International Journal of Advanced Science and Research
www.allsciencejournal.com
ISSN: 2455-4227
Received: 24-04-2024, Accepted: 16-05-2024, Published: 08-06-2024
Volume 9, Issue 1, 2024, Page No. 13-18

Assessment of physical and chemical parameters of the Murna river: Spatial variation in water quality across different sampling sites

Akshita Shrivastava[1], Sonali Shrivastava[1], Jagrati Chaturvedi[1], Samrah Rehan[2], Manisha Shukla[1*]
[1] Department of Biotechnology, Pandit S.N. Shukla University, Shahdol, Madhya Pradesh, India
[2] Department of Biochemistry, Ganesh Shankar Vidyarthi Memorial Medical College, Kanpur, Uttar Pradesh, India

Abstract
This study evaluates the physical and chemical parameters (pH, Temperature, Turbidity, Suspended Solids, Total dissolved Solids (TDS), Electrical conductivity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Alkalinity, Chloride, Calcium Hardness, Magnesium Hardness and Total Hardness) of the Murna River at three distinct sampling sites: Kalyanpur Shahdol (S1), MPEB Shahdol (S2), and Sohagpur Shahdol (S3). The analysis revealed significant variations in water quality across these sites. The pH was highest at S1 (more alkaline) and neutral at S2, indicating minimal anthropogenic influence, while S3 showed slightly acidic conditions. Chloride levels were significantly higher at S2 and S3, likely due to pollution. Turbidity peaked at S2, reflecting high suspended solids. Suspended solids were highest at S3 (~50 mg/L) due to sediment accumulation and runoff, moderate at S2, and lowest at S1. Total solids followed a similar pattern, with maximum levels at S3 and minimum at S1. BOD was lowest at S1, indicating minimal organic pollution, and highest at S3, suggesting significant organic matter pollution. COD followed a similar trend, with lowest levels at S1 and highest at S3. Coliform bacteria were abundant at S3, indicating contamination, while S1 had negligible amounts. These findings highlight the varying degrees of pollution and mineral content in different sections of the Murna River, with S1 being relatively pristine and S3 showing significant pollution and mineral content, likely from anthropogenic and geological sources.

Keywords: Murna River, Shahdol, Sohagpur, Physico-chemical parameters, Total coliform

Introduction

The geographic coordinates of District Shahdol are 23°15' N to 24° N latitude and 81°E to 81°45' longitude. The district spans 110 km north-south and 30 km east-west, making up a total area of roughly 5642 sq km, or 1.83% of the M.P. Shahdol is reachable by road from Jabalpur, Rewa, Bilaspur, Mandla, Sidhi, and Koria district. It is located on the Katni-Bilaspur railway line.

The district is bordered on the north by the Sone River, the south by Dindauri, the east by Koria (Sarguja), the west by Jabalpur and Umaria, and the east by the Satna and Sidhi district.

District Shahdol is located roughly 110 miles (177 km) northwest of Bilaspur along the Murna River, a tributary of the Son River. The Murna River runs northeastward from the south. The Murna River also supplies a few Shahdol city settlements with the water they need. It was discovered during the survey that there is essentially no forest cover along the Murna River's bank. Along the riverbank, there were also both big and little slum encroachments. The river Munra (which is now a drainage) has drastically dried up as a result of the bank of the river being encroached upon [1].

Water is a common natural resource that is necessary for all living things. It is one of the essential components with the greatest influence on life [2]. It can be used for many different things, like as drinking, irrigation, fishing, navigation, and leisure. It is the cornerstone of the social and economic infrastructure and is required for sustained growth and a flourishing community [3]. Water pollution is any change to the physical, chemical, or biological status of the environment that has an adverse effect on the standard of living for people, other animals, and plants [2].

Because of urbanization and population growth over the past few decades, there has been an increased need for freshwater. This demand is satisfied by the rivers, which provide water for both agricultural and human habitation. Waste generated from industry and human activity has caused river water quality to decrease, affecting human health as well as aquatic life [4]. River water quality is affected by sewage water, healthcare facilities, industrial waste effluents, and runoff from agriculture. It is well known that pathogens, suspended particles, and other organic and inorganic pollutants found in home wastewater contribute to river pollution [5].

According to reports from the WHO, CPCB, BIS, and ICMR, these pollutants were the cause of around 70% of India's contaminated river water, and part of that water was unsafe for human consumption [6, 7]. Numerous research on the assessment of river water quality using different metrics (physico-chemical and biological) as well as different methods and tactics for river water protection have been published in the literature [8, 9, 10]. The goal of the current study is to evaluate how the physico-chemical characteristics of Shahdol City's Murna River have changed. To evaluate water quality and determine if it is suitable for a certain purpose, physical, chemical, and biological factors must be analyzed. This study conducts extensive testing to assess the water quality of the Murna River. We want to ascertain the current condition of the river's ecosystem by analyzing variables including temperature, pH, dissolved oxygen, turbidity, nutrient levels, and the existence of microbiological pollutants such total coliform bacteria. The analysis's findings will shed important light on the Murna River's environmental health and identify any possible threats to the general public's health and the region's biodiversity.

