

Physico-Chemical Water Quality Assessment of Betwa River at Vidisha City, (M.P.)

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Abstract: *The present study was carried out to assess the water quality of Betwa River at Vidisha city (M.P.). The water samples were collected in plastic containers of 300 ml capacity from six (06) different locations along the river during rainy season from the month of Jun-2022 to Sept-2022. These samples were collected from different selective pollution prone locations and ten (10) important physico-chemical parameters as Temperature, pH, Turbidity, Electrical Conductance (EC), Total Alkalinity (TA), Total Hardness (TH), Total Dissolve Solids (TDS), Dissolve Oxygen (DO), Chlorides and Nitrates were analyzed. The statistical data obtained of the study were compared with the water quality standards as prescribed by WHO and BIS. From the results, it was found that the most of the parameters of Betwa River water were within the permissible limit of WHO and BIS (10500). The results of the overall study reveals that during study period the Betwa River water quality of studied area is suitable for domestic and irrigation purposes and it may be used after some proper treatment. However, more efficient management is also required to conserve the river water quality.*

Keywords: Physico-Chemical Parameters, Water Quality Parameters, Water Quality Standards, Betwa River, Vidisha City (M.P.)

1. Introduction

The oceans, the rivers and lakes together with the land constitute the canvas on which life grows and interacts. Water is also crucial for the quality of life. Water has become an essential commodity for the industrials and agricultural development. Water is absolutely essential not only for survival of human being but also for animals, plants and all other living things. On the other hand, polluted water has become the greatest source of diseases. Today, with increasing industrialization, urbanization and technological advance in all fields, sources of water bodies are getting more and more seriously polluted. The survival of life on earth will be threatened, if the present rate of pollution continues unabatedly. The utility of river water for various purposes is governed by physico-chemical and biological quality of the water. To evaluate the quality of river water for the purpose of health, domestic and irrigation etc. it has become essential to identify the physico-chemical characteristics of the water body that are important for respective fields. The present study was aimed to assess the quality of Betwa River water for its domestic, irrigation purpose.

2. Study Area

In order to determine the water quality of Betwa River, Vidisha town was selected. Vidisha town is the district head quarter and located in Eastern part of the Malwa region. It is near the state capital city Bhopal and about 10kms from Sanchi. The Betwa, a Southern tributary of River Yamuna and flows between the states of Madhya Pradesh and Uttar Pradesh, is a river of great ancient past and immense legendary values for the people of Malwa region of Madhya Pradesh for many years. It originates near Barkhera village (in Vindhya range) Raisen district of Madhya Pradesh. It enters about 06 km away from vidisha town towards south and flows for about 96 kms in this district. It travels length of 232 kms in Madhya Pradesh and 358 kms are in Utter Pradesh. The Betwa is the lifeline for the region along which

it passes and plays an important role in all round growth and development of the terrain and acts as a main water source for all the activities related to domestic water supply, irrigation, industrial water requirement and other water related activities. The Betwa River water samples were collected from six main sampling stations namely S₁ (Near Ram Ghat), S₂ (Near Shri Bahra Baba Ghat), S₃ (Shri Mahal Ghat), S₄ (Near Barwala Ghat), S₅ (Near Triveni Ghat) and S₆ (Near Janki Ghat) in between the Months of Jun 2022 to Sept. 2022 on monthly basis. The sampling points were chosen considering the location of domestic use, bathing zone area and agricultural runoff which joins the river water and are responsible for pollution load in the river water. Samples were collected in acid clean 300 ml polyethylene bottles during the first week of every month in the morning hours in between 6.00 AM to 9.00 AM. Some of the studied parameters were recorded at the sampling stations whereas the analysis of other physico-chemical parameters followed by the method prescribed by APHA (1995).

3. Results and Discussion

The results are shown by statistical evaluation as Maximum Value, Minimum Value, Average Value (AV) Standard Deviation (SD) Standard Error (SE) and Confidence Limit (CL, 95%). The results obtain during the course of present study are tabulated in table 1 and 2.

