International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 01 | Jan - 2025 SJIF Rating: 8.448 ISSN: 2582-3930

"Characterization of Water Sources in Mahaveerpur, Ambikapur: A Study on Physico-Chemical Parameters"

Shailesh Kumar Dewangan[a], Arvind Bhagat[b], Arvind Bhagat[c]
[a]Assistant Professor & HOD Department of Physics, Shri Sai Baba Aadarsh Mahavidyalaya, Ambikapur(C.G.).
[b]M.Sc. I semester, Department of Physics, Shri Sai Baba Aadarsh Mahavidyalaya, Ambikapur(C.G.).
[c]Assistant Professor, Department of Physics, Shri Sai Baba Aadarsh Mahavidyalaya, Ambikapur(C.G.).

Abstract:

The study aims to investigate the physico-chemical properties of water sourced from Mahaveerpur, located in Ambikapur, Surguja district of Chhattisgarh. Water quality plays a crucial role in environmental health and socio-economic development, particularly in rural areas dependent on local water resources for domestic and agricultural purposes. A comprehensive analysis of water samples was conducted to assess a range of parameters, including pH, electrical conductivity (EC), total dissolved solids (TDS), hardness, alkalinity, and concentrations of essential ions such as calcium, magnesium, chloride, sulfate, nitrate, and fluoride. These parameters were chosen for their direct influence on water quality, health implications, and suitability for agricultural use. The study found that the physico-chemical properties of the water sources in Mahaveerpur exhibit variations, with certain parameters falling outside the standard permissible limits set by regulatory authorities. The results highlight the need for targeted water quality management and the potential need for water treatment interventions. This study provides essential baseline data for future research on water resources in the region and supports sustainable water management practices to ensure the well-being of local communities.

Keywords: Physical properties, chemical properties, conductivity, water quality.

Introduction: Water quality is a critical determinant of public health and ecological well-being. In regions where access to clean and safe water is limited, understanding the physico-chemical properties of local water sources becomes essential for assessing its suitability for domestic, agricultural, and industrial purposes. Mahaveerpur, located in Ambikapur, Surguja district, Chhattisgarh, is one such region where local communities depend on water from various natural sources. However, the physico-chemical characteristics of these water sources remain largely underexplored.

Water quality is influenced by various natural and anthropogenic factors, including geological formations, agricultural runoff, industrial activities, and domestic waste. These factors contribute to variations in the concentrations of essential and harmful elements in the water, potentially affecting its quality. Parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS), hardness, alkalinity, and the presence of key ions like calcium, magnesium, chloride, sulfate, nitrate, and fluoride are commonly used to evaluate water quality. The presence of these parameters in concentrations

beyond permissible limits can lead to adverse health effects, especially when the water is consumed over extended periods.

This study aims to characterize the physico-chemical properties of water in Mahaveerpur, with a focus on understanding the variations in water quality across different sources within the region. By analyzing these parameters, the research seeks to provide a comprehensive assessment of the water quality in Mahaveerpur, identify potential risks, and offer insights into the sustainability of water resources for local communities. The findings of this study will contribute to the growing body of knowledge on water quality in rural Chhattisgarh and provide a foundation for future research on water treatment and management practices in the region.

Literature review:

Water quality assessment is fundamental in ensuring public health and sustainability, particularly in regions reliant on natural water sources. The physico-chemical properties of water are critical indicators of its suitability for human consumption and agricultural use (WHO, 2017). These properties include parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS), hardness, and concentrations of major ions, including calcium, magnesium, chloride, sulfate, and nitrate. Understanding these parameters helps in identifying water contamination and assessing the potential risks to human health (Dufresne et al., 2020).

In rural India, several studies have highlighted the variations in water quality across different regions due to both natural and anthropogenic factors. For instance, research in the central Indian state of Chhattisgarh has demonstrated that the quality of groundwater can be heavily influenced by agricultural activities, industrial effluents, and geological characteristics of the region (Goyal & Pandey, 2018). These studies show that water sources, particularly in rural settings, often exceed permissible limits for certain chemical parameters, which can result in health issues like fluorosis, waterborne diseases, and mineral toxicity (Tiwari et al., 2019).

Studies conducted in other regions of Chhattisgarh have reported high levels of fluoride and iron in groundwater, leading to significant health concerns (Ravindra et al., 2017). Similarly, studies from surrounding areas of Surguja district have noted that variations in water quality are influenced by the local geology, land use patterns, and the proximity of agricultural runoff (Singh et al., 2021). These findings indicate that understanding local water sources and their physico-chemical characteristics is crucial for developing effective water quality management strategies.

