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Water Quality Monitoring of Mula-Mutha River In Pune Region, Maharashtra, India

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ABSTRACT

All the ancient civilizations have developed along the banks of rivers, as they provided them with the most essential need "water". Water quality of the river is directly reflected on the health and lifestyle of the people depending upon it. River water pollution is one of the major concerns of many countries. All the factors affecting the quality of water should be handled with equal attention. Mula-Mutha river is one of the vulnerable river of Pune city. Mula originates from Mulshi dam and it passes through Poud, Lavasa, Wakad, Balewadi, Baner, Aundh, Khadki, Vishrantwadi, and ends at Sangamwadi. Monitoring involves comparison of water quality data between stations (water quality descriptors, fluxes), analysis of water quality trends, development of cause-effect relationships between water quality data and environmental data (geology, hydrology, land use, pollutant sources inventory), and judgement of the adequacy of water quality for various uses etc. For specific problems, and the evaluation of the environmental significance of observed changes, external expertise may be needed. Publication and dissemination of data and reports to relevant authorities, the public, and the scientific community is the necessary final stage of assessment activities.

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I. INTRODUCTION

All the ancient civilizations have developed along the banks of rivers,as they provided them with the with the most essential need "water". Water quality of rivers is directly reflected on the health and lifestyle of the people depending upon it. River water pollution is one of the major concerns of many countries. All the factors affecting the quality of water should be handled with equal attention.

Rivers form the lifeline of human society .These are vital fresh water systems of strategic importance across the world, providing main water resources for domestic, industrial, agriculture and recreational purpose At the present time, to safeguard fresh water resources, it is important to develop a comprehensive river water quality monitoring program all over the world .Increase in globalization and industrialization country faces the various challenges for providing clean and safe water to the public .As more number of rivers in getting polluted , the acting bodies such as municipalities are finding it difficulties.

Mula -Mutha River is one of the major vulnerable river of Pune city. Mula originates from Mulshi dam & it passes through Paud, Lavasa, Wakad, Balewadi,Baner ,Aundh, Khadki, Vishrantwadi and ends at Sangamwadi.Mula-Mutha is one of the most polluted water bodies because of their role in carrying municipal ,industrial and run-off from agriculture lands in their vast drainage basins .Despite of the various standards and laws made by government many industries were discharging their waste directly into the river making its quality poor day by day. Detailed research and analysis is needed to evaluate different process and mechanism involved in polluting water. So we are analyzing the water quality indices of Mula-Mutha in each season Viz, monsoon, pre-monsoon, post-monsoon

Sampling Locations

The sampling locations were selected randomly by considering the population, location and source. Water samples were collected from the locations along the route of the Mula - Mutha River basin in Pune district. The sampling locations were Sambhaji bridge , Municipal corporation , Sangamwadi , Khadki , and Mundhwa which are described below (Table-1).

Physico-Chemical Analysis

Standard procedures as described by APHA (1985) was followed for the Sample collections, stabilization and transportation to the laboratory as well as storage. Water samples were analyzed for thirteen parameters to determine the overall quality with respect to Temperature, pH, Total Suspended Solids (TSS), Total Hardness, Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Electrical Conductivity (EC), Chloride, Total Alkalinity, Chemical Oxygen Demand (COD),Turbidity, Sodium (Na), Potassium (K). The water samples were analysed for various parameters in the laboratory of Jspm's Imperial College Of Engineering , Department of Civil Engineering, Pune, Maharashtra, during the period of August 2016 to May 2017. In general, the standard methods recommended by APHA (1985) was adopted for determination of various physico-chemical parameters.

Water Quality Index

Calculating of water quality index is to turn complex water quality data into information that is understandable and useable by the public. Therefore, water Quality Index (WQI) is a very useful and efficient method which can provide a simple indicator of water quality and it is based on some very important parameters.

In current study, Water Quality Index (WQI) was calculated by using the Weighted Arithmetic Index method as described by Cude, C. 2001. In this model, different water quality components are multiplied by a weighting factor and are then aggregated using simple arithmetic mean.

