WATER QUALITY ANALYSIS OF MULA RIVER ON THE UPSTREAM SIDE OF PUNE CITY

Shubham Shinde*, Vikas Singh*, Vinit Jain*, Vikrant Singh*, Sagar Bhoge*, Himali Mehta**
*Undergraduate Student, Bharati Vidyapeeth's College of Engineering, Lavale, Pune
**Assistant Professor, Bharati Vidyapeeth's College of Engineering, Lavale, Pune

Abstract- Mula is one of the major rivers passing through the city of Pune. A number of researchers have worked on quality of river water within the city limits. However, not much is reported about the quality of water before it enters the city at Balewadi. On the upstream side of Balewadi, the river water is used by the inhabitants of villages located on its banks for domestic and agricultural purposes, without any regular treatment. This would put them at direct health risk if river water quality is not good. Hence, it is imperative to learn about the quality of water in these upstream areas. The present study focuses on physico-chemical analysis of Mula River water before it enters the Pune city. Water samples were collected from four locations covering a span of 16 – 17 km and parameters including pH, alkalinity, conductivity, hardness, TS, TDS, BOD, COD, nitrates and phosphates were analysed. This paper presents the river water quality data during September 2017 to February 2018.

Keywords: Physico-chemical analysis, Mula river, Pollution, Industrial effluents, Agricultural runoff

Introduction

Water is one of the most important elements amongst all the resources that are vital for the survival of living organisms. Although 70 % of the Earth is covered with water, only about 3 % of it is available in the form of fresh water. Due to increasing urbanisation, population explosion, industrialization, changing lifestyle and other human activities the quality of water is deteriorating day by day. And that is why it is being said that if fourth world war is ever fought, it will be fought for water. Many cities worldwide have started facing severe shortage of water – Cape Town and Johannesburg among the first in line. Polluted water sources only make the problem graver. The environment, health, economic growth and development are largely influenced due to the non-availability of clean water.

Rivers are the main inland water sources for domestic, industrial and irrigation purposes and often carry a large number of pollutants including industrial effluents, agricultural runoff, sewage and domestic waste. India has a large number of rivers and is rightly referred to as the "land of rivers." Rivers are often worshipped in India but in spite of this profound respect towards rivers, we have failed to maintain their purity, cleanliness and physical well-being.

The city of Pune is blessed with the presence of number of rivers in its vicinity, some of them being Mula, Mutha, Indrayani, Ramnadi and Pavana. Mula river flows down to meet Mutha River at Sangamwadi located at the heart of the city. The river originates around 70 km ahead of Pune. There are number of villages located on its banks. The river water is used by the inhabitants of villages located on its banks for domestic and agricultural purposes, without any regular treatment. This would put them at direct health risk if river water quality is not good. Hence, it is imperative to learn about the quality of water in these upstream areas. A number of researchers have analysed the quality of Mula river water after it enters the city. However, not much is reported about its quality on the upstream side of Pune. Hence, the focus of this study is the section of Mula River before it enters Pune city limits.

Materials and Methods:

Study area:

The study was carried out for Mula River in Pune, Maharashtra. Pune is located at 18° 31' 22.45" North 73° 52' 32.69" East, near the western margin of the Deccan Plateau. Mula River emerges at Deoghar, 70 km west of Pune, is dammed near the Western Ghats at Mulshi and enters Pune city near Balewadi. Further downstream, in Pune city, it merges with the Pavana River on the left bank and Mutha River on the right bank to form the Mula-Mutha river, which later meets the Bhima River.

Physico-chemical analyses were carried out over a 17 km stretch between Bhare and Balewadi. Water samples were collected from four locations viz., Bhare, Lavale, Nande and Balewadi. Map of the study area with the respective sampling locations is given below:

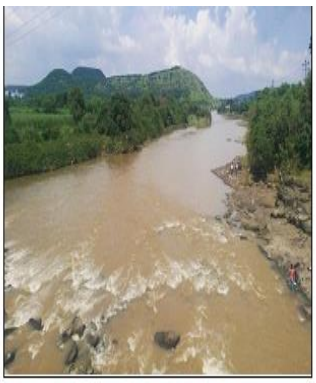
Collection and analysis of samples:

