A COMPREHENSIVE ASSESSMENT ON WATER QUALITY STATE OF PUNE CITY

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***Abstract*— Water is one of the most important substances on earth. All plants and animals must have water to survive. If there was no water there would be no life on earth. Water that is safe for drinking is called potable water.This means that the water must be free from germs and be clear.Maharashtra is a state in the western region of India and is India's second-most populous state and third-largest state by area. Pune is the second largest city in the Indian state of Maharashtra and the ninth most populated city in the country. Surface water is any water that collects on the surface of the earth. This includes oceans, seas, lakes, rivers, or wetlands The city of pune draws water from the following surface sources. Pollution from effluents released into the surface water sources at Pune has been found to cause high levels of pollution in the Bhima River and Mulla-muttha river too, resulting in a lot of water borne ailments.Due to high levels of pollution, including 125 MLD of untreated sewerage water being discharged into the river by the Pune Municipal Corporation. Increase in urbanization, industrialization, agriculture activity and various human activities has increase the pollution of surface water & ground water.Hence we are going to perform compressive assessment of Mulla Mutha river and also suggest various remedial measures to overcome the problem faced by the people.**

***Key words*— Water pollution ,Urbanization ,Industrialization ,Agricultural activities ,Comprehenssive assessment.**

I. INTRODUCTION

Maharashtra is a state in the western region of India and is India's second-most populated state and third-largest state by area. Pune is the second largest city in the Indian state of Maharashtra and the ninth most populated city in the country. In terms of its fast growth and development, Pune city becomes one of the growing and emerging cities of India [2] Surface water is any water that collects on the surface of the earth. This includes oceans, seas, lakes, rivers, or wetlands. Increase in urbanization, industrialization, agriculture activity and various human activities has increase the pollution of surface water & ground water. Mula-Mutha River in pune (India) is one of the most vulnerable water bodies to pollution because of their role in carrying municipal and industrial wastes and run-offs from agricultural lands in their vast drainage basins. Pollution of the aquatic environment by inorganic and organic chemicals is a major factors posing serious threat to the survival of aquatic organisms including fish [3]. The physicochemical properties will also help in the identification of sources of pollution, for conducting further investigation on the eco-biological impacts and also for initiating necessary steps for remedial actions in case of polluted water bodies[7].

Despite of the various standards and laws made by government many industries are discharging their waste directly into the river making its quality poor day by day. Therefore Water Quality Analysis is carried out to analyze the present pollution level of river.

II. PROBLEM STATEMENT

Water quality analysis is required mainly for monitoring purpose. Some importance of such assessment includes. To check whether the water quality is in compliance with the standards, and hence, suitable or not for the designated use. To monitor the efficiency of a system, working for water quality maintenance. To check whether change of an existing system is required and to decide what changes should take place.

In present study the analysis area is confined to stretch of rivers Mula and Mutha. Mula River receives heavy loads of agricultural runoff through non point sources. Mutha River since it passes through the city of Pune receives heavy loads of domestic sewage with some industrial waste .

STUDY AREA

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. Mutha river origin from Khadakwasla dam & it passes through Dhari, Nanded, z-bridge, Junabazzar, Pune RTO and ends at Sangamwadi. Both Mula and Mutha River merged at Sangamwadi which is further joined by Indrayani & Bhima River. Figure 3a shows the maps of various stations selected for collecting the water samples.

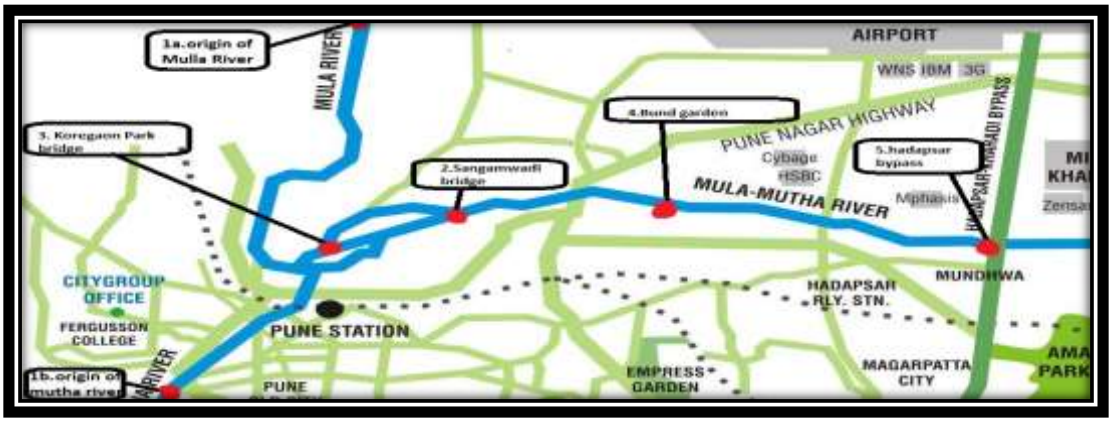

Figure 3a - Location map of Mulla Mutta river origin and the various stations selected for sample collection- (GoogleMaps)

