Analysis of Physico-chemical Parameters of Godavari River of Nashik District, Maharashtra, India

Mrs. Sonali Ramesh Deore
Department of Zoology, M. S. G. College , Malegaon, Maharashtra, India.Savitribai Phule Pune University, Pune.

***Abstract*—This study assessed the water quality of the Godavari River by comparing urban (Eklahre) and rural (Odha) sampling sites. Using WHO standards, researchers tested five blocks for pH, conductivity, TDS, and total hardness. The analysis revealed that urban water samples have higher mineral content and hardness than rural ones, though all samples maintained a neutral pH. Ultimately, the study confirms that all physico-chemical parameters are within safe, acceptable limits, even though urban areas show a higher impact on water composition.**

***Index Terms*—Total hardness, nutrients, physico-chemical analysis, water samples, TH, TDS, COD, and BOD.**

I. INTRODUCTION

Water is the fundamental pillar of human existence and the survival of all living organisms. Beyond biological necessity, freshwater is a critical driver of food production, industrial operations, and socioeconomic development. Despite its vital importance, access to potable water remains a significant challenge; according to the World Health Organization (WHO), approximately 65% of the rural Indian population and 36% of urban residents lack access to safe drinking water.

The integrity of groundwater resources is inextricably linked to the surrounding environmental conditions. As noted by Gurunathan (2006), human-induced landscape modifications significantly alter watershed hydrology. In recent decades, the dual pressures of rapid urbanization and industrial expansion have placed unprecedented stress on these systems. In rural regions where alternative sources—such as rivers, dams, or canals—are scarce, groundwater serves as the primary lifeline for both domestic use and agriculture.

However, the proliferation of human activity and the discharge from thermal power plants have led to a marked deterioration in water quality. This contamination is not merely an environmental concern but a direct threat to public health. The rising incidence of water-borne diseases underscores the urgent need to understand aquatic environmental chemistry, including the origin, composition, and reactive pathways of pollutants in the water supply. Because water quality is a primary determinant of human well-being, systematic physico-chemical analysis is essential to mitigate health risks and ensure the sustainable management of this finite resource.

II. MATERIALS AND METHODS

2.1 Sampling and Field Measurements

Water samples were collected from four distinct locations during the morning hours (09:00 to 11:00 AM) during the year 2024-2025 to ensure consistency in diurnal variations. Samples were gathered in pre-cleaned polyethylene bottles. To minimize chemical alterations, the samples were immediately transported to the laboratory for analysis. In-situ measurements of water temperature and pH were conducted using a mercury thermometer and a calibrated digital pH meter (Systronics), respectively.

2.2 Instrumental Analysis

The physical properties of the water were quantified using digital instrumentation:

- Electrical Conductivity (EC): Determined using a digital conductivity meter to assess ionic concentration.
- Total Dissolved Solids (TDS): Measured via a digital TDS meter.
- Alkali Metals: Concentrations of Sodium (Na^+) and Potassium (K^+) were determined using Flame Photometry.

2.3 Chemical Characterization

Quantitative analysis of the remaining chemical constituents was performed following standard analytical procedures. The concentrations of Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Chloride (Cl^-), Sulphate (SO_4^{2-}), Nitrate (NO_3^-), and Manganese (Mn^{2+}) were estimated according to established laboratory protocols. All methodologies and quality control measures were aligned with standard scientific techniques as prescribed by APHA (1985) and Trivedy and Goel (1986).

Table 1: Water sample physical characteristics of Odha and Eklahare

	PH	Conductivity	TDS	Odour	Temperature
Odha	6.98	0.52	384	0	30
Eklahare	6.79	0.54	389	0	32

