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An Assessment of the River Water Quality Parameters: A Case of Pavana River, India

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ABSTRACT
Since river water is needed for irrigation, drinking, domestic use, and aquatic life, including plants and animals, it is a major concern. This study was carried out to assess water quality in the Pavana River, Pune, India. Total 29 samples were collected from different station points. The results indicated that water quality is varied over different station points. While the water quality in the Pavana river is found to be poor at some places. Highest value of the BOD at 50.56 mg/lit at station point 114-R and the lowest at 3.37 mg/lit at 113-R. Highest value observed for COD is 160 mg/lit at 105-R and lowest is 8 mg/lit at 15-L. 26 samples exhibit BOD values that are higher than what is allowed for residential usage. Severe pollution at some places of the river is reportedly present. The two main causes of river pollution are silt buildup and the discharge of untreated industrial waste. More studies are needed for completing water quality evaluation.
KEYWORDS: *Pavana River, Physicochemical Parameter, Water Quality.*

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INTRODUCTION

Today the problem is not only of water availability but of environmental quality and ecological balance.Water sources are becoming increasingly critically contaminated due to rising urbanization, industrialization, and technological advancement in all industries. If pollution increases at the current rate without stopping, the existence of life on Earth will be threatened. A wide range of inorganic, organic, and biological contaminants are present in natural streams. In some circumstances, like the highly toxic metal cadmium, a contaminant becomes directly harmful at a low concentration. In other instances, the pollutant itself is not harmful, but its presence causes problems for the quality of the water.

Rivers are an essential source of fresh water for life, but they are deteriorating as a result of the discharge of industrial and domestic waste water [1], agricultural runoff, and agricultural practices in watersheds, all of which are significant contributors to river pollution [2]. Large amounts of sewage are produced in urbanized areas of India and are frequently dumped into water bodies without being properly treated [3] and [4]. Numerous studies [5–8] have been conducted on various aspects of the rivers water quality. These parameters help in determining the level of pollution, doing additional research on the eco-biological effects, and launching corrective efforts in the event of polluted water bodies.

In the present study an assessment of the water quality parameters for Pavana River, Pune, Maharashtra, India are discussed. This study is done during the months of April-May 2023. About 6 km south of Lonavala, the Pavana River, a tributary of the Bhima River, rises in the Western Ghats. Prior to its confluence with the Mula river in Sangavi, it flows first eastward before turning southward and passing through the Pune suburbs of Ravet, Thergaon, Chinchwad, Pimpri, and Dapodi. Surface waters, lakes, and rivers are becoming more and more contaminated due to sewage disposal, urbanization, and modernization issues. Some reports are already published previously on water quality assessment of Pavana river in past [9],[10].

The location of the study area is the river stretch of the Pavana River, starting from Pavana Dam to Ravet Bandhara. Various station points were selected for sampling along this river stretch. Pavana Dam is bounded by three forts: Gheravitangad, Tung, and Visapur. The river stretch is surrounded by agricultural land, industrial zones, and burning grounds. Water samples were collected from 29 stations located along a stretch of the Pavana River. The water samples were collected from the left and right sides of the stream. Standard procedures were followed in the collection of water samples and further physiochemical analysis.

The physicochemical parameters like BOD, COD, DO, pH, Conductance, TDS, chloride content, hardness, alkalinity and turbidity were analyzed.

MATERIAL AND METHODS

Study Area:

Water samples were collected from selected sampling stations of river Pavana between April 2023 to May 2023. The location of the study area is the river stretch of the Pavana River, starting from Pavana Dam to Ravet Bandhara within 29 location points [**Figure-1**].