The samples were collected as grab samples from four

locations along a stretch of 17 km of Mula River. While selecting the sampling points, safe accessibility was given due consideration. Four locations identified are – Bhare, Lavale (downstream of Bhare), Nande (downstream of Lavale) and Balewadi (downstream of Nande). Samples were collected from the centre of the river from more or less the same location every time. Photographs were taken every time while collecting the sample to have an approximate idea of the water level in the river. The samples were collected in 5 L clean plastic cans. The cans were kept in a refrigerator to avoid as far as possible, any change in characteristics. The samples were analysed for eleven different physico-chemical parameters - pH, Conductivity, Hardness, Alkalinity, Total Solids, Total Dissolved Solids, COD, BOD, Nitrates and Phosphates. Care was taken to perform pH, DO, BOD and COD analysis immediately after collecting the samples. The analyses were performed as per the APHA Standard Methods.

The samples were collected during September 2017 and February 2018. The objective was to get the idea of water quality during monsoon, winter and summer months and see what difference the season would make.

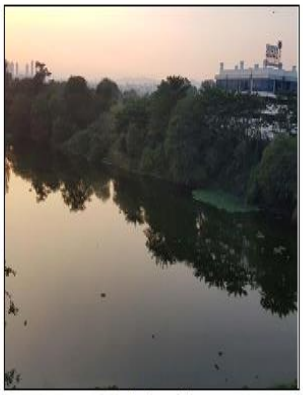
Some time around November-December 2017, the Balewadi site became inaccessible due to start of construction work on the highway. Hence, another site at Fasipul, little upstream of Balewadi was selected for collection of samples then on.



Bhare

Lavale

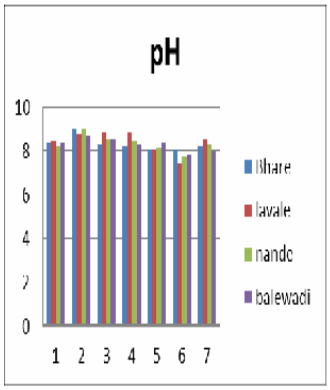
Nande

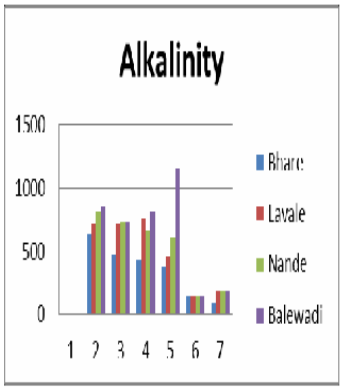


Balewadi

Results and Discussion:

The data on analysis of samples from four locations during September 2017 to February 2018 are Presented in the table 1.





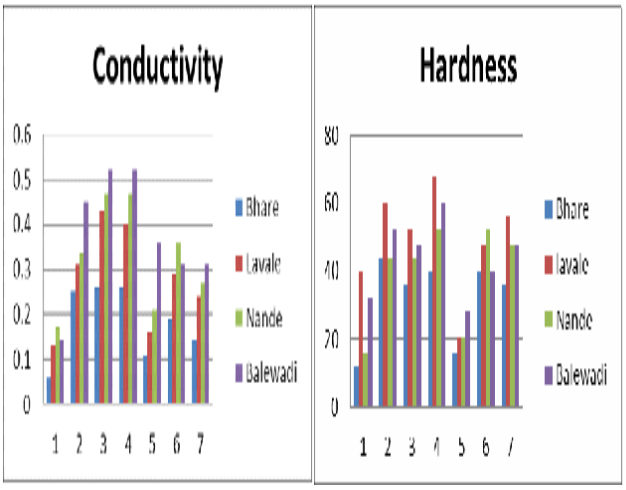
pH of the water at all locations remained alkaline within the range of 8 – 8.5.

Alkalinity varied in a wide range from 92 to 1156 mg/l as CaCO3. But it has been observed that in all the cases, minimum alkalinity was at Bhare while maximum was at Balewadi/ Fasipul.

