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Analysis of Water Quality using Physico-Chemical Parameters of River Vyarma in District Damoh (M.P.)

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Abstract:

In the Damoh District, a thorough investigation has been done to evaluate the river Vyarma's water quality index. Five sampling stations provided 60 water samples, which were then examined for physicochemical properties (temperature, pH, DO, hardness, total alkalinity, turbidity, chloride, specific conductivity, TDS, phosphate, and nitrate.). People from both urban and rural areas live along the Vyarma river's bank. Their daily garbage is dumped into the river, changing its physicochemical characteristics. Several physicochemical analysis results shows that certain water samples from the research locations are found to have parameters including pH, electrical conductivity, total dissolved solids, turbidity, and hardness in excess of the permissible limit. Between July 2021 to June 2022, the current study was carried out. The findings showed that the majority of the physicochemical properties of river water samples were within WHO guidelines.

Key Words: Physiochemical Analysis, Water Quality Index, portability, Pollution.

1.0 Introduction

The stability and physico-chemical properties of an aquatic environment have a significant role in determining how life exists there. Any aquatic body's physico-chemical state has a direct correlation with its biological production (Sharma et. al., 2013 [1]). The best source to gauge the water quality of any aquatic body is physico-chemical characteristics. One of the various applications of water is for hydroelectric power, transportation, recreation, household, industrial, and commercial purposes. Also, water sustains all life forms and has an impact on our health, way of life, and financial well-being. Just 2.8% of the water on Earth is suitable for human consumption, despite the fact that more than 75% of its surface is made up of water (Iskandar, 2010 [2]). Without adequate supplies of fresh water of sufficient quantity and quality, sustainable development will not be possible (Kumar, 1997 [3]). Fresh water is a limited resource that is necessary for agriculture, industry, and even human existence. In contrast to runoff from agricultural land, which is a seasonal occurrence, municipal and industrial wastewater plays a significant role in the absorption or disposal of rivers (Muduli et al. 2010) [4]. Most developing nations are located in the tropical region, and their populations are expanding quickly. As a result, the demand for food, fuel, fibre, medication, and buildings is constantly rising. Natural resources are exploited as a result. Rivers are not only exploited in many nations including India, but they are also used as dumping grounds for solid wastes, effluents, and sewage. Drinking water sources can undergo unwanted modifications due to direct or indirect interaction with chemicals or waste water, making it unsafe for all living organisms. In India, there have been numerous investigations into the physico-chemical characteristics of river water (Borse et al. 2003; Singh and Gupta 2004; Barai and Kumar 2012; Deshmukh 2012; Chaurasia and Karan 2013; Napit 2014 [5–9]). A body of water has an impact on the area by charging the ground water. Any harm done to this water source by any organization would disrupt the aquatic ecosystem in addition to making life miserable. So, in order to determine if river water is potable, it is required to examine its quality using physicochemical measures.

2.0 Study Area

Damoh is a district of Madhya Pradesh State (India). Sagar Division includes the district. It is located at 23 degrees 09' north latitude and 79 degrees 03' east longitude in the state's northeastern region. Sagar to the west, Narsinghpur and Jabalpur to the south, Chhatarpur to the north, and Panna and Katni to the east surround the district. It is located around 12 miles away on a plateau (19 km)

2.1 About the Vyarma River

The Vyarma river rises on Johri Toriya hill in the Rehli tehsil of the Sagar district and flows north-east until joining the Sunar river close to Khamargaur village in the Hata tehsil. It is then travels via Taradehi of Tendukheda block, Nohta of Jabera block, Nohta, Banwar, Ghatera of Jabera block, Patera block, Hardua, Kota, Barrat, Imlia, and Bijwar of Hata block. It merges with the Sunar river close to Gasabad in Khamargaur. The Vyarama river receives all of the rainwater that falls from Sagar and the mountainous parts of the Damoh district, but due to not preserving water, it appears dry as soon as the rainy season is through.