Sampling procedure:

The 1000 ml plastic bottles were thoroughly cleaned and then rinsed with 3-4 ml dil.HCl. The bottles were rinsed once more with the water that had been sampled, and the water samples were then carefully collected, labeled, and sealed. As far as feasible, aeration was prevented during the sampling process. The water samples were carefully sent to the laboratory, where they are being stored for physical and chemical analysis. Samples were collected from river in the distance of about 500-800 meter from one sample to another. Parameters and methods used for water quality assessment study areas per Indian standards and are mentioned in **Table-1.**

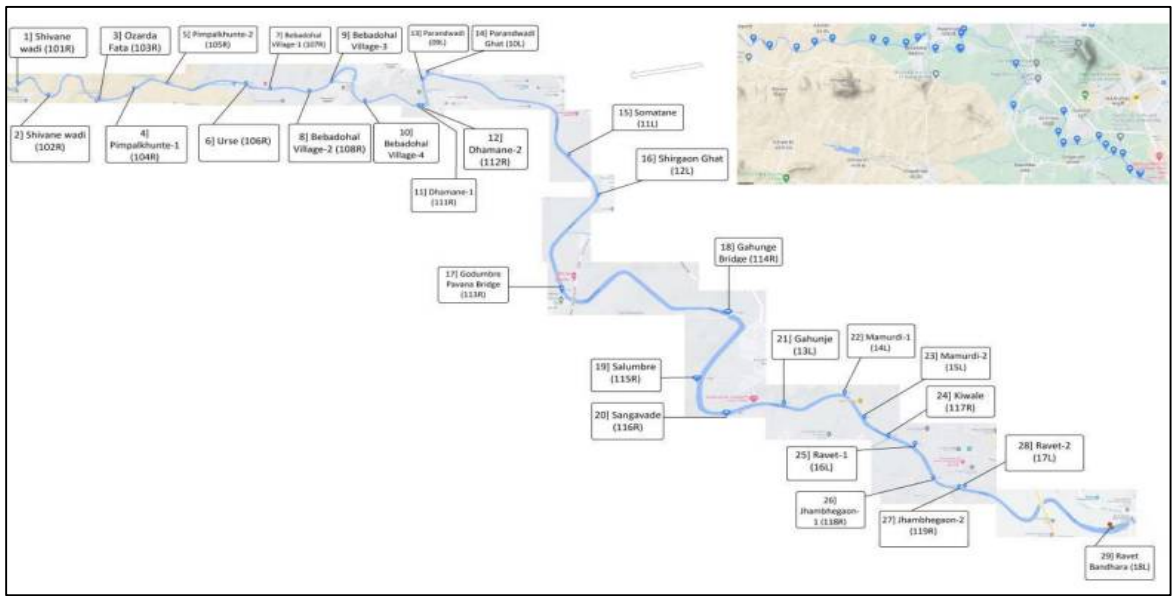

Fig. 1 Selected Station Points of Pavana River

Table 1: Parameters used and methods applied for study as per Indian Standards.

Sr. No.	Parameters used	Methods applied for study	Indian Standard [BIS 10500:2012]
1	pH	Electrometric Method	6.5-8.5
2	TDS (mg/lit)	Electrometric Method	Below 500
3	Conductance (µS)	Electrometric Method	750
4	DO (mg/lit)	Azide modification method	7.6-7.0
5	COD (mg/lit)	$K_2Cr_2O_7$ reflux method	250
6	BOD (mg/lit)	Azide modification method	30
7	Hardness (mg/lit) as $CaCO_3$ equivalent	EDTA Titration Method	300
8	Alkalinity (mg/lit) as $CaCO_3$ equivalent	Acid-base Titration Method	600
9	Chlorine content (mg/lit)	Titration method	Below 250
10	Turbidity (NTU)	Turbidity meter	1-5

RESULTS AND DISCUSSION

Water quality parameters of Pavana river at various station points are mentioned in **Table-3.** In many other applications, including water treatment and purification facilities, pH readings are crucial. In this present study, the pH readings are observed in the range of 5.28 to 6.25.

