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Seasonal Assessment of Organic Pollution Using DO–BOD–COD in the Water Sources of Budni Tehsil, District Sehore, M.P., India

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Abstract: The seasonal assessment of organic pollution was conducted using Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), and Biological Oxygen Demand (BOD) in surface and subsurface water samples collected from 24 villages during Kharif and Rabi seasons (2022–2023). The results show noticeable seasonal variation influenced by agricultural activities, rainfall patterns, and hydrological conditions. DO levels ranged from 6.4–6.9 mg/L in Kharif and increased to 6.9–7.3 mg/L in Rabi, indicating better oxygenation during post-monsoon conditions. In contrast, COD values were higher in Rabi (13.2–16.0 mg/L) compared to Kharif (11.8–14.8 mg/L), suggesting increased chemical oxidation due to the accumulation of organic and inorganic residues. BOD levels also showed higher concentrations in Rabi (3.2–4.1 mg/L) than in Kharif (2.8–3.5 mg/L), reflecting intensified microbial activity and organic matter degradation. Overall, the integrated DO–BOD–COD assessment reveals moderate organic pollution across the villages, with Rabi season showing comparatively higher organic load. This study highlights the need for regular monitoring and improved management strategies to prevent organic pollution in rural water sources.

Keywords: *Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Organic Pollution, Seasonal Variation, Water Quality Assessment, Rural Water Sources, Budni Tehsil.*

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I. INTRODUCTION

Water quality plays a vital role in sustaining human health, agricultural productivity, and ecological balance, particularly in rural regions where communities depend directly on natural water sources. Rural water bodies are often exposed to various pollutants originating from agricultural runoff, domestic wastewater, livestock activities, and seasonal hydrological changes. Among different types of pollutants, organic pollution is one of the most significant because it directly influences the biological and chemical characteristics of water.

To evaluate organic contamination, three major physico-chemical indicators are widely used—Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD). DO represents the amount of oxygen available for aquatic organisms and is a key indicator of water quality. BOD measures the oxygen consumed by microorganisms during the decomposition of organic matter, whereas COD estimates the chemically oxidizable organic and inorganic substances present in water. Together, these parameters provide a comprehensive understanding of the organic load and its impact on water bodies.

Seasonal variation greatly influences water quality in rural areas. During the Kharif season, increased rainfall and runoff transport organic and inorganic materials into water bodies, while in the Rabi season, reduced water flow and evaporation may lead to the concentration of pollutants. Understanding these seasonal changes is essential for accurate water quality assessment and for developing strategies to protect rural water resources.

Budni Tehsil is an agriculturally dominated region where water sources are highly vulnerable to contamination from field activities and household effluents. Therefore, assessing DO, BOD, and COD in this area is crucial to determine the extent of organic pollution and its seasonal fluctuations. The present study evaluates these parameters in water samples collected from 24 villages of Budni Tehsil during Kharif and Rabi seasons (2022–2023), providing

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valuable insights into the environmental status and sustainability of rural water sources.

II. REVIEW OF LITERATURE

Water quality assessment using physico-chemical indicators has been widely studied across different regions to evaluate the impact of organic pollution on surface and groundwater**.** Dissolved Oxygen (DO) is considered a primary indicator of ecological health because it reflects the balance between oxygen consumption and production processes. According to WHO (2017), DO levels below 5 mg/L can stress aquatic organisms and indicate organic pollution.

Biochemical Oxygen Demand (BOD) has been used extensively to measure the oxygen required for microbial degradation of organic matter. Trivedi and Goel (1986) highlighted BOD as one of the most reliable parameters for determining biodegradable organic load in natural waters. Likewise, BIS (2012) recommends that BOD values should remain below 2 mg/L for drinking water sources.

Chemical Oxygen Demand (COD) is a strong indicator of both biodegradable and non-biodegradable organic substances. APHA (2017) standardized the COD determination methods and emphasized its utility in evaluating chemically oxidizable pollutants in rural and agricultural regions. Studies conducted by Sharma and Meena (2021) and Singh & Verma (2019) also reported significant increases in COD values during agricultural activity seasons due to fertilizer and pesticide runoff.

Seasonal variation is another important factor influencing water quality. Research by Yadav & Kumar (2020) found that monsoon runoff typically increases organic and inorganic load in rural water bodies during the Kharif season, whereas pollutant concentration increases during Rabi due to reduced dilution and stagnation.