Material and Methodology

This study was carried out on Murna River and water samples were collected in the mornings of the first week of March 2024 from three selected places namely S1: Kalyanpur Shahdol (latitude 23.291216°/longitude 81.349732°; city entrance), S2: MPEB Colony Shahdol (latitude 23.296317°/longitude 81.348981°; city centre), S3: Sohagpur Shahdol (latitude 23.2949° longitude 81.342176°; city end). Two liters of water samples were taken from each site in sterile Jerkin bottles, stored and transported to the Madhya Pradesh Pollution Control Board (MPPCB) Shahdol laboratory for analysis of physical, chemical and microbiological parameters as per routine. Samples were analyzed using standard methods.

1. Physical measurements: The temperature of all water samples were measured using a digital PH meter (Systronics, 361). Turbidity was measured with the Nephelo-Turbidity Meter (Systronics, 135) and the Digital Conductivity Meter (Systronics, 304), respectively. Suspended solids and total solids were calculated using a gravimetric scale (Sartorius, CPA224S Balance).

2. Chemical measurements: The pH of the water sample was measured using a calibrated pH meter (Digital PH Meter 361, model no.: 361). Total hardness, calcium hardness and magnesium hardness of tap water were determined using the titration method with EDTA solution. Chloride and alkalinity were determined quantitatively by adding standard H2SO4 to water samples using standard methods. Bioavailable organic matter (BOD) and total oxygen demand (COD) of all wastewater were estimated in using the alkali azide method and the dichromate conversion method.

3. Biological parameters: The total number of coliform bacteria was evaluated using the filtration method. Water samples of 100 ml each were filtered using sterile filter paper (pore size 0.45 μmm) and placed in an incubator at 37 °C on Endo agar medium for 24–48 h. After incubation, all colonies of coliform bacteria were counted.

4. Statistical Analysis: To determine the reliability of the data, each sample was subjected to three testing procedures that formed the basis of a comprehensive analysis of all relevant parameters. All statistical analyzes were performed using GraphPad Prism software version 6.0 (San Diego, CA, USA).

Result and Discussions

The evaluation of physical and chemical parameters of the Murna River at different sampling sites revealed significant differences across the sampled sites (Fig 3).

1. pH Levels, Temperature and Chloride

pH (Fig 1A): The pH was highest at S1, indicating more alkaline conditions at these sites. S2 had the most neutral pH, which is typical for a source point with less anthropogenic influence with S3 having a slight acidic pH. Temperature (Fig 1B): During January to March 2024, temperatures across the sites varied from around 22°C to 24°C. These variations are typical for the season, with no extreme deviations observed among the sites. Chloride (Fig 2A): The chloride levels at S2 and S3 showed significant higher values, possibly due to higher pollution levels from anthropogenic sources while S1 had lower values.

2. Turbidity, Alkalinity and Conductivity

Turbidity (Fig 1C): Turbidity was highest at S2, reflecting the high suspended solids and sediment load. Alkalinity (Fig 2L): Alkalinity was lowest at S3 and highest at S1, suggesting different levels of bicarbonate and carbonate ions due to varying geological and environmental factors. Electrical Conductivity (Fig 2L): Conductivity, which indicates the water's ability to conduct electrical current due to dissolved ions, was observed to be highest at S1.

3. Suspended Solids and Total Solids

Suspended Solids (Fig 1E): The highest concentration of suspended solids was recorded (~50mg/L) at Sohagpur Shahdol (S3). This is likely due to sediment accumulation and runoff in the reservoir area. S2 (MPEB Shahdol) has around 40 mg/ml and S1 (Kalyanpur Shahdol) exhibited had the lowest concentration, reflecting its relatively pristine condition. Total Solids (Fig 1F): Similarly, S3 had the maximum total solids, indicating higher sediment and dissolved solids in this section of the river. S2 showed almost similar to S1 results, with the minimum value observed at S1.

4. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

BOD (Fig 2C): The lowest BOD was observed at S1, suggesting minimal organic pollution at the source. In contrast, S3 had the highest BOD, indicating significant organic matter pollution likely from agricultural runoff and domestic waste. COD (Fig 2D): COD levels were lowest at S1. S2 had higher concentrations as compared to S1 while S3 exhibited highest COD levels, pointing to considerable chemical pollutant presence.

