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ASSESSMENT OF WATER QUALITY ANALYSIS USING PHYSICO-CHEMICAL PARAMETERS: A CASE STUDY OF BHIMA RIVER IN DAUND TAHSIL, PUNE DISTRICT, MAHARASHTRA.

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ABSTRACT

Objective: Our objective is to examine the previous and current physical and chemical properties of the water in Bhima river in the study area as well as to assess the change in physical and chemical properties of the study area.

Materials and Methods: The physico-chemical characteristics of Bhima river water in Daund Tahsil (Pune district) have been studied. The stretch of Bhima river in Daund Tahsil is extending downstream from Dahitane to Malthan. Bhima River was assessed at three various stations in terms of critical pollution parameters in the year 2010-11 and 2011-12. Three sampling stations viz., Station A-near Dahitane (Towards the West side), Station B-near Rahu (in the middle), and Station C-near Daund (towards East side) were established for the collection of water samples during April, 2011 to March, 2012. The water quality parameters namely transparency, colour, (transparent-very turbid), turbidity, total dissolved solids pH ,dissolved oxygen, free carbon dioxide, total alkalinity, Biochemical Oxygen Demand, Chemical Oxygen Demand, total hardness, chloride, nitrate, nitrite, sulphate, phosphate , silicate, sodium, potassium, Calcium and Magnesium reflects on the nature of the river in the study area.

Results: On the basis of various parameters studied it was found that the rivers receive industrial effluents from various industries, which are situated on the bank of river, along with the heavy loads of agriculture run off.

Conclusion: The conclusion also deals with community response about Bhima river out of the many problems perceived by the river bank residents, the priority problem observed by maximum is that of the mosquitoes and habitants, Agriculture, including commercial livestock and poultry farming. is the source of many organic and inorganic pollutants in surface waters and ground water. Hence the river water quality is needed to be improved

Keywords: Physico-Chemical Characteristics, Total dissolvent, Water analysis, Bhima, River.

INTRODUCTION

As per the United Nations Report published on 22 March 2010, contaminated and polluted water kill more people than all forms of violence including war [1-2]. A report of UNESCO published in 2006 indicates that a vast chunk of population in India has no access to safe drinking water and that about 66 million people still rely on unsafe water for consumption [3-4]. Water supplies contaminated with faucal matter cause number of diseases. Besides this, various human and animal activities cause pollution in river water. The runoff carrying various agricultural wastes, fertilizers, pesticides, sewage, industrial effluents etc. contaminate river water [5-7]. Bacteriological and physico-chemical studies have been carried out in recent years at different places for various rivers in Maharashtra [8]. These studies also reported that increased urbanization and industrialization have been resulted deterioration of water quality due undesirable variation in physico-chemical, bacteriological parameters. Various kinds of same activities are observed in the Bhima basin too [9-10]. Therefore, an attempt is made to study the water quality in the basin which is based on primarily the core parameters.

MATERIALS AND METHODS

Analytical Water Quality Procedures

Central Water commission follows the standard protocol for sampling, transportation and preservation and analysis of the water samples [11]. The water samples are collected on first working day of every month during monsoon and non-monsoon season between 8.0 to 10.0 AM. The monsoon season considered is June to November while non-monsoon season is considered from December to May. For arriving at average values during the monsoon and non-monsoon periods, the average of monthly values of parameters has been considered. The method of analysis is as prescribed in Standard Analytical Procedures, Water Quality Analysis, Hydrology Project. The instruments used are as per the accuracy and precision prescribed in the standard procedure [12-14]. Chemicals of analytical grade were used during the analysis.

The Water Samples from Bhima river were collected from three different stations in the morning hours between 8 to 10 am in Polythene bottle regularly for every month. The Water samples were immediately brought in to Laboratory for the Estimation of various Physico -chemical parameters, and pH were recorded at the time of sample collection by using Thermometer and Pocket Digital pH Meter. While other Parameters Such as DO, TDS, Free CO2, Hardness, Alkalinity, Chlorides, Phosphate and Nitrate were estimated in the Laboratory by using Indian Standard Procedures [15-16].

The water samples were stored in 4° C. Following methods were employed for the estimation of various factors:

Parameter	Methods
pH	ELICO pH electrode
Electrical conductivity	ELICO conductivity bridge
Total dissolved solids	ELICO conductivity bridge
Turbidity	Turbidity tube method
Hardness	EDTA titrimetric method
Calcium hardness	EDTA titrimetric method
Magnesium hardness	Magnesium by calculation
Sodium	Flame emission photometric method
Potassium	Flame emission photometric method
Acidity	NaOH titrimetric method
Alkalinity	H_2SO_4 titrimetric method
Chlorides	Argentometric method

Nitrates	Phenol Disulphonic acid method
Phosphates	Stannous chloride method
Sulphates	Turbidimetric method

RESULTS

The river water quality is generally influenced by chemical, biological and environmental factors. Seasonal variations (Monsoon and Non-Monsoon) were noticed in physico-chemical properties of water in Bhima basin. The values of core parameters viz. pH, EC, DO, NO_3^-, NO_2^-, BOD and Total Coliform (Tcol) & Faecal Coliform (Fcol) during monsoon and non-monsoon season are obtained at various sites. These values are compared with standard values of parameters prescribed for Classification of Inland Surface Water; the results are as discussed below:

pH

Hydrogen ion concentration plays very important role in biological processes of all aquatic organisms. Low pH values indicate acidic water having corrosive properties and high pH values indicate alkaline properties. pH values between 6.5 to 8.5 is considered as acceptable. However, no health-based guideline value has been proposed for pH.