Station 1

Below figure shows the Bridge crosses the Mutha River at Sangamwadi, just before their merger, areas surrounding the river experienced flash floods due to high levels of pollution and garbage dumped into the river. The College of Engineering, Pune (CoEP) holds an annual boating festival at the river near its premises

Figure 3b- Sangamwadi bridge

Station 2

Koregaon Park or **KP** is an area located south of the Mula-Mutha River in Pune, a city in the province of Maharashtra in western India; this area is often viewed as one of the most prestigious addresses in Pune. The area was primarily a residential area with lush greenery, but of late has been growing into a commercial market place.It has been observed that due to the rapid growth of commercial buildings various dumping activities were noticed i.e. dumping of garbage ,construction materials ,household waste etc.Figure 3c show the river flowing at Koregaon Park.

Figure 3c - Koregaon park

Station 4

Below figure shows bund garden bridge.The gardens are situated next to Fitzgerald Bridge and took their name from the bund, or dam, on the Mula river, just before sangamadi bridge, areas surrounding the river experienced high levels of pollution and garbage dumping activities which includes industrial waste,festival waste,human activities etc.

Figure 3d - Bund Garden

Station 5

Below figure shows that river is highly contaminated due to industrial, Illegal dumping of construction material, garbage and sewage disposal. Hadapsar bypass is a suburb located on the banks of Mula-Mutha river off MH SH 27 (Pune-Ahmednagar State Highway) to the east of Pune city in India. A bypass road connecting Pune-Ahmednagar state highway to Pune-Solapur National highway passes through Kharadi.

Figure 3e- Hadpasar Bypass

III. METHODOLOGY

We selected 5 different locations (i.e. station 1a-Origin of Mulla River ,Station 1b- origin of Muttha River,Station 2-Sangamwadi bridge ,Station 3-Koregaon Park Bridge,4-Hadapsar bypass,Station 5-. Bund garden) to understand the contamination of water.The water samples were collected and the analysis were conducted in 2 seasons November 2017 & April 2018.

Parameters to be Analyzed:

1. Total Dissolved Solids
2. Hardness
3. pH
4. Chloride
5. Conductivity
6. Temperature
7. Turbidity
8. Dissolved oxygen
9. BOD
10. COD

Table 1a- Analytical methods adopted with Indian Standard values

Parameters	Method adopted	Indian Standard
Total Dissolved Solids(mg/l)	Electrometric method	500-1000
Hardness(mg/l)	EDTA Titratiion method	300
pH	Electrometric method	6.5-8.5
Chloride(mg/l)	Electrometric method	250
Conductivity	Conductivity meter	-

Temperature	Thermometer	-
Turbidity(NTU)	Electrometric method	5
Dissolved oxygen(mg/l)	Azide modification	7.6
BOD(mg/l)	Azide modification	30
COD(mg/l)	Dichromate reflux	250

Total Dissolved Solids

A measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular suspended form is called Total Dissolved Solids (TDS).

Hardness

Total hardness mainly depends upon the dissolved salts present in water. Hard water is water that contains high levels of dissolved calcium, magnesium and other mineral salt such as iron. The greater is amount of dissolved minerals in water, more is the water hard.

pH Value

pH is basically a measure of the acidity or basicity of an aqueous solution. Solutions having pH less equal to 7. Primary pH standard values are found out by using a concentration cell with transference, simply by measuring the potential difference between a standard electrode such as the silver chloride electrode & hydrogen electrode.

Chloride Content

Naturally, chlorides are found as salts such as sodium chloride (NaCl), potassium chloride (KCl), and calcium chloride ($CaCl_2$). Chlorides are leached from different rocks into soil and water due to weathering. Chloride levels in unpolluted waters are generally below 10 mg/litre and sometimes even below 1 mg/litre. Chloride in water may be significantly increased by treatment processes in which chlorine or chloride is used.

Conductivity

The measure of the ability of an electrolyte solution to conduct electricity is called its conductivity. Conductivity is also referred to as specific conductance. The SI unit of conductivity is siemens per meter (S/m).

Temperature

In an established system the water temperature controls the rate of all chemical reactions, and affects fish growth, reproduction and immunity. Drastic temperature changes can be fatal to fish.However the water temperature plays an important factor which influences the chemical ,bio-chemical characteristic of water body.

Turbidity

The haziness or cloudiness of a fluid due to various individual particles (TSS or TDS) that can be seen with naked eyes (like smoke in air) is known as turbidity. The determination of value of turbidity might be termed as one of the most important tests of water quality.

