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Water Quality Assessment and Mapping of Parameters for Mutha River: A Review

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ABSTRACT: Water quality refers to the chemical, physical, biological, and radiological characteristics of water. River water quality is highly variable by nature due to environmental conditions such as basin lithology, vegetation and climate. Rivers flowing in Pune district have now earned the dubious distinction of being the most polluted in the state. Builders and local residents have turned the river into a dumping site. During the past few years, industrial units in the vicinity of Pune have been dumping untreated waste into the river, destroying the quality of water. Assessment can be done by testing the parameters such as Temperature, pH, Turbidity, TDS, D.O., B.O.D. and C.O.D. The study includes tests for selected water quality parameters. Spatial variation in river water quality is shown by Quality Contour Map, by using Surfer Software. Assessment and mapping can provide indication for water quality.

KEYWORDS: Water Quality, Assessment, Mutha River, Mapping, Surfer Software.

I. INTRODUCTION

Rivers are the major source of water in India. The utilizable annual surface water in rivers of the country is 690 km³. Human activities like artificial dams, reservoirs are also included in the same category and have capacity to increase utilization of the water. The demand of water from various water users, namely, domestic, municipal, agricultural, horticultural, recreation, power and industrial sectors are increasing, and this has put tremendous pressure on the water resources systems. Pune is located at 18°31'52.7" North 73°51'37.2" East, near the western margin of the Deccan Plateau. Pune lies on the leeward side of the Sahyadri ranges and Western Ghats, 560 m (1837 ft.) above the sea level, at the confluence of Mula and Mutha rivers, which are tributaries of the Bhima. Two more rivers, Pavana and Indrayani traverse the North-western outskirts of the urban area. Today Pune, 7th most populated city in India and 2nd largest city of Maharashtra. Pune's Rivers are under tremendous stress of urbanized developmental processes. In recent years, permeable soils are covered by impermeable layers of infrastructure layers. In last two decades, area around Pune is converting to urban area by the growth of concrete jungle by decimating green jungle. River landscape & green landscape (including agricultural & forest lands) have lost their natural glory completely to wear the cosmetic modern architectural sheen of manicured look of urban green composed of non-native species majorly. In short, the urban watershed of Pune's rivers is changing with lightning speed. Out of the 744 million litres per day (MLD) of waste generated by Pune through sewage and other means, 177 MLD of waste is entering the rivers without treatment. It is therefore necessary to check the water quality at regular interval of time.

Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater), usually as a result of human activities. Water pollution is one of many types of pollution which results from contaminants being introduced into the natural environment. Pollution causes adverse change. Water pollution is often caused by the discharge of inadequately treated wastewater into natural bodies of water. This can lead to environmental degradation of aquatic ecosystems. Before going to decorating the river banks directly by parks, plantation, gardens or applying river front development directly to make river patch beautiful, it is necessary to make river clean, at least from the point of view of appearance. And again, before going for cleaning of river, it is necessary to make river safe from all illegal activities. Our paper is only dealing with the current worst status of river by various means. A visionary of policy to

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retain, restore & sustain ecological health of rivers is essential for the liveability & nature-friendliness of Pune to bring back glory of harmonious habitat.

Surfer is the grid based graphic program used for mapping xyz data into grids. These grids can be used to create mini-maps including contour maps, vector maps, wire frame maps and surface maps

II. RELATED WORK

Various technical paper on Assessment of River Water Quality and Mapping were studied for formation of this paper. Singh Rajesh, BahukhandiKanchan, et al [1] have studied the overall water quality of Ganga River from Gangotri to Haridwar. Maximum concentration for most of the parameter from surfer maps was observed at Khadkhadi (Haridwar) which is an indication of impact of pollution due to anthropogenic activities. Drains which directly or indirectly discharging into the river, without proper treatment is found to be major source of pollution. Policy should be framed for proper treatment of the drains before reaching river Ganga, so that water quality could be maintained. This paper gives the idea of water quality mapping using software like ARC-GIS, Surfer, and wiz. 13 parameters namely pH value, Electrical Conductivity, Total Dissolve Solid, Hardness, Alkalinity, Chloride, Nitrate, Sulphate, Iron, Sodium, Potassium, Calcium and Magnesium are studied in this research. These water qualities are compared with drinking water standards BIS 10500-2012. pH map of contouring from Surfer gives detailing of pH along the river flow.

