International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Issue 5, pp 283-286, May-2023

https://doi.org/10.47001/IRJIET/2023.705038

Bhima River Water Quality Monitoring and Modeling

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***Abstract* - The Bhima River is a major river in South India. Along the river stretch there are about 7000 industries comprising large, medium and small-scale units according to CPCB. Most of the industries are located in the Maharashtra Industrial Development Corporation (MIDC). The river is 80 percentage polluted by industries pollution and 20 percentage by domestic wastewater. Based on sampling on various locations, it was found that the river stretches of Bhima River and its tributaries are polluted. River water qual-its models are used extensively in research as well as in the design and assessment of water quality management measures. The application of mathematical models for that purpose dates back to the initial studies of oxygen depletion due to organic waste pollution. Since then, models have been constantly refined and updated to meet new and emerging problems of water pollution. In order to handle the complex interactions caused by the increased influence of human activities in rivers. It is today mandatory to river water quality models with model describing emissions from the drainage and sewerage system. Special attention is given here to the modeling of convergence processes, but also the methods and tools to work with the models i.e., parameter estimation, and simulation software QUAL2E are discussed. QUAL2E is a framework for the simulation of water quality in streams and rivers.**

Keywords: Bhima River, Water quality analysis, Modeling, QUAL2E.

I. INTRODUCTION

Water, forms a basic need of humans and almost all the livings on this planet. Water is necessary to maintain life. We need water for drinking, bathing, washing and for cooking food. Water is also needed for irrigation of crops in agriculture. Water is required in Industry and also for navigation purposes. Water cycle in nature gives us fresh water inform of rain and snow. Fresh water is a renewable resource but is not evenly distributed in country. Some regions get more rainfall and some regions get low rainfall. With more and more demand by the ever-increasing population water has become a scarce commodity in many regions of country.

1.1 Problem

Indapur town situated near Solapur boundary, it is taluka place of the region in council of Pune District, Maharashtra. The place has its own historical importance in mythological stories. Many significant changes are related with the river and are flow directions. River is Alluvial River and has most of alluvial deposits and much more scouring has occurred and lead to changes in basin shapes. Bhima is Sacred River and regarded as second most important river in the Indian mythology, people worship the river and are very sensitive about the issues related to the river. Fresh water supply to the river is totally dependent on the rainfall; dam constructed across the river in downstream side of Indapur is Ujani Dam which regulates the flow of the river.

The problem lays in the region are that due to a greater number of industries present near the Bhima River stretch level of pollutants released into the river is getting increase day by day and self- cleansing capacity of river is getting decreases. River flows in months of rainy season i.e., during months of July to October, and there on in months of October to March the river have retained backwater of barrage constructed in downstream, an driver remains dry bed for the rest of months. Release of pollutants continue throughout the year and in certain variations as per the operations of industries in seasons along with addition of pollutants from agricultural activities as per plantation periods, domestic wastes more or less remain same throughout the year. Another important source of pollutant is the waste discharge from the industries.

Table 1: Sample collection and storage and agricultural waste

Parameter	Container	Min. Sample Size (ml)	Recommended	Regulatory
BOD	Plastic/Glass	1000	6hr	48hr
COD	Plastic/Glass	10	7	28d

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DO	Plastic/Glass	300	0.25hr	2hr
Chloride	Plastic/Glass	50	Not Specified	28d
pH	Plastic/Glass	50	0.25 hr	4hr
Hardness	Plastic/Glass	100	6months	6 months
Turbidity	Plastic/Glass	100	24hr	48hr
Conductivity	Plastic/Glass	500	28d	28d
Temperature	Plastic/Glass	100	0.25 hr	0.25 hr

Due to which there is need to check the water quality to identify the level of pollution in the river. So that necessary action can be taken in order to avoid further pollution.

1.2 Importance

Water source for the region is mainly dependent on the river water retained by the barrage which helps it to infiltrate and increase ground water level to be used for functioning of the rural life. Whereas the population and the small scale industries are insufficient in processing enough economic prospects for establishing a good quality water by direct treatment plants establishments. Water Treatment plant Establishment for given locality may have various conflicts in case of revenues related cases as the level of pollutants released by small industries is considerably high to meet with standards and may cost high against the company prospects. Although control of the point sources by the industries as per the law for release of pollutants is checked the problem continues with release of non-point sources of pollution by the town and agricultural activities. To determine the level of pollution in the river. It is necessary to check the water quality of river. Similarly, the Use of water quality modeling would be an effective tool in developing solution to problem in such case. With use of property of self cleansing of river, pollution level is reduced to a great extent and thus in turn achieving economy and also control on pollutants. The study deals with the determining the water flow conditions and along with it the waste polluting matter released at various intervals by various agencies.

