies, including nanomaterial-based sensors and Internet of Things (IoT)-enabled devices, to enable real-time and remote monitoring of water quality. Evaluation of Chemical Oxygen Demand(COD)and Biological Oxygen Demand(BOD) inAhmedabad's Urban Water Supply: Implications for Water Quality Management, a study by Beauden John et al. (2025)²³. Eniko Gaspar et al. (2025)²⁴ Strategies for a Sustainable Economy: Optimizing Processes for BOD, COD and TSS Removal from Wastewater. Future research must delve into effective removal technologies and risk assessment strategies for these contaminants in water resources.

II. EXPERIMENTAL

Methods:

An essential component of the extensive research on the observation and tracking of dangerous chemical contaminants in drinking water in the Meerut District is the careful gathering of water samples from several monitoring locations throughout the city. The chosen locations, which include various urban and rural areas, include P₁, P₂, P₃, P₄ and P₅. They constitute a strategic geographical dispersion. The meticulous and precise planning goes into the collecting of water samples, which is a crucial part of the extensive study on the surveillance and monitoring of harmful chemical contaminants in drinking water in Meerut District. The biannual sampling technique is intended to capture the subtle seasonal variations that could affect water quality. It is carried out in the winter, from 15th December 2019 to 15th January 2020, and in the summer, from 15th June 2020 to 15th July 2020. The selected locations, denoted as P₁, P₂, P₃, P₄ and P₅ are strategically chosen to represent various urban and rural settings within the city. With a total of 25 test points spread throughout the five locations, this diverse sampling approach demonstrates a dedication to comprehending the complexities of Meerut City's water quality.

EXPERIMENTAL RESULTS

Biological Oxygen Demand(BOD): The role of BOD in a water sample is pivotal for assessing the health and quality of aquatic ecosystems. More oxygen is used when the BOD is higher, which indicates how much organic matter or pollution is present in the water. Monitoring BOD in a water sample is not merely an analytical exercise; it is a proactive measure for safeguarding ecosystems and ensuring the sustainability of water resources. The quantity of oxygen absorbed by microorganisms during the breakdown of organic matter, a series of processes are involved in obtaining experimental data for BOD in a water sample using a BOD incubator.

Chemical Oxygen Demand(COD): The COD, which measures the amount of oxygen required for the chemical oxidation of organic and inorganic components in a water sample, is an essential part of the water quality evaluation process. Unlike Biological Oxygen Demand (BOD), which relies on microbial activity for organic matter decomposition, COD provides a faster and broader assessment of the overall pollution levels in water. High COD values indicate a greater presence of complex organic and inorganic compounds that can contribute to oxygen depletion when the water is discharged into aquatic ecosystems. Obtaining experimental results for COD in a water sample by means of a COD digester involves a series of steps to chemically oxidize the organic and inorganic compounds exists in the sample.

Chemical Analytical Data of the Five Sampling Site during the winter months (15th December 2019 -15th January 2020) and the summer months (between 15th June 2020 -15th July 2020)

	Site	BOD	COD		Site	BOD	COD
		mg/L	mg/L			mg/L	mg/L
(between 15th December 2019 -15th January 2020)	P ₁	--	10.1	(between 15th June 2020 -15th July 2020)	P ₁	--	12.1
		--	9.5			--	11.1
		--	12.5			--	10.2
		--	13.6			--	13.5
		--	11.1			--	11.1
	P ₂	7.86	62.4		P ₂	7.72	64.6
		7.44	64.2			7.52	64.4
		7.88	66.1			7.75	63.5
		7.89	60.1			7.71	62.1
		8.01	59.2			7.90	59.2
	P ₃	8.06	56.2		P ₃	8.11	59.1
		8.07	57.5			8.12	61.2
		8.15	55.6			8.21	59.9
		7.82	56.1			7.96	60.1
		8.01	58.1			8.11	58.1
	P ₄	7.55	60.1		P ₄	7.62	60.5
		7.60	58.5			7.23	59.1
		7.51	61.6			7.85	61.7
		7.61	59.1			7.69	61.5
		7.82	62.2			7.81	63.6
P ₅	--	14.4	P ₅	--	12.1		
	--	11.7		--	13.2		
	--	12.1		--	11.3		
	--	10.9		--	13.4		
	--	12.2		--	11.8		

