



Assessment of physical and chemical characteristics of Johila River dam water

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Abstract

This study investigates the physical and chemical characteristics of the Johila River Dam water at various sampling sites (S1, S2, and S3) to understand the impact of both natural processes and human activities on water quality. Parameters such as pH, temperature, turbidity, conductivity, alkalinity, chloride content, suspended solids, total solids, calcium hardness, magnesium hardness, total hardness, Biological Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) were analyzed. pH and Temperature showed no significant variation between treated and untreated water, indicating stability through the treatment process. Turbidity value found highest at S1, suggesting high suspended solids and sediment load. S2 reflected highest conductivity and Chloride contents due to presence of salts and minerals. Alkalinity observed highest at S3, indicating variations in bicarbonate and carbonate ions. Suspended and Total Solids found highest at S1, indicating sediment accumulation and runoff. Magnesium hardness was highest at S2, while total and calcium hardness was highest at S1. Highest BOD at S2 and highest COD at S3, indicating varying levels of organic and chemical contaminants. The results underscore the importance of effective water treatment processes to reduce contaminants, enhance water clarity, and ensure safe water for human use. Additionally, targeted conservation efforts are recommended to manage pollution and protect the ecological health of the Johila River Dam. These include stricter effluent regulations, improved agricultural practices to minimize runoff, and sediment management initiatives.

Keywords: Water quality, Johila River Dam, physical, chemical, parameters

Introduction

The system of rivers provides the majority of the freshwater available. Along its path and tributaries, it transports a fair amount of material, either in dissolved or particulate form. Both natural and artificial causes may have produced these [1]. Only 2% of the 1386 million cubic kilometers of water that make up the oceans—which cover more than 71% of the planet—are used for human and other activities' requirements, according to Prakash [2]. Most of the drinkable water comes from rivers that get rainfall [3]. Rivers are delicate freshwater systems that sustain life. They provide most of the water supplies required for local, industrial, and agricultural demands, acting as vital conduits around the world [4].

They also promote soil fertility, wildlife protection, and the expansion of forest resources [5]. It is common knowledge that rivers are essential to the flow of goods and services. They also manage the removal of rubbish from residences, companies, and local governments. River water columns eventually pick up pollution-producing runoff from farms and other sources, which causes the river to become contaminated [6].

The decline in water quality is one of the most significant environmental problems that the world is currently confronting. Other ecosystems as well as the water body itself are significantly impacted by the introduction of various dangerous pollutants into the water. The aquatic food chain may bio-accumulate as a result of harmful substances in the water system, which could have an effect on the aquatic environment's living species. Agrochemical use in the surrounding areas, seasonal fluctuations in river flow, and industrial operations all have an impact on the quality of inland surface water [7]. River water is widely used for many industrial and domestic applications,

including as power generating, irrigation, navigation, and leisure [8].

However, the abuse of various agrochemicals in the surrounding area, unrestrained urbanization, haphazardly constructed buildings along the riverbanks, rapid industrialization, and population growth are all contributing to the rivers' increasing contamination. Water contamination is a major issue because of the rising demand for water due to both industrial and household consumption. The sources of water pollution are nearly multiplied daily. Pollution levels are rising in tandem with an increase in water-related ailments.

Therefore, it is essential for the survival of all living creatures, including humans, to ascertain the level of water contamination. For any body of water to function properly, it must be pure (Table 1). Because of this, the concept of controlling water quality is becoming more and more important [9]. Aquatic ecosystem health depends on both biological diversity and physiochemical traits [10]. In order to prevent disease outbreaks and additional degradation, regular monitoring and assessment of river quality are essential. Research on bacteria reveals that an excessive number of microorganisms can contaminate water, which may cause diseases in plants and animals to spread. Enteric microorganisms are responsible for most waterborne illnesses [11].

A significant environmental problem, water pollution in rivers has an adverse effect on human health as well as aquatic species. It's a widely held belief that enhancing welfare requires giving households access to clean drinking water [12]. The World Health Organization [13] reports that 1.7 billion cases of diarrhea result in the death of 525,000 children annually. Water quality monitoring is crucial for preventing waterborne illness by using the proper water treatment and control techniques and monitoring their

effectiveness ^[10]. The physiochemical properties of the Mangthar Road Birsinghpur Pali, Johila River Dam were

examined in this study at three distinct times, namely January, February, and March 2024.