The value of pH in Bhima basin is varying from 7.6 to 8.6 in monsoon season and 7.9 to 8.9 in non monsoon season. The alkaline pH river water is due to presence of alkalinity minerals in water. The slightly higher pH values during non-monsoon could be due to increased photo synthetic assimilation of dissolved inorganic carbon by planktons [17]. As per the Classification of Inland surface waters (IS:2296-1982) it is suitable for A and B class of water.

Electrical Conductivity (or specific conductance)

The ability of water to conduct an electric current is conductivity or specific conductance and it depends on the concentration of ions in solution. It is an index to represent total concentration of soluble salts in water. Electrical conductivity is an estimate of total dissolved salts in water and water with EC values between 2500 and 10000 µmho/cm is not recommended for human consumption and normally not suitable for irrigation [18]. The value of conductivity of water in Bhima basin is varying from 204 µmho/cm to 829 in monsoon and from 299 µmho/cm to 1194 µmho/cm in non-monsoon. The electrical conductivity in both the monsoon and non monsoon season is less than 2250 µmho/cm and therefore suitable for use as irrigation water.

Dissolved Oxygen

Dissolved Oxygen (DO) is of considerable importance in water quality investigations as its concentration in water indicates ability of a water body to support a well-balanced aquatic life [19]. DO in water is replenished through photosynthesis, dissolution from the atmosphere and addition of oxygen-rich water such as through runoff. Simultaneously, DO is consumed during heterotrophic oxidation of organic matter and respiration by aquatic flora and fauna as well as oxidation of some naturally occurring constituents in water. Thus, equilibrium is maintained between consumption and replenishment of DO. In natural waters the rate of consumption of DO is lower than the rate of replenishment resulting in maintenance of adequate concentrations DO. Oxidizable matter such as sewage and certain pollutants consume more DO than that the water body can replenish thereby degrading the ecological quality.

Nitrate and Nitrite

Nitrate (NO_3^-) is found naturally in the environment and it is an important plant nutrient [20]. It is present at different concentrations in plants and is a part of the nitrogen cycle. Nitrite (NO_2^-) is not usually present in significant concentrations except in a reducing environment. Nitrate is the most stable oxidation state of nitrogen; it can be formed by the microbial reduction of nitrite. Nitrate can reach surface water as a consequence of agricultural activity from wastewater disposal and from oxidation of nitrogenous waste products in human and animal excreta, including septic tanks. Surface water nitrate concentrations can change rapidly due to surface runoff of fertilizer, uptake by phytoplankton and de-nitrification by bacteria. The values of NO_3^- in Bhima basin are varying from 0.11 mgL^{-1} to 3.13 mgL^{-1} in monsoon and 0.12 mgL^{-1} to 1.89 mgL^{-1} in Non-monsoon. The value of NO_2^- is varying from 0. 11 mgL^{-1} to 3.13 mgL^{-1} in monsoon and 0.0 mgL^{-1} to 0.35 mgL^{-1} in Non-Monsoon. Hence the value of NO_2^- and NO_3^- are within described limit of 50 mg/l for water.

Total coliforms and Faecal coliforms

The purpose of the total coliform counts in water bodies is to estimate the number of coliforms in water samples as an index of magnitude of biological contamination. Total coliform count in water bodies is an important parameter for checking possible contamination. The Total coliform group comprises several types of bacteria. These bacteria reach water through faeces of humans and other warm-blooded animals, as well as through contaminated soils [21]. This group of bacteria is widely used as a measure of health hazard from faecal contamination. The total coliform group comprises the aerobic and facultative, gram negative, non-spore-forming, rod shaped bacteria that ferment lactose with gas formation within 48 hours at 35 °C. The specific bacterium *Escherichia coli* is part of this group. The test for faecal coliform is at an elevated temperature of 44.5 °C, where growth of other non-faecal bacteria is suppressed [22].

The average values of faecal coliforms in Bhima basin are varying from 100 to 5450 MPN/100 ml in monsoon and from 85 to 1513 MPN/100 ml in non-monsoon. The average values of Total coliforms are varying from 190 to 47000 MPN/100 ml in monsoon and from 100 to 6492 MPN/100 ml in non-monsoon. During Monsoon season, higher values of total coliforms bacteria observed at all sites in Bhima Basin. The higher values of total coliform most probably arise from untreated wastewater discharged into river and animal activities. The presences of coliform organism are taken as an indication that pathogenic organism may also be present. For C class of water, the total coliform should not be more than 5000 MPN/100 ml. Hence the water at most of the location in Bhima basin is fit for human consumption with conventional treatment and disinfection.

CONCLUSION

Analysis of river water at nine sites in Bhima basin was carried out for the data of two years from 2010-11 and 2011-12 for both monsoon and non monsoon periods. The values of core parameters viz. pH, EC, DO, BOD, NO_3^-, NO_2^-, Total Coliform (Tcol) & Faecal Coliform (Fcol) were analyzed and compared with the standard values mentioned for classification of Inland Surface Waters (IS:2296-1982). It was observed that the values of pH, EC are generally within the limit at all the sites. The value of DO and BOD are higher than the prescribed limits at sites Rahu and Daund. This may be due to discharge of industrial and the domestic effluent in the river from nearby towns. The value of, NO_2^- and NO_3^- are within limits in all the sites. However, the presence of total and faecal coliform is beyond the prescribed limit for class A, B of water at almost all the sites. These values are higher particularly at sites Rahu and Daund which may be due to discharge of effluent from nearby towns. However, considering all the core parameters, water in Bhima basin is of reasonably good quality and fit for irrigation and can also be used for human consumption with conventional treatment and disinfection.

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