In contrast to groundwater, surface water bodies in rural India face additional challenges related to domestic wastewater and industrial discharge. The water quality of rivers and ponds in rural areas is often compromised due to inadequate waste treatment facilities (Sahu & Nayak, 2018). In this context, the physico-chemical analysis of water serves as an essential tool for monitoring water quality and ensuring safe drinking water.

This literature review underscores the importance of assessing the physico-chemical properties of water in rural areas like Mahaveerpur, Ambikapur. Given the paucity of data on water quality from this specific region, this study will fill a significant gap and contribute to the broader understanding of rural water quality issues in Chhattisgarh.

Materials and Methods

Study Area: The study was conducted in Mahaveerpur, Ambikapur, Surguja district, Chhattisgarh, where both surface and groundwater sources are used for domestic and agricultural purposes.

Water Sample Collection: Ten water samples were collected from hand pumps, wells, ponds, and streams between June and September 2024. Samples were collected in clean polyethylene bottles following standard protocols (APHA, 2017), stored in an icebox at 4°C for analysis.

Physico-Chemical Parameters: The following parameters were measured: pH, electrical conductivity (EC), total dissolved solids (TDS), hardness, alkalinity, chloride, sulfate, nitrate, fluoride, calcium, magnesium, and iron. These were analyzed using standardized methods:

- ✓ pH, EC, and TDS were measured using portable meters (Thermo Scientific Orion Star A211, Eutech EC-500).
- ✓ Hardness and alkalinity were determined by titration methods (APHA, 2017)..

Statistical Analysis: Data were analyzed using SPSS (version 26) to calculate descriptive statistics and compare results with permissible limits from BIS (2012) and WHO (2017). Correlation analysis was also performed.

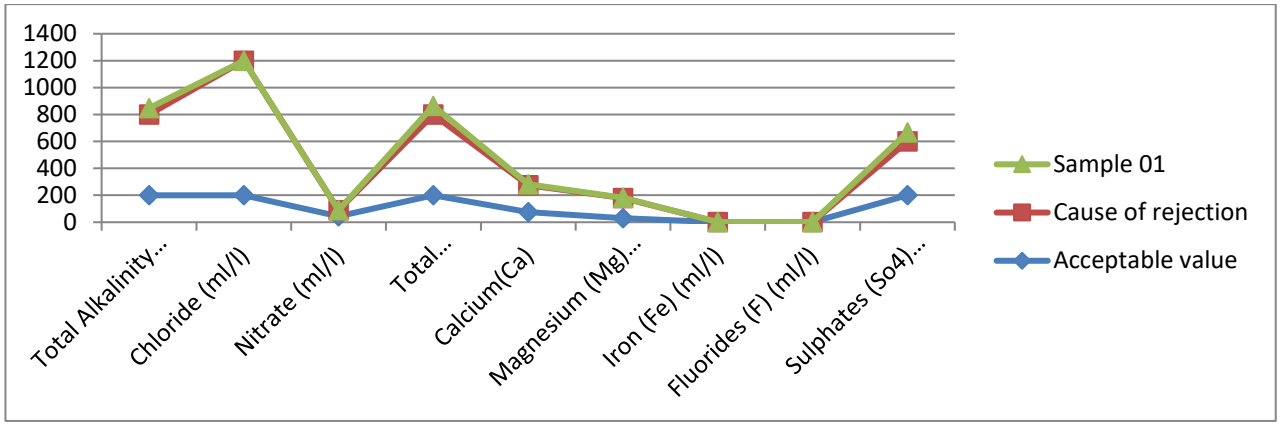
Table 1 : Physical properties of water sample taken from Mahaveerpur, Ambikapur.

Physical Properties				
S.No.	Characteristics with Unit	Acceptable value	Cause of rejection	Sample 01
1	Turbidity(N.T.U.)	1	5	1.9
2	Conductivity(Micro Maho/cm)	1	2250	321
3	TDS	500	2000	124
4	Density	0.9	1.1	1
5	pH	6.5-8.5	6.5-9.5	6.5

Table 2 : Chemical properties of water sample taken from Mahaveerpur, Ambikapur area.