Previous studies consistently indicate that DO decreases with rising organic load, while BOD and COD increase correspondingly. This integrated DO–BOD–COD relationship is widely accepted as a robust framework for assessing organic contamination in rural and agricultural landscapes.

III. MATERIALS AND METHODS

➢ *Study Area*

The study was conducted in Budni Tehsil, a rural and agriculturally dominant region where water sources are highly influenced by seasonal activities and environmental conditions. A total of 24 villages were selected, covering both surface and subsurface water sources including ponds, wells, tube wells, hand pumps, and small streams.

➢ *Sample Collection*

Water samples were collected during two major agricultural seasons:

- Kharif (Monsoon)
- Rabi (Winter/Post-Monsoon)

Sterilized airtight sampling bottles were used to prevent contamination and oxygen loss. Samples were stored in iceboxes and transported to the laboratory for analysis within 24 hours.

➢ *Parameters Analysed*

Table 1 The Following Key Organic Pollution Indicators were Measured

Parameter	Purpose	Method Used	Reference
Dissolved Oxygen (DO)	Indicates oxygen availability	Winkler iodometric method	APHA (2017)
Biochemical Oxygen Demand (BOD)	Measures microbial oxygen demand	5-day incubation at 20°C	APHA (2017)
Chemical Oxygen Demand (COD)	Measures oxidizable organic matter	Closed reflux titrimetric method	APHA (2017)

➢ *Data Interpretation*

The collected data for DO, BOD, and COD from 24 villages of Budni Tehsil during Kharif and Rabi seasons were interpreted by comparing them with national and international water quality standards such as BIS (2012) and WHO (2017). Seasonal comparison was carried out to identify variations in organic pollution levels. In general, DO showed higher values during the Rabi season, indicating improved aeration and reduced microbial activity, whereas slightly lower DO values during Kharif suggested increased organic load due to monsoon runoff. On the other hand, BOD and COD exhibited an opposite trend, with higher values in the Rabi season, reflecting the accumulation of organic matter and reduced dilution during the dry period. Village-wise analysis revealed moderate organic pollution across most locations, with certain sites exhibiting comparatively higher COD and BOD concentrations. Overall, the integrated interpretation of DO–BOD–COD patterns helped classify the water sources into good, moderate, and highly polluted categories based on standard pollution limits, providing a clear understanding of seasonal influences and the extent of organic contamination in Budni Tehsil.

IV. RESULTS AND DISCUSSION

The analysis of Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) in the surface and subsurface water samples of 24 villages in Budni Tehsil reveals clear seasonal variations and the influence of local environmental and agricultural activities. The results are summarized below.

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➢ *Dissolved Oxygen (DO)*

DO values during the Kharif season ranged between 6.4–6.9 mg/L, while during the Rabi season, the values increased to 6.9–7.3 mg/L across different villages. This increase in DO during Rabi may be attributed to lower temperatures and reduced microbial activity, which together enhance oxygen retention in water. Higher DO in Rabi also indicates improved aeration and reduced organic decomposition. On the other hand, slightly lower DO in Kharif suggests greater organic load carried by monsoon runoff, which increases microbial oxygen demand.

➢ *Biochemical Oxygen Demand (BOD)*

BOD values showed a consistent seasonal trend, being higher in Rabi (3.2–4.1 mg/L) compared to Kharif (2.8–3.5 mg/L). The increased BOD in Rabi indicates greater microbial decomposition of accumulated organic matter due to stagnant water conditions and reduced dilution. During Kharif, rainfall improves the dilution capacity of water bodies, thereby slightly lowering BOD values. However, in both seasons, BOD levels exceed the BIS limit of 2 mg/L, indicating the presence of organic pollution in most sampled locations.

➢ *Chemical Oxygen Demand (COD)*

COD values during Kharif were recorded between 11.8–14.8 mg/L, while in Rabi, they rose to 13.2–16.0 mg/L. COD values higher in Rabi season reflect the accumulation of chemically oxidizable organic and inorganic matter due to limited water flow and evaporation. Agricultural activities, including fertilizer and pesticide use, likely contribute to higher COD levels during the post-monsoon period. In several villages such as Sudania, Baktra, and Itarsi, COD values reached close to or above 15 mg/L, indicating moderate levels of chemical pollution.

