



Assessment on pollution impact and correlation study of lake water from Thane region of Maharashtra, INDIA

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Abstract

Water is a source of life. But pollution of water is the biggest threat in today's world. Thane city of Maharashtra state is known for its beautiful lakes. It has many lakes as per the record of Thane Municipal Corporation. As most of these water bodies situated right next to the roads receive heavy flux of agricultural waste, domestic sewage, industrial waste thus deteriorating water quality. The increasing trend in concentration of heavy metals in the environment has created lot of awareness about environmental pollution. These heavy metals have a marked effect on the aquatic flora and fauna which through bio magnification enter the food chain thereby affecting the human being. Hence this study is carried out to assess the quality of water in lake water samples from eight different lakes. Physico-chemical analysis is done over the period of march 2013 to February 2014 to estimate the parameters such as pH, conductivity, alkalinity, salinity, hardness, chemical Oxygen Demand(COD), Dissolved Oxygen (DO), Biological Oxygen Demand, Total Dissolved Solid and heavy metal content like Cu, Hg, As and Fe. The study shows high level of BOD ranging from 15mg/l (minimum) to 67mg/l (maximum). Very low level of dissolved oxygen in water indicates pollution. As the quality of water greatly affect the all forms of life, this attempt has made to assess and monitor the quality by studying physico-chemical properties of water.

Keywords: Lakes, water pollution Toxic heavy metal content, AAS, pH, TDS, DO waste, Thane, Maharashtra.

Introduction

Water is an essential part of our life on which depends life cycle and existence of entire bio-diversity. Human being can not make or generate either of these basic elements of life in a form in which those are needed. As such the human beings have no right to destroy, waste with any of these resources. Wherever and in whatever form those may be found, it is our basic responsibility to conserve such natural resources. Water quality has become a serious issue due to increasing industrialization, urbanization and man-made problems. The constituents present in the water systems depends on the nature where the water body is situated and the discharge quality from various sources in that water body.

Thane city has many lakes. Some lakes are in the city, some are near the industrial area. Lakes are also used for Ganesh idol immersion during Ganesh festival. Boating is the biggest activity carried out at some lakes. Oil seepage is the biggest problem at some lake. Most of the lakes situated right next to the road. Surface drainage from roads is let into the lakes. The lakes have a complex and fragile ecosystem, as they do not have self-cleaning ability and therefore readily accumulate pollutants. It has been reported that sewage effluents of municipal origin contain appreciable amount of major essential plant nutrients and therefore the fertility level of the soil are improved (Sharma et al, 2004). However studies on water of

vasai creek, Maharashtra, reveals that presence of heavy metal like Fe and Pb reduce soil fertility (Lokhande and Kelkar, 1999). The quality of the water sample varies with the type of the area of lake location. Location of lake decides the variety of waste material and sewage added to the lake. Various pollutants entering the ecosystem may be bio-degradable and non-biodegradable through drains and increases the level of BOD and COD very high which depleting the dissolved oxygen in water hence regular monitoring of water quality is the mandatory in developing countries like India, because of urbanization and industrial developments are moving towards coastal area. The inshore areas usually get disturbed with more critical water pollution problems than offshore^{1,2}