For the majority of aquatic species, oxygen is the most crucial gas; free oxygen, or DO, is required for respiration. Fish cannot survive at DO concentrations below 1 ppm; the majority of the fish population typically requires concentrations between 5 and 6 ppm. The average amount oxygen depends on the processes like biological, physical and chemical which are taking place in the water body [11]. To evaluate the quality of raw water and keep an eye on stream pollution, it is essential to be aware of DO levels. Since

DO serves as the foundation for the BOD test, all aerobic biological waste water treatment processes require it [12]. Since oxygen content in boiler feed water is a key contributor to corrosion, the DO test is employed to regulate it [13]. Here observed values are 6.0 to 7.7 mg/lit. Location wise variation in DO values are indicated by **Figure-2**.

The amount of dissolved oxygen that heterotrophic aerobic bacteria use to oxidize decomposable organic matter in waste water is known as BOD (Biological Oxygen Demand). The estimation of BOD is very important because when the pollution load is large, the DO (dissolved oxygen) drops to zero. Here, BOD is determined by a 3- day 27°C standard procedure as per revised Indian norms. The highest BOD observed is 50.56 mg/lit at station point 114-R, and the lowest BOD observed is 3.37 mg/lit at station point 107-R. The average value of BOD observed is 20.60 mg/lit. At some of the places where BOD and COD results are highest due to discharged pollutants from domestic activities, untreated or partially treated industrial wastewater was discharged into river water bodies, which is an organic and inorganic degradable load. Location wise variation in BOD values are indicated by **Figure-3**.

As per the Central Pollution Control Board of India, there are 5 classes of water, as below:

PURPOSE OF WATER	CLASS	PERMISIBLE AMOUNT OF BOD(mg/lit)
Drinking water	A	2 mg/litor less
Outdoor bathing	B	3 mg/litor less
Drinking water after conventional treatment and disinfection	C	3 mg/litor less
Propagation of wildlife and fisheries	D	4 mg/litor less
Irrigation, industrial cooling, Controlled waste disposal	E	Exceeding limits of above classes

According to the World Health Organization, a value of less than 5.0 mg/lit is optimum for aquatic bodies; at this range, BOD has no negative effects on the human body. Waste water sewage must have a BOD of roughly 80 ppm for discharge. The river having average BOD value greater than 30 mg/lit is considered as highly polluted river and need treatment on priority. The river having BOD values between 20-30 mg/lit is also considered as polluted river and need treatment. As we can see, we have a total of 26 values under class E among 29, and only 3 values matching the standards for classes A, B, C, and D. That means, as per our investigation, 89.65% of the river area which was selected for study is polluted, with BOD values not matching standards for domestic use.

COD is a measurement of all oxidizable pollutants found in sewage. The amount of physiologically oxidizable and biologically inert organic matter in a sample of sewage is measured by COD. It is a crucial and readily measurable characteristic for the examination of steam and industrial waste water, as well as for water treatment facilities. The COD levels that were actually measured in this investigation vary from 8 to 160 mg/lit. Location wise variations in COD values are indicated by **Figure-4**.

Out of 29 locations, some of the locations where BOD and COD values are observed to be different are those where natural purification occurs along the desired length of the river, which reduces BOD and COD, and also those where no pollutants are added into the river water. However, in some places, BOD and COD values are higher due to the discharge of pollutants from domestic and industrial activities, and sometimes there is not enough time and distance to have natural purification of the river water. The summary of DO, BOD & COD parameters for Pavana river study is mentioned in **Table-2**.

Table 2 Summary of DO, BOD & COD parameters for Pavana river study.