Table 1: Drinking Water Standards as per WHO and Indian System

S.N.	Parameters	Unit	Drinking water Indian Standards	Drinking Water WHO Standards
1.	Temperature	°C	10-22	-
2.	Turbidity	NTU	1-5	Less than 5
3.	Electrical Conductivity	µmhos/cm	200-800	1000
4.	Suspended Solid	mg/L	Less than 50	1-50
5.	Total Solid	mg/L	Less than 50	Less than 50
6.	pH	-	6.5-8.5	6.5-8.5
7.	Chlorite	mg/L	250	250
8.	Alkalinity	mg/L	200	-
9.	Calcium Hardness	mg/L	75	200
10.	Magnesium Hardness	mg/L	30	30-100
11.	Total Hardness	mg/L	300	200-500
12.	BOD	mg/L	4.0	Less than 5
13.	COD	mg/L	200	Less than 200

Methodology

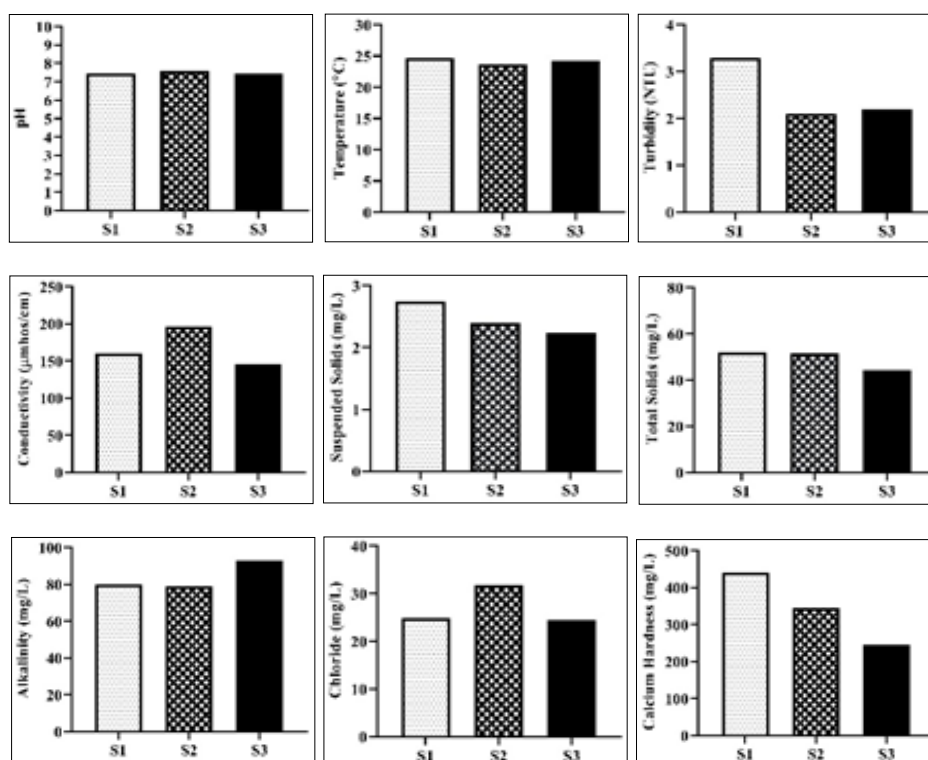
Two liters of tap water samples were collected on 5-litre jerry Cans at each location to ensure the purity of the samples. Prior to collection, the water taps were allowed to run for 3 to 4 minutes, facilitating the removal of any superficial impurities and adhering strictly to the guidelines outlined by the World Health Organization (WHO). Subsequently, the collected samples were transported and preserved to the laboratory facilities of the Madhya Pradesh Pollution Control Board (MPPCB) Shahdol for subsequent examination. Each sample underwent rigorous triple testing procedures to ensure the utmost precision and reliability of the data obtained, thereby laying the groundwork for meticulous analysis across all relevant parameters.