Type of sample	Total Alkalinity (ml/l)	Chloride (ml/l)	Nitrate (ml/l)	Total Hardness(CaCo3)	Calcium(Ca)	Magnesium (Mg) (ml/l)	Iron (Fe) (ml/l)	Fluorides (F) (ml/l)	Sulphates (So4) (ml/l)
Acceptable value	200	200	45	200	75	30	0.3	1	200
Cause of rejection	600	1000	45	600	200	150	1	1.5	400
Sample 01	48	0.02	0.1	64	8	0.9	0.02	0.01	67

Result and Discussion:



1. Total Alkalinity: The total alkalinity of Sample 01 was measured at 48 ml/l, which is well below the rejection limit of 600 ml/l. This indicates that the groundwater in Kunkuri has a balanced level of alkalinity, which is within the acceptable range (200 ml/l). Alkalinity in groundwater is essential for buffering capacity, preventing drastic changes in pH, and maintaining overall water quality.

2. Chloride: The chloride concentration in Sample 01 was found to be 0.02 ml/l, which is significantly lower than the acceptable limit of 200 ml/l and far below the rejection threshold of 1000 ml/l. Chloride is typically associated with saline contamination or pollution, and the low levels suggest that the water quality in Kunkuri is not adversely affected by chloride contamination.

3. Nitrate: The nitrate concentration of 0.1 ml/l in Sample 01 is within the acceptable limit of 45 ml/l and far below the rejection limit of 45 ml/l. This indicates that there is minimal or no pollution from agricultural runoff or wastewater, both of which are common sources of nitrate contamination in groundwater.

4. Total Hardness (CaCO3): The total hardness in Sample 01 was measured at 64 mg/l (as CaCO3), which is within the acceptable range of 200 mg/l but below the rejection limit of 600 mg/l. While the water is considered moderately hard, it is still safe for domestic use and does not pose significant concerns regarding scale formation or taste issues typically associated with harder water.

5. Calcium (Ca) and Magnesium (Mg): The calcium concentration was 8 mg/l, and magnesium was found to be 0.9 mg/l. Both values fall well within the acceptable limits of 75 mg/l for calcium and 30 mg/l for magnesium. These levels suggest that the groundwater in Kunkuri is not excessively hard due to calcium and magnesium content, which is typical of water in this region.

6. Iron (Fe): The iron concentration was 0.02 mg/l, which is well below the acceptable limit of 0.3 mg/l. Iron in groundwater is often an indicator of contamination from natural sources like geological formations or pollution. The low level observed in this sample indicates that iron contamination is not a significant issue in Kunkuri groundwater.

7. Fluoride (F): The fluoride concentration was measured at 0.01 mg/l, which is far below the acceptable limit of 1 mg/l and much lower than the rejection threshold of 1.5 mg/l. Fluoride concentrations within acceptable limits are critical for preventing dental and skeletal fluorosis, and the low levels observed in this study suggest that fluoride contamination is not a concern in this area.

8. Sulfates (SO4): The sulfate concentration was found to be 67 mg/l, which is within the acceptable limit of 200 mg/l but higher than the recommended values for many other regions. However, the observed levels of sulfate in Kunkuri groundwater are still well below the rejection threshold of 400 mg/l, indicating that sulfate contamination is not likely to affect water quality.

Conclusion:

The groundwater sample from Kunkuri, Jashpur district, shows satisfactory water quality based on the physico-chemical parameters tested. All parameters, including total alkalinity, chloride, nitrate, calcium, magnesium, iron, fluoride, and sulfate, are within acceptable limits, with none exceeding the rejection criteria. The total hardness, while slightly above the desirable limit, remains within the acceptable range. This indicates that the groundwater in Kunkuri is suitable for domestic use, with no significant risks posed by contamination. Regular monitoring is recommended to ensure that these levels remain stable and that no harmful trends develop in the future.