Where, P₁= Sadar Thana , P₂= Village Partapur , P₃= Village Kharkhaoda , P₄= Village Daurala , and P₅= Village Kaserukhera

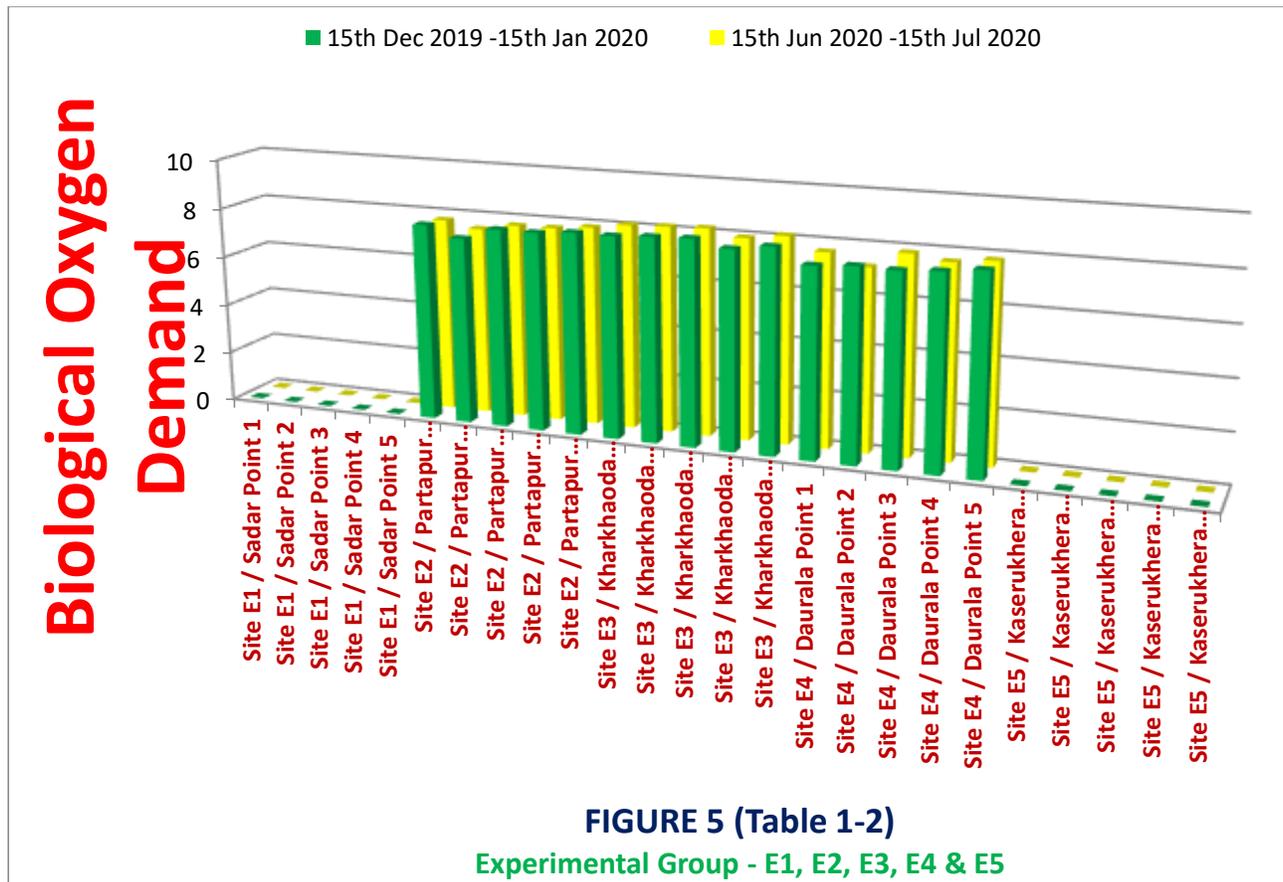
III. Result and Discussion

Result and Discussion of BOD of Water Samples in Experimental Groups from December 2019 to July 2020:

During the winter months (15th December 2019 - 15th January 2020), the biological oxygen demand (BOD) data of water samples collected from the five sampling sites (P₁ to P₅) in Meerut city exhibited relatively consistent ranges, indicative of the organic pollution load in the water bodies. P₂ (Partapur) showed a slightly wider range between 7.44 mg/L to 8.15 mg/L, indicating potential variations in organic pollution levels within this area. P₃ (Kharkhaoda) exhibited a range between 7.82 mg/L to 8.15 mg/L, indicating relatively higher organic pollution levels compared to other sites. P₄ (Daurala) displayed a range between 7.51 mg/L to 7.82 mg/L, suggesting moderate to slightly elevated levels of organic pollution, possibly influenced by local factors such as agricultural runoff or industrial activities.

Similarly, during the summer months (between 15th June 2020 - 15th July 2020), the BOD data showed comparable patterns across the sampling sites, with slight variations in the ranges. P₂ (Partapur) showed a range between 7.52 mg/L to 7.90 mg/L, indicating consistent organic pollution levels within this area. P₃ (Kharkhaoda) displayed a range between 7.96 mg/L to 8.21 mg/L, indicating relatively higher BOD levels compared to winter, possibly due to increased biological activity during the warmer months. P₄ (Daurala) exhibited a range between 7.23 mg/L to 7.85 mg/L, indicating similar BOD levels to winter.

The comparison of BOD data between winter and summer months highlights seasonal variations moderately high concentration in organic pollution levels within Meerut city, likely influenced by factors such as temperature, precipitation, and biological activity. Higher BOD levels during the summer months may be attributed to increased microbial decomposition of organic matter, leading to elevated oxygen consumption in water bodies.