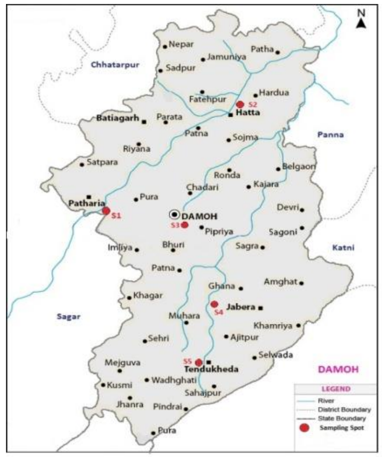

Figure 2.1: Studied location Damoh, Madhya Pradesh -Central India

Sampling stations:

1. Patharia
2. Khamargaur village in the Hata tehsil
3. Damoh Block
4. Nohta of Jabera block
5. Taradehi of Tendukheda block

3.0 Material and methods

3.1 Apparatus & Reagents

All the analytical grade chemicals used in the current experiment are from E. Merck India, S.D. Fine Chemicals, and B.D.H. The glassware used was made by Borosil India Ltd. Thermometer,

TDS meter, burette, pipette, test tube, pH meter, water analysis kit, Spectrophotometer (SQ 118) were used to analyze all the parameters.

3.2 Experimental procedure

Throughout the analysis period, seasonal water samples were taken at the study location. During the course of a year, a total of 90 water samples were taken from five different locations during the winter, summer, and rainy seasons (July 2021 to June 2022). Hence, the samples were examined in the lab using the recommended techniques of (APHA, 1989, 2005 [10], Neeri [11]).

The water sample collection protocol included a weekly sampling in accordance with industrial standards and Battish, 1992's literature. Early in the day, water samples were taken from the location (6 am to 8 am). Plastic jerry cans were used to collect water samples. Grab sampling technique was used for sampling. Standard techniques were used to examine water samples. The laboratory was then used to perform additional qualitative analysis and quantitative estimation of the river water samples. In order to explore numerous characteristics, a general survey of the river was conducted. Water has the unusual ability to dissolve and carry large suspensions of a wide range of chemicals, which has the unfavorable effect of making water easily contaminant (APHA, 1989) [10]). Monthly water samples were taken from locations along the river's surface (up to a depth of 500 cm). The mean values of all three observations were taken into consideration after collecting water samples in three replicates from the surface, column, and bottom. The collection of relevant data necessitates proper sampling and storage techniques. The most widely acknowledged method for sample preservation was cooling at 4°C. Most tests of the other parameters were performed within 24 hours of the sample collection. Twelve physicochemical characteristics of water were measured, including depth, temperature, pH, DO, hardness, total alkalinity, turbidity, chloride, specific conductivity, TDS, phosphate, and nitrate. Temperature and TDS were analyzed immediately at the time of sampling in the sampling sites with the help of thermometer and TDS meter. Whereas remaining parameters were analyzed in the laboratory by titration, water analyzer kit and spectrophotometer. Correlation coefficients have been calculated between various parameter pairs and for the significance of statistical investigations, t- test were used.

4.0 Result and Discussion

Industrial and domestic waste if discharged into river water can give rise to significant deterioration in its quality .The current investigation was carried out for a year at a chosen Vyarma river sample station in the Damoh area (from July 2021 to July. 2022). Five different locations were selected for the study (S1-S5) and compared. Covering the three main seasons of the year: the wet (July, August, September and October), the cold (Nov., Dec., Jan., and Feb.), and the warm (March, April, May, and June).

In order to analyze the water quality and pollution level, physico-chemical and bacteriological parameters were used to the samples taken from the study region. Details of the same were provided in tables to highlight the seasonal variations of selected parameters.

4.1 **Depth:** The current work has evaluated depth seasonally. It was found that during the winter, summer, and rainy seasons, the depth varied from 83 to 315cm, 81 to 261 cm, and 160 to 432.24 cm. respectively. Summer had the lowest value (S5-81), while in the rainy season found the highest value (S5- 432). The reduced depth might be brought about by a rise in temperature, suspended colloidal organic matter and debris as a result of reduced flow. (Table-1, 2 & 3).

4.2 **Temperature:** The water temperature during the current study ranged from 16.0°C to 17°C in the winter, 26.6°C to 30.2°C in the summer, and 23.4°C to 27.6°C during the rainy season. The winter season at S2 and S5 stations had the lowest value (S2, S5- 15° C), while the summer season at S4 station had the highest value (S4- 30.2°C) (Table-1&2). Some workers have claimed that river water reached high temperatures throughout the summer and mansoon months (Jhanjharia and Singh 2011 [12]). The cause of the higher temperature in summer is the greater light penetration at higher intensities over longer periods of time during the day.

4.3 **pH:** In the winter, summer, and monsoon seasons, the pH of the water samples ranged from 6.71 to 7.02, 6.51 to 6.96, and 6.96 to 7.02. S3 station (winter season) had a high pH value, while S2 station had a lower pH value (summer season). Throughout the study period, the rainy season had the highest pH, whereas winter and summer had more moderate pH levels (Table-1&2).