➢ *DO–BOD–COD Relationship*

A strong inverse relationship was observed between DO and BOD/COD. Villages showing higher BOD and COD values exhibited lower DO, confirming the impact of organic load on oxygen depletion. COD values were consistently higher than BOD across all villages, indicating the presence of both biodegradable and non-biodegradable organic matter. The DO–BOD–COD pattern suggests ongoing organic contamination from agricultural runoff, domestic wastewater, and livestock operations.

➢ *Seasonal Interpretation*

The comparison of both seasons shows: Kharif: Lower BOD and COD due to dilution by rainwater and increased water flow. Rabi: Higher BOD and COD due to concentration of pollutants and reduced dilution. Thus, Rabi season exhibits relatively higher organic pollution in almost all villages. Overall Pollution Status The combined analysis of DO, BOD, and COD indicates that most water sources in Budni Tehsil fall under the moderately polluted category. Higher BOD and COD values during the Rabi season reflect increased organic load, while slightly lower DO levels during Kharif indicate the influence of monsoon runoff. Although DO remain within acceptable limits, the elevated BOD and COD suggest ongoing organic contamination in several villages. Overall, the seasonal patterns confirm persistent organic pollution in the rural water sources of the region.

Table 1: Seasonal Variation in Average DO, BOD and COD Values of Surface and Subsurface Water Samples from 24 Villages of Budni Tehsil (2022–2023)

ST	Village	Season	DO (mg/L)	COD (mg/L)	BOD (mg/L)
01	Budni	Kharif	6.8	12.5	3.2
		Rabi	7.2	14.0	3.8
02	Amon	Kharif	6.9	12.0	3.0
		Rabi	7.0	13.6	3.5
03	Akola	Kharif	6.6	13.8	3.3
		Rabi	7.1	15.2	3.9
04	Sudania	Kharif	6.7	14.5	3.4
		Rabi	7.0	16.0	4.0
05	Jawahar Kheda	Kharif	6.8	11.8	2.8
		Rabi	7.3	13.2	3.2
06	Bisakhedi	Kharif	6.5	13.0	3.0
		Rabi	7.0	15.0	3.7
07	Hoda	Kharif	6.9	12.5	3.1
		Rabi	7.2	13.8	3.6
08	Baktra	Kharif	6.4	14.2	3.5
		Rabi	6.9	16.0	4.1
09	Bagwada	Kharif	6.7	13.4	3.2
		Rabi	7.1	15.0	3.9
10	Dungaria	Kharif	6.6	12.8	3.1
		Rabi	7.0	14.5	3.8
11	Holipura	Kharif	6.8	13.2	3.3
		Rabi	7.3	14.8	3.9

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12	Dobi	Kharif	6.5	12.0	2.9
		Rabi	6.9	13.2	3.3
13	Sudon	Kharif	6.9	14.8	3.5
		Rabi	7.2	15.6	3.9
14	Ukai	Kharif	6.8	13.5	3.4
		Rabi	7.0	14.8	3.7
15	Murai	Kharif	6.6	13.2	3.2
		Rabi	7.1	14.0	3.6
16	Talpura	Kharif	6.7	13.5	3.3
		Rabi	7.0	14.8	3.7
17	Joshipur	Kharif	6.8	14.0	3.5
		Rabi	7.1	15.2	3.9
18	Narayanpur	Kharif	6.7	13.2	3.2
		Rabi	7.0	14.5	3.7
19	Pipaliya Kharra	Kharif	6.6	12.8	3.0
		Rabi	6.9	14.0	3.5
20	Sankhedi	Kharif	6.5	13.6	3.4
		Rabi	7.0	15.0	3.9
21	Chikli	Kharif	6.9	13.4	3.2
		Rabi	7.3	15.2	3.8
22	Mokodia	Kharif	6.8	13.0	3.1
		Rabi	7.0	14.0	3.5
23	Itarsi	Kharif	6.7	14.2	3.4
		Rabi	7.1	15.6	3.9
24	Gonda Kheda	Kharif	6.6	13.8	3.3
		Rabi	7.0	15.4	3.8