5. Calcium Hardness, Magnesium Hardness and Total Hardness

Calcium Hardness (Fig 2E): S3 exhibited the highest calcium hardness, indicating significant mineral content in the water, possibly from geological formations or inflows. Magnesium Hardness (Fig 2F): S3 also showed the highest magnesium hardness, suggesting a different mineral composition at this site compared to others. Total Hardness (Fig 2G): Total hardness was also maximum at S2, indicating overall high levels of calcium and magnesium ions in the water.

6. Analysis of total coliform bacteria

Coliform bacteria were found to be abundant in S3 (Sohagpur Shahdol), while S1 site (Kalyanpur Shahdol) having presence of negligible amount of the coliform bacteria (Fig 4).

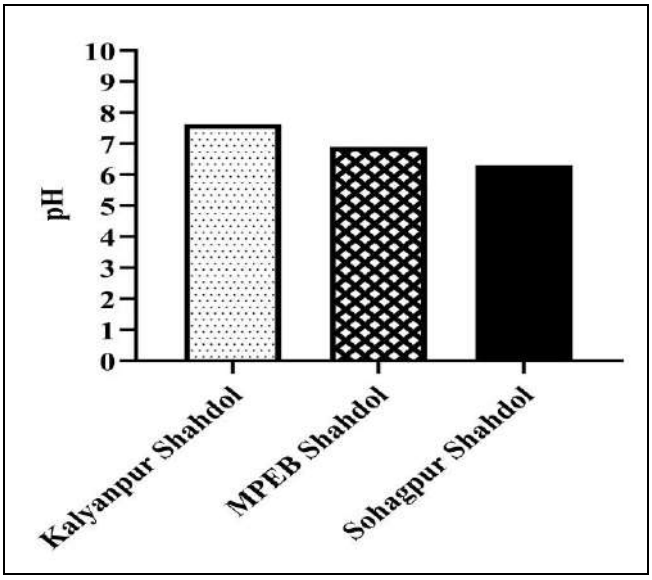