Table: 1 Data on analysis of Mula River water

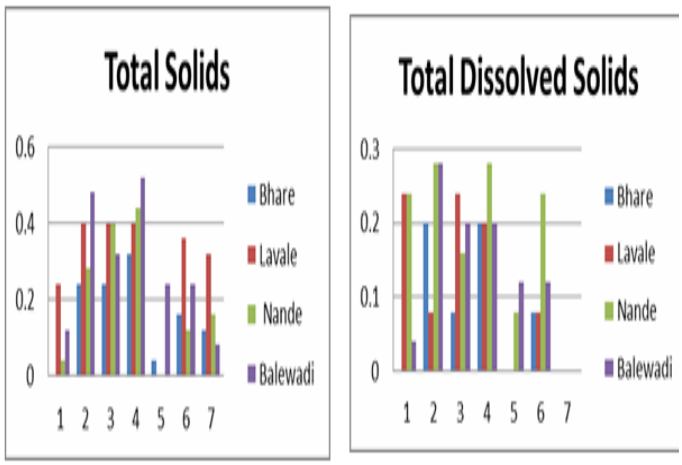
Date	Location	Parameters										
		pH	Alkalinity	Conductivity	Hardness	TS	TDS	BOD	COD	Phosphates	Nitrates	DO
21/09/2017	Bhare	8.35		0.06	12	0	0					7.783
	Lavale	8.47		0.13	40	0.24	0.24					7.487
	Nande	8.24		0.17	16	0.04	0.24					7.487
	Balewadi	8.41		0.14	32	0.12	0.04					7.192
25/10/2017	Bhare	8.96	630	0.25	44	0.24	0.2			0.024		8.275
	Lavale	8.77	720	0.31	60	0.4	0.08			0.046		7.389
	Nande	9.04	810	0.34	44	0.28	0.28			0.046		6.995
	Balewadi	8.67	860	0.45	52	0.48	0.28			0.0196		6.403
21/12/2017	Bhare	8.31	476	0.26	36	0.24	0.08	2.6	4	0.024	3.13	7.684
	Lavale	8.8	716	0.43	52	0.4	0.24	<2	16	0.216	4.43	7.586
	Nande	8.53	728	0.47	44	0.4	0.16	<2	44	0.068	6.06	7.586
	Fasipul	8.5	732	0.52	48	0.32	0.2	<2	64	0.088	4	7.773
27/12/2017	Bhare	8.2	432	0.26	40	0.32	0.2	2.6	20	0.024	3.13	3.448
	Lavale	8.86	764	0.4	68	0.4	0.2	<2	200	0.068	4.43	4.335
	Nande	8.43	664	0.47	52	0.44	0.28	<2	120	0.046	6.06	4.433
	Fasipul	8.28	812	0.52	60	0.52	0.2	<2	140	0.046	4	4.236
15/01/2018	Bhare	8.11	372	0.11	16	0.04	0	<2	0	0.01	0.53	8.768
	Lavale	8.03	460	0.16	20	0	0	<2	28	0.058	0.886	7.882
	Nande	8.13	612	0.21	20	0	0.08	<2	36	0.034	0.992	7.389
	Fasipul	8.39	1156	0.36	28	0.24	0.12	3.2	40	0.105	1.8	7.192
31/01/2018	Bhare	8.01	136	0.19	40	0.16	0.08	<2	4	0.01	<0.2	8.374
	Lavale	7.43	140	0.29	48	0.36	0.08	<2	104	0.082	0.904	7.568
	Nande	7.77	140	0.36	52	0.12	0.24	<2	8	0.058	<0.2	7.98
	Fasipul	7.83	140	0.31	40	0.24	0.12	2.9	24	0.034	<0.2	6.699
09/02/2018	Bhare	8.2	92	0.14	36	0.12	0.04	<2	0	0.01	<0.2	5.812
	Lavale	8.5	156	0.24	56	0.32	0.12	3.15	20	0.058	<0.2	5.123
	Nande	8.29	160	0.27	48	0.16	0.08	<2	216	0.105	<0.2	5.911
	Fasipul	7.99	188	0.31	48	0.16	0.08	2.18	72	0.034	<0.2	6.798

All the parameters are expressed in mg/l except pH, Conductivity. Conductivity is in mS/cm.