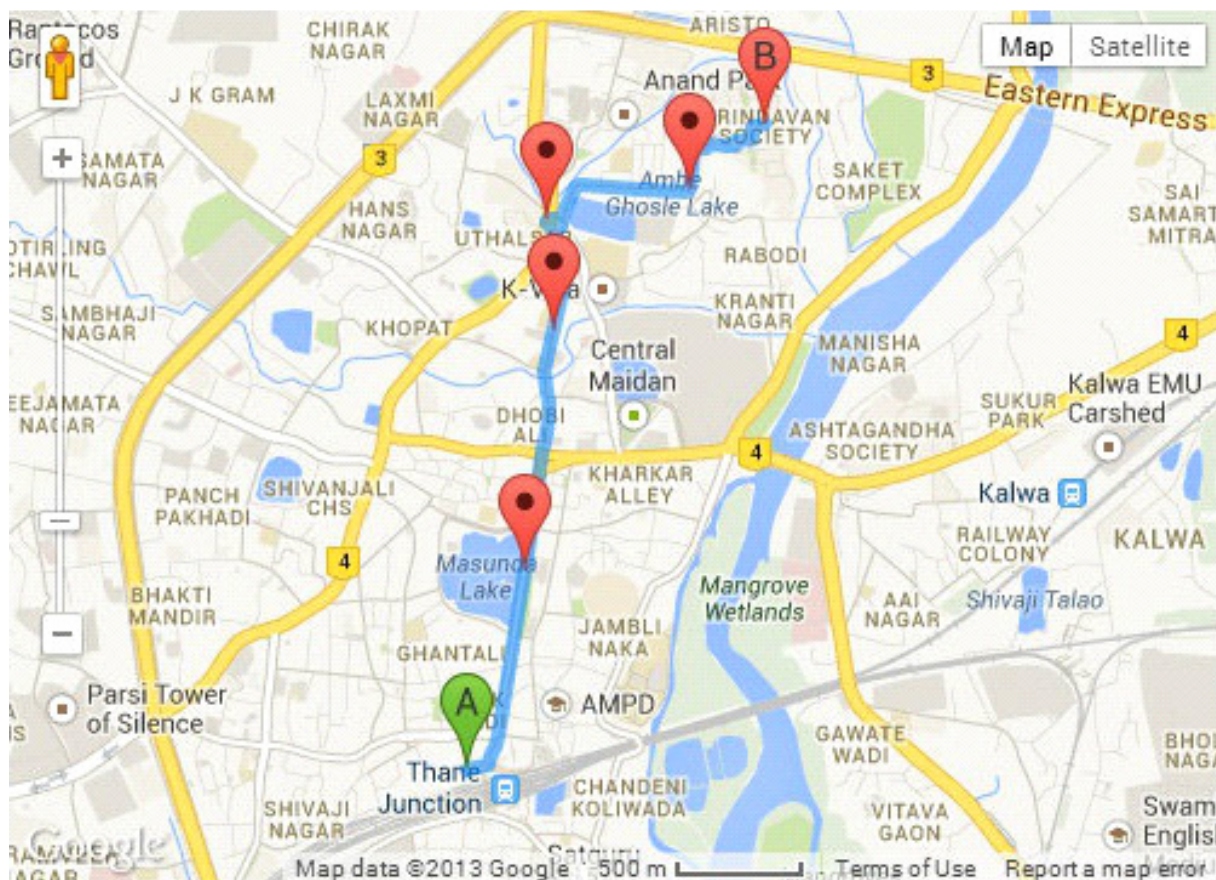
As the quality of water disturbed because of various sources, a systematic study was carried out to assess the quality of water from different lakes by monitoring Physico-chemical parameters of 8-different lake water samples for the period (March 2013 to February 2014) and the pollution level of each water samples are compared with guidelines prescribed by Indian Standard Institution.

Objective of the study: To measure and monitor the existing condition of water body by assessing the monthly variations of physico-chemical parameters.

Material and methods

Study Area: Thane district lies in the Northern part of Maharashtra in India. The city lies to the North Eastern side of Mumbai on the western coast of Maharashtra. Its total area is 127 square kilometer. The city is surrounded by hills, and is divided into two parts. There are around 36 lakes as per record of Thane Municipal Corporation. Also it has large industrial area consisting of Wagle estate, Trans Thane creek area known

as Thane Belapur road, Ghodbunder road. Thane region also marked with long coast line and rapidly growing residential area of Thane, Ghodbunder road etc. Also has various types of industries, these includes paper mill, paint, dye manufacturing, pharmaceuticals. The waste from these industries directly or indirectly released in the various water bodies like lakes, creeks and affects the water quality