The water quality analysis of tap water samples collected from different educational institutions (S1, S2 and S3) have

been carried out for physical parameters analysis including Temperature, Turbidity, Electrical conductivity (EC), Suspended Solids (SS), and Total Solids (TS) and Chemical parameters analysis such as pH, Chloride, Calcium Hardness, Magnesium Hardness, Total Hardness, Alkalinity, BOD and COD. The samples were analyzed using standard procedures and compared with WHO and Indian Standard guidelines ^[14, 15]

Result

The considerable findings were revealed in our study that showed a significant difference between the water qualities obtained. The following figure 1 and table 2 and 3 illustrates the result obtained in this study.



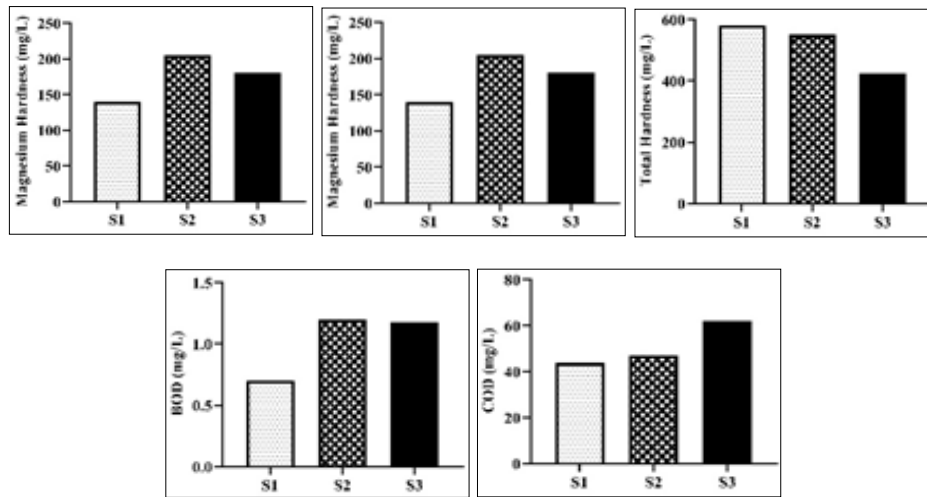


Fig 1: Physicochemical Parameters of Surface Water from 3 different sites: pH, Electrical Conductivity, Temperature, S.S (Suspended Solids), T.S (Total Solids), Total Hardness, Calcium Hardness, Alkalinity, Chloride, COD (Chemical Oxygen Demand), and BOD (Biological Oxygen Demand)"

Table 2: Physical Parameters of Surface Water from 3 different sites: Colour, Temperature, Turbidity, Conductivity, S.S (Suspended Solids), and T.S (Total Solids)

S.N.	Parameters	January (S1)	February (S2)	March (S3)
1.	Sample Description	Mangthar Road Birsinghpur Pali, Johila River Dam	Mangthar Road Birsinghpur Pali, Johila River Dam	Mangthar Road Birsinghpur Pali, Johila River Dam
2.	Colour	Colour less	Colour less	Colour less
3.	Temperature	24.70°C	23.60°C	24.20°C
4.	Turbidity	3.30 NTU	2.10 NTU	2.4 NTU
5.	Conductivity	160 µmhos/cm	196 µmhos/cm	145 µmhos/cm
6.	Suspended solid	2.74 mg/L	2.4 mg/L	2.23 mg/L
7.	Total Solids	52.12 mg/L	51.4 mg/L	44.12 mg/L

Table 3: Chemical Parameters of Surface Water from 3 different sites: pH, Total Hardness, Calcium Hardness, Magnesium Hardness, Alkalinity, Chloride, COD (Chemical Oxygen Demand), and BOD (Biological Oxygen Demand)"

S.N.	Parameters	January (S1)	February (S2)	March (S3)
8.	pH	7.45	7.60	7.43
9.	Total Hardness	580 mg/L	550 mg/L	425 mg/L
10.	Calcium Hardness	440 mg/L	345 mg/L	245 mg/L
11.	Magnesium Hardness	140 mg/L	205 mg/L	180 mg/L
12.	Alkalinity	80 mg/L	79 mg/L	93 mg/L
13.	BOD	0.70 mg/L	1.20 mg/L	1.175 mg/L
14.	COD	43.68 mg/L	46.8 mg/L	62.10 mg/L
15.	Chloride	24.90 mg/L	31.79 mg/L	24.46 mg/L

1. pH, temperature and turbidity: The pH and temperature of both the treated and untreated dam water was found to be similar. The turbidity was found to be highest in the samples of S1.