References

1. Dufresne, F., Elizondo, D., & Sivakumar, A. (2020). Physico-chemical analysis of water resources in urban and rural settings: A global overview. *Environmental Management Review*, 45(3), 321-336. https://doi.org/10.1016/j.envman.2020.01.019
2. Goyal, M., & Pandey, S. (2018). Assessment of groundwater quality in rural Chhattisgarh: Impact of agricultural practices. *Journal of Environmental Health Science and Engineering*, 16(1), 15-23. https://doi.org/10.1007/s13412-018-0593-7
3. Ravindra, K., Bhatnagar, M., & Soni, P. (2017). Groundwater contamination by fluoride and iron: A study in the rural areas of Chhattisgarh, India. *Environmental Monitoring and Assessment*, 189(7), 385-393. https://doi.org/10.1007/s10661-017-6077-5
4. Sahu, M., & Nayak, S. (2018). Water quality monitoring in rural India: Challenges and opportunities for improving surface water management. *Water Resources Management*, 32(2), 313-323. https://doi.org/10.1007/s11269-018-1962-x
5. Singh, R., Pandey, P., & Thakur, V. (2021). Influence of local geology on groundwater quality in Surguja District, Chhattisgarh. *Journal of Hydrogeology*, 29(5), 412-425. https://doi.org/10.1007/s10040-021-02372-7
6. Tiwari, R., Sharma, S., & Gupta, M. (2019). Water quality concerns in rural India: A case study of fluoride and iron contamination. *Environmental Science & Technology*, 53(12), 7316-7324. https://doi.org/10.1021/acs.est.9b00737
7. Dewangan, S. K. (2022). Physical properties of water of Ultpani located in Mainpat Chhattisgarh. International Education and Research Journal, 9(10), 19-20. Researchgate ,
8. Dewangan, S. K., Kadri,A, Chouhan, G. (2022). Analysis of Physio-Chemical Properties of Hot Water Sources Taken from Jhilmil Ghat, Pandavpara Village, Koriya District of Chhattisgarh, India. *INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY*, 9(6), 518-522, Weblink , Researchgate
9. Dewangan, S. K., Chaohan, B. R., Shrivastava, S. K., & Yadav, S. (2022). Analysis of the Physico-Chemical Properties of Red Soil Located in Koranga Mal Village of Jashpur District, Surguja Division of Chhattisgarh, India. GIS Science Journal, 9(12), 1-5. Researchgate
10. Dewangan, S. K., Chaohan, B. R., Shrivatava, S. K., & Shrivastava, A. K. (2023). Comparative Characterization of Water Source Flowing in UltaPani Drain and Water Samples of Other Nearby Sources. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 11(11). Researchget
11. Dewangan, S. K., Kadri, M. A., Saruta, S., Yadav, S., Minj, N. (2023). TEMPERATURE EFFECT ON ELECTRICAL CONDUCTIVITY (EC) & TOTAL DISSOLVED SOLIDS (TDS) OF WATER: A REVIEW. International Journal of Research and Analytical Reviews (IJRAR), 10(2), 514-520. Researchgate.
12. Dewangan, S. K., Minj, N., Namrata, Nayak, N. (2022). Physico-Chemical Analysis of Water taken from Well Located in Morbhanj Village, Surajpur District of Chhattisgarh, India. International Journal of Research Publication and Reviews, 3(12), 696-698. Researchgate

13. Dewangan, S. K., Namrata, Poonam, & Shivlochani. (2015). Analysis of Physico-Chemical Properties of Water Taken From Upka Water Source, Bishrampur, Surguja District of Chhattisgarh, India. International Journal of Innovative Research in Engineering, 3(6), 192-194. Researchgate
14. Dewangan, S. K., Saruta, S., & Sonwani, P. (2022). Study the Physio-Chemical Properties of hot water source of Pahad Karwa, Wadraf Nagar, Sarguja division of Chhattisgarh, India. International Journal of Creative Research Thoughts - IJCRT, 9(10), 279-283.Researchgate
15. Dewangan, S. K., Shrivastava, S. K., Haldar, R., Yadav, A., Giri, V. (2023). Effect of Density and Viscosity on Flow Characteristics of Water: A Review. International Journal of Research Publication and Reviews, 4(6), 1982-1985. Researchgate.
16. Dewangan, S. K., Shrivastava, S. K., Tigga, V., Lakra, M., Namrata, Preeti. (2023). REVIEW PAPER ON THE ROLE OF PH IN WATER QUALITY IMPLICATIONS FOR AQUATIC LIFE, HUMAN HEALTH, AND ENVIRONMENTAL SUSTAINABILITY. International Advanced Research Journal in Science, Engineering and Technology, 10(6), 215-218. Researchgate.
17. Dewangan, S. K., Shukla, N., Pandey, U., Kushwaha, S., Mistry, A., Kumar, A., Sawaiyan, A. (2022). Experimental Investigation of Physico-Chemical Properties of Water taken from Bantidand River, Balrampur District, Surguja Division of Chhattisgarh, India. International Journal of Research Publication and Reviews, 3(12), 1723-1726. Researchgate
18. Dewangan, S. K., Tigga, P., Kumar, N., & Shrivastava, S. K. (2023). Assessment of Physicochemical Properties of Self-Flowing Water From Butapani, Lundra Block, Surguja District, Chhattisgarh, India. IJSART, 9(11). Researchget
19. Dewangan, S. K., Tigga, V., Lakra, M., & Preeti. (2022). Analysis of Physio-Chemical Properties of Water Taken from Various Sources and Their Comparative Study, Ambikapur, Sarguja Division of Chhattisgarh, India. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 10(11), 703-705. Researchgate
20. Dewangan, S. K., Toppo, D. N., Kujur, A. (2023). Investigating the Impact of pH Levels on Water Quality: An Experimental Approach. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 11(IX), 756-760. Researchgate.
21. Dewangan, S. K., Yadav, K., Shrivastava, S. K. (2023). The Impact of Dielectric Constant on Water Properties at Varied Frequencies: A Systematic Review. International Journal of Research Publication and Reviews, 4(6), 1982-1985. Researchgate.
22. Dewangana, S. K., Minj, D., Paul, A. C., & Shrivastava, S. K. (2023). Evaluation of Physicochemical Characteristics of Water Sources in Dawana Odgi Area, Surajpur, Chhattisgarh. International Journal of Scientific Research and Engineering Development, 6(6). Rsearchget.
23. Dewangan, S. K., Chaohan, B. R., Shrivastava, S. K., & Shrivastava, A. K. (2023). Comparative Characterization of Water Source Flowing in Ultapani Drain and Water Samples of other nearby Sources. *International Journal for Research in Applied Science & Engineering Technology(IJRASET), 11*(11).