Chemical and biochemical reactions are greatly affected by temperature. During the present study, **Temperature** was fluctuated between 17.5 to 23.9^oc. It was found minimum as 17.5 ^oc at sampling station no.S1 in the month of Sept. and maximum as 23.9^oc at the sampling station no.S6 in the month of Jun. **Turbidity** in water is due to the presence of colloidal and extremely fine dispersion and indicates the extent of pollution in water body. It was found minimum as 5.5 NTU at S2 in Jun and maximum as 6.9 NTU at S6 in the month of Sept. The **pH** value indicates the alkaline nature of water body. During the present study, it varied between 7.5 to 8.2. It was found minimum as 7.5 at sampling station no. S3 in the month of Jun. and maximum as 8.2 at the sampling

station no. S6 in the month of Sept. The **Electrical Conductivity (EC)** of water depends on the present of ions in water. Electrical Conductivity was recorded varied between 142.4 to 178.3 $\mu\text{mhos/cm}$. It was recorded minimum in the month of Jun at S1 and maximum at S2 in Jul. The **Total Hardness (TH)** values found varied between 121.6 to 130.9 mg/l. It was found minimum as 121.6 mg/l at sampling station no. S1 in the month of Jun. and maximum as 130.9 mg/l at the sampling station no. S3 in the month of Sept. **Total Alkalinity (TA)** is the sum of total carbonate and bicarbonate ions present in water. In the present study, Total Alkalinity was recorded in the range between 135.1 to 149.5 mg/l. It was found minimum at sampling station no. S1 in the month of Jun and maximum at the sampling station no.S1 in the month of Sept. In the present study, **Total**

dissolved solids (TDS) were found range from 158.8 to 190.2 mg/l. It was recorded minimum in the month of Jun at S1 and maximum at S6 in Aug. **Dissolved Oxygen (DO)** was fluctuated between 8.2 to 9.5 mg/l. It was found minimum at sampling station no. S1 in the month of Jun and maximum at the sampling station no. S6 in the month of Jul. A large content of Chloride in clean water is an indicator of organic pollution. During the study, **Chloride** was recorded minimum as 84.5 mg/l at S1 in the month of Jun and maximum as 120.1 mg/l at S6 in Aug. In the present study, **Nitrate** was fluctuated between 7.2 to 7.9 mg/l. Maximum concentration of nitrate was observed in the month of Aug. at sampling station no. S6 and minimum was in Jun at sampling station no. S1.

Table 1: Stastical Analysis of Monthly Variation in Physico Chemical Parameters of Betwa River