For assessing the quality of water in this study, firstly, the quality rating scale (Qi) for each parameter was calculated by using the following equation;

$$Qi = \{[(V_{actual} - V_{ideal}) / (V_{standard} - V_{ideal})] * 100\}$$

Where,

Qi = Quality rating of ith parameter for a total of n water quality parameters

Vactual = Actual value of the water quality parameter obtained from laboratory analysis

Videal = Ideal value of that water quality parameter can be obtained from the standard Tables.

Videal for pH = 7 and for other parameters it is equalling to zero, but for DO Videal = 14.6 mg/L

Vstandard = Recommended WHO standard of the water quality parameter.

Then, after calculating the quality rating scale (Qi), the Relative (unit) weight (Wi) was calculated by a value inversely proportional to the recommended standard (Si) for the corresponding parameter using the following expression;

$$Wi = 1/ Si$$

Where,

Wi = Relative (unit) weight for nth parameter

Si= Standard permissible value for nth parameter

I = Proportionality constant.

That means, the Relative (unit) weight (WI) to various water Quality parameters are inversely proportional to the recommended standards for the corresponding parameters.

Finally, the overall WQI was calculated by aggregating the quality rating with the unit weight linearly by using the following equation:

$$WQi = \Sigma QiWi/ \Sigma Wi$$

Where,

Qi = Quality rating

Wi = Relative weight

In general, WQI is defined for a specific and intended use of water. In this study the WQI was considered for human consumption or uses and the maximum permissible WQI for the drinking water was taken as 100 score.

Chemical analysis of water gives a concept about its physical and chemical composition by some numerical values but for estimating exact quality of water, its better to depend on water quality index which gives the idea of quality of drinking water.

The rating of WQI is shown below.

WQI level	Water Quality Rating
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very Poor
> 100	Unfit for Drinking Purposes.

II. RESULTS AND DISCUSSION

The results obtained from analysis of water samples of river Mula – Mutha are shown in table 1. The reported values refer to the mean value of water samples collected in different seasons at different areas along the stretch of Ganga river. The results indicate that the quality of water varies considerably from location to location. A summary of the findings is given below:

The water temperature of the Ganga at Hardwar ranged between 10.18 ºC to 19.73 ºC. The maximum water temperature started decreasing due to the melting of snow at the peaks of the Himalaya. The water temperature showed an upward trend from winter season to summer season followed by a downward trend from rainy season onwards.

The conductivity of water is affected by the suspended impurities and also depends upon the amount of ions in the water. The highest conductivity 36.07µmho/cm of the Mula-Mutha water was observed in monsoon season. From monsoon season onwards the conductivity decreased and minimum conductivity 6.4µmho/cm was observed in winter season.

The turbidity in the river Mula-Mutha at corporation was lowest during winter season. From summer season onwards the water became turbid due to rains. The maximum turbidity 66.9 NTU was observed in monsoon season and minimum 18 NTU was observed in winter season.

Total suspended solids were recorded maximum 0.12 mg/l in monsoon season and minimum 0.001 mg/l.

The pH of the Mula-Mutha river was slightly acidic in monsoon. It ranged from 6.16 to 6.7.

The Mula-Mutha water contained highest dissolved oxygen during winter season, followed by a gradual decrease to its lowest values during monsoon season. The higher concentrations of dissolved oxygen during winter season was probably due to low water temperature, no turbidity and increased photosynthetic activity of the green algae found on the submerged stones and pebbles. The maximum 9 mg/l oxygen content of water was recorded in winter season and minimum 0.1 mg/l in rainy season. From monsoon season the water of Mula-Mutha starts becoming turbid which reduces the photosynthetic activity of the algae and thus decreases oxygen concentration.

The following map is showing the river Mula-Mutha and sampling sites-

The C.O.D. ranged from 12mg/l to 256mg/l. The minimum C.O.D. was recorded in Winter season and maximum in summer season.

The B.O.D. was minimum 1.3 mg/l in monsoon season and maximum 6.2 mg/l in winter season.