Table 1. Physico-chemical parameters and Comparative study of Vyarma River of Damoh (M.P.) in winter season

S. NO	Parameters	Sampling Stations					Ranges	
		S1	S2	S3	S4	S5	Min.	Max.
1	Depth(cm)	315	99	104	88	83	83	315
2	Water temp. (°C)	16	15	17	16	15	15	17
3	pH	6.91	6.75	7.02	6.92	6.71	6.71	7.02
4	Alkalinity (mg/l)	68	72	70	65	50	50	72
5	Turbidity (NTU)	2.70	2.79	1.80	1.98	0.90	0.90	2.79
6	Dissolved oxygen (mg/l)	5.76	5.67	6.12	6.03	5.67	5.67	6.12
7	Chloride (mg/l)	34	51	38	38	21	21	51
8	Hardness (mg/l)	173	178	175	187	119	119	187
9	Nitrate (mg/l)	0.20	0.33	0.77	0.26	0.29	0.20	0.77
10	Phosphate (mg/l)	0.02	0.35	0.40	0.06	0.17	0.02	0.40
11	Specific Conductivity (µmho/cm)	347	468	522	293	113	113	522
12	TDS (mg/l)	454	626	389	305	473	305	626

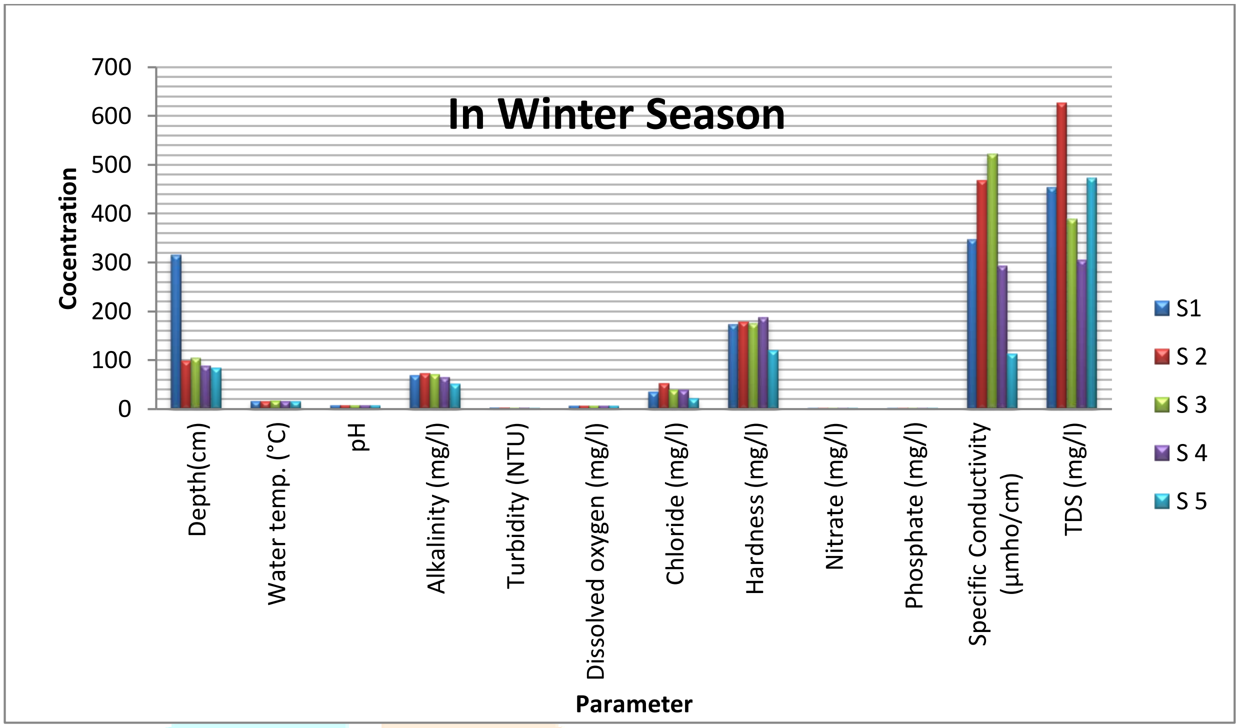

Figure 4.1 Concentration of different parameters at S1-S5 sampling sites in winter season.

