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# Water Quality Index Assessment of Bada Talab, Chhatarpur, (M.P.) India

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## ABSTRACT

This study focuses on assessing the water quality of “Bada Talab” at five different sampling sites over the course of one year, from January 2022 to December 2022.In this study, various physico-chemical parameters were used to assess the water quality. The parameters tested are Nitrate, DO,Temperature, pH, EC, Turbidity, TS,TDS, TSS, Fluoride, Total Hardness, BOD and Iron on Pre-monsoon, Monsoon and post-Monsoon basis. The Water Quality Index (WQI) is a composite index that takes into account several water quality parameters to provide an overall assessment of water quality. In this study, the calculated WQI values indicate that the lake is moderately and slightly polluted. As a result, the water may not be suitable for direct domestic use without treatment. However, it is considered acceptable for irrigation and other non-potable purposes.

Figure : 01 References : 24 Table : 01

KEY WORDS : Bada Talab, Monsoon, Physico-chemical parameter, Water, WQI

## Introduction

Water is one of the most indispensable and vital resources for life on Earth. It plays a fundamental role in sustaining all life forms and is essential for the functioning of ecosystems and human societies. The availability of freshwater from resources is minimal. The demand for freshwater is growing day by day and will increase with the rapid growth of population, agriculture and industry[12].Water crisis is a serious problem in semi-arid zones of India, because of low precipitation and high evaporation rate. Groundwater is generally affected by seasonal variations, and the water Table tends to go down during the summer season, particularly from mid-April to June[13].All ancient kings knew that surface water is the main source of water in this region so they made a large number of Talab/Pond/Lake/Baoli[22].

These water bodies were designed to store water during periods of ample rainfall, which could then be utilized during drier seasons or droughts. By capturing and storing surface water, they ensured a more consistent and reliable water supply. Some of these water bodies were strategically located in areas where the water could percolate into the ground, recharging the groundwater Table and enhancing overall water availability. Several reports on the assessment of water quality of lakes, ponds, and reservoirs[8,18,21] based on chemical properties and physico-chemical and biological parameters have been published by several workers in India[9,19].

## Material and Method

**Study Area:**

Chhatarpur district is a region situated in the central part of the plateau of Bundelkhand in the state of Madhya Pradesh (M.P.), India. It covers an area of approximately 8616.82 square km. The district is located at the northern boundary of Madhya Pradesh and is positioned between North latitudes 24° 06’ and 25° 20’ and East longitudes 79° 59’ and 80° 26’. The region falls under the survey of India toposheets No. 54O, 54P, and 63D.

Chhatarpur is known for its historical and cultural significance, as it is home to several ancient temples and historical landmarks. The district’s landscape is

**TABLE 1: The average recorded value of physico-chemical properties of Bada Talab from Jan 2022 to Dec-2022**

| S.No. | Parameters | Pre-Monsoon | Monsoon | Post-Monsoon | Standard(WHO) |
|---|---|---|---|---|---|
| 1 | Temp. | 20.03±2.71 | 29.32±0.64 | 19.335±1.73 | 25°C |
| 2 | pH | 7.69±0.19 | 8.069±0.27 | 7.88±0.32 | 6.6-8.5 |
| 3 | TDS | 481.2±17.55 | 499.85±13.42 | 357.85±23.17 | 500 mg/dl |
| 4 | TS | 557.25±14.09 | 654.75±51.10 | 650.95±29.19 | 500 mg/dl |
| 5 | TSS | 58.35±5.43 | 296.9±46.57 | 169.75±45.65 | 500 mg/dl |
| 6 | DO | 6.16±0.44 | 5.095±0.19 | 6.277±0.20 | 4-6 mg/l |
| 7 | BOD | 4.02±0.29 | 3.677±0.43 | 5.07±0.43 | 6 mg/l |
| 8 | TH | 177.15±5.58 | 216.9±20.35 | 249.3±12.37 | 500 mg/l |
| 9 | Nitrate | 10.30±0.06 | 11.525±0.52 | 9.15±0.32 | 45 mg/l |
| 10 | Hardness(Mg) | 53.35±4.56 | 41.20±0.75 | 50.2475±3.11 | 100 mg/l |
| 11 | Hardness(Ca) | 64.64±3.49 | 38.43±11.96 | 63.7005±1.39 | 200 mg/l |
| 12 | Sodium | 57.78±11.14 | 39.37±9.27 | 54.028±7.98 | 30-60 mg/l |
| 13 | Conductivity | 769.35±7.65 | 854.45±47.58 | 749.85±23.98 | 400 µS/cm |

characterized by its plateau topography, reflecting the typical features of the Bundelkhand region.