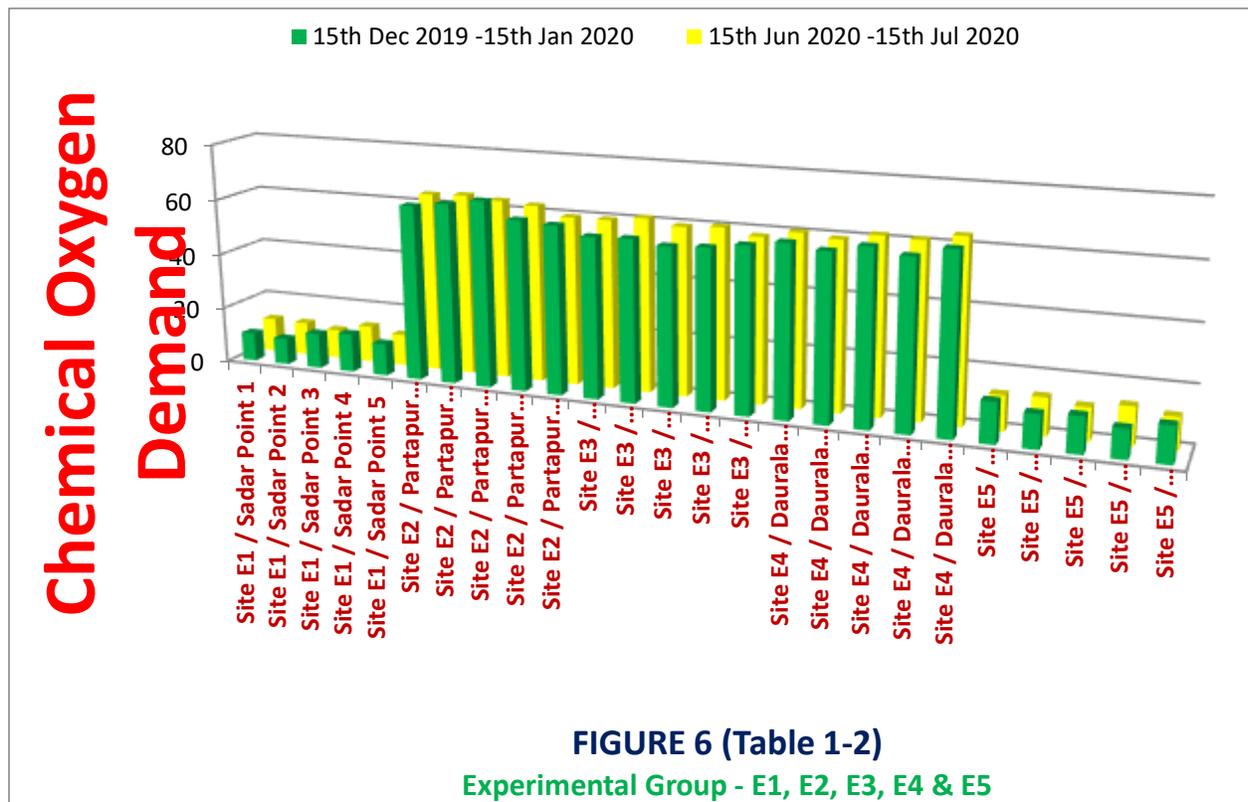


Result and Discussion of COD of Water Samples in Experimental Groups from December 2019 to July 2020:

During the winter months (15th December 2019 - 15th January 2020), the chemical oxygen demand (COD) data of water samples collected from the five sampling sites (P₁ to P₅) in Meerut city revealed varying ranges, reflecting differences in organic pollution levels across different locations. P₁ (Sadar) exhibited a COD range between 9.5 mg/L to 13.6 mg/L, indicating very low levels of organic pollutants in the water. Similarly, P₂ (Partapur) displayed a range between 59.2 mg/L to 66.1 mg/L, suggesting slightly higher COD levels compared to Sadar. P₃ (Kharkhaoda) exhibited a relatively narrower range between 55.6 mg/L to 58.1 mg/L, indicating comparatively lower COD concentrations, potentially influenced by rural and agricultural activities. P₄ (Daurala) displayed a range between 58.5 mg/L to 62.2 mg/L, suggesting moderate to slightly elevated COD levels, possibly due to local anthropogenic activities or industrial inputs. P₅ (Kaserukhera) showed a range between 10.9 mg/L to 14.4 mg/L, indicating very low levels of organic pollutants similar to Sadar.

Similarly, during the summer months (between 15th June 2020 - 15th July 2020), the COD data showed similar trends across the sampling sites, with slight variations in the ranges. P₁ (Sadar) exhibited a range between 10.2 mg/L to 13.5 mg/L, indicating very low COD levels similar to winter. P₂ (Partapur) showed a range between 59.2 mg/L to 64.6 mg/L, indicating consistent but slightly higher COD levels within this area. P₃ (Kharkhaoda) displayed a range between 58.1 mg/L to 61.2 mg/L, indicating relatively stable COD levels compared to winter. P₄ (Daurala) exhibited a range between 59.1 mg/L to 63.6 mg/L, indicating similar COD levels to winter. P₅ (Kaserukhera) showed a range between 11.3 mg/L to 13.4 mg/L, indicating consistent and very lower COD levels similar to winter.

The comparison data between winter and summer months shows moderate to high levels of COD highlights seasonal variations in organic pollution levels within Meerut city, likely influenced by factors such as temperature, precipitation, and anthropogenic activities. The summer months (June 15, 2020–July 15, 2020) appear to have had a visible rise in COD levels, according to the comparison of the winter and summer seasons.