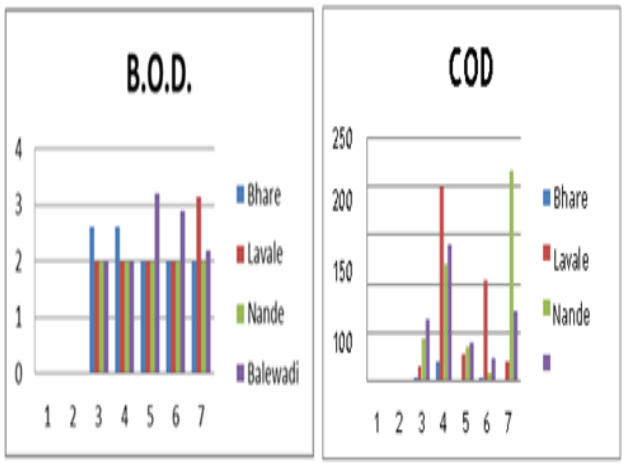


Conductivity showed similar trend – Minimum value was observed at Bhare and maximum at Balewadi/ Fasipul. The value varied between 0.06 and 0.52 mS/cm. This value observed at Balewadi is comparable to those observed by Wagh et.al for the river Mutha within city limits – 0.58 mS/cm. Freshwater streams ideally should have a conductivity between 150 to 500 µS/cm to support diverse aquatic life.

The value of Hardness at all the four sites and across all the seasons remained in two digits – minimum being 12 mg/l as CaCO3 at Bhare and maximum being 68 mg/l as CaCO3 at Lavale. An interesting trend was observed in case of Hardness – the maximum value was observed at Lavale and then the value reduced as river flowed further downstream. Increase in hardness is normally due to natural accumulation of salts from contact with soil, or due to mixing of industrial effluents and domestic sewage. In this case, if it was due to salts present in soil, the same type of soil and land use prevails on downstream side, too. Entry of domestic sewage was not observed anywhere near any of the site. Hence, this shows possibility of mixing of some industrial effluent upstream side of Lavale. Corresponding value within city limits was observed between 130-190 mg/l as CaCO3 by Wagh et.al. and Fadtare & Mane in their studies.

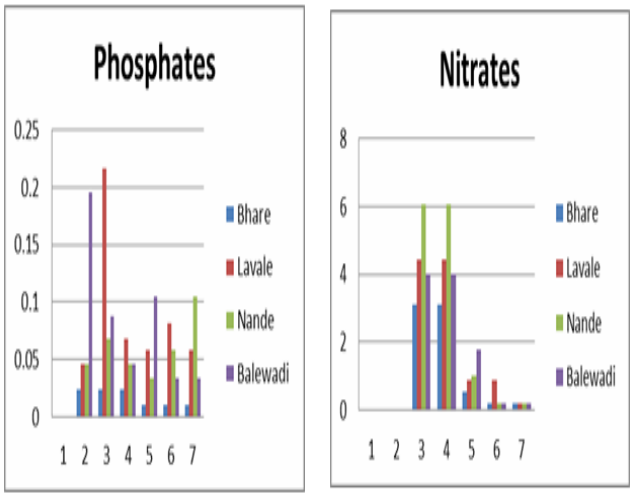


Total solids and Total Dissolved Solids were found to be on low side at all the four sites in all the observations.



BOD value of 2 mg/l is desirable for surface waters. In the present study, majority of the samples show BOD as less than 2 mg/l, barring a few times when it was found to be 2.6 – 3.2 mg/l. These values indicate practically non-existent to low level organic pollution of the river water. Other researchers have reported values of 8-51mg/l (Pali Sahu et.al.), 163-348 mg/l (Fadtare & Mane) and 18-272 mg/l (Wagh et.al.) for different rivers of Pune within city limits.