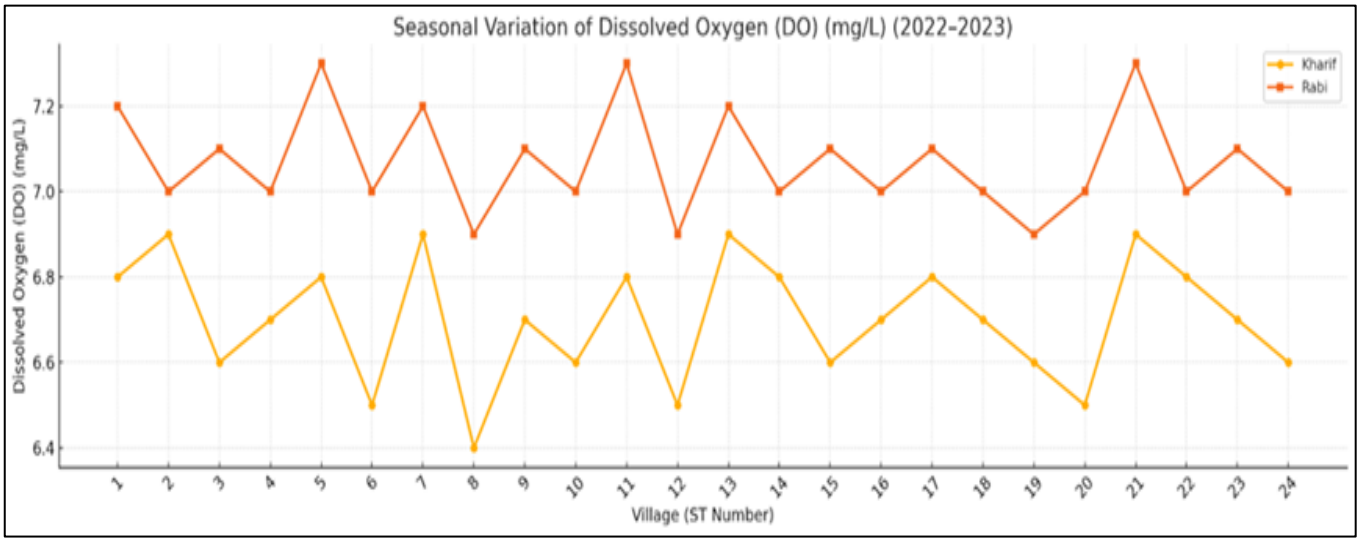

Fig 1: Seasonal Variation of Oxygen Demand (DO) in Swater Samples of 24 Villages of Budni Tehsil During 2022–2023.

The Figure 1 compares DO concentrations between Kharif and Rabi seasons, indicating higher DO levels in Rabi due to lower temperature and higher oxygen solubility.

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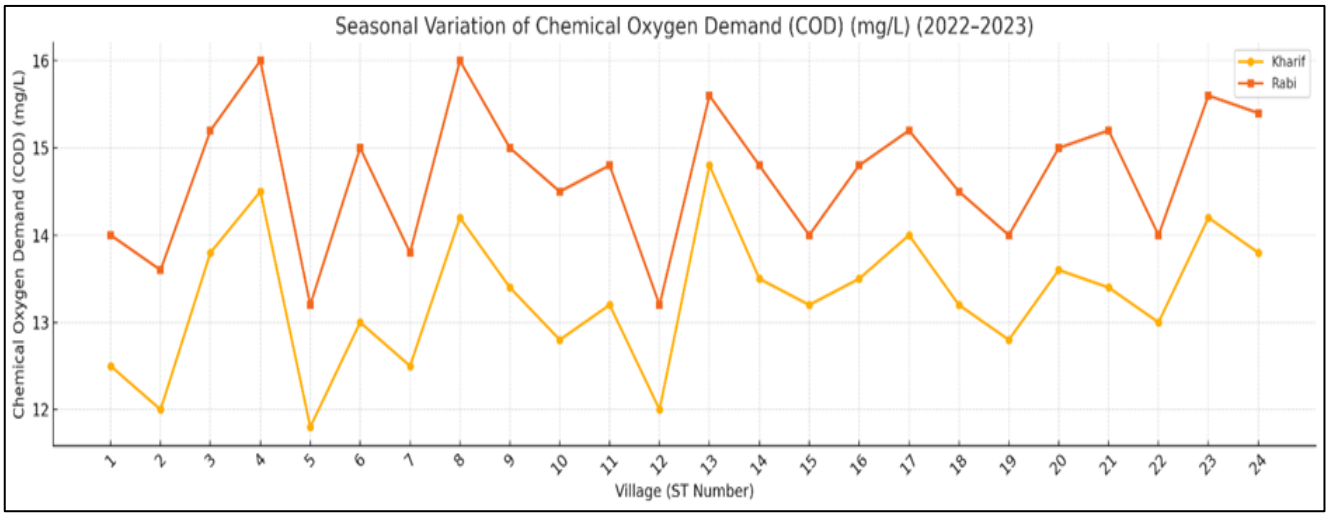