2. Conductivity, Alkalinity and Chloride content: The conductivity of the S2 sample was highest with S1 being the lowest. The chloride content of the S2 was greater while that of S1 and S3 were lesser than S2 and similar in almost values. The alkalinity of the S3 was highest among all the three water samples.

3. Suspended Solids and Total Solids: The suspended solids were highest in the S1 while the lowest in S3 and the total solids were almost similar in values in all the three samples while the highest being in S1.

4. Calcium Hardness, Magnesium Hardness and Total Hardness: Magnesium hardness was found to be highest in the S2 samples while lowest in the S1. Total Hardness and the Calcium hardness appeared highest in the S1 samples while lowest in the S3 samples.

5. BOD and COD: The BOD was found to be highest in the S2 samples while lowest in the S1 and COD was found to be highest in the S3 samples while lowest in the S1.

Discussion

The results of the study show that treated and untreated water differ significantly in terms of quality, highlighting the significance and efficacy of water treatment procedures in guaranteeing the safety of the water for human use. The pH and temperature values of the water samples, both treated and untreated, were comparable. Given that pH and temperature are largely stable and less affected by common water treatment techniques, this consistency shows that the treatment process does not dramatically change these parameters. The turbidity of S1 was found to be highest reflecting the high suspended solids and sediment load. The water samples from S2 site had higher electrical conductivity and a higher chloride level. Higher ion concentrations, such as those of salts and minerals, which are lowered during the treatment process, are frequently indicated by elevated conductivity. Alkalinity was lowest at S2 and highest at S3, suggesting different levels of bicarbonate and carbonate ions due to varying geological and environmental factors. The highest concentration of suspended solids was recorded at S1. This is likely due to sediment accumulation and runoff in the reservoir area while S exhibited the lowest concentration, reflecting its relatively pristine condition. Similarly, S1 had the maximum total solids, indicating higher sediment and dissolved solids in this section while the minimum value observed at S3. The fact that these solids are reduced by treatment emphasizes how crucial it is to remove particle matter in order to

increase water clarity and lower the danger of contamination.

Magnesium hardness was found to be highest in the S2 samples while lowest in the S1 suggesting a different mineral composition at these sites. Total Hardness and the Calcium hardness appeared highest in the S1 samples while lowest in the S3 samples indicating significant mineral content in the water, possibly from geological formations or inflows. By reducing the hardness of the water through treatment, the water becomes safer to drink and more appropriate for use in industry and the home. The BOD was found to be highest in the S2 samples while lowest in the S1 and COD was found to be highest in the S3 samples while lowest in the S1. Increased levels of contaminants and organic matter are indicated by higher Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) values in untreated water. A major hazard to aquatic life is elevated BOD levels, which can cause stress, asphyxiation, and death in organisms as a result of oxygen deprivation^[16], and elevated COD values may be related to increased chemical contaminants^[17]. These factors are essential for figuring out how much organic pollution there is in the water and whether or not it can support microbial life.

Conclusion

In this study, the physical and chemical characteristics of the Johila River Dam at different times are studied, and the results show clear spatial changes caused by both human activity and natural processes. Implementing focused conservation activities is essential to ensuring the Dam's sustainable management, especially at locations with high pollution levels. Stricter effluent laws, improved agricultural practices to minimize runoff, and projects to improve sediment management at dam sites are a few possible strategies. In order to preserve and improve the river's health and guarantee that it can sustain a variety of ecological functions and supply clean water to the neighboring populations, it is imperative that thorough river basin.

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Conflicts of Interest

The authors declare no conflict of interest.

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