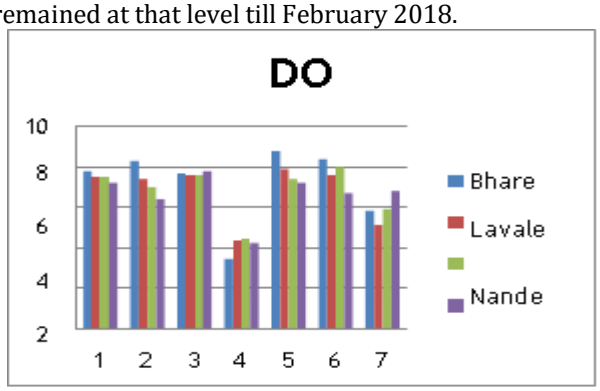
COD values as high as 390 mg/l (Kanase et.al.) were observed for river Mula within city limits. However, in present study, at Bhare, COD was found to be the lowest – on couple of occasions even zero – indicating no pollution of river water up to that point. It increased on the downstream side but no definite pattern was observed. It was interesting to note that on all occasions, the BOD : COD ratio was found to be very low indicating presence of more chemically oxidizable matter in the water. This could be attributed to addition of either industrial effluents or agricultural runoff or both.



River water should not exceed 0.1 mg/l of phosphates. Phosphate concentration was found to be minimum at Bhare i.e. 0.01-0.02 mg/l. It remained low in almost all measurements, only occasionally touching high point of 0.2 mg/l. Phosphate concentrations of 1.58 mg/l (Fadtare & Mane) and 2.8 mg/l (Kanase et.al.) were found by other researchers in the river water within

the citylimits.

Natural levels of nitrate are usually less than 1 mg/L. Concentrations over 10 mg/L will have an effect on the freshwater aquatic environment. Nitrate concentration observed by Kanase et.al in Mula river within city limits was 15.2 mg/l while that by Fadtare & Mane was 0.3-0.5 mg/l. In present study, highest Nitrate concentration recorded was 6.06 mg/l. However, this value was observed immediately after monsoon probably showing influence of agricultural runoff which went on to decrease to 0.2 mg/l later and remained at that level till February 2018.



Consistently high levels of dissolved oxygen are best for a healthy ecosystem. As far as DO levels are concerned,

0-2 mg/L: not enough oxygen to support life.
2-4 mg/L: only a few fish and aquatic insects can survive.
4-7 mg/L: good for many aquatic animals, low for cold water fish 7-11 mg/L: very good for most stream fish

In present study, DO levels were found to be more than 7.0 mg/l in majority of the cases. Only once it was recorded around 4.0 mg/l. Interestingly, this particular period when DO was minimum (3.5-4.5 mg/l) at all the four locations, COD was abnormally high. This probably shows some contamination of river water around that particular time.

Conclusion

A survey carried out by the Maharashtra Pollution Control Board (MPCB) found that rivers flowing through Pune city are among the highly polluted ones. The MPCB has categorised the water quality of rivers flowing through Pune district as "bad or very bad". All the investigations on river water quality within city limits of Pune have concluded that the quality of water was not acceptable from majority of physico-chemical parameters.

Present study shows that the water quality of Mula River before it enters Pune city at Balewadi, is good and quite within the acceptable limits for all the parameters. The findings of this study also substantiate the work done by other researchers in the sense that the deterioration of water quality once the river enters city limits is because of dumping of untreated domestic wastewater, construction waste and other industrial wastewaters. Now that the Pune city limits are extended to include a number of villages in the vicinity, it is a challenge to keep Mula river water quality intact.

REFERENCES:

1. V. M. Wagh , V. S. Ghole , P. N. Wavde , V. V. Todkar and K. K. Kokate, "Assessment of Water Quality of Mutha River in Pune City", GCE 2008: Indo-Italian International Conference on Green and Clean Environment March 20-21, MAEER's MIT College of Engineering, Pune

2. Lakshmi. E , Dr. G. Madhu, An Assessment of Water Quality in River Periyar, Kerala, South India Using Water Quality Index, Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 8, Issue 8 Ver. II (Aug. 2014), PP 11-16

3. A.B. More, C.S. Chavan, Ajoy Gurung, Pramod Sarwade, Shashikant Chaudhari and RohitVyas, "Water Quality Status of Mula-Mutha River", Global Journal for Research Analysis; Volume : 3, Issue : 4, April 2014 (ISSN No 2277 – 8160)

