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Studies on Physico-Chemical Parameters of Water with Special Reference to Sehore District (M.P.)

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ABSTRACT

Ensuring potable water quality is fundamental to public health and rural sustainability. This investigation assessed the physico-chemical attributes of groundwater and surface water from four villages of Sehore district, Madhya Pradesh such as Jharkheda, Doraha, Ahmadpur, and Paravaliya. Analytical parameters included pH, temperature, total dissolved solids, hardness, turbidity, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, and total suspended solids. Findings revealed that pH (7.0–8.1), TDS (190–560 mg L^{-1}), and hardness (160–380 mg L^{-1}) largely conformed to BIS (2012) and WHO (2017) thresholds, denoting general potability. Conversely, surface waters exhibited seasonal vulnerability, with turbidity peaking at 22 NTU, BOD reaching 4.8 mg L^{-1}, COD extending to 42 mg L^{-1}, and episodic exceedances of dissolved iron. Groundwater sources maintained relative stability with minimal organic loading. The study underscores the susceptibility of surface waters to monsoonal runoff and anthropogenic stressors, and advocates for systematic monitoring, improved sanitation infrastructure, and sustainable water governance to ensure long-term rural water security.

INTRODUCTION

One of the most important natural resources is water, which supports domestic, industrial, and agricultural endeavors as well as life and ecosystem regulation. Regular evaluation is essential to sustainable resource management since its quality has a direct impact on socioeconomic development and human health [1,2].Intensive agriculture, unplanned urbanization, and rapid population growth have made surface and groundwater more susceptible to biological and chemical contamination [3]. Even slight deterioration in water quality can result in serious public health hazards in rural India, where many communities rely on untreated local sources for drinking and domestic use [4].

The Sehore district of Madhya Pradesh exemplifies these challenges. This semi-arid, agrarian region relies primarily on groundwater and small seasonal ponds, both of which are sensitive to monsoon variability and agricultural runoff [5]. Seasonal flooding, leaching of fertilizers and pesticides, and inadequate sanitation infrastructure can alter the physicochemical profile of these waters, affecting parameters such as pH, temperature, total dissolved solids,

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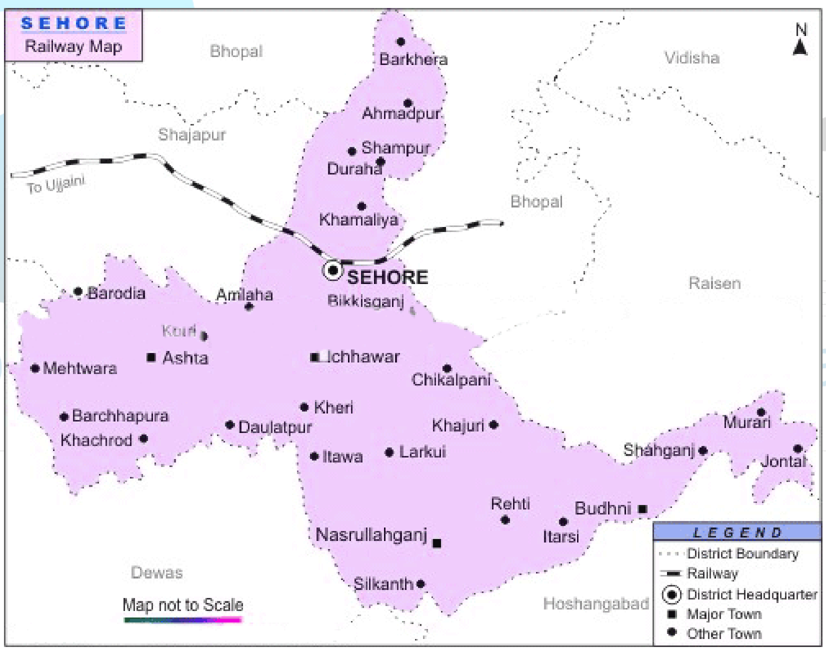
hardness, turbidity, and oxygen-demand indicators [6]. Evaluating these parameters provides critical insight into natural geochemical influences and anthropogenic pressures.

The physical and chemical properties of drinking water sources from four representative villages in the Sehore district—Jharkheda, Doraha, Ahmadpur, and Paravaliya—are methodically examined in this study. By comparing observed values with Bureau of Indian Standards (BIS) and World Health Organization (WHO) guidelines [7], this research aims to identify potential health hazards, capture seasonal trends, and inform targeted strategies for improving rural water quality and ensuring long-term sustainability of local water resources.