Total alkalinity was maximum 304 mg/l in winter season and minimum 100 mg/l in summer .

The hardness was higher in the summer season (134.4mg/l) and lower in the winter season (8 mg/l). Calcium ions make major contribution to the hardness of river water.

Maximum concentration of Sodium 10 mg/l was found in summer season and minimum 6.22 mg/l in monsoon season. Similarly, maximum concentration of potassium 2 mg/lit was found in summer season and minimum 1.63 mg/l in monsoon season. Sodium was found to have greater values than potassium throughout the study.

The chloride was observed maximum (88.97 mg/l) in summer season and minimum (20.26 mg/l) in monsoon season.

In the present study water of river Mula-Mutha was found to be in good quality in winter season at all the five sampling sites as the WQI was 38.62 this years. Water of River Mula-Mutha was found to be of poor quality in rainy season as WQI was 67.72 . The WQI starts decreasing from winter to summer and it further increases from summer to rainy season.

Table-1 : Mean of different parameters in different sampling stations

Parameters	Monsoon	Winter	Summer
pH	6.37	7.53	7.104
Electrical Conductivity	31.45	7.504	6.313
Alkalinity	207	224	116
Hardness	46.8	83.6	115.84
TSS	0.022	0.12	0.0126
Chlorides	36.64	39.96	85.17
DO	0.212	3.36	4.46
BOD	2.12	2.84	4.24
Turbidity	45	24.8	19.8
Na	6.802	7.372	8
K	1.686	1.772	1.9
temperature	26.88	27.7	31.44
COD	29	104	149.6

Table-2 : Drinking water quality standards (Maximum permissible limit) Standards are taken according to BIS ,ICMR etc.

Parameters	Sn	V_{id}	1/Sn
pH	6.5-8.5	7	0.1538
Electrical Conductivity	300	0	0.00333
Alkalinity	200	0	0.005
Hardness	200	0	0.005
TSS	500	0	0.002
Chlorides	250	0	0.004
DO	5	14.6	0.2
BOD	5	0	0.2
Turbidity	1	0	1
Na	30	0	0.033
K	10	0	0.1

Table 3: Water Quality Index and description of river water samples in different season

S No. sites	Sampling Season	WQI	Description
1	Monsoon	67.71	Poor
2	Winter	38.62	Good
3	Summer	37.96	Good

Table 4: An example calculation of Water Quality Index for sample

Parameters	Observed values	Standard values (si)	Unit weight (wi)	Quality rating (qi)	WiQi
pH	6.334	6.5-8.5	0.09016	133.2	12.009
Electrical conductivity	31.45	300	0.001953	10.48	0.02046
Total Alkalinity	207	200	0.00293	103.5	0.030325
Total Hardness	46.8	200	0.00293	23.4	0.0685
TSS	0.022	500	0.0011722	0.0044	5.15768*10^-6
Chlorides	36.63	250	0.00234	14.652	0.03428
DO	0.212	5	0.11722	149.785	17.568
BOD	2.12	5	0.11722	42.4	4.9701
Turbidity	45	1	0.5861	55.11	32.299
Na	6.78	30	0.019536	22.6	0.4415
K	1.678	10	0.05861	0.1678	9.8347*10^-3
				∑qi=555.3892	∑wiqi =67.7239