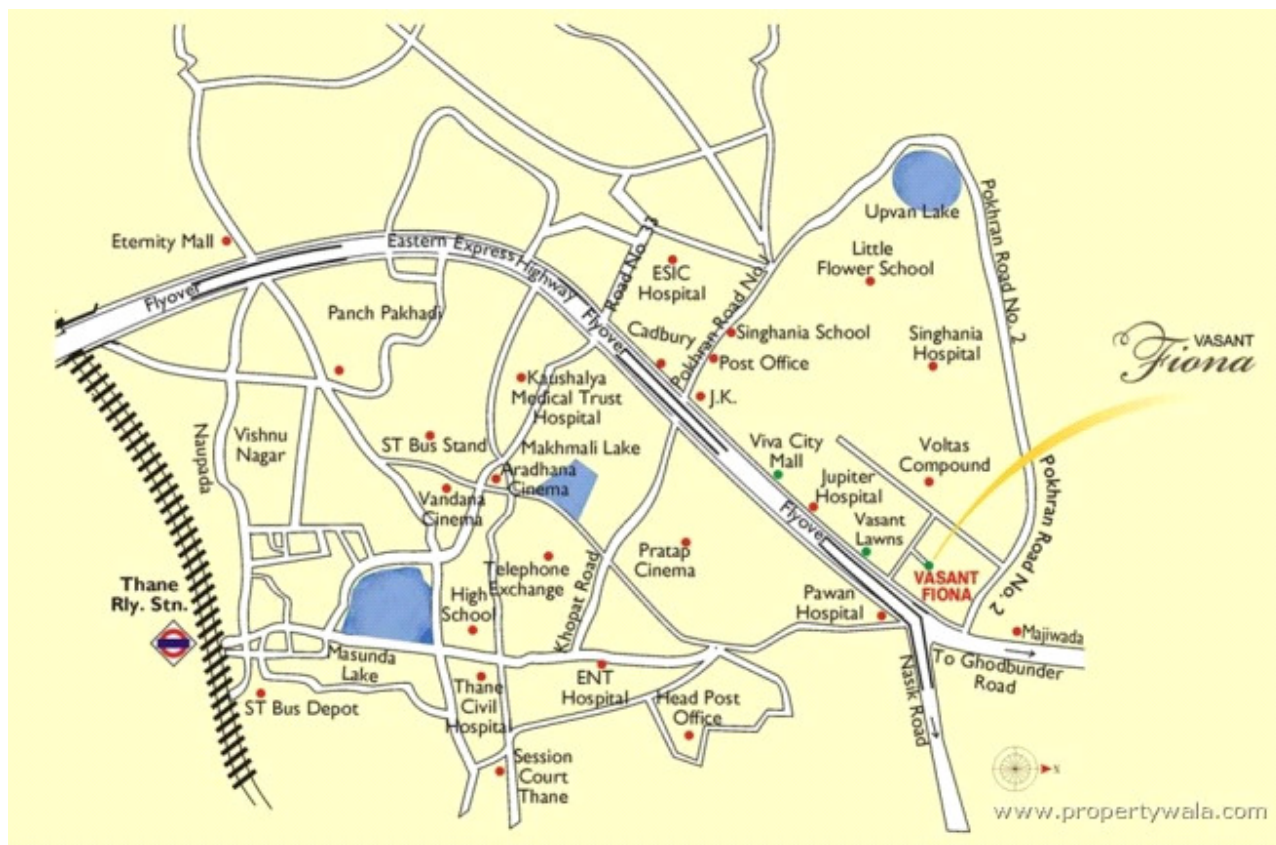


Figure-1
 Map showing the location of some lakes of Thane city

The methods followed for the collection, preservation, analysis and interpretation are those given by rainwater and Thatcher (1960) Brown et al(1970) and APHA(1995)¹ The present study was carried out to investigate the monthly variations in water samples collected during the period of March 2013-February 2014 and analysed for pH ,conductivity, total alkalinity, salinity, total hardness (TH), chemical oxygen demand (COD), dissolved oxygen (DO), and biological oxygen demand(BOD). and total dissolved solid (TDS).

Heavy metal analysis: The analysis for trace metals like Cu, Hg, As and Fe was done by flame absorption spectrophotometer (20003 model) mercury was analysed with a cold-vapour atomic adsorption spectrophotometer. Average values of three replicates were taken for each determination.

Heavy metal analysis is done for kacharali lake (s1), railadevi lake (s2), siddeshwar talao (s3), bramhala (s4), jari-mari (s5) and kopri talao (s6).

Results and Discussion

The results obtained are reported in the table .3 and table 4. Each reported value in the table is the average of one year.

Table-1
 For physico-chemical study 8- different sampling stations (lakes) were selected

Selected sampling stations	Locations	AREA
Siddeshwar Lake	Uthalsar Ward Committee	
Kopri Talav	Kopri Ward	0.2416 Hectare
Brahmala Talav	Uthalsar Ward Committee	0.5173 hectare (Garden Area :0.4 hec)
Kacharali Lake	Naupada Ward Committee	2.00 hectare
Railadevi Talao	Railadevi Ward Office	8 hectare
Shivaji Talao	Balkum Area	0.2247 hectare
Kharigaon Lake	Kalwa Ward Office	0.7377 hectare
Makhamali Lake	Uthalsar Ward Committee	hectare (Garden Area :0.51)