Dissolved Oxygen

DO is one of the most important parameter. Its correlation with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification etc. In the progress of summer, dissolved oxygen decreased due to increase in temperature and also due to increased microbial activity.

Biochemical Oxygen Demand (BOD)

BOD is a measure of organic material contamination in water, specified in mg/L. BOD is the amount of dissolved oxygen required for the biochemical decomposition of organic compounds and the oxidation of certain inorganic materials (e.g., iron, sulfites). Typically the test for BOD is conducted over a five-day period.

Chemical Oxygen Demand (COD)

COD is another measure of organic material contamination in water specified in mg/L. COD is the amount of dissolved oxygen required to cause chemical oxidation of the organic material in water. Both BOD and COD are key indicators of the environmental health of a surface water supply. They are commonly used in waste water treatment but rarely in general water treatment.

Table1b: Sampling Point variation in Post-Monsoon Season

Parameters	Station (1a)	Station (1b)	Station (2)	Station (3)	Station (4)	Station (5)
Temperature	21.79±0.94	23±0.74	18.51±0.87	20.79±0.94	22.43±1.27	21.2±0.35
pH	7.95	7.82	6.6	6.2	6.5	6.3
TDS	161	162	320	261	297	309
D.O	3.4	4	6	0	4	0
B.O.D	10	8	35.4	46	38	47.7
C.O.D	15	13	40	52	62.5	58
Hardness	17	15	92.58	75	112.2	86.3
Conductivity	330	310	236.66	498.61	488.12	352.89
Turbidity	4	3.8	15	11	7	13
Chloride Content	45	46.5	204	261	198	209

Table1c: Sampling Point variation in Pre-Monsoon Season

Parameters	Station (1a)	Station (1b)	Station (2)	Station (3)	Station (4)	Station (5)
Temperature	24.2±0.94	26±0.74	26.3±0.87	29.4±0.94	27.43±1.27	29.2±0.35
pH	6.5	6.2	5.6	4.1	5.2	5.9
TDS	32	37	301	287	298	290
D.O	2.7	2.6	0.47	0	0.35	0
B.O.D	11	10	38.2	55	51	54
C.O.D	41	38	37	48	62.5	51.2
Hardness	16.51	15.42	104.58	85	92.34	77.80
Conductivity	330	310	236.66	498.61	488.12	352.89
Turbidity	2	2.1	19	20	18	19
Chloride Content	45	46.5	204	261	198	209

IV. RESULTS AND DISCUSSION

pH Value

The desirable range of pH for drinking water is from 7-8.5 As observed from the analysis for both pre –monsoon & post-monsoon majority of the stations are acidic ,which may be because of the presence of metal ions such as iron, manganese ,copper ,lead and zinc etc.

Conductivity

Electrical conductivity in water is due to the presence of salt and the current produced by them. It is observed that all the stations have higher content of E.C in both post-monsoon and pre-monsoon. The cause of higher content of E.C may be due to discharge of the industrial waste.

Total dissolved solids

TDS indicates the salinity of the surface water which is mainly composed of carbonates ,bicarbonates ,chlorides, phosphates and nitrates of calcium and magnesium. The observed values of TDS of both pre-monsoon and post monsoon is slightly less as compared to standard values.

Temperature

The water temperature controls the rate of all chemical reactions, and affects the fish growth reproduction and immunity. Drastic temperature changes can be fatal to fish.

Dissolved Oxygen

Dissolved oxygen concentrations in unpolluted water normally range between 8 and 10 mg/l and concentrations below 5 mg/l adversely affect aquatic life. Dissolved oxygen content of the water samples is observed quite low in station 3 & 5.

BOD

BOD is measure of oxygen required by microorganisms by breaking down organic matter. Highest value of BOD was observed at station 5 which is 54 mg/l. While the lowest was with 8 mg/l at station 1.

COD

The measure of COD determines quantities of organic matter found in water. It is been observed that COD is low at all the stations.

Hardness

Hard water contains high level of dissolved calcium, magnesium and iron. Station 4 shows highest hardness and station 1 shows lowest.

Chloride content

Amount of chloride present in station 3 is 261 mg/l which exceeds the permissible limit of 250 mg/l as per Indian Standards as well as WHO standards and this obviously affects the taste of water.

VI. CONCLUSION

Increasing Water pollution is a major problem in all the rivers. Contaminated water is the biggest health risk and continues to threaten both quality of life and public health. From our analysis on Mula Muta River we concluded following points:
The analysis and result clearly shows that river water quality has deteriorated mainly due todomestic sewage in case of river Mutha and industrial effluents in case of Mula River..It is clear from the present analysis that the environment of the Mula and Mutha River showed increasing load of pollution. There is need to have proper collection and treatment of waste and need to regulate the flow.

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