Table 2. Physico-chemical parameters and Comparative study of Vyarma River of Damoh (M.P.) in summer season

S. NO	Parameters	Sampling Stations					Ranges	
		S1	S2	S3	S4	S5	Min.	Max.
1	Depth(cm)	261	90.1	94.7	85.5	81	81	261
2	Water temp. (°C)	28.8	28.4	26.6	30.2	29.7	26.6	30.2
3	pH	6.82	6.51	6.89	6.96	6.78	6.51	6.96
4	Alkalinity (mg/l)	75.6	79.2	75.6	70.2	57.6	57.6	79.2
5	Turbidity (NTU)	7.38	7.2	6.66	6.48	5.67	5.67	7.38
6	Dissolved oxygen (mg/l)	5.4	4.86	5.31	5.4	5.58	4.86	5.58
7	Chloride (mg/l)	30	32	36	40	32	30	40
8	Hardness (mg/l)	50.9	72.1	55.1	59.3	29.7	29.7	72.1
9	Nitrate (mg/l)	184	194	184	230	130	130	230
10	Phosphate (mg/l)	0.34	0.41	0.80	0.32	0.8	0.32	0.80
11	Specific Conductivity (µmho/cm)	0.23	0.33	1.28	0.13	0.58	0.13	1.28
12	TDS (mg/l)	176	481	620	400	176	176	620

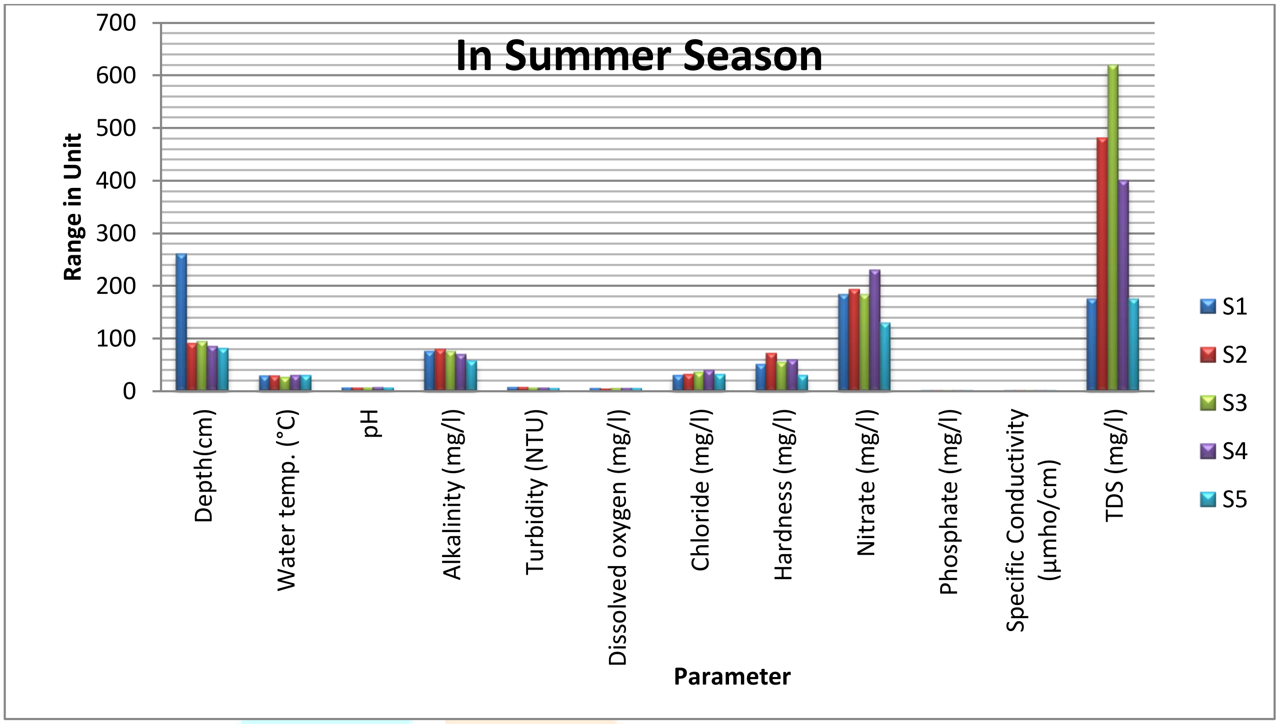

Figure 4.2 Concentration of different parameters at S1-S5 sampling sites in Summer Season.

