Physico-chemical Assessment of Water Quality of River and the Hydro-biological Study of Algae

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Abstract - Biological assessment is a useful alternative for assessing the ecological quality of aquatic ecosystems since the biological communities integrate the environmental effects of water chemistry. Algal and water samples were collected from three sites of River Dham (Pavnar, M.S.). viz., Pavnar Ashram (S1), Ghorad (S2) and Morchapur (S3) and analyzed for Water quality variables (physicochemical) parameters. The data was analysed with reference to ISI & WHO standards. It was found that the water is safe for domestic purposes and aquatic life as far as levels of pH, density, surface tension, viscosity, conductance, TDS, alkalinity, DO and chloride concentration. However, the water quality parameters such as total hardness and Ca++ hardness at some stations were beyond the permissible limit. Therefore, it was suggested to remove total hardness and Ca++ hardness to make it fit for consumption. Phytoplanktons encountered in the water body reflect the average ecological conditions and they may be used as indicators of water quality. During the investigation total 53 algal species were encountered and identified.

Keywords: Dham River, Aquatic life, Physicochemical parameters, Phytoplankton's, ISI and WHO standards.

1 INTRODUCTION

Algae are frequently found in polluted and unpolluted water and due to this behaviour they are generally considered useful to determine the quality of water because water is essential for life. The main reason of water contamination is urbanization and industrialization. In rural areas where the water sources like dam, canal, or river are not available and ground water is explored for agricultural purposes. As per current analysis, this is observed that the ground water get polluted drastically because of increased human activities, because of which, water borne diseases has been seen which causes the lot of health problems.

Therefore, basic concentration is needed to monitor the quality of water as well as to find out various sources which increased ground water pollution. This paper basically focused to examine the water quality of various potable water sources viz. ground water at Pavnar. During experimentation, Physico-chemical parameters of water were tested to ensure good quality of water. But chemical analysis of water provide a good indication of the chemical quality of the aquatic systems, but do not integrate ecological factors such as altered riparian vegetation or altered flow regime and therefore, do not necessarily reflect the ecological state of the system [1]. Biological assessment is a useful alternative for assessing the ecological quality of aquatic ecosystems, since biological communities integrate the environmental effects of water chemistry, in addition to the physical and geomorphological characteristics of Rivers and lakes [2]. Phytoplankton encountered in the water body reflects the average ecological condition and therefore, they may be used as indicator of water quality [3], [4]. These are very suitable organisms for the determination of the impact of toxic substances on the aquatic environment because any effect on the lower level of the food chain will also have consequence on the higher level [5]. Algae are used for assessing the degree of pollution or as indicator of water pollution of different water bodies [6], [7], [8]. With the advent of development, there is exponential increase in the demand for water. The main source to fulfil this demand of irrigation, industries and drinking water is river water. The quality of water is directly linked with human welfare. A comparative study of surface water and ground water sources from villages of different Talukas of Ariyalur area, Tamil Nadu [9]. Shilpi Bansal [10] studied hydrochemical monitoring of pollutants in drinking water of Aligarh. The results indicate that drinking water quality of Aligarh is deteriorating and water is becoming polluted due to untreated industrial and sewage water discharge which can be controlled by adopting standard methods for water treatment. Dr. Indradev Yadav [11] analyse the drinking water before and after the flood of east zone of Kosi division and concluded that when the concentration of Nitrate exceed 40 mg/lit, the skin becomes glue due to the decreasing efficiency of haemoglobin to combine with oxygen. It affects the mortality in pigs and calves due to the presence of high concentration in cattle.

Mathew Koshy [12] studied water quality parameters of reverse in Alappuzha district. The results of present work indicate that there are variations in the physicochemical parameters in the river

water system. D.V. Tayade [13] reported the assessment of some metal in ground water and canal water of Nagapur village of Yavatmal district, Maharashtra. The result found to contain Calcium; Magnesium and Iodide elements were below maximum permissible limit, whereas fluoride was above the maximum permissible limit. Bilgrami and Dattamunshi [14] examined the pH values in river Ganga and its major tributaries mainly Gandak, Barni, Kosi and attributed pH changes due to planktonic and fish activities.

Area of study:

The phytoplankton's and water samples were collected from Dham River of Pavnar. Pavnar is situated in the Wardha district (M.S.). Wardha district is located in the central part of the Vidarbha region of Maharashtra and was one of the major centres of activities during the pre-independence period. It is well known for Sevagram Ashram of Mahatma Gandhi and Pavnar Ashram of Vinoba Bhave. The Wardha district lies between north latitudes of 20018' to 21021' and east longitudes of 7804' to 79015'. The district falls in the survey of India degree sheet nos. 55 K/L and P, on the north eastern side of the state Maharashtra.