| S.No. | Month | Parameter | Sampling Stations | | | | | | MIN. | MAX. | AV | SD | SE | AV \pm CL |
|---------|-------|-----------|-------------------|-------|-------|-------|-------|-------|-------|-------|--------|-----------------|------|-------------------|
| | | | S1 | S2 | S3 | S4 | S5 | S6 | | | | | | |
| 1. | JUN | Temp. | 23.3 | 23.5 | 23.8 | 23.2 | 23.4 | 23.5 | 23.2 | 23.9 | 23.52 | 0.28 | 0.11 | 23.52 \pm 0.22 |
| | | Tur. | 5.8 | 5.5 | 5.6 | 5.6 | 5.7 | 5.9 | 5.5 | 5.9 | 5.68 | 0.15 | 0.06 | 5.68 \pm 0.12 |
| | | pH | 7.8 | 7.7 | 7.5 | 7.9 | 7.6 | 7.8 | 7.5 | 7.9 | 7.72 | 0.15 | 0.06 | 7.72 \pm 0.12 |
| | | EC | 142.4 | 143.9 | 142.8 | 148.6 | 147.7 | 152.3 | 142.4 | 152.3 | 146.28 | 3.91 | 1.60 | 146.28 \pm 1.13 |
| | | TH | 121.6 | 124.2 | 125.1 | 124.7 | 125.3 | 126.1 | 121.6 | 126.1 | 124.50 | 1.56 | 0.64 | 124.50 \pm 1.24 |
| | | TA | 135.1 | 138.4 | 136.5 | 137.2 | 137.7 | 138.2 | 135.1 | 138.4 | 137.18 | 1.23 | 0.50 | 137.18 \pm 0.99 |
| | | TDS | 158.8 | 162.4 | 166.3 | 166.2 | 167.4 | 168.5 | 158.8 | 168.5 | 164.93 | 3.64 | 1.49 | 164.93 \pm 2.91 |
| | | DO | 8.9 | 8.7 | 8.2 | 8.3 | 8.4 | 8.2 | 8.2 | 8.9 | 8.45 | 0.29 | 0.12 | 8.45 \pm 0.23 |
| | | Chloride | 84.5 | 92.1 | 88.4 | 86.5 | 87.8 | 89.3 | 84.5 | 92.1 | 88.10 | 2.57 | 1.05 | 88.10 \pm 2.06 |
| Nitrate | 7.2 | 7.3 | 7.4 | 7.2 | 7.5 | 7.7 | 7.2 | 7.7 | 7.38 | 0.19 | 0.08 | 7.38 \pm 0.16 | | |
| 2. | JULY | Temp. | 21.2 | 21.5 | 21.8 | 21.6 | 21.4 | 21.5 | 21.2 | 21.8 | 21.50 | 0.20 | 0.08 | 21.50 \pm 0.16 |
| | | Tur. | 6.5 | 6.4 | 6.6 | 6.5 | 6.6 | 6.7 | 6.4 | 6.7 | 6.55 | 0.10 | 0.04 | 6.55 \pm 0.08 |
| | | pH | 7.9 | 8.1 | 7.7 | 7.6 | 7.8 | 7.9 | 7.6 | 8.1 | 7.83 | 0.18 | 0.07 | 7.83 \pm 0.14 |
| | | EC | 165.6 | 178.3 | 173.2 | 167.6 | 169.3 | 172.4 | 165.6 | 178.3 | 171.07 | 4.55 | 1.86 | 171.07 \pm 3.64 |
| | | TH | 128.3 | 129.1 | 130.1 | 128.5 | 128.6 | 128.9 | 128.3 | 130.1 | 128.92 | 0.65 | 0.26 | 128.92 \pm 0.52 |
| | | TA | 142.5 | 145.3 | 144.7 | 143.5 | 146.2 | 148.1 | 142.5 | 148.1 | 145.05 | 1.99 | 0.81 | 145.05 \pm 1.59 |
| | | TDS | 178.2 | 179.1 | 183.5 | 182.4 | 185.6 | 187.2 | 178.2 | 187.2 | 182.67 | 3.54 | 1.44 | 182.67 \pm 2.83 |
| | | DO | 9.1 | 9.2 | 9.3 | 9.3 | 9.5 | 9.1 | 9.1 | 9.5 | 9.25 | 0.15 | 0.06 | 9.25 \pm 0.12 |
| | | Chloride | 115.1 | 112.2 | 114.3 | 110.1 | 111.7 | 118.1 | 110.1 | 118.1 | 113.58 | 2.86 | 1.17 | 113.58 \pm 2.29 |