**Analytical design:**

The analysis of water properties was conducted according to the methods specified in the "Standard Methods for the Examination of Water and Wastewater"[2]. Additionally, a HiMedia (WT 023) Kit was utilized, which likely contains reagents and equipment specifically designed for water analysis as below (Table-1). For Water Quality Index (WQI) eight parameters were considered for the calculation of the water quality index[6].

Water Quality Index (WQI) = "qiwi

Where qi (water quality rating) = 100 x (Va- Vi) / (Vs-Vi),

When Va = actual value present in the water sample

Vi = ideal value (0 for all parameters except pH and DO which are 7.0 and 14.6 mg l-1 respectively).

Vs = standard value.

If quality rating qi = 0 means complete absence of pollutants, while 0<qi<100 implies that, the pollutants are above the standards.

Wi (unit weight) = K / Sn where is Sn = 'n' number of standard values. Category wise water quality[20]

Where K (constant)
$$\frac{1}{\frac{1}{Vs1}+\frac{1}{Vs1}+\frac{1}{Vs1}+\frac{1}{Vs1}\ldots\ldots\ldots+\frac{1}{Vsn}}$$

Sn = 'n' number of standard values. Water quality should fall into the following categories[20]:

I- Water is slightly polluted but still safe to drink if the water quality index (WQI) is less than 50.

II- WQI of 51 to 80 indicates moderate pollution.

III- The Water is overly contaminated if the WQI is between 80 and 100.

## Results and Discussion

**Temperature** and photoperiod are important factors that control the behavior, physiology, and distribution of organisms in a water body.The water temperature during the study period ranged from 19.3°C to 29.3°C, with higher temperatures observed in summer and lower temperatures in winter. A similar observation was shown by previous workers[7,8,16].

**pH** is a measure of acidity or alkalinity in the water and can have significant effects on aquatic life. The pH range between 6 to 9 is generally considered safe for most aquatic organisms, including fish. However, the toxicity of common pollutants can be influenced by changes in pH within this range. Increased acidity or alkalinity may enhance the toxicity of these pollutants, making them more harmful to aquatic life.

**Electrical Conductivity (EC**) In the context of water quality, electrical conductivity (EC) is a measure of the ability of water to conduct an electrical current, and it primarily depends on the concentration of ions or dissolved inorganic substances present in the water. These substances include various salts, minerals, and other dissolved solids. As a result, EC is often used as an indicator of the overall ionic content in the water, TDS in mg/l is half of the EC in (µs/cm). The maximum value of EC of 854 µs/cm was observed during the Monsoon season, while the lowest value of 749 µs/cm was recorded during the post-monsoon period.

**Total Hardness (TH)** refers to the concentration of certain minerals, primarily calcium (Ca++) and magnesium (Mg++), in the water. These two cations are the most dominant contributors to water hardness. Hardness is typically measured in milligrams per liter (mg/l) or parts per million (ppm) and is an important parameter to consider when assessing the suitability of water for various purposes. During the study, maximum total hardness was observed during the post-monsoon period, with a value of 249 mg/l. On the other hand, the minimum total hardness of 216 mg/l was recorded during the monsoon season.

**Nitrate**The concentration of nitrate in freshwater increases due to various factors, including agricultural waste and sewage contamination.Agricultural activities, such as the use of fertilizers and manure, are significant sources of nitrate in freshwater. When fertilizers are applied to fields, excess nitrogen can leach into groundwater or surface water, leading to elevated nitrate levels, similarly Sewage contamination is another major source of nitrate in freshwater. In urban areas and regions with inadequate waste water treatment facilities, untreated or inadequately treated sewage can release nitrogen compounds, including nitrate, into rivers, lakes, and groundwater. waste and sewage contamination[1].During the monsoon period, the maximum nitrate concentration recorded was (11.5 mg/l). Monsoon is a time when there may be increased runoff from agricultural lands and other sources, leading to higher nitrate levels in water bodies,and during the post-monsoon period, the minimum nitrate concentration recorded was (9.1 mg/l).

**Dissolved Oxygen (DO)**Dissolved oxygen is a vital component in aquatic ecosystems, playing a crucial role in regulating various metabolic processes of organisms and influencing the overall community structure. It is essential for the survival of aquatic organisms, as many species rely on dissolved oxygen to carry out respiration and maintain their physiological functions. The main sources of dissolved oxygen in water are diffusion of oxygen from air and photosynthetic activity taking place in water. The diffusion of oxygen from the air is mainly dependent on temperature, salinity, total dissolved salt and water movements, *etc*[8]. In this study, the Dissolved Oxygen ranged from 5.0 mg/l to 6.2 mg/l.