2 MATERIAL AND METHOD

The water of Dham River is utilized for various purposes like domestic, farming, industrial purposes etc. The effluents from industries and sewage water from villages mostly polluted the river. Hence, in order to know the impacts of pollution due to industrial effluents and waste water it was also thought of interest to investigate the physico-chemical parameters of this river along with the investigation of Hydrobiological study of Dham River. Water samples were collected from different heights were mixed in equal volumes and preserved in 500ml stopper bottles and were allowed to stand for at least 24 hours. Thereafter from the settled planktons, employing a graduated pipette, an aliquot of samples was taken and one drop (0.05 ml) of the sample was placed on a clean glass slide for qualitative and quantitative analysis. Phytoplankton's were identified by employing the manual of Desikachary and Raja Rao [15]. All the chemicals used in the study were of A.R. grades. Double distilled water was used throughout the study. Standard methods for collection, preservation and analysis were adopted [16].

Stations: - Water samples from three stations of the river Dham were collected at Pavnar Ashram (Station 1), Ghorad (Station 2) and Morchapur (Station 3) of Wardha district (M.S.) in the month of

January 2008. All samples were collected between 11.00 am to 12.00 pm.

3 RESULT AND DISCUSION

3.1Analytical study of Algae:

Physicochemical parameters viz. Temperature, colour, turbidity, density, viscosity, surface tension, electrical conductivity, pH, DO, hardness, alkalinity, TDS, chloride concentration etc were analysed for the selected three stations of Dham River for the month of January 2008. Analytical results were tabulated in Table 1.

Table 1:

S.No.	Parameter	Unit	S1	S2	S3
1	Colour	-	colourless	colourless	colourless
2	Temperature	oC	24	25	26
3	pH	-	6.62	7.27	8.24
4	Turbidity	-	visibly not turbid	visibly not turbid	visibly not turbid
5	Density	gm/cm3	0.9965	0.9924	0.9966
6	Viscosity	mpoise	7.557	8.465	8.566
7	Surface Tension	dyne/cm	72.4158	68.95	73.80
8	Conductance	mM	0.465	0.40	0.998
9	Suspended Solids	ppm	281	224	163
10	Dissolved Solids	ppm	88	128.77	103.828
11	T.D.S.	ppm	367	351.78	264.828
12	Temporary Hardness	mg of CaCO3/lit	112.6	169.5	125
13	Permanent Hardness	mg of CaCO3/lit	156.1	154.93	140.3
14	Total Hardness	mg of CaCO3/lit	268.7	324.51	266.2
15	Ca++ Hardness	mg of CaCO3/lit	156.8	146	79.2
16	Mg++ Hardness	mg of CaCO3/lit	110	296.6	187.1
17	Alkalinity of water				

(I)	Total Alkalinity	mg /lit	83	75	36
(II)	Phenolphthalein Alkalinity	mg /lit	0	0	0
(III)	Methyl orange Alkalinity	mg /lit	85	76	37
18	D.O.	ppm	1	16	2.886
19	Chloride	mg /lit	163.780	172.1	137.54

Temperature: The fluctuations in temperature of different stations may be due to the influence of environmental temperature due to that point of time. **pH:** The pH is one of the most important factors that influence the aquatic production. In the present study the pH was found to be acidic at Station 1 and normal to alkaline at Stations 2 and 3. The range of pH was 6.62-8.24. The higher alkaline state of pH at Station 3 might be due to the enhanced chemical interaction that leads to buffering and release of alkaline ions (bicarbonate and carbonate ions) or salts in the river water.

Density, Surface Tension and Viscosity: Density and Surface tension were found to be lowest at Station 2 and highest at Station 3. The viscosity is found nearly the same at Station 2 and 3 while it is comparatively least at Station 1.

Electrical Conductivity: Electrical conductivity is useful tool to evaluate the purity of water which is minimum at Stations 1 and 2 and maximum at Station 3.

TDS: TDS are those which get dissolved in water 7 cannot be separated from water by filtration. They may be chemically organic or inorganic. According to Trivedi and Goel [17] TDS are composed mainly of carbonates, bicarbonates, chlorides, sulphates, calcium, magnesium, phosphate, nitrate, sodium, potassium and iron. In the present investigation, the highest value of TDS was recorded at Station 1. The high value may be due to the evaporative loss of water and consequent increase in the concentration of salts present in water. The ISI standard for dissolved solids is up to 500 mg/lit and the maximum permissible quantity is 1500 mg/lit [18]. The results indicate that all the samples of water from all stations were within permissible limit of ISI standard.