| Nitrate | 7.8 | 7.7 | 7.6 | 7.2 | 7.4 | 7.7 | 7.2 | 7.8 | 7.57 | 0.23 | 0.09 | 7.57 \pm 0.18 | | |
| 3. | AUG. | Temp. | 18.3 | 18.1 | 18.4 | 18.2 | 18.3 | 18.5 | 18.1 | 18.5 | 18.30 | 0.14 | 0.06 | 18.30 \pm 0.11 |
| | | Tur. | 6.8 | 6.9 | 6.7 | 6.6 | 6.7 | 6.8 | 6.6 | 6.9 | 6.75 | 0.10 | 0.04 | 6.75 \pm 0.08 |
| | | pH | 8.2 | 7.9 | 8.1 | 7.8 | 7.7 | 8.0 | 7.7 | 8.2 | 7.95 | 0.19 | 0.08 | 7.95 \pm 0.15 |
| | | EC | 170.3 | 169.8 | 172.1 | 168.5 | 169.2 | 170.1 | 168.5 | 172.1 | 170.00 | 1.22 | 0.50 | 170.0 \pm 0.98 |
| | | TH | 128.4 | 129.9 | 130.5 | 130.2 | 129.9 | 130.4 | 128.4 | 130.5 | 129.88 | 0.77 | 0.31 | 129.88 \pm 0.61 |
| | | TA | 148.1 | 146.3 | 145.6 | 146.7 | 147.3 | 147.8 | 145.6 | 148.1 | 146.80 | 0.95 | 0.39 | 146.80 \pm 0.76 |
| | | TDS | 181.2 | 184.5 | 187.8 | 186.4 | 187.1 | 190.2 | 181.2 | 190.2 | 186.20 | 3.08 | 1.26 | 186.20 \pm 2.46 |
| | | DO | 9.2 | 9.1 | 9.1 | 9.0 | 9.1 | 9.0 | 9 | 9.2 | 9.08 | 0.08 | 0.03 | 9.08 \pm 0.06 |
| | | Chloride | 118.9 | 119.5 | 120.1 | 119.2 | 119.9 | 120.1 | 118.9 | 120.1 | 119.62 | 0.50 | 0.20 | 119.62 \pm 0.40 |
| Nitrate | 7.9 | 7.8 | 7.8 | 7.7 | 7.8 | 7.9 | 7.7 | 7.9 | 7.82 | 0.08 | 0.03 | 7.82 \pm 0.06 | | |
| 4. | SEPT. | Temp. | 17.5 | 17.8 | 17.7 | 17.6 | 17.8 | 17.9 | 17.5 | 17.9 | 17.72 | 0.15 | 0.06 | 17.72 \pm 0.12 |
| | | Tur. | 6.9 | 6.8 | 6.8 | 6.7 | 6.8 | 6.9 | 6.7 | 6.9 | 6.82 | 0.08 | 0.03 | 6.82 \pm 0.06 |
| | | pH | 8.2 | 8.1 | 8.1 | 8.0 | 8.1 | 8.2 | 8 | 8.2 | 8.12 | 0.08 | 0.03 | 8.12 \pm 0.06 |
| | | EC | 171.1 | 171.0 | 170.8 | 170.5 | 171.3 | 171.5 | 170.5 | 171.5 | 171.03 | 0.36 | 0.15 | 171.03 \pm 0.28 |
| | | TH | 129.6 | 130.2 | 130.9 | 130.5 | 130.2 | 130.8 | 129.6 | 130.9 | 130.37 | 0.48 | 0.19 | 130.37 \pm 0.38 |
| | | TA | 149.5 | 148.6 | 147.5 | 146.1 | 148.2 | 148.5 | 146.1 | 149.5 | 148.07 | 1.16 | 0.47 | 148.07 \pm 0.93 |
| | | TDS | 184.5 | 183.7 | 185.7 | 183.8 | 184.2 | 185.9 | 183.7 | 185.9 | 184.63 | 0.95 | 0.39 | 184.63 \pm 0.76 |
| | | DO | 9.1 | 9.0 | 9.1 | 9.0 | 9.1 | 9.2 | 9 | 9.2 | 9.08 | 0.08 | 0.03 | 9.08 \pm 0.06 |
| | | Chloride | 119.4 | 118.7 | 119.1 | 118.2 | 119.1 | 119.2 | 118.2 | 119.4 | 118.95 | 0.43 | 0.18 | 118.95 \pm 0.35 |
| Nitrate | 7.8 | 7.9 | 7.8 | 7.7 | 7.6 | 7.8 | 7.6 | 7.9 | 7.77 | 0.10 | 0.04 | 7.77 \pm 0.08 | | |