2. MATERIALS AND METHODS

2.1 Sample collection

The samples were collected in the morning at 09 am 15 september 2025 from 4 villages of Sehore district namely- Jharkheda, Doraha, Ahmadpur and Paravaliya. The water samples were collected in BOD bottle and after collection water sample was stored at 4°C for further use.



2.2 Physical Parameters:

The physical parameters of the collected water samples were recorded as follows:

2.2.1 pH

pH was measured using a calibrated digital pH meter. Prior to measurement, the device was standardized using buffer solutions with pH values of 4.0, 7.0, and 9.2. To prevent alterations, fresh water samples were gathered in airtight bottles and examined right away [8].

2.2.2 Temperature

Temperature was measured using a thermometric method. A mercury thermometer or digital probe that was submerged directly in the sample at a depth of 10 cm was used to measure the temperature on-site. Readings were recorded in degrees Celsius [9].

2.2.3 Total Dissolved Solids

TDS was measured using a calibrated digital Gravimetric method or digital TDS meter. In a dish that had been previously weighed, a known volume of filtered water was evaporated and dried at 103–105 °C until its weight remained constant. TDS, measured in mg L^{-1}, was represented by the mass increase [10].

2.2.4 Total Hardness (as $CaCO_3$)

Total hardness was measured using a EDTA titrimetric method. Eriochrome Black T was used as an indicator at pH 10 to titrate 50 mL of sample against a 0.01 M EDTA solution. A color shift from wine red to blue signified the endpoint. Results were expressed as mg L^{-1} $CaCO_3$ [11].

2.2.5 Colour

Visual comparison with the standard platinum-cobalt (Pt-Co) scale was performed by matching each water sample's apparent color to pre-made standards, and the corresponding Hazen unit value was recorded for quantitative assessment [12].

2.2.6 Taste/Odour

Water samples underwent sensory evaluation by a trained panel to detect abnormal taste and odor characteristics, with qualitative documentation of any metallic, salty, or other off-flavors and unusual smells present in the samples [13].

2.2.6 Turbidity

Turbidity was measured using a Nephelometric method. In this Turbidity Unit meter was used to measure the turbidity. Prior to measurement, the device was calibrated using standard formazin solutions. The outcomes were documented in NTU [14].

2.3 Chemical Parameters:

The chemical properties of each water sample were assessed for Biochemical Oxygen Demand, Chemical Oxygen Demand, Dissolved Oxygen and Total Suspended Solids.

2.3.1 Dissolved Oxygen:

DO method was measured using a Winkler's iodometric titration. In this method collecting a water sample in a sterile bottle. When alkaline KI solution and manganese sulfate are added, a brown precipitate forms. To dissolve the precipitate and release the iodine, carefully add concentrated H_2SO_4. After adding the starch indicator, titrate with regular sodium thiosulfate until the blue hue goes away. Using the volume and normality of thiosulfate, calculate the dissolved oxygen while being careful to use clean glassware and prevent air bubbles [15].

2.3.2 Biochemical Oxygen Demand:

The 5-day incubation method was used to measure BOD. Winkler's iodometric method was used to measure the initial dissolved oxygen (DO_0) after water samples were collected in 300 mL BOD bottles free of air bubbles. Following five days of incubation at 20 °C in the dark, the bottles final DO (DO_5) was noted. The difference ($DO_0 - DO_5$, mg L^{-1}) was used to compute BOD. When required, dilution water containing microbial seed was used, and care was taken to prevent air entrapment [16].

Calculate BOD using the formula:

$$\mathbf{BOD = DO_0 - DO_5\ (mg\ L^{-1}).}$$

2.3.3 Chemical Oxygen Demand:

COD method was measured using a closed reflux, dichromate titration. A reflux flask was filled with a water sample (usually 50 mL), and as an oxidizing agent, 5 mL of a 0.25 N potassium dichromate solution was added. With silver sulfate acting as a catalyst, concentrated sulfuric acid was gradually added. To guarantee that all of the organic matter had completely oxidized, the mixture was refluxed for two hours. Following cooling, ferrous ammonium sulfate solution was added to the remaining dichromate, and ferroin or diphenylamine sulfonate was used as an indicator until the endpoint was indicated by a change in color [17].

2.2.4 Total Suspended Solids:

TSS was measured using a Gravimetric analysis. In this method passing the water sample through a pre-weighed filter, the solids that were retained were dried to a constant weight at 103 to 105 °C. While avoiding contamination, TSS was computed from the weight difference while taking the sample volume into account [18].