Total Hardness: The total hardness of water samples ranges from 266.2-324.51 mg/lit. According to ISI, the acceptance limit of total hardness (as CaCO3) is 200

mg/lit which can be extended to 600 mg/lit. Ca++ & Mg++ are important ions contributing towards total hardness. Hardness has no known adverse effects. Hardness above 200 mg/lit of water is not suitable for domestic use in washing, cleaning and laundry. The acceptable limit of Ca++ & Mg++ for domestic use are 75 mg/lit & 200 mg/lit respectively (ISI).But according to Ministry of Rural Development , India , in ground water in case of non-availability of alternate water source , Ca++ & Mg++ up to 200 and 400 mg/lit respectively can be accepted.

In studied area, Ca++ content ranged from 79.2-156.8 mg/lit. It means all three stations have Ca++ content within the acceptable limit. Similarly Mg++ content is also within the permissible limit (110 to 296.6 mg/lit).

Alkalinity: The phenolphthalein alkalinity of all the water samples is 0. But the total alkalinity is found between 36 to 83 mg/lit. According to ISI, the acceptable limit of total alkalinity of drinking water sample is 500 mg/lit and maximum desirable limit is 1500 mg/lit. The alkalinity may be due to the contamination due to leaching process through surface water during rainy season [19].

DO: In the present investigation, DO was found to be in the range of 1-16 ppm. This reveals that the DO at Station 2 is beyond the acceptable limit.

Chloride: Chloride value range from 137.54 to 172.1 mg/lit. The acceptable desirable limit is 200 mg/lit [20]. Results showed that all samples fall within acceptable limit. It produces a salty taste at 250 mg/lit to 500 mg/lit [21].

3.2 Hydrobiological study:

From the collected water samples of Dham River, Pavnar following species of algae were identified.

Table: 2. Table showing the total number of species in Dham River.

Algal groups	Names of Algae	Stations			Total
		S1	S2	S3	
Cyanophyceae	*Anabaena cercinus*	+	+	-	**05**
	Microcystis flosaquae	-	-	+	
	Merismopedia punctata	+	-	-	
	Oscillatoria limosa	+	+	+	
	Oscillatoria splendider	-	+	-	
Chlorophyceae	*Oedogonium sp.*	+	+	+	**39**
	Mougeotia sp.	+	-	-	
	Chlorela regularis	+	+	-	
	Cosmarium reniforme	+	+	+	
	Cosmarium contractum	+	+	-	
	Cosmarium depressum	-	-	+	
	Cosmarium quasillus	+	+	+	

	Cosmarium tetraophthalmum	+	-	-	
	Cosmarium biretum	+	+	-	
	Cosmarium pseudopyramidatum	-	-	+	
	Cosmarium punctulatum	+	+	-	
	Closterium ehrenbergii	+	+	+	
	Closterium costatum	+	+	+	
	Closterium moniliforme	+	+	-	
	Closterium acutum	+	+	+	
	Closterium pronum	+	-	-	
	Hydrodictyon reticulatum	+	+	-	
	Pediastrum biradiatum	+	-	-	
	Pediastrum boryanum	+	+	+	
	Pediastrum tetras	-	+	+	
	Pithophora sp.	+	-	+	
	Volvox sp.	+	+	-	
	Eudorina sp.	+	-	+	
	Spirogyra sp.	+	+	+	
	Zygnema stellinum	+	+	+	
	Zygnema pectinatum	+	+	+	
	Scenedesmus obliquus	-	+	-	
	Scenedesmus bijugatus	+	+	-	
	Scenedesmus bijuja	+	-	+	
	Scenedesmus armatus	-	+	-	
	Scenedesmus acuminate	+	-	-	
	Scenedesmus quadricauda,	+	+	-	
	Staurastrum furcigerum	-	-	+	
	Staurastrum anatinum	-	+	-	
	Staurastrum natator	+	+	+	
	Staurastrum manfeldii	-	-	+	
	Euastrum ampullaceum	+	-	-	
	Euastrum didelta	-	+	-	
	Pandorina morum	+	-	-	
Bacillariophyceae	*Navicula oblonga*	+	-	+	**08**
	Navicula radiosa	+	+	-	
	Pinnularia nobilis	+	-	-	
	Pinnularia major	-	+	-	
	Synedra sp.	+	-	+	
	Fragillaria capucina	+	-	-	
	Fragillaria gracilis	+	+	-	
	Gomphonema purvulum	-	+	+	
Xanthophyceae	*Chlorobotrys regularis*	-	+	-	**01**