Fig 1A: Analysis of pH in Murna River Water samples

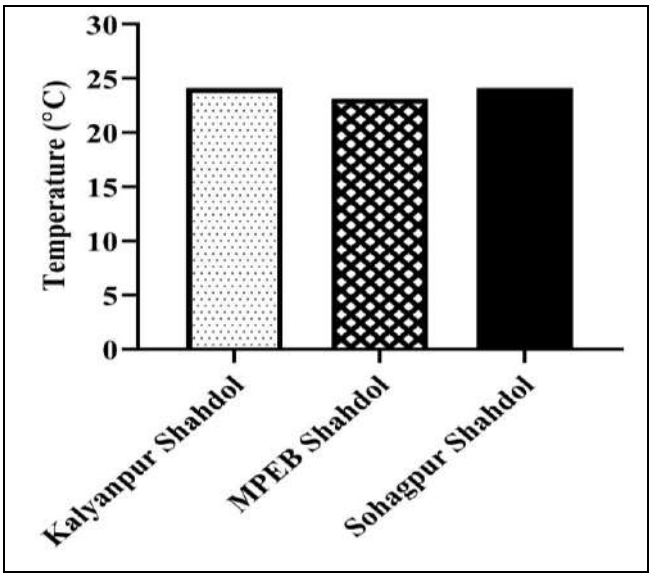

Fig 1B: Analysis of Temperature in Murna River Water samples

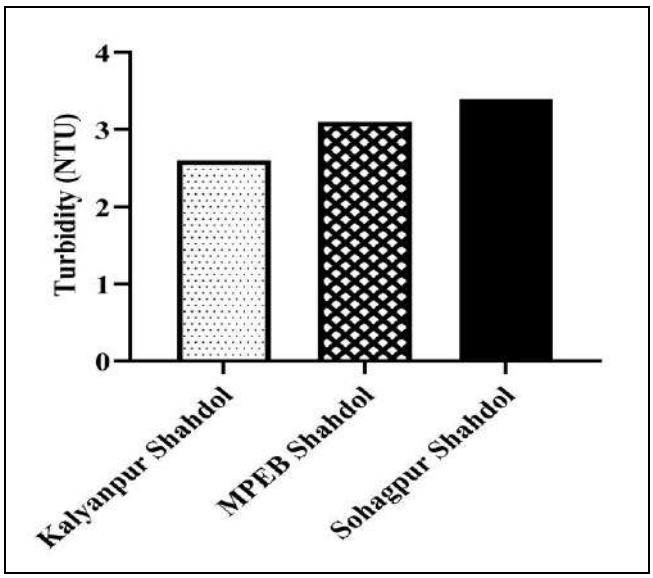

Fig 1C: Analysis of Turbidity in Murna River Water samples

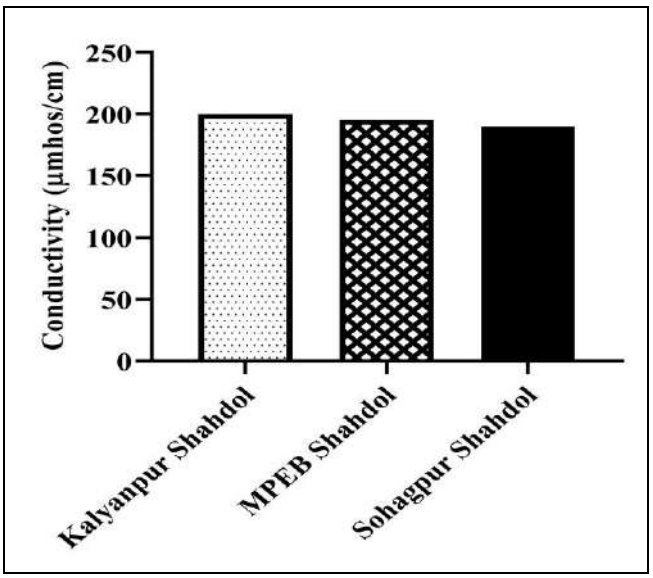

Fig 1D: Analysis of Conductivity in Murna River Water samples

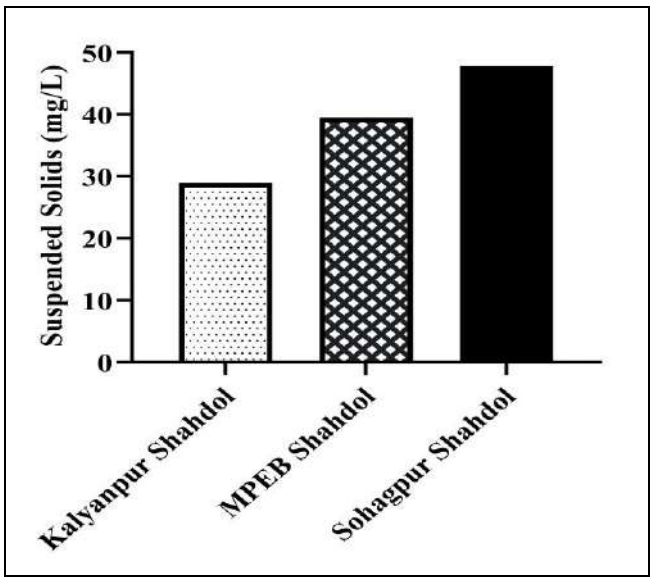

Fig 1E: Analysis of Suspended Solids in Murna River Water samples

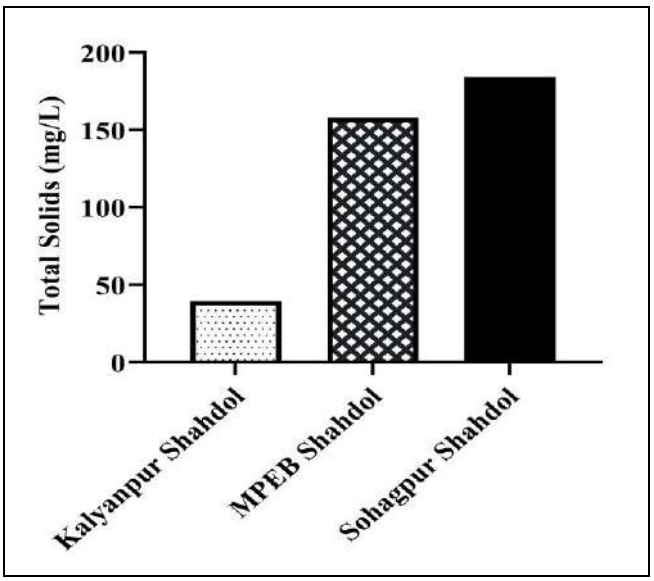

Fig 1F: Analysis of Total Solids in Murna River Water samples

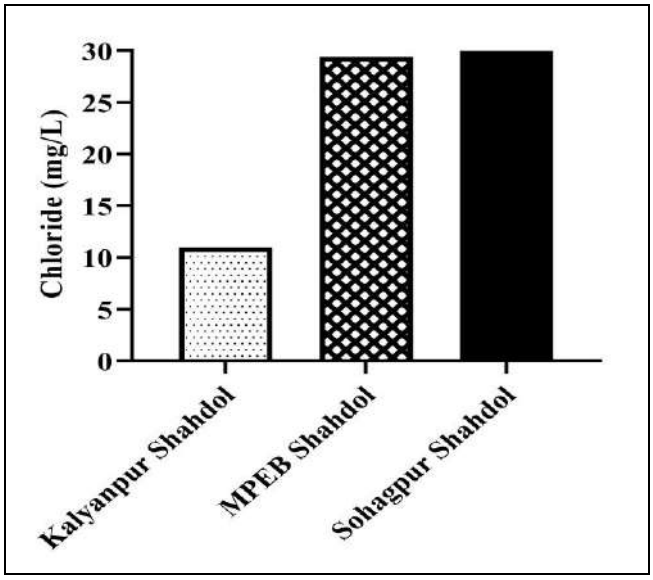

Fig 2A: Analysis of Chloride in Murna River Water samples

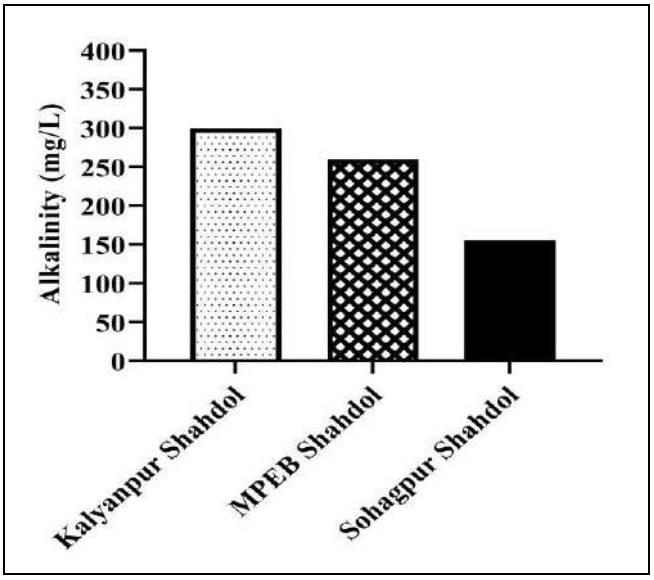

Fig 2B: Analysis of Alkalinity in Murna River Water samples

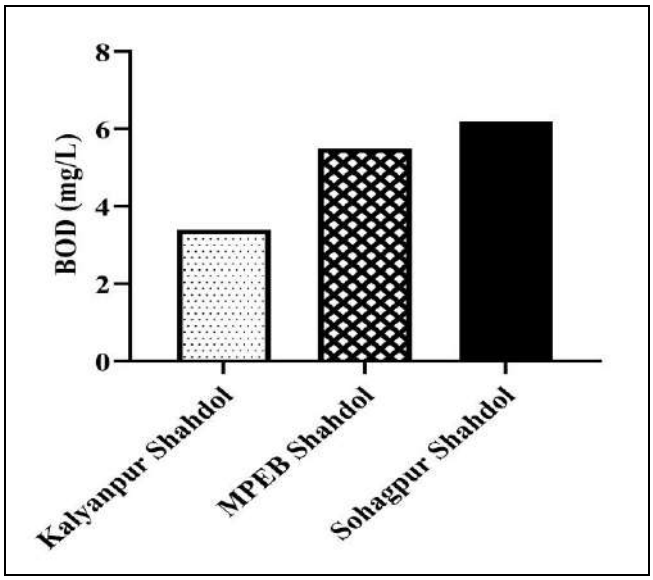