4. P. ThillaiArasu, S. Hema, Mai-Nefhi, Dr. Sivanthi Aditanar; "Physico-chemical analysis of Tamirabarani river water in South India", Indian Society for Education and Environment, Indian Journal of Science and Technology, Vol.1 No.2 (Dec. 2007), Kovilpatti,Tamil Nadu, India

5. Yogendra Singh, P.W. Ramteke, Shashwat Mishra, Pradeep K. Shukla2 "Physico-Chemical Analysis of Yamuna River Water"; International Journal of Research in Environmental Science and Technology 2013; 3(2): 58-60 (ISSN 2249–9695)

6. Joshua NizelHalder, M. Nazrul Islam "Water Pollution and its Impact on the Human Health"; JOURNAL OF ENVIRONMENT AND HUMAN, Volume 2, Number 1, January 2015

7. Mane A. V., Pardeshi R. G., Gore V. R., Walave R. L., Manjrekar S. S. and Sutar G. N "Water quality and sediment analysis at selected locations of Pavana river of Pune district, Maharashtra"; Journal of Chemical and Pharmaceutical Research, 2013, 5(8):91-102; J. Chem. Pharm. Res., 2013, 5(8):91-102

8. Rajnee Naithani, Dr. I.P. Pande "Comparative analysis of the trends in river water quality parameters: A Case study of the Yamuna River"; International Journal of Scientific Research Engineering & Technology (IJSRET), ISSN 2278 – 0882 Volume 4, Issue 12, December 2015

9. Narendra Singh Bhandari and Kapil Nayal, "Correlation Study on Physico-Chemical Parameters and Quality Assessment of Kosi River Water, Uttarakhand", E-Journal of Chemistry, Vol. 5, No.2, pp. 342-346, April 2008

10. Pali Sahu, Sonali Karad, Sagar Chavan and Sourabh Khandelwal, "PHYSICOCHEMICAL ANALYSIS OF MULA MUTHA RIVER PUNE", Civil Engineering and Urban Planning: An International Journal (CiVEJ) Vol.2,No.2, June 2015

11. Nidhi Jain and R.K. Shrivastava, "Comparative

Review of Physicochemical Assessment of Pavana River", IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR- JESTFT) e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 8, Issue 6 Ver. III (Jun. 2014), PP 25-30

12. Smita Rout, Asit Kumar Behera and Aliva Patnaik, "Water Quality Analysis of River Mahanadi in Sambalpur City", International Journal of Scientific and Research Publications, Volume 6, Issue 2, February 2016

13. Vinaya V. Fadtare and T.T. Mane, "STUDIES ON WATER POLLUTION OF MULA, MUTHA AND PAWANA RIVERS IN SUMMER SEASON IN THE PUNE CITY REGION", Nature Environment and Pollution Technology, vol. 6, No. 3, pp. 499-506, 2007

14. D.G. Kanase, S.D. Jadhav, R.W. Jawale, M.S. Kadam, "A Study On Some Physico - Chemical Characteristics Of Flowing Water Of Major Rivers In Pune City," International Conference, 2005-06

15. Ram S. Lokhande, Pravin U. Singare, Deepali S. Pimple, "Study on Physico-Chemical Parameters of Waste Water Effluents from Taloja Industrial Area of Mumbai, India", International Journal of Ecosystem 2011; 1(1): 1-9

16.Lakhanpal S. Kendre, Sagar M. Gawande and Anantrao Pawar, "Study of Physico-Chemical Characteristics of Pavana River: Review", International Journal of Engineering Research, Volume No.6, Issue No.4, pp :216-219, 1st April, 2017

17.Pawan Kumar Singh and Pradeep Shrivastava, "ANALYSIS OF WATER QUALITY OF RIVER NARMADA", International Journal of Current Research Vol. 7, Issue, 12, pp.24073-24076, December, 2015

18. Garima Mishra, Dying Rivers of Pune Part I: Untreated sewage, garbage define Mula, Mutha | The Indian Express, Published: January 15, 2017

19. A.D.Kshirsagar and V.R. Gunale, Pollution status of river Mula (Pune city) Maharashtra, India, J. Ecophysiol. Occup. Hlth. Vol. 11, pp. 81-90, 2011