During the investigation total 53 algal species were encountered. Out of these station1 characteristically shown the (Pavnar Ashram) abundance of Cyanophycean members of algal flora like, *Anabaena cercinus, Merismopedia punctata, Oscillatoria limosa.* Chlorophycean members like *Oedogonium*

sp., Mougeotia sp., Chlorela regularis, Cosmarium reniforme, Cosmarium contractum, Cosmarium quasillus, Cosmarium tetraophthalmum, Cosmarium biretum, Cosmarium punctulatum, Closterium ehrenbergii, Closterium costatum, Closterium moniliforme, Closterium acutum, Closterium pronum, Hydrodictyon reticulatum, Pediastrum biradiatum, Pediastrum boryanum, Pithophora sp., Volvox sp., Eudorina sp., Spirogyra sp., Zygnema stellinum, Zygnema pectinatum, Scenedesmus bijugatus, Scenedesmus bijuja, Scenedesmus acuminate, Scenedesmus quadricauda, Staurastrum natator, Euastrum ampullaceum, Pandorina morum. Bacillariophycean members like *Navicula oblonga, Navicula radiosa, Pinnularia nobilis, , Synedra sp., Fragillaria capucina and Fragillaria gracilis.* At Station 2 (Ghorad), Cyanophycean members were *Anabaena cercinus, Oscillatoria limosa, Oscillatoria splendider. Chlorophycean members- Oedogonium sp., Chlorela regularis, Cosmarium reniforme, Cosmarium contractum, Cosmarium quasillus, Cosmarium biretum, Cosmarium punctulatum, Closterium ehrenbergii, Closterium costatum, Closterium moniliforme, Closterium acutum, Hydrodictyon reticulatum, Pediastrum boryanum, Pediastrum tetras, Volvox sp., Spirogyra sp., Zygnema stellinum, Zygnema pectinatum, Scenedesmus obliquus, Scenedesmus bijugatus, Scenedesmus armatus, Scenedesmus quadricauda, Staurastrum anatinum, Staurastrum natator, Euastrum didelta* and Xanthophycean member- *Chlorobotrys regularis*-a single member were identified and at station 3 (Morchapur) Cyanophycean members such as *Microcystis flosaquae* and *Oscillatoria limosa* were observed. Chlorophycean members such as *Oedogonium sp., Cosmarium reniforme, Cosmarium depressum, Cosmarium quasillus, Cosmarium pseudopyramidatum, Closterium ehrenbergii, Closterium costatum, Closterium acutum, Pediastrum boryanum, Pediastrum tetras, Pithophora sp., Eudorina sp., Spirogyra sp., Zygnema stellinum, Zygnema pectinatum, Scenedesmus bijuja, Staurastrum furcigerum, Staurastrum natator, Staurastrum manfeldii.* Bascillariophycean members such as *Navicula oblonga, Synedra sp.,* and *Gomphonema purvulum* were observed in Dham River. At station 1 and 3 Xanthophycean members were absent.

Chlorophycean members were dominant on other three groups of algae. At station 1 more algal species were identified than the station 2 and station 3. Station 3 has lowest number of algal species.

4 CONCLUSIONS

From the observations and results it can be concluded that the different studied physicochemical parameters such as pH, density, viscosity, S.T., conductance, TDS, alkalinity, DO, chloride concentration were within the permissible limit. However the water quality parameters like total hardness and Ca++ hardness were beyond the permissible limit at some stations. Therefore, it was suggested that the river water should be treated to remove excess of total hardness and Ca++ hardness to make fit for consumption.

Demonstration-cum-awareness camps for the purpose should be arranged in the rural areas. Total hardness and Ca++ hardness can be removed by ion exchange and boiling. The Government should make firm policies and guidelines for the utilization of ground water. The above analysis of water also revealed that all the three stations under study were fairly suitable, productive and healthy for aquatic ecosystem. The values of parameters were well within the permissible limit (except some parameters) and therefore, can support and sustain the dependent aquatic organisms. The concentration of algal taxa increases from station 3 towards station 1. It might be because of the enhanced chemical interaction that led to buffering and release of alkaline ions or salts in the river water.

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