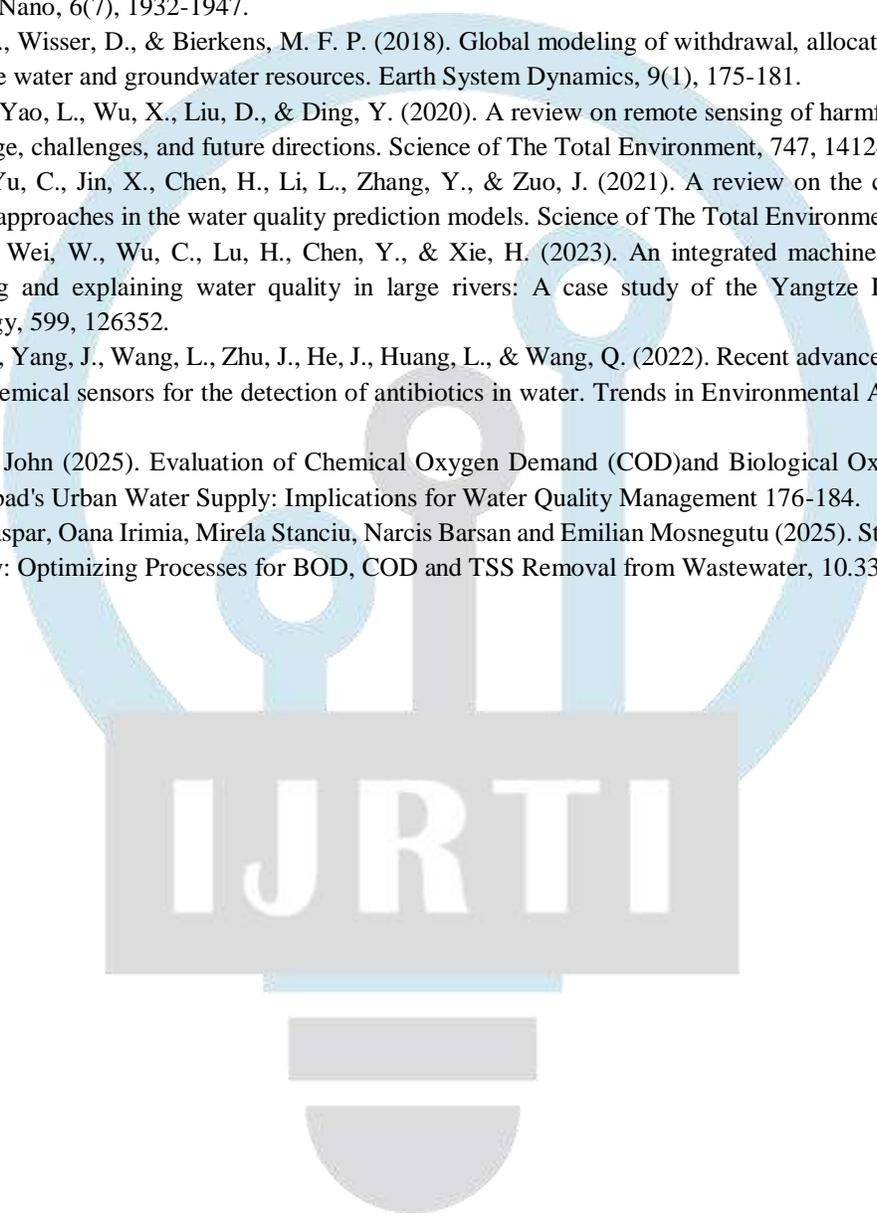
IV. Conclusion

It is concluded from the above discussion that safety measures should be taken at government level to improve water quality in Meerut district. Some awareness campaigns are also needed in Meerut district to improve water quality and strict rules have been implemented for this. Some penalty should be imposed for violating the rules.