Fig 2C: Analysis of BOD in Murna River Water samples

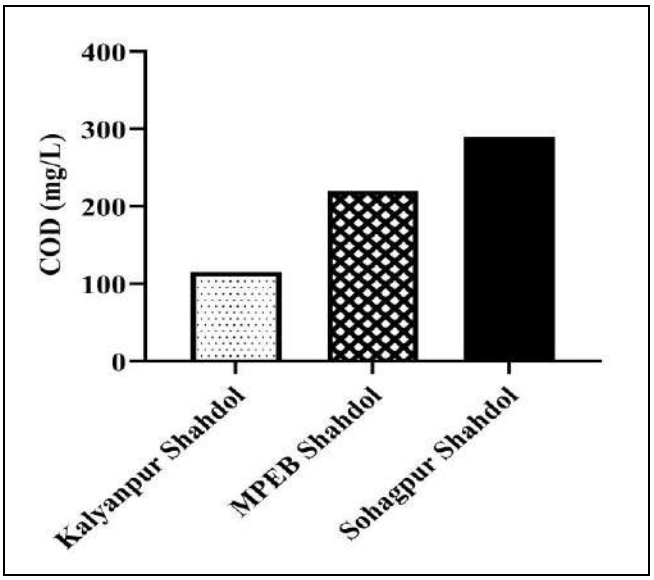

Fig 2D: Analysis of COD in Murna River Water samples

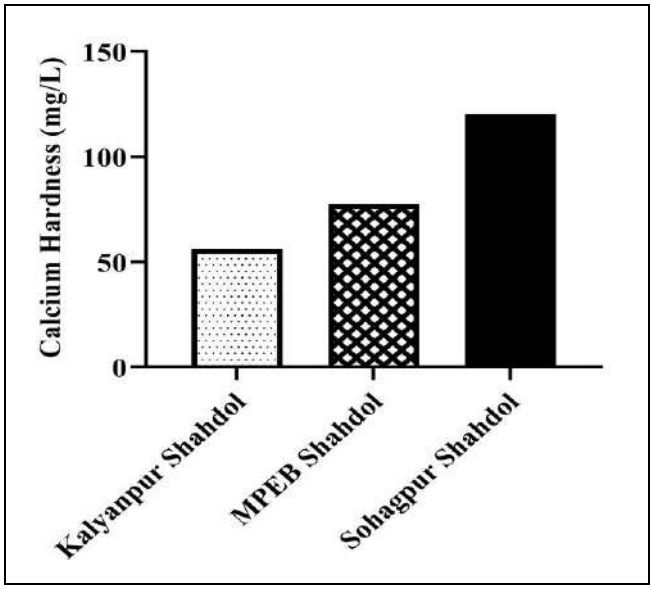

Fig 2E: Analysis of Calcium Hardness in Murna River Water samples

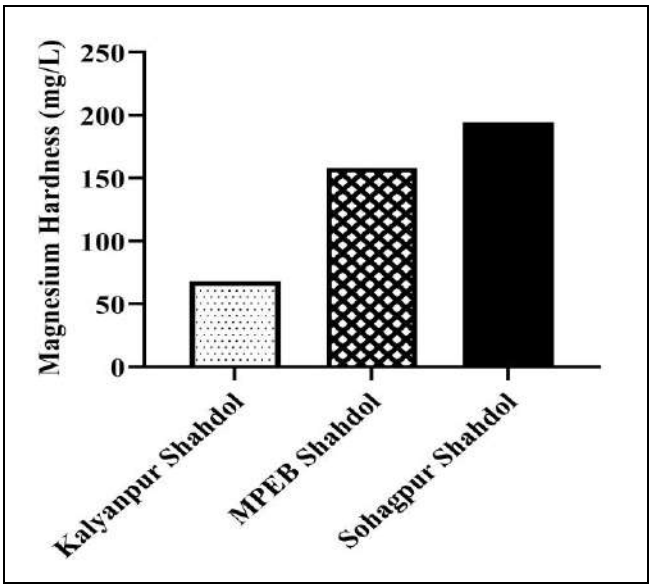

Fig 2F: Analysis of Magnesium Hardness in Murna River Water samples

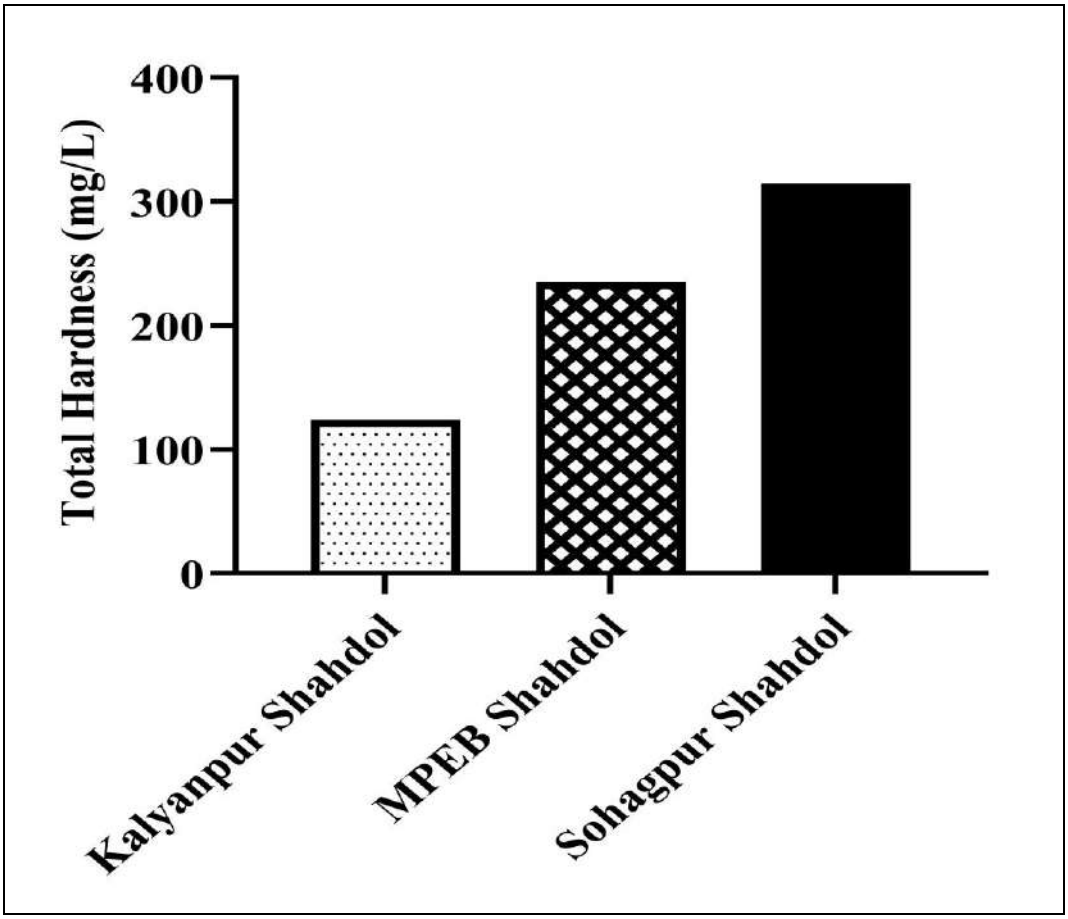

Fig 2G: Analysis of Total Hardness in Murna River Water samples

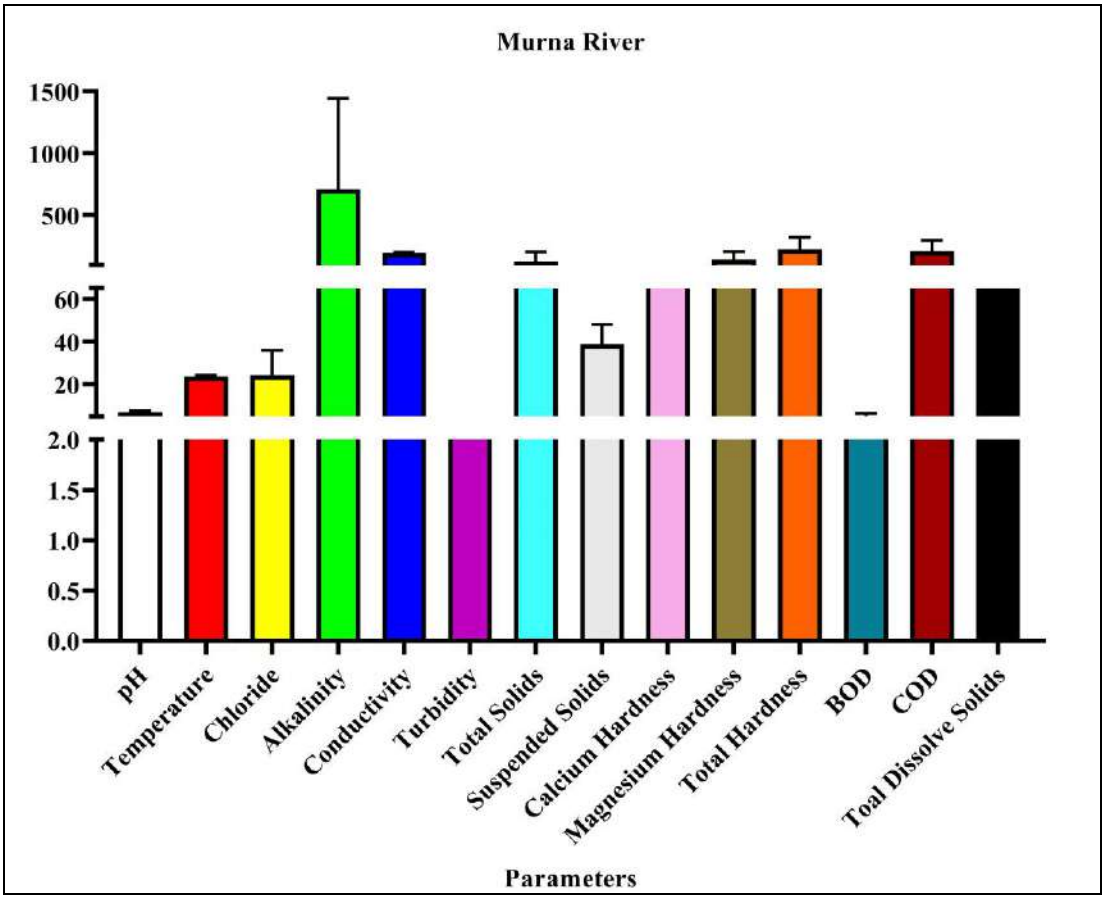

Fig 3: Physiochemical Analysis of Murna River Water samples

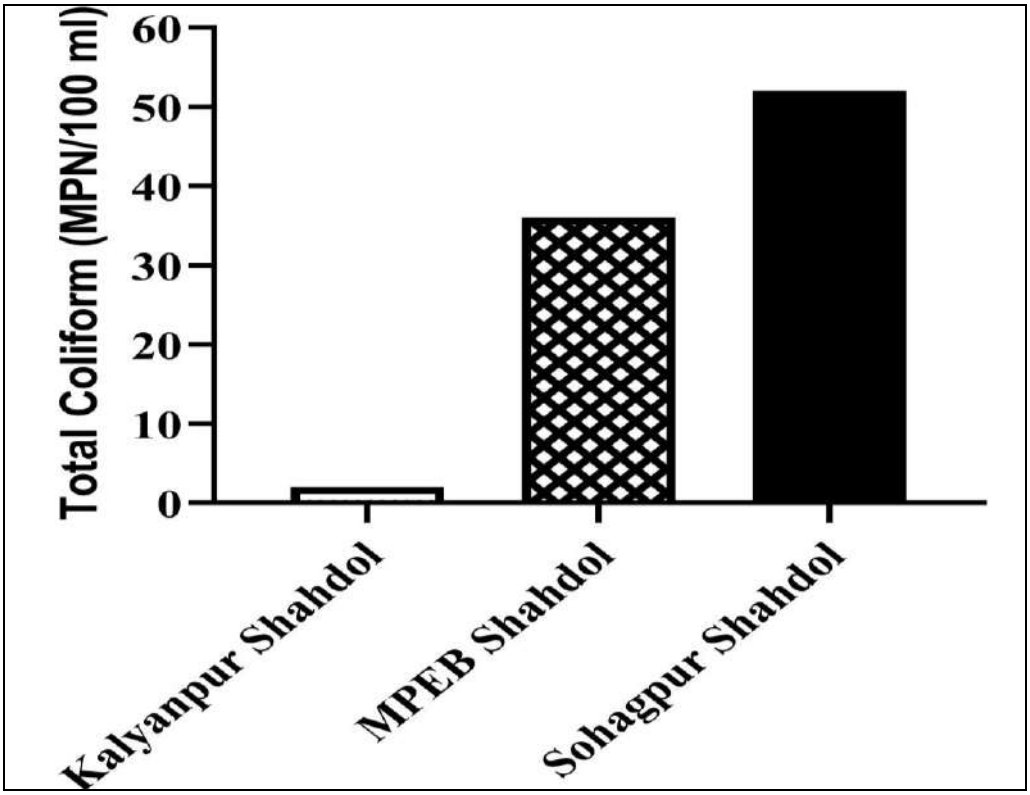

Fig 4: Analysis of Total Coliform bacteria in Murna River Water samples

Conclusion