Surfer 9 is used for Showing the study area and sampling location and plotting the Water Quality Parameter status graph and their trend respectively. After in depth analysis major reason for pollution was found near Jageetpur STP, due to its lack of capacity of treating sewage water from Haridwar city. The contour map on surfer consist of latitude on Y-axis and longitude on X-axis, and respective parameter on Z-axis.

V. V. Fadtare and T.T. Mane [2] have studied water pollution in Mula-Mutha River in Summer Season. Following 12 parameters were determined: pH, turbidity, D.O, B.O.D, C.O.D, hardness, calcium, magnesium, sodium, potassium, nitrates and nitrites. 19 sample stations were selected for 20km patch of Mutha. Selection of points for sampling was decided based on the accessibility and point of confluence between sewers and river. This paper studies the summer trends of water quality in Mutha River.

The detailed assessment of Mutha River over span of six months is studied by V.M.Wagh, V.S.Ghole et al [3]. Seven water quality parameters were determined from January to July at five locations- Khadakwasla downstream, Vitthalwadi, Maharashtra Education Society, Balgandharva and Sangambridge. Parameters studied: pH, electrical conductivity, B.O.D, C.O.D, D.O and total hardness.

Physiochemical Analysis of Mula-Mutha River, have studied by Pali Sahu, SonaliKarad at al [4]. The parameters for analysis were chosen from APHA guidelines as pH, total hardness, turbidity, D.O, B.O.D, and C.O.D. No dynamic fluctuation observed in pH. Maximum Turbidity observed at Vitthalwadi (21 NTU). Total Hardness was observed maximum at Bund Garden (124 mg/lit), due higher concentration of calcium and magnesium. DO gradually decreased from Rajaram bridge to Bund Garden (from 3.2 mg/lit to 0.3 mg/lit).

Various Private and Government agencies are now in motion for River Water Assessment as Riverfront Development is on the verge of its start. The IS: 10500-2012 [5] gives drinking water quality standards, applicable for river water. Maximum permissible limits for Turbidity, Temperature, pH, Total Dissolved Solids, D.O, C.O.D, B.O.D.

III. PARAMETERS FOR WATER QUALITY ASSESSMENT

Water Quality is determined by assessing three classes of Parameters: Physical, Chemical, and Biological. Generally water quality is assessed by chemical parameters such as: pH, D.O, B.O.D, C.O.D, Nitrates, Phosphate, and Physical assessment is done by parameters such as: Temperature, Total Dissolved Solids, Turbidity, and wiz. From the study of previous works and suitability parameters are chosen.

1) Temperature: Temperature is basic parameter of physiochemical analysis of water. Temperature of river water is measured on site directly with the help of thermometer. Thermometer is dipped directly in the sample collected in the container at that sampling station only and noted down immediately. The standards suggest temperature of the river must be $\pm 3^{\circ}$ C to atmospheric temperature; maximum 40° C.

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2) pH: P is potenz or power of $(H)^+$ hydrogen ion concentration. pH is very important parameter in water chemistry. The hydrogen ion concentration is an important quality parameter of both natural waters and wastewaters. The usual means of expressing the hydrogen ion concentration is as pH, which is defined as the negative logarithm of the hydrogen ion concentration. $pH = -\log_{10}(H^+)$. The Maximum permissible range for pH is 6.5-7.5 for drinking water.

3) Dissolved Oxygen (D.O.): D.O. is the dissolved gaseous form of oxygen. It is essential for respiration of fish and other aquatic organisms. D.O. enters water by diffusion from the atmosphere and as a by-product of photosynthesis by algae and plants. The concentration of D.O. in epilimnetic waters continually equilibrates with the concentration of atmospheric oxygen to maintain 100% D.O. saturation. Excessive algae growth can over-saturate (greater than 100% saturation) the water with D.O. when the rate of photosynthesis is greater than the rate of oxygen diffusion to the atmosphere. Hypolimnetic D.O. concentration is typically low as there is no mechanism to replace oxygen that is consumed by respiration and decomposition. Fish need at least 3-5 mg/L of D.O. to survive. The term dissolved oxygen is used to define amount of oxygen present in the unit mass of water. D.O. is approximate method to define pollution. To define D.O, titration process is used. D.O. is essential parameter for ecosystem of the river.