**Total solids (TS)** are a measure of the suspended and dissolved solids in water. Total solids are those that can be retained on a water filter and are capable of settling out of the water column into the stream bottom when stream velocities are low. They include silt, clay, plankton, organic wastes, and inorganic precipitates such as those from Acidmine drainage. Dissolved solids are those that pass through a water filter. They include some organic materials, as well as salts, inorganic nutrients, and toxins. In this study maximum total solid was recorded during monsoon (650 mg/l) and minimum during pre-monsoon (557 mg/l).

**Total Suspended Solids (TSS)** The suspended solids determination is particularly useful in the analysis of sewage and other waste waters and also indicates a significant relationship with BOD determination. It is used to evaluate the strength of domestic waste water and the efficiency of treatment units. Suspended solids containing much organic matter may cause putrefaction *i.e.,* decomposition and consequently the water body may be devoid of dissolved oxygen. In this study, maximum TSS was recorded during monsoon (296 mg/l) and minimum was found during pre-monsoon (58.3 mg/l).

**Total Dissolved Solids (TDS)** refer to the total concentration of inorganic salts, small amounts of organic matter, and other dissolved materials in water. These substances can include carbonates, chlorides, sulfates, nitrates, and phosphates, as well as elements such as calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), iron (Fe), manganese (Mn), and others. In this study, maximum TDS concentration of 499 mg/l