Parameter	Minimum Value	Maximum Value	Average Value	Permissible limit [As per WHO]	No. of Sample Above Permissible Limits	No. of Sample Below Permissible Limits
DO [mg/lit]	6	7.7	6.74	3	28	0
BOD [mg/lit]	3.37	50.56	20.6	5	26 [89.65%]	3[10.34%]
COD [mg/lit]	8	160	43.16	50	10	19

Calcium and magnesium, two alkaline earth metals, are the main causes of the water's hardness. The weathering process and mineral dissolution are the main causes of the magnesium and calcium concentrations in groundwater and surface water [14] and [15]. Hardness of the river water or any stream is also due to activities like bathing, washing clothes at the bank of rivers, disposal of untreated waste from the chemical factories making the detergents. The observed hardness values for this study are within the limit of 80 to 250 mg/lit.

Table 3 Water quality Parameters of Pavana River at Various station Points.

Sr No.	Location Details	Sample Number	Location			Distance From Reference Points	DO (mg/lit)	BOD (mg/lit)	COD(mg/lit)	Hardness (mg/lit)	TDS(mg/lit)	Turbidity (NTU)	Alkalinity(mg/lit)	pH	Conductance (in µS)
			Latitude	Longitude	Elevation (inm)										
1	Shivane	101R	18.69	73.58	593	0	6.56	10	24	130	198	1.2	90	5.8	97.2
2	Shivanewadi	102R	18.69	73.59	566	646.6m	6.52	6.74	20	150	254	22	60	6.05	111
3	Ozarda Fata	103R	18.69	73.60	572	1.64 km	6.82	50	125.5	110	195	21	70	5.28	94.5
4	Pimpalkhunte-1	104R	18.69	73.61	588	2.28 km	6.8	5	12	130	228	2.8	80	5.75	119.5
5	Pimpalkhunte-2	105R	18.69	73.61	573.2	2.95 km	6.59	35	160	150	190	9.3	80	5.38	98.6
6	Urse	106R	18.69	73.63	560	4.46 km	7.02	10	28	200	261	6.4	70	6.15	124.4
7	Bebadohal Village-1	107R	18.69	73.63	573.9	4.95 km	6.81	3.37	13	150	374	40	110	6.2	177.9
8	Bebadohal Village-2	108R	18.69	73.64	572	5.72 km	7.08	25	40	150	225	15	80	5.91	107.2
9	Bebadohal Village-3	109R	18.69	73.64	573.4	6.16 km	6.82	4.49	11.5	150	214	19	90	5.86	107.5
10	Bebadohal Village-4	110R	18.6	73.65	571.3	6.82 km	6.48	35	40	100	254	2.5	80	5.92	111.4
11	Dhamane-1	111R	18.6	73.66	571.1	7.71 km	6.48	6.18	20	160	258	47	90	5.85	108.9
12	Dhamane-2	112R	18.69	73.66	572	7.79 km	6.65	35	72	250	254	3.5	100	6.05	116.8
13	Parandvadi	09L	18.69	73.66	569.4	7.79 km	7.6	30	62.5	150	325	4.4	60	5.76	119.1
14	Parandvadi Ghat	10L	18.69	73.66	570	7.89 km	7.7	25	56	170	385	13	90	5.74	117.4