4) Biochemical Oxygen Demand (B.O.D.): B.O.D is defined as, "The amount of dissolved oxygen utilised by heterotrophic, aerobic microorganism while oxidising decomposable organic matter present in waste water." DO and B.O.D are dynamically inter related. They are two different parameters graduated in opposite directions of the measuring device. It is used for evaluating pollutional strength of water bodies. B.O.D tests are also used in carrying out stream sanitation studies and for enforcing water pollution control measures. They are also used for determining the status of treated effluents for disposal with reference to recommended standards. B.O.D shows the intensity of the pollution. Higher the B.O.D more concentrated pollution levels. Maximum permissible limit for B.O.D is 3 mg/lit.

5) Chemical Oxygen Demand (C.O.D.): It is a measure of the total quantity of oxygen required for oxidation of nearly all organic compounds in waste water by the action of strong oxidising agent such as potassium dichromate ($K_2Cr_2O_7$), as it can oxidize a large variety of organic substances into CO_2 and H_2O . Aromatic hydrocarbons and Pyridine are exceptions as they remain un-oxidised. B.O.D is a measure of the carbonaceous component of bio-degradable organic matter in a waste whereas C.O.D measures nearly all the oxidisable matter (chemically as well as biologically) in the waste therefore C.O.D. value for a waste is greater than its B.O.D value. C.O.D value indicates practically overall pollution strength of raw domestic or industrial waste. C.O.D value along with B.O.D value is used to find treatability index for that particular waste. C.O.D test is used for determining the suitability of treated waste for disposal. C.O.D levels are not expected in drinking water. Therefore, BIS does not include MPL for C.O.D.

6) Total Dissolved Solids (TDS): A total dissolved solid indicates the salinity or degree of dissolved substances. The amount of total dissolved solids depends on the geological character of watershed, rainfall and amount of surface runoffs. Total Dissolved Solids (Inorganic) indicate the suitability of wastewater for irrigation and fish culture. An electronic TDS meter is used for the measurement of TDS.

7) Turbidity: Turbidity is a characteristic of suspended matter in water, which offer obstruction to the passage of light through it. The greater the obstruction, the greater is the turbidity of water. Turbidity in water is caused by inorganic matter such as clay, silt and rock, debris and to the lesser extent by organic matter such as sewage solid, algae bacteria, protozoa and other microorganisms. Turbidity is more in rainy season than in winter season.

The propensity of particles to scatter a light beam focused on them is now considered a more meaningful measure of turbidity in water. Turbidity measured this way uses an instrument called a nephelometer with the detector set up to the side of the light beam.

The Water Quality Assessment is primary stage of any water related project. It is used to measure the pollution levels by comparing with standards.

IV. WATER QUALITY MAPPING: SURFER SOFTWARE

Singh Rajesh, BahukhandiKanchan, et al [1] used Surfer for mapping, it can be done in various software. Surfer is the grid based graphic program software used for mapping xyz data into grids. These grid files can be used for making maps such as contour maps, vector maps, surface maps and wire frame maps. Surfer helps us to visualize our data. In surfer, we require exact location of sampling station. Hence longitude and latitude of each sampling station is required. We can arrange these locations in excel sheets as per season. These data is xyz type data i.e. longitudes on X-axis,

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latitudes on Y-axis and respective value of water quality parameter on Z-axis. For preparing contour maps, firstly grid files are needed. We can generate grid files from these excel files easily. Excel sheets are called as worksheets in surfer. Using 'Plot New Map' function, we can generate contour maps from these grid files. Many additional options are available for modifying contour maps as per our requirements. One of such is colour scaling for different contours. These contour maps can be generated for each water quality parameter as per season. These maps are called as Contour Maps of Water Quality Parameter. Additionally with this, we can extend these contour maps in Google Earth Pro using 'Export Function' which gives us view of contour maps overlaying on the actual river map. The mapping on Surfer gives detailed information about assessment rather than just theoretical values. Using SURFER visualization of samples is easy by creating a map of Mutha River. 2-D and 3-D contouring is possible using surfer.

V. CONCLUSION

Water Quality Assessment is basic tool for any water quality projects. Water quality is dependent on the type of the pollutant added and the nature of self-purification of water. We can get the spatial variation of water quality parameter. Also seasonal variation of water quality can be obtained. Contour Map is easy tool for visualising the scenario of water quality of river. By comparing each water quality parameter with the standards of drinking water as per BIS, we can get the pollution severity of the river. The contours gives most affected area in the river patch. This data can be used for future works such as planning of new method of treatments such as wetlands, phytoremediation, etc. Also we can use this study for water quality modelling of the river using software.

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