The study reveals that the water of the river Murna is deteriorated very badly as a result of addition of urban waste, domestic sewage, which enters the river from both the banks during its course through the heart of Shahdol city. Direct discharge of human and animal waste not only imparts the quality of water but also affects the health of the people down stream of Shahdol city where the same water is used for washing, bathing and sometimes for drinking purposes. The urban runoff and continuous dumping of waste materials especially sanitary waste are affecting the water quality of river Murna. There is considerable need for better understanding of these small rivers so that they can be managed effectively.

Acknowledgements

The authors acknowledge the support and assistance provided by the Madhya Pradesh Pollution Control Board (MPPCB) Shahdol and Pandit S.N. Shukla University Shahdol, Madhya Pradesh, India.

Funding

None

Conflicts of Interest

The authors declare no conflict of interest.

Reference

1. Khan S. Physico-chemical study of water quality of Murna river in Shahdol city Madhya Pradesh, India. Govt. Polytechnic College, Shahdol, Madhya Pradesh, India.
2. Thompson LF. Biodiversity of Vibrios. Microbiol Mol Biol Rev,1992:68:403-31.
3. Simpi B, Hiremath SM, Murthy KNS, Chandrashekarappa KN, Patel AN, Puttiah ET. Analysis of water quality using physico-chemical parameters Hosahalli Tank in Shimoga District, Karnataka, India. Global J Inc USA,2011:(3).
4. Gupta N, Pandey P, Hussain J. Effect of physicochemical and biological parameters on the quality of river water of Narmada, Madhya Pradesh, India. Water Sci,2017:31(1):11-23.
5. Savita D. Analysis of physico-chemical parameters of Kshipra river water at Ujjain, India. Int Res J Environ Sci,2013:2(7):1-4.
6. Ramakrishnaiah CR, Sadashivaiah C, Ranganna G. Assessment of water quality index for the groundwater in Tumkur Taluk, Karnataka State, India. E-J Chem,2009:6(2):523-30.
7. Jindal R, Sharma C. Studies on water quality of Sutlej River around Ludhiana with reference to physicochemical parameters. Environ Monit Assess,2011:174:417-25.
8. Shah KA, Joshi GS. Evaluation of water quality index for River Sabarmati, Gujarat, India. Appl Water Sci,2017:7:1349-58.
9. Yisa J, Tijani JO. Analytical studies on water quality index of river Landzu.
10. Avvannavar SM, Shrihari SJ. Evaluation of water quality index for drinking purposes for river Netravathi, Mangalore, South India. Environ Monit Assess,2008:143:279-90.