15	Somatane	11L	18.68	73.68	556	9.87 km	6.49	25	56	150	363	6.8	90	5.9	116.5
16	Shirgaon Ghat	12L	18.68	73.68	567	10.28 km	6.86	20	56	250	365	7.1	70	6	115.2
17	Godumbre Pavana Bridge	113R	18.67	73.68	568	10.08 km	6.68	3.37	12.5	150	289	2.1	80	5.85	113.3
18	Gahunje Bridge	114R	18.66	73.69	567.8	11.90 km	6.7	50.5	60.25	140	343	78	90	5.75	116.4
19	Salumbre	115R	18.66	73.69	567.2	11.98 km	7.63	20	52	130	303	2	80	5.93	119.5
20	Sangavade	116R	18.65	73.69	567.5	12.31 km	6.58	35	45	100	315	2	90	5.91	123.4
21	Gahunje	13L	18.65	73.70	567	12.74 km	6.75	12	28.63	120	341	97	100	6.25	119.3
22	Mamurdi-1	14L	18.66	73.71	560	13.48 km	6.78	15	56	200	384	9.7	90	6.02	116.3
23	Mamurdi-2	15L	18.65	73.71	568	13.83 km	6.08	4	8	250	164	35	110	5.85	197.8
24	Kiwale	117R	18.65	73.71	568	14.19 km	6.64	11.8	24.5	150	306	22	100	6.02	116
25	Ravet-1	16L	18.65	73.71	569.4	14.54 km	6	30	42.5	100	554	24	100	5.59	168.1
26	Jhambhe-1	118R	18.64	73.72	537	14.99 km	6.79	25	28	80	283	0.3	80	6.06	124.7
27	Jhambhe-2	119R	18.647	73.72	559	15.37 km	6.61	20	25.6	150	330	3.2	110	6.07	126.8
28	Ravet-2	17L	18.64	73.72	568.2	15.43 km	6.44	30	40	100	410	3.8	70	5.96	128.9
29	Ravet Bandhara	18L	18.64	73.74	562.8	17.73 km	6.13	15	32	254	509	1.1	80	5.96	139.1

The alkalinity of stream water is a measure of its ability to neutralize acid. Acidic contamination from rainfall or waste water can be more effectively neutralized by river water with comparatively high alkalinities. The water from the Pavana River does not have more alkalinity than the allowed level of 600 mg/lit [16]. The observed alkalinity values for this study are in the range from 60 to 110 mg/lit.

According to Singh et al. [17], the majority of the total dissolved solids in natural waters is inorganic salts like carbonates, bicarbonates, chlorides, sulphates, phosphates, calcium, magnesium, sodium, and

potassium, with a tiny amount of organic matter and dissolved gases. TDS up to 500 mg/lit is preferred and 1,500 mg/lit is the upper allowable level, as per the World Health Organization regulation (WHO, 2017) [18].The observed TDS values for this study are in the range from 164 to 554 mg/lit. An approximation of the total amount of dissolved substances in water is represented by electrical conductivity. It was discovered that the EC in groundwater and river water was found to be higher at the time of dry seasons as compared to rainy seasons [19]. The maximum value for electrical conductivity in this study is found to be 197.8 µS.

The amount of light dispersed by a sample of river water when it is illuminated serves as a measurement of turbidity, which is the degree to which water is cloudy. Therefore, turbidity is a measure of how much particulate matter, such as clays, silts, and algae, is being carried by the water. Sediment entering the river from agricultural and/or urban operations might result in increased turbidity or cloudiness. The observed turbidity values for this study are in the range from 0.3 to 97 NTU.

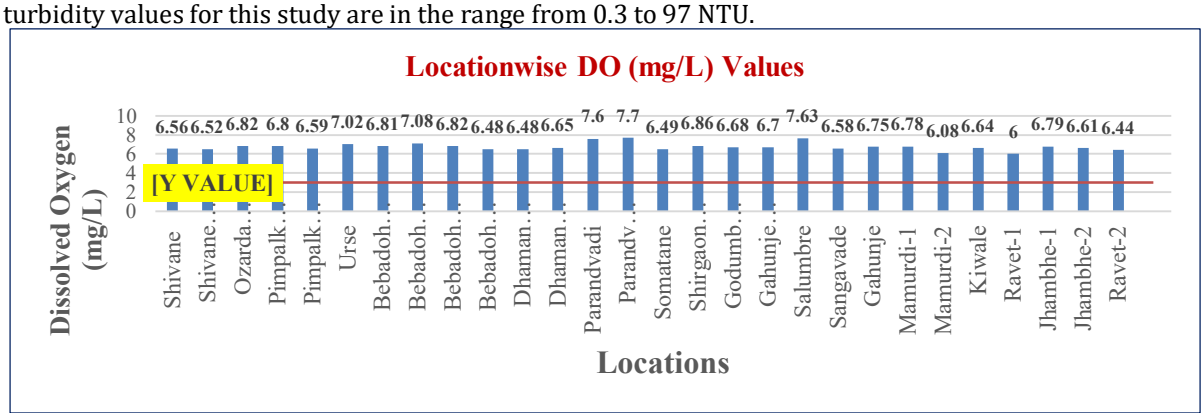

Fig. 2 Location wise variation in DO values.