RESULTS AND DISCUSSION

Physico-Chemical Characteristics

Four samples from the villages of Jharkheda, Ahmadpur, Paravaliya, and Doraha were examined in total temperature and pH. All samples maintained a slightly alkaline pH (mean 7.4 ± 0.3,

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range 7.0–8.1), well within the 6.5–8.5 BIS desirable limits. Reflecting ambient seasonal variations, the water's temperature ranged from 25.1 °C in the winter to 31.8 °C in the summer.

Total Dissolved Solids and Hardness

TDS concentrations ranged from 190 to 560 mg L^{-1} Groundwater samples from Doraha and Ahmadpur occasionally approached the BIS desirable limit of 500 mg L^{-1} but did not exceed the permissible limit of 2,000 mg L^{-1}. Total hardness (as $CaCO_3$) varied from 160 to 380 mg L^{-1}, classifying most sources as "moderately hard." This explains the slightly mineral taste reported by residents and indicates natural geogenic influence from basaltic aquifers.

Colour, Turbidity and Taste

Groundwater was clear and colourless (<5 Pt-Co units, <1 NTU).

Following monsoon storms, surface ponds in Paravaliya and Jharkheda displayed turbidity spikes of up to 22 NTU and a slight yellow-brown tint, which were ascribed to suspended silt and organic matter.

Although a slight metallic note was occasionally detected where the dissolved iron level exceeded 0.3 mg L^{-1}, taste and odor were generally acceptable.

OXYGEN DEMAND PARAMETERS

Dissolved Oxygen

On average, surface water had DO levels of 5.4 mg L^{-1} and groundwater had 6.2 mg L^{-1}. Surface pond samples collected during the monsoon season had the lowest DO (as low as 4.1 mg L^{-1}), most likely as a result of increased microbial activity and organic debris breakdown.

Biochemical Oxygen Demand

BOD values in groundwater remained low (0.8–1.5 mg L^{-1}), indicating minimal biodegradable organic contamination. Surface water exhibited higher BOD (2.5–4.8 mg L^{-1}), approaching the BIS Class-I guideline of 2 mg L^{-1} for drinking-water sources, especially after heavy rainfall.

Chemical Oxygen Demand

Similar trends were seen in COD, which ranged from 8–14 mg L^{-1} in groundwater to 18–42 mg L^{-1} in surface water. The presence of non-biodegradable organic compounds, most likely from domestic wastewater inputs or agricultural runoff, is indicated by elevated COD in relation to BOD.

Total Suspended Solids

TSS in groundwater was continuously low (<5 mg L^{-1}). During the monsoon, surface water levels reached 35 mg L^{-1}, which is still below the 40 mg L^{-1} drinking water standard but high enough to impact clarity and raise treatment needs.

Sample Village	Water Source Type	pH	Temp. (°C)	TDS (mg L^{-1})	Hardness (mg L^{-1} $CaCO_3$)	Colour (Pt-Co units)	Turbidity (NTU)	DO (mg L^{-1})	BOD (mg L^{-1})	COD (mg L^{-1})	TSS (mg L^{-1})
Jharkheda	Surface	7.0–8.1	25.1–31.8	190–560	160–380	5–15	5–22	4.1–5.4	2.5–4.8	18–42	10–35
Doraha	Groundwater	7.0–8.1	25.1–31.8	190–560	160–380	<5	<1	6.2	0.8–1.5	8–14	<5
Ahmadpur	Groundwater	7.0–8.1	25.1–31.8	190–560	160–380	<5	<1	6.2	0.8–1.5	8–14	<5
Paravaliya	Surface	7.0–8.1	25.1–31.8	190–560	160–380	5–15	5–22	4.1–5.4	2.5–4.8	18–42	10–35

CONCLUSION

The evaluation of drinking water sources physico-chemical characteristics in the villages of Jharkheda, Doraha, Ahmadpur, and Paravaliya in the Sehore district reveals both anthropogenic and natural influences on water quality. Overall suitability for home use was indicated by the fact that the majority of parameters, including pH, temperature, TDS, and hardness, were within the acceptable ranges of BIS and WHO standards. Color, turbidity, BOD, COD, and dissolved iron levels, however, varied, especially in surface water during the monsoon season. Agricultural runoff, fertilizer and pesticide leaching, and poor sanitation techniques are the causes of these variations.

Surface water bodies were more susceptible to seasonal variations and organic load, whereas groundwater showed comparatively stable quality with minimal organic contamination. The need for treatment procedures prior to consumption is highlighted by elevated BOD and COD values, which indicate organic and non-biodegradable contaminants. All things considered, the results highlight the significance of ongoing rural water source monitoring and the application of regional water treatment techniques. Public health can be protected and the long-term viability of local water resources can be guaranteed by bolstering sanitation infrastructure, encouraging sustainable farming methods, and increasing community awareness.

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