Figure 1: Graphical representation of physical properties

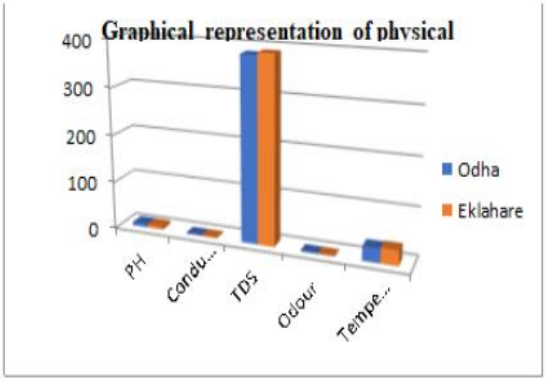
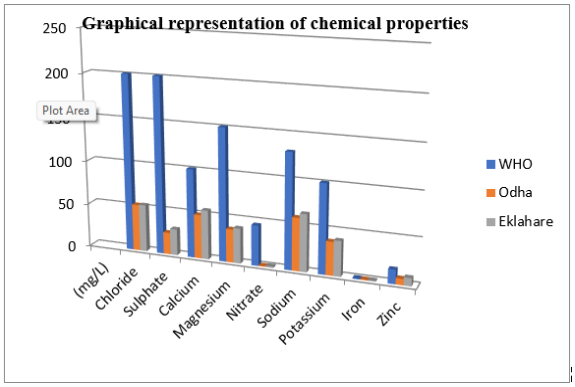


Table 2: Water sample chemical characteristics of Odha and Eklahare

Chemical property (mg/L)	WHO	Odha	Eklahare
Chloride	201	53.2	53.8
Sulphate	201	25	30
Calcium	101	50	56
Magnesium	151	38	40
Nitrate	46	1.0	1.5
Sodium	131	60	65
Potassium	101	38	40
Iron	1.1	0.78	0.85
Zinc	16	7	9

Figure 1: Graphical representation of Chemical properties



III. RESULTS AND DISCUSSION

3.1 Physico-Chemical Analysis

The analysis of the Godavari River water samples revealed a stable chemical environment throughout the study period. The pH values exhibited minimal fluctuation, ranging from 6.9 to 7.5, which falls within the neutral to slightly alkaline range ideal for aquatic ecosystems.

A consistent upward trend was observed in salinity, specific conductance, turbidity, and total hardness when comparing Sample 1 to Sample 2. This

correlation suggests an increase in dissolved ionic concentrations and suspended matter at specific sampling points, likely influenced by localized runoff or urban discharge.

3.2 Organic Load and Biological Activity

The Biological Oxygen Demand (BOD) consistently remained below 3 mg/L across all sampling sites. This low BOD value indicates that the organic load is minimal and that microbial respiration is within typical, healthy limits for a river system.

Interestingly, while the chemical profile remained within safe limits, Sample 1 and Sample 2 exhibited higher levels of Gram-positive bacterial activity. This localized increase in microbial presence suggests that while the water is free from hazardous chemical pollution, it may be subject to specific organic inputs that favor bacterial growth in those blocks.

3.3 Summary of Water Quality

The integrated assessment of physico-chemical and chemical characteristics indicates that the study area is currently free from hazardous chemical contamination. The primary productivity in various regions appears to be regulated by these fluctuating physico-chemical factors. According to the current analysis, the water quality remains within acceptable parameters for general use, though the elevated bacterial activity in specific samples warrants continued monitoring.

IV. CONCLUSION

The present study provides a comparative assessment of the physico-chemical characteristics of water sources in both urban and rural blocks. The investigation reveals that while essential mineral levels—specifically Sodium (Na^+), Calcium (Ca^{2+}), and Magnesium (Mg_2^+)—remain well within the permissible limits established by the World Health Organization (WHO), there is a distinct spatial variation in their distribution.

Urban water sources consistently demonstrated higher concentrations of dissolved ions compared to rural samples, suggesting a higher mineral availability in urban supplies. Despite this higher ionic load, urban water was found to be "softer" than rural water. In contrast, the rural samples exhibited total hardness levels between 70 and 80 mg/L, classifying them as moderately hard. These results align with previous observations by Pandey [14], Trivedy [15], and Kedar [16], who noted similar trends in varying geographical contexts.

Based on the analysis of pH, EC, TDS, and various ionic concentrations ($Ca^{2+,}$ Mg_2^+, Cl^-, NO_3^-, SO_4^{2-}, Fe^{2+}, and Zn^{2+}), both sources are considered chemically safe for consumption. However, the distinct hydro-geochemical profiles suggest that the water quality is influenced by localized soil compositions and anthropogenic factors.

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