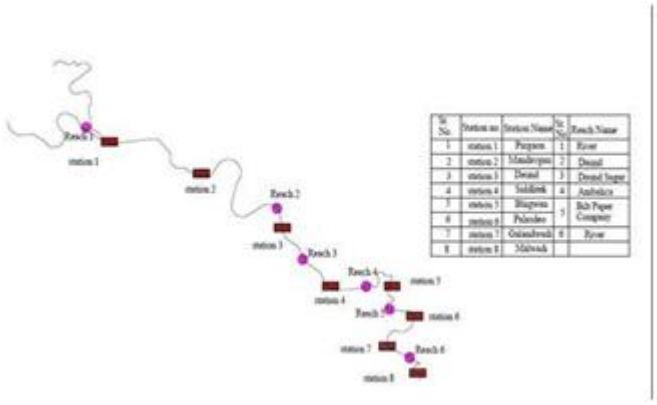

Figure 1: Study map of Bhima River

II. LITERATURE REVIEW

Review of Literature

Kakhiashvili K. (2007) conducted study on Modelling and simulation of pollutants transport in rivers, Applied Mathematical Modelling This paper is devoted to mathematical modeling and computer simulation of diffusion and transport of chemicals in rivers. In this paper the author has presented one, two, and three-dimensional models in terms of time-dependent convection diffusion reaction differential equations, further we give the finite difference approximation and appropriate numerical algorithms for these models, and finally we discuss briefly the computer implementation of this methodology in a user friendly software package. In order to evaluate the quality, the accuracy, and the per- romance of the methods and the developed software we have applied one-, two- and three dimensional models to the same case, for which we had data from measurements. By analyzing the difference between the measured and the simulated values of controlled chemicals in the rivers, we have estimated the effect of agricultural activities along the banks of the river (in the interval between two sections) on the pollution degree of the Habits Kali River. In this sense, the example is schematic, since the number, the arrangement, and the capacities of pollution sources of Habits Kali only partially correspond to the real situation. Though, the geometry of the rivers, the arrangement of the control sections, and the concentrations of polluting substances in the rivers matches well the real data.

From Various literatures studies it was observed that the river water quality is one of the important issues all over the world. River water quality along with water quality assessment was done by Ntengwe, Ram and Joshi, Gupta et al. and Wagh and Kamat. Most of these studies concluded that wastewater entering from industries as well as from domestic sources severely polluted the river. Ram-Joshi and Ashraf-Mukundan studied the seasonal variations in water quality parameters of river. It was seen that river water was severely polluted in summer than winter or monsoon season due to low flow of water in the river. Literature review of the studies showed that water quality monitoring, seasonal variations in water quality of river, study of water quality parameters of rive is essential for thorough analysis of river water quality. Such studies have been carried out for several rivers in India

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like Ganga, Yamuna, Godavari, Periyar, Mandakini etc. But very few studies have been carried out for Bhima River water quality analysis. Quality of water supplied to Indapur taluka is largely affected due to the river pollution. Also, no studies were done to study the effects of variations in river water quality on drinking water quality of the adjacent city and no one did the analysis for variations in water quality across the width of river. similarly there are very few studies were conducted on water quality modeling of Bhima river.

The aim of present study is to check the water quality of Bhima River for monthly variation. Also, changes in physico-chemical parameters along the length and across the width of the river which gives a better idea about the spread of pollution. Along with water quality analysis the water quality mout using QUAL2E software.

III. DISCUSSION OF MODELING RESULT

The results obtained for the rainy season in august month shows favorable results for the BOD and DO Concentrations which are within acceptable limits. On downstream from Daund to Bhigwan water is highly polluted and not suitable for use. Another important issue to be pointed out is that the number of sampling point locations in this study are very few which shows better results along 160 km river stretch. In addition, the reliability of the available observation data may also be questionable since there is a very high variance in the observed concentration values at some of the sampling locations.

It is observed that with reduction in flow condition there is increase in BOD level in River for month of September than August whereas for October month there is high BOD content due to low flow values thus it is observed that BOD Levels can be kept low by having regulated flow conditions. In general it may be concluded that the BOD levels are much high during non-flow conditions and water becomes unusable, also the concentrations of pollutants exceeded in river at barrage locations and the point of junction with Ambalica (sugar factory).It must be clearly seen that the actual release of pollutants are not to be standardized on just fixed emission standards but on capacity of water body to purify and make sanitary conditions feasible, by modeling the average flow conditions and probable outsource of pollutants from various aspects.

IV. CONCLUSION

In this study the samples were collected to check the water quality of Bhima River. Samples were analyzed for significant parameter namely pH, DO, BOD, TDS, chloride, hardness and MPN. Samples were also collected from various stations in the river. Study of monthly variations in water quality parameters along the river was carried out. Also the river water quality modeling was done using QUAL2E software using by considering parameter DO, temperature and BOD. Following conclusions are drawn from the whole study. Stations S3 and S4 on the downstream side shows higher values of BOD, TDS, chloride and hardness due to discharge of wastewater from industry. DO at S3and S4 was mostly below 3 mg/l which made both stations unfit for survival of aquatic life. Low value of DO and high values of BOD in the range of 203 to 210 mg/L indicated severe organic pollution at stations S3 and S4. Similar the COD values for station S3 and S4 are beyond permissible limit it is in range of 391 to 596mg/l.

ACKNOWLEDGEMENT

We have great pleasure in delivering the report on the topic “Bhima River. Water Quality Monitoring and Modeling”. This report has helped us to express our gratitude towards Honorable Principal Dr. S.T.Shirkande, H.O.D. Prof. R.B. Ghogare for their support. We would like to thanks specially to our project guide Prof. S.M.Baral for his imply help and guidance towards successful completion of our report.

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Citation of this Article:

Prof. S. M. Baral, Ghogare Kumar Shivaji, Godase Pradip Dhanaji, Shinde Ajit Tatyaso, Pawar Ajay Bhimrao, "Bhima River Water Quality Monitoring and Modeling" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 7, Issue 5, pp 283-286, May 2023. https://doi.org/10.47001/IRJIET/2023.705038

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