$$WQI = \sum WiQI / \sum Wi$$
$$= 67.7239 / 1.000171$$
$$= 67.712$$

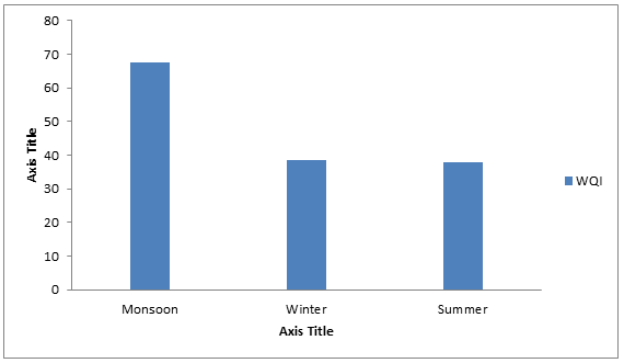
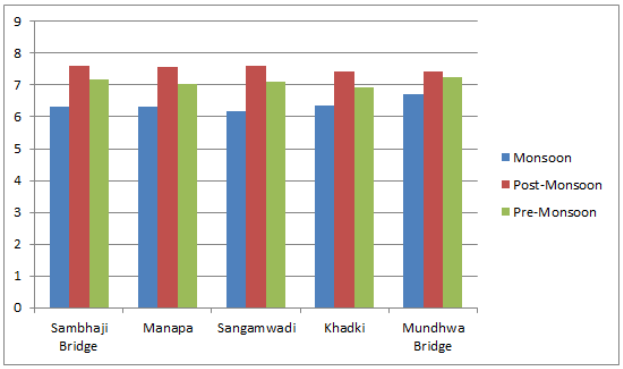
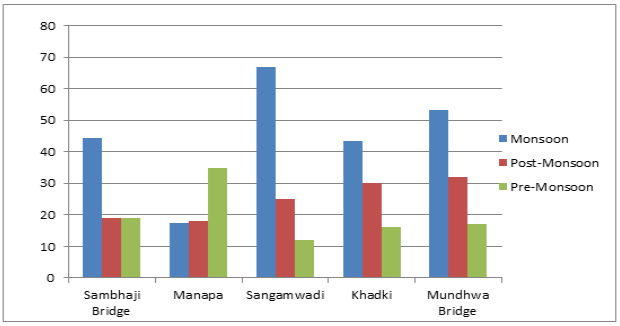