(MIN: Minimum, Max: Maximum, AV: Average Value, SD: Standard Deviation, SE: standard Deviation, CL: Confidence Limit)

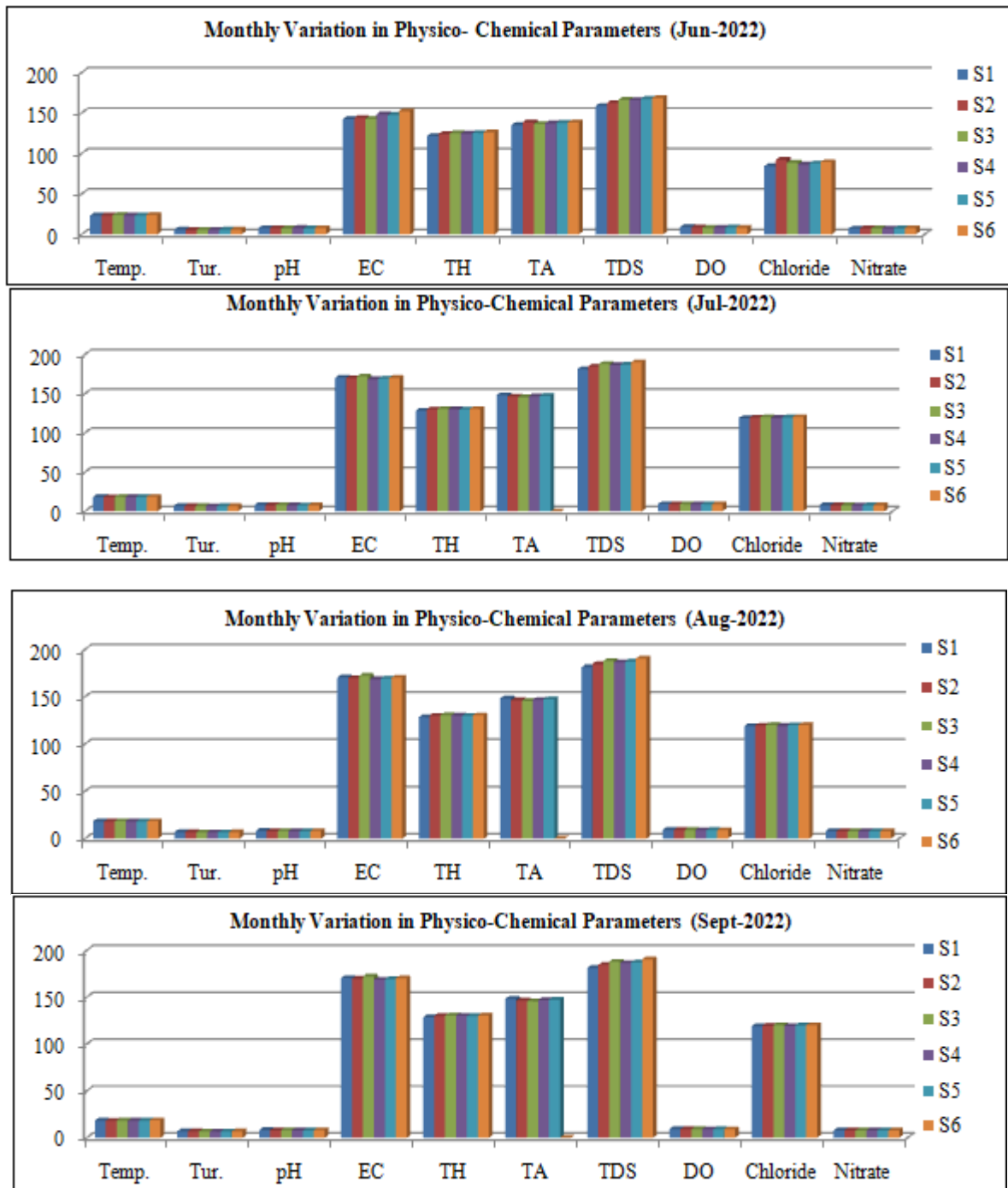


Table 2: Standard Permissible Limit of various Physico-Chemical Parameters suggested by WHO and BIS:10500

| S. No. | Parameters | unit | Permissible Limit | |
|--------|---|----------|-------------------|------------|
| | | | WHO | BIS :10500 |
| 1 | Temperature | °C | - | - |
| 2 | pH | - | 7.5 – 8.5 | 6.5 – 8.5 |
| 3 | Turbidity | NTU | 5.0 | 5 - 10 |
| 4 | Electrical Conductivity (EC) | µmhos/cm | 1400 | - |
| 5 | Total Hardness (TH) | mg/l | 1000 | 200 - 600 |
| 6 | Total Alkalinity (TA) | mg/l | 120 | 200 - 600 |
| 7 | Total Dissolved Solids (TDS) | mg/l | 1000 | 500 - 2000 |
| 8 | Dissolved Oxygen (DO) | mg/l | - | >5 |
| 9 | Chlorides (Cl) | mg/l | 250 | 250 -1000 |
| 10 | Nitrates(NO ₃ ⁻) | mg/l | 5.0 | 45 |

4. Conclusion

Water quality is a critical factor in well being of any area. The various parameters studied were found within the permissible limit as per WHO and BIS (10500) standards for drinking and domestic use water (Table no.1 & 2). On the basis of present study, it is concluded that during study period the Betwa River water quality of studied area is suitable for domestic and irrigation purposes and it may be used after some proper treatment. However, more efficient management is also required to conserve the river water quality.

References

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