Fig 2: Seasonal variation of Chemical Oxygen Demand (COD) in Swater Samples of 24 Villages of Budni Tehsil During 2022–2023.

Figure 2 COD values show increased organic and chemical load during the Rabi season, reflecting enhanced decomposition and anthropogenic influence.

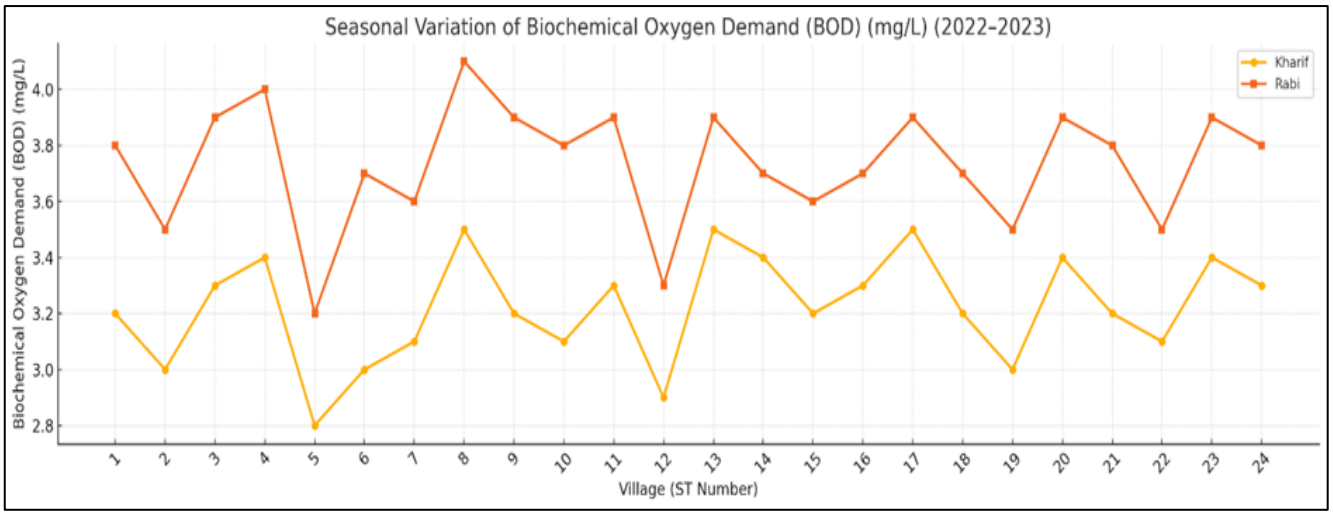

Fig 3: Seasonal Variation of Biochemical Oxygen Demand (BOD) in Swater Samples of 24 Villages of Budni Tehsil During 2022–2023.

Figure 3 Higher BOD values show in Rabi indicate elevated microbial activity and greater organic pollution compared to Kharif.

V. CONCLUSION

The present study assessed organic pollution levels in the rural water sources of Budni Tehsil using DO, BOD, and COD indicators during the Kharif and Rabi seasons (2022–2023). The findings reveal clear seasonal differences, with higher BOD and COD values observed in the Rabi season due to reduced dilution and accumulation of organic materials. DO values remained within acceptable limits but showed slight reduction in locations with higher organic load, confirming its sensitivity to pollution. The consistent pattern of elevated BOD and COD beyond permissible limits indicates moderate organic contamination across most villages. Overall, the integrated DO–BOD–COD approach proved effective in identifying the extent of organic pollution and highlighting the need for improved water quality management in Budni Tehsil.

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