Fig. 2: Graphs showing variations in values of WQI in different sampling season

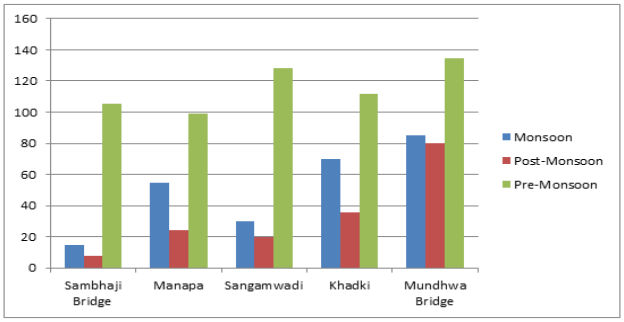


pH

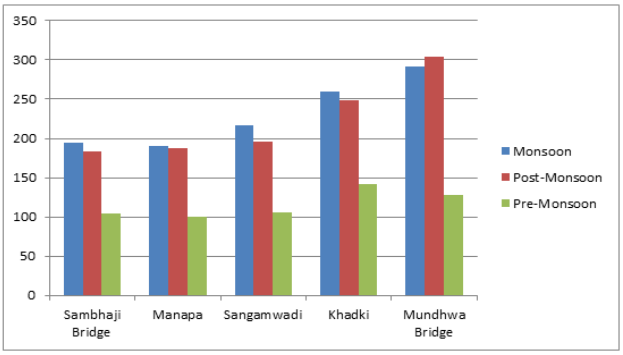
Turbidity



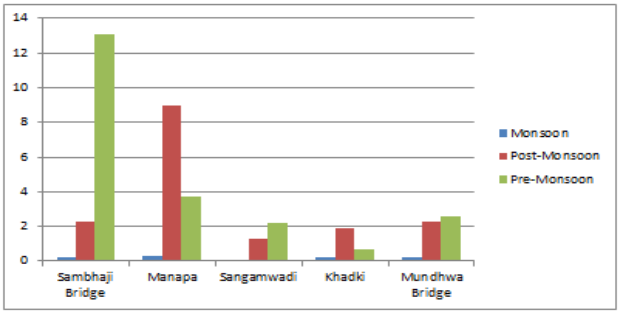
Hardness



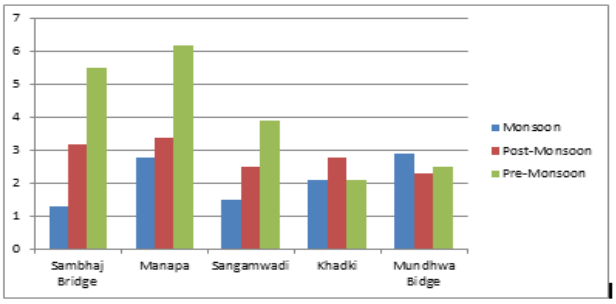
Alkalinity



DO



BOD



Electrical Conductivity

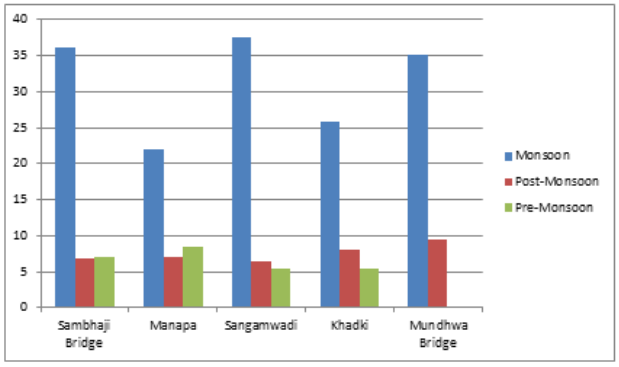


Fig. 2: Graphs showing variations in values of different physico-chemical parameters at different sampling locations

III.CONCLUSION

From present investigations we concluded that the quality of most of the water samples under study was suitable for drinking purpose except in rainy season. In rainy season WQI increases due to increased Turbidity and electrical conductivity .

REFERENCES

1)A.A. KARIM and R.B. PANDA (2014), "Assessment of Water Quality of Subarnarekha RiverInBalasore Region, Odisha, India".Vol. 9(2), 437-446

2)Dhananjay Kumar, Anjali Verma, NamitaDhusia and Nandkishor(2013), "Water Quality Assessment of River Gomti in Lucknow".Volume3, Issue 3: 337-344(2013)

3)Gupta R.C.1, Ajay K. Gupta 2, ShrivastavaR.K3(2014), "Water quality management of river Kshipra (India)".Research article ISSN 0976 – 4399 Volume 5, No 2

4)SnehGangwar(2013), "Water Quality Monitoring in India".ISSN 0974-2239 Volume 3, pp. 851-856

5)Devendra Pandey1 & Mir MubashirAli2(2013), "Water Quality Index Of The Wainganga River, BhandaraMaharashtra, India".ISSN 2249-6866
Vol. 3, Issue 2, Jun 2013, 115-124

6)Sudevi Basu1 and LokeshK(2012), "Evaluation of Cauvery River Water Quality at Srirangapatna in Karnataka using Principal Component Analysis".ISSN: 2278-4721, Vol. 1, Issue 4 , PP 6-12

7)DeekshaKatyal(2012), "Water quality assessment of Yamuna River in Delhi region using index mapping". Vol. 13, Nos. 2/3

8)DeepshikhaSharma ,ArunKansal(2000-2009), "Water quality analysis of River Yamuna using water quality index in the national capital territory, India .

9)S. Shrestha, F. Kazama, "Assessment of surface water quality using multivariate statistical techniques: A case study of the Fuji river basin, Japan"(2006)

10)Yves de Lafontaine ,Franc¸ ois Gagne, Christian Blaise ,Georges Costan , Pierre Gagnon,H.M. Chan , "Biomarkers in ebra mussels (Dreissenapolymorpha) for the assessment and monitoring of water quality of the StLawrence River (Canada)".(1999)

11) Dhirendra Mohan Joshi1, Alok Kumar2, and Namita Agrawal2, "studies on physicochemical parameters to assess the water quality of river ganga for drinking purpose in haridwar district ". Vol.2, No.1 (2009), 195-203 ISSN: 0974-1496

12) A.A. Karim1 and R.B. Panda2, "Assessment of Water Quality of Subarnarekha River In Balasore Region, Odisha, India" Vol. 9(2), 437-446 (2014)