Table 3. Physico-chemical parameters of Vyarma River of Damoh (M.P.) in rainy season.

S. NO	Parameters	Sampling Stations					Ranges	
		S1	S2	S3	S4	S5	Min.	Max.
1	Depth(cm)	432	194	261	189	160	160	432
2	Water temp. (°C)	23.40	23.85	27.54	23.40	24.30	23.40	27.54
3	pH	6.84	7.01	7.05	6.75	6.92	6.75	7.05
4	Alkalinity (mg/l)	61	65	58	54	47	47	65
5	Turbidity (NTU)	13.68	12.60	12.78	11.79	11.97	11.79	13.68
6	Dissolved oxygen (mg/l)	5.40	5.67	5.76	5.94	5.40	5.40	5.94
7	Chloride (mg/l)	29.63	29.67	33.91	25.43	33.91	25.43	33.91
8	Hardness (mg/l)	158	169	169	180	112	112	180
9	Nitrate (mg/l)	0.38	0.53	2.61	2.02	0.40	0.38	2.61
10	Phosphate (mg/l)	0.34	0.28	1.49	1.78	0.29	0.28	1.78
11	Specific Conductivity (µmho/cm)	277	626	707	513	225	225	707
12	TDS (mg/l)	720	1152	1476	1152	995	720	1476

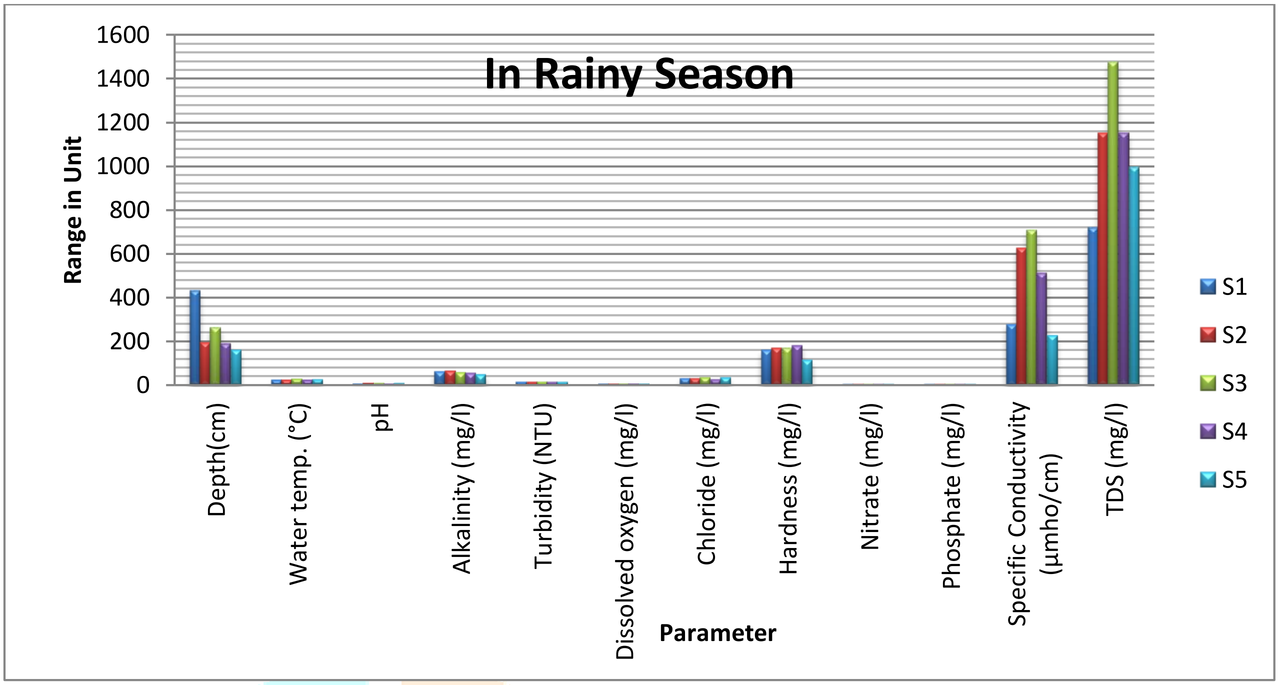

Figure 4.3 Concentration of different parameters at S1-S5 sampling sites in Rainy Season.