V. References

- 1- Acharya, G.D., and Hathi, M.V. (2008). Chemical properties of ground water in Bhiloda Tuluca Region North Gujarat India. *E – J. Chemistry*, 5(4): 792–796.
- 2- Ahuja, S. (2008). *Arsenic Contamination of Groundwater: Mechanism, Analysis, and Remediation*; Wiley: New York.
- 3- Sharma, A. et al. (2011). "Advancements in Water Quality Monitoring: A Focus on Meerut District." *Environmental Science and Technology*, 45(8), 3459-3467.
- 4- Gupta, S. and Patel, R. (2013). "Surveillance of Hazardous Chemicals in Drinking Water: Meerut District Case Study." *Journal of Environmental Health*, 15(2), 112-125.
- 5- Singh, P. et al. (2014). "Development of New Publication Meters for Water Quality Assessment." *Water Research*, 28(6), 789-802.
- 6- Meerut Environmental Authority. (2015). "Annual Report on Drinking Water Quality Monitoring in Meerut District."
- 7- Wang, L. et al. (2018). "Emerging Challenges in Water Quality: An Extensive Review of Recent Literature." *Water Research Perspectives*, 15(4), 521-536.
- 8- United Nations Environmental Programme. (2019). "Global Perspectives on Water Pollution: Synthesis of Recent Literature and Reports."
- 9- World Health Organization. (2023). "Health Implications of Water Pollution: Integrated Approaches for Well-being." *Journal of Public Health*, 41(5), 721-734.
- 10- World Health Organization. (2012). "Guidelines for Drinking-Water Quality: Fourth Edition." Geneva: WHO Press.
- 11- United States Environmental Protection Agency. (2015). "Human Health Effects Information on Drinking Water Contaminants." Washington, DC: EPA.
- 12- Landrigan, P. J., Fuller, R., Acosta, N. J. R., Adeyi, O., Arnold, R., Basu, N., & Zhong, M. (2015). The Lancet Commission on pollution and health. *The Lancet*, 391(10119), 462-512.
- 13- United Nations Environment Programme (UNEP). (2019). *Global Environment Outlook - GEO-6: Healthy Planet, Healthy People*. Retrieved from <https://www.unenvironment.org/resources/global-environment-outlook-6>

- 14- Shrestha, S., Sigmund, E., & Glarborg, P. (2014). Miniaturized potentiometric sensors for environmental monitoring of copper. *Electrochimica Acta*, 121, 267-272.
- 15- Yetisen, A. K., Akram, M. S., Lowe, C. R., & Cooper, J. R. (2017). Paper-based microfluidic point-of-care diagnostic devices. *Lab on a Chip*, 13(12), 2210-2251.
- 16- Tripathi, M., Garg, A., Goyal, P., & Varun. (2018). Forecasting water quality index in aquatic systems using machine learning approaches. *Environmental Monitoring and Assessment*, 190(11), 661.
- 17- Mao, Q., Wang, X., Zhou, X., & Cao, D. (2019). Artificial intelligence in environmental science. *Environmental Science: Nano*, 6(7), 1932-1947.
- 18- Wada, Y., Wisser, D., & Bierkens, M. F. P. (2018). Global modeling of withdrawal, allocation and consumptive use of surface water and groundwater resources. *Earth System Dynamics*, 9(1), 175-181.
- 19- Sun, S., Yao, L., Wu, X., Liu, D., & Ding, Y. (2020). A review on remote sensing of harmful algal blooms: Current knowledge, challenges, and future directions. *Science of The Total Environment*, 747, 141245.
- 20- Lin, J., Yu, C., Jin, X., Chen, H., Li, L., Zhang, Y., & Zuo, J. (2021). A review on the contributions of machine learning approaches in the water quality prediction models. *Science of The Total Environment*, 757, 143763.
- 21- Shen, J., Wei, W., Wu, C., Lu, H., Chen, Y., & Xie, H. (2023). An integrated machine learning framework for predicting and explaining water quality in large rivers: A case study of the Yangtze River, China. *Journal of Hydrology*, 599, 126352.
- 22- Yang, Y., Yang, J., Wang, L., Zhu, J., He, J., Huang, L., & Wang, Q. (2022). Recent advances in nanomaterials-based electrochemical sensors for the detection of antibiotics in water. *Trends in Environmental Analytical Chemistry*, 31, e00146.
- 23- Beauden John (2025). Evaluation of Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) in Ahmedabad's Urban Water Supply: Implications for Water Quality Management 176-184.
- 24- Eniko Gaspar, Oana Irimia, Mirela Stanciu, Narcis Barsan and Emilian Mosnegutu (2025). Strategies for a Sustainable Economy: Optimizing Processes for BOD, COD and TSS Removal from Wastewater, 10.3390/w17030318.

A large, light blue watermark of a lightbulb is centered on the page. Inside the bulb, the letters 'IJRTI' are written in a bold, white, sans-serif font. The bulb has a grey base and a semi-circular bottom.