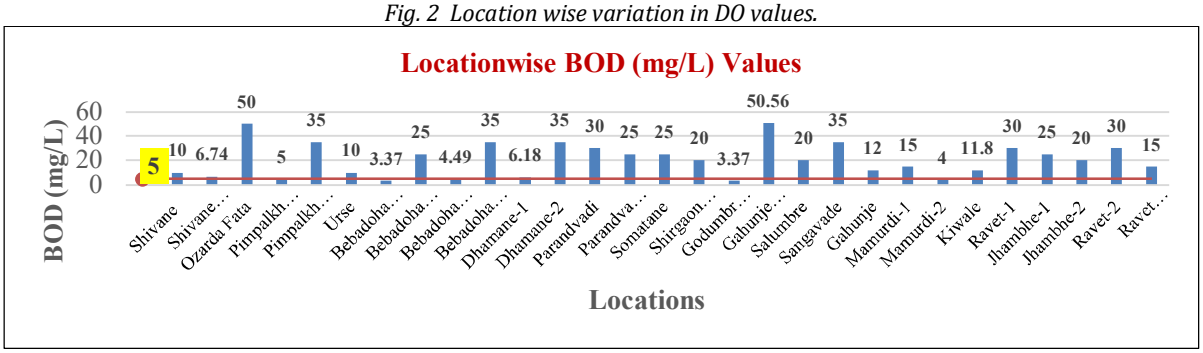

Fig. 3 Location wise variation in BOD values.

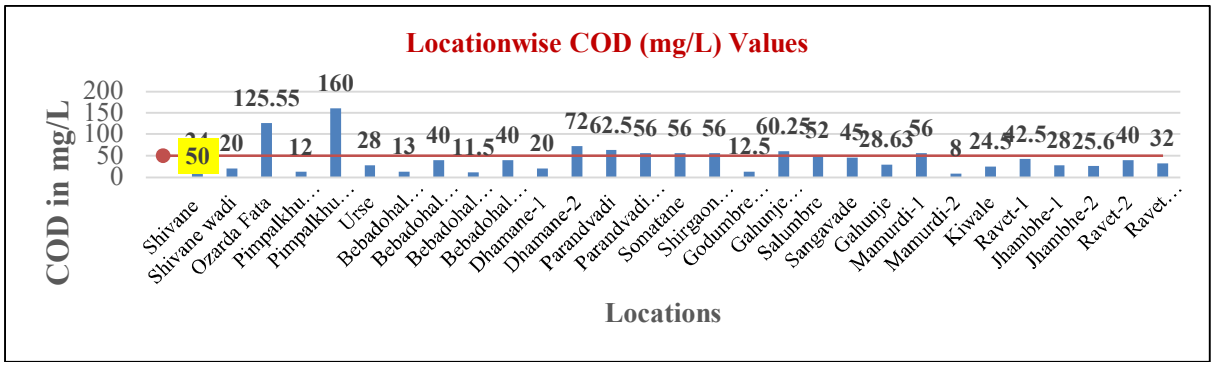

Fig. 4 Location wise variation in COD values..

CONCLUSION

This study showed that the physical and chemical parameters of the water quality of the Pavana River were not in the normal range at some places over the area of river studied. Severe pollution at some places of the river is reportedly present. So continuous monitoring of the water quality of the river should be done to monitor its status. All Non Government Organizations and government bodies should play an important role and be more effective in preventing the degradation of the aquatic environment of the Pavana River

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