4.4 **Alkalinity:** The alkalinity ranged from 50 to 72 mg/l in winter, 57.6 to 79.2 mg/l in summer and 47 to 65 mg/l during the rainy season. Summer, followed by rainy and winter seasons, saw the highest alkalinity readings. In S2 station, the high range was discovered (Table-2). Jain et al. also voiced a similar viewpoint (1996).

4.5 **Turbidity:** The turbidity range (in mg/l) during winter season has found in between 0.90 to 2.79 in winter season, 5.67 to 7.38 in summer season and 11.79 to 13.68 in rainy season. So the data were varying from minimum value 0.90 mg/l to highest value 13.68 mg/l shows the changes due to season change. In rainy season the highest value of the turbidity is due to the increasing run off flow because of rain.

4.6 **Dissolved oxygen (DO):** During the winter season, stations had a high value of 6.12mg/l and a low value of 5.67mg/l; during the summer season, stations had a value of 5.58 mg/l and a low value of 4.86 mg/l; and stations had a value of 5.4 mg/l and a high value of 5.96 mg/l, respectively (rainy season). The summer season had the lowest value of DO while the winter season had the greatest amount. (Siamak Boudaghpour 2011 [13])

4.7 **Chloride:** Chloride levels varied from 21 to 51 mg/l in the winter, 29.2 to 72 mg/l in the summer and 25.43 to 33.91 mg/l in the rainy season. In S2 station, the maximum value was discovered during the summer (Table-2). (Tripathi [14]) has had comparable outcomes (1982).

4.8 **Hardness:-** Total hardness values recorded in the current study ranged from 119-187 mg/l during the winter, 130-230 mg/l during the summer, and 112-180 mg/l during the rainy season. The summer season found the highest total hardness values, while the monsoon (rainy) season found the lowest values (Table-1, 2&3).

4.9 **Nitrate:** One of the most crucial nutrients in aquatic ecosystems is nitrate. Nitrate levels in river water ranged from 0.22 to 0.77 mg/l in the winter, 0.32 to 0.80 mg/l in the summer and 0.38 to .61 mg/l in the rainy season. Throughout the study period, greater nitrate content values were observed during the rainy season, moderate levels during the summer, and lower levels during the winter (Table-1&3). Poonam et al. made a similar observation and reported it as well (2000).

4.10 **Phosphate:** One of the main nutrients responsible for biological productivity is phosphate. The phosphate level was discovered to be between 0.02 and 0.40 mg/l in the winter, 0.13 and 1.28 mg/l in the summer, and 0.28 and 1.78 mg/l in the rainy season. The concentration of phosphate was lower in the winter and higher in the summer (Table-1&2). Singh (1990) and Sultan et al. noted a comparable seasonal variation (2003).

4.11 **Specific conductivity:** It is found to be between 113 and 520 mho/cm in winter, 176 to 620 mho/cm in summer, and 225 to 707 mho/cm in monsoon during the study period. In S3 station (during the rainy season), the value of specific conductivity was found to be high (786 mho/cm), whereas at S5 station (during the winter season), the value was found to be low (125 mho/cm) (Table- 1&3).

4.12 **TDS (Total Dissolved Solids):** The readings of TDS during the research period displayed a pattern of variation that was mostly identical to those of conductivity. Throughout the study period, the lowest range of TDS was discovered in the winter season (305-626mg/l), and the highest range was discovered in the monsoon season (540-620mg/l). In S4 station, the lowest TDS value was discovered during the winter (Table-1). Khan and Ejike (1983) noted similar events in artificial lakes in Ghana and Jos, Plateau, Nigeria, respectively. The town's waste flow into the river is likely the cause of the slightly elevated concentration of chloride, phosphate, and nitrate that was discovered. Any aspect of water that affects aquatic species' chances of surviving, reproducing, growing, and producing offspring, management choices, environmental effects, or product quality and safety can be categorized as a water quality variable.

5.0 Conclusion

This study's goal was to determine the drinking water quality of the Vyarma River in the Damoh district. The results data for TDS show that the water of the maximum study area is highly contaminated with total solids. As a result of high concentration of TDS, water loses its quality and reduces the DO in water Rest experimental results of the Vyarma River water quality investigation, the water quality is good and the majority of the parameters are within the ranges established by organizations like the WHO and Bureau of Indian Standard (BIS). From the aforementioned investigation, it can be inferred that, with the exception of a minor variance, all physico-chemical parameters at the study site of the Vyarma River in the Damoh district were within acceptable limits. It is indicated that as water is used for drinking, suitable precautions are required to prevent pollution. The river is currently useful for fishing and irrigation purposes.

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