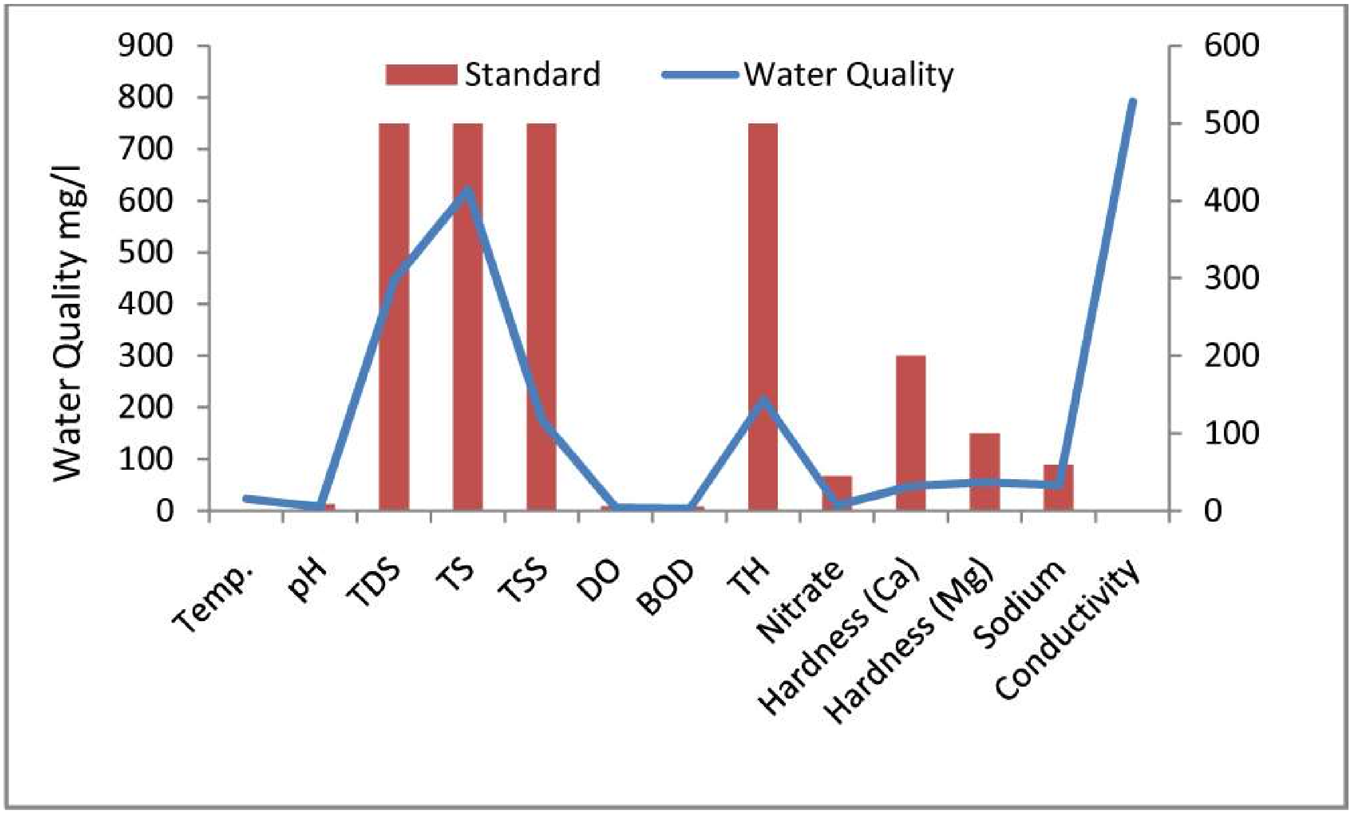


**Fig. 1 :Different parameters of water**

was recorded during monsoon season and minimum TDS concentration of357 mg/l during post-monsoon.

**Biochemical Oxygen Demand (BOD)** determines the amount of oxygen required for the biological oxidation of organic matter with the help of microbial activities. The highest value of BOD was recorded (20 mg/l) in river Purna in Maharashtra due to high pollution load by organic enrichment, and decay of plant and animal matter in the river [4]. In the present study, maximum and minimum BOD were recorded at 5.07 mg/l and 3.6 mg/l respectively.

**Sodium** is a significant cation found in its natural form. However, high sodium content in soil can make it hard to plow and unsuitable for seedling emergence, which is why monitoring sodium concentration is important**.**In this study,it is observed that its value is maximum during pre-monsoon57.78 mg/l and minimum during monsoon39.3 mg/l.

**Magnesium** is often found alongside calcium in various water bodies, but its concentration is generally lower compared to calcium. While both minerals are important for various aquatic organisms, the concentration of magnesium appears to play a significant role in determining the population of phytoplankton. In this study, the value is maximum during pre-monsoon53.35 mg/l and minimum during monsoon41.20mg/l.

**Calcium** is indeed one of the most essential nutrients for aquatic living beings, and it is commonly present in various water bodies.

It is important to note that the concentration of calcium in water bodies can vary over time due to various factors. One factor that can influence calcium levels is the absorption of calcium by living organisms present in the water. As organisms utilize calcium for their biological processes, it can lead to fluctuations in the overall calcium concentration in the water.

The study also revealed that the maximum calcium concentration was recorded during the pre-monsoon period at 64.64 mg/l, while the minimum concentration was observed during the monsoon at 38.4 mg/l.

The seasonal variation in calcium levels can be attributed to several factors. During the pre-monsoon period, there may be reduced water flow and increased evaporation, leading to higher concentrations of dissolved substances like calcium in the water. On the other hand, the monsoon season typically brings increased rainfall and water runoff, which may dilute the water and lower the calcium concentration.

Understanding the seasonal variations and the factors affecting calcium levels in the water is essential for managing water quality in the ecosystem. Calcium plays a crucial role in supporting aquatic life, and maintaining appropriate levels is necessary to ensure the health and productivity of the aquatic environment. Additionally, the observed calcium concentrations can serve as valuable data for future studies and comparisons to assess changes in water quality over time.

## Conclusion

Based on the observations, it can be concluded that Bada Talab's water quality is moderately polluted. However, despite this pollution, the lake remains productive and can support a diverse range of organisms, including plankton, benthos, fish, and macrophytes. This productivity is supported by the abundance of chemical ions necessary for energy inter-conversion and the production of organic materials in the lake.

One notable threat to the lake's productivity is the case of cultural eutrophication, which has been observed in the lake. Cultural eutrophication refers to the excessive nutrient enrichment of a water body, usually caused by human activities such as agricultural runoff, sewage discharge (in this case), or industrial waste. This leads to an overgrowth of algae and other aquatic plants, which can negatively impact the lake's ecosystem.

The results of the physico-chemical examination of Bada Talab are crucial for managing the lake's water quality and fisheries. Understanding the specific chemical parameters and nutrient levels can help in developing appropriate strategies to mitigate pollution and maintain a healthy ecosystem.

Furthermore, the data obtained from studying Bada Talab can serve as a valuable baseline and reference point for future assessments. These data can be used to monitor changes in the lake caused by natural processes or human activities over time. Having this reference point is essential, especially considering that there is a lack of published information on these important lakes.

In summary, the observations indicate that while Bada Talab is moderately polluted, it remains a productive ecosystem supporting a diverse range of organisms. Addressing the issue of cultural eutrophication and using the collected data for management and monitoring purposes would be essential to ensure the long-term health of the lake and its biodiversity.

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