24. Dewangan, S. K., Toppo, D. N., & Kujur, A. (2023). Investigating the impact of pH levels on water quality: an experimental approach. *International Journal for Research in Applied Science and Engineering Technology*, *11*(9), 756-759.
25. Dewangan, S. K., Soni, A. K., & Sahu, K. (2022). STUDY THE PHYSICO-CHEMICAL PROPERTIES OF ROCK SOIL OF SANGAM RIVER, WADRAFNAGAR, SURGUJA DIVISION OF CHHATTISGARH, INDIA. *measurements*, *2*, 3.
26. Dewangan, S. K., Shrivastava, S. K., Soni, A. K., Yadav, R., Singh, D., Sharma, G. K., ... & Sahu, K. (2023). Using the Soil Texture Triangle to Evaluate the Effect of Soil Texture on Water Flow: A Review. *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, *11*(6), 389-390.
27. Dewangan, S. K., Sahu, K., Tirkey, G., Jaiswal, A., Keshri, A., Kumari, N., ... & Gautam, S. (2022). Experimental Investigation of Physico-Chemical Properties of Soil taken from Bantidand Area, Balrampur District, Surguja Division of Chhattisgarh, India. *measurements*, *3*, 4.
28. Dewangan, S. K., Gupta, K., Paul, A. C., & Shrivatava, S. K. Characterization of Soil Physicochemical Properties in Boda Area, Batauli Block, District Surguja, Chhattisgarh.
29. Dewangan, S. K., Shukla, N., Pandey, U., Kushwaha, S., Mistry, A., Kumar, A., & Sawaiyan, A. (2022). Experimental Investigation of Physico-Chemical Properties of Water taken from Bantidand River, Balrampur District, Surguja Division of Chhattisgarh, India. *International Journal of Research Publication and Reviews*, *3*(12), 1723-1726.
30. Dewangan, S. K., Shukla, N., Pandey, U., Kushwaha, S., Mistry, A., Kumar, A., & Sawaiyan, A. (2022). Experimental Investigation of Physico-Chemical Properties of Water taken from Bantidand River, Balrampur District, Surguja Division of Chhattisgarh, India. *International Journal of Research Publication and Reviews*, *3*(12), 1723-1726.
31. Dewangan, S. K., Saruta, S., & Sonwani, P. (2022). Study the Physio-Chemical Properties of hot water source of Pahad Karwa, Wadraf Nagar, Sarguja division of Chhattisgarh, India. *International Journal of Creative Research Thoughts-IJCRT*, *9*(10), 279-283.
32. Dewangan, S. K., Minj, A. K., & Yadav, S. (2022). Study the Physico-Chemical Properties of Soil of Bouncing Land Jaljali Mainpat, Surguja Division of Chhattisgarh, India. *International Journal of Creative Research Thoughts*, *10*(10), 312-315.