Table-2

**Permissible limits of physico-chemical parameters of water
 For drinking purpose as per standard methods**

Turbidity	2.5 Units
Colour	5.0 units Pt scale
Taste and odour	Unobjectionable
pH	7.0-8.5
conductivity	300micromhos/cm
Total Hardness (TH)	200 mg/l AS CaCO ₃
Alkalinity as caco3 (TA)	200 mg/l (strong)
Dissolved oxygen (DO) (mg/l)	>4.0-6.0
Chemical oxygen demand(COD) (mg/l)	<4.0
Biochemical oxygen demand (BOD) (mg/l)	Above 10 + very polluted
Total dissolved solid (TDS)	500 mg/l

PH :- pH values range from 6.68 to 7.31. The pH values decreases during monsoon³.The lower values was due to high turbidity,and enhances microbial activity, causing excessive production of CO₂ and reduced pH¹.The low pH does not cause any harmful effect⁹.The study shows that the average pH range is 7.09 to 8.89. (Table no 3) which are within the permissible limit.

Electrical conductivity-Electrical conductance is a good measure of dissolved solids⁴. It makes water hard due to dissolution of calcium and magnesium in water⁶. The permissible limit is 300micromhos/cm¹⁰.In present study the conductivity vary from 732 to 972 which is much above the permissible limits

Table-3

Physico-chemical analysis of water samples collected from different lakes

Parameter Sampling stations	Colour	pH	Conductance	TDS	DO	BOD	COD	TH	Total alkalinity	salinity
Siddheshwar	Dark reen	7.19	745	598	1.1	67	129	124	199	0.153
Kopri	lightgreen	7.84	863	645	2.7	56	88	158	205	0.120
Brahmala	Light green	7.94	834	450	3.5	38	125	146	240	0.165
Kacharali	colourless	8.09	732	420	8.5	15	52	176	224	0.120
Railadevi	Yellow	7.40	823	567	6.3	44	96	194	236	0.245
Shivagi Nagar	Light green	8.89	972	612	6.4	37	54	136	244	0.644
Kharegaon	Light green	7.09	997	709	1.5	66	109	254	150	0.158
Jari-Mari	Light green	7.73	732	533	5.2	48	71	260	195	0.103

All the parameters are expressed in mg/L except specific conductance which is in micromhos/cm

Table-4

Result of heavy metal analysis of six different water samples

Parameters	units	WHO	NDWQS	Results Samples					
				1	2	3	4	5	6
Cu	mg/l	0.5	0.5	0.125	0.267	0.106	0.104	0.116	0.121
Hg	mg/l	0.001	0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
As	mg/l	0.05	0.05	<0.01	<0.01	<0.01	0.011	<0.01	<0.01
Fe	mg/l	0.1	0.1	0.245	0.346	0.125	0.326	0.125	0.119

Total Dissolved Solids :-Total dissolved solid refers to solid matter dissolved in water.High range of TDS indicates more suspended or dissolved solid matter present in water, which decreses the potability of water quality and may cause serious health problem specially stomach retated⁵.The water containing 500 mg/l TDS is the desirable limit for potable water⁶. TDS observed to be minimum 420 mg/L for Kacharali lake and the maximum of 709mg/L (Table no 3) for Kharegaon lake.

Total hardness: The condition that makes water forming an insoluble curd type substance with soap and is primary due to presence of calcium and magnesium.These calcium and magnesium are key factors for total hardness in water. Total

hardness is not so much harmful in health point of view⁶. Permanent hardness of water sample is caused mainly by sulphates and chlorides of metals . The highest hardness value in summer season are mainly attributed to rising temperature thereby increasing the solubility of Ca and Mg salts^{5,6}. The permissible limits prescribed is 300 mg/l¹¹. As per classified water in range of 60-120 mg/l is moderate⁶. For Jari-Mari lake the hardness was 260 mg/L which is maximum and for Siddheshwar lake is 124 mg/l(Table no 3) which is minimum

Salinity: The salinity of lake water samples vary from 0.101 to 0.644mg/L (table-3).

Total alkalinity: Most of the lake waters are alkaline due to substantial amounts of dissolved carbon dioxide, bi-carbonates and hydroxides. Strong acid neutralise capacity denotes as Total Alkalinity. The alkalinity below 50mg/l indicates low

photosynthetic rate¹². Alkalinity values of water samples vary from 150 to 244 mg/L which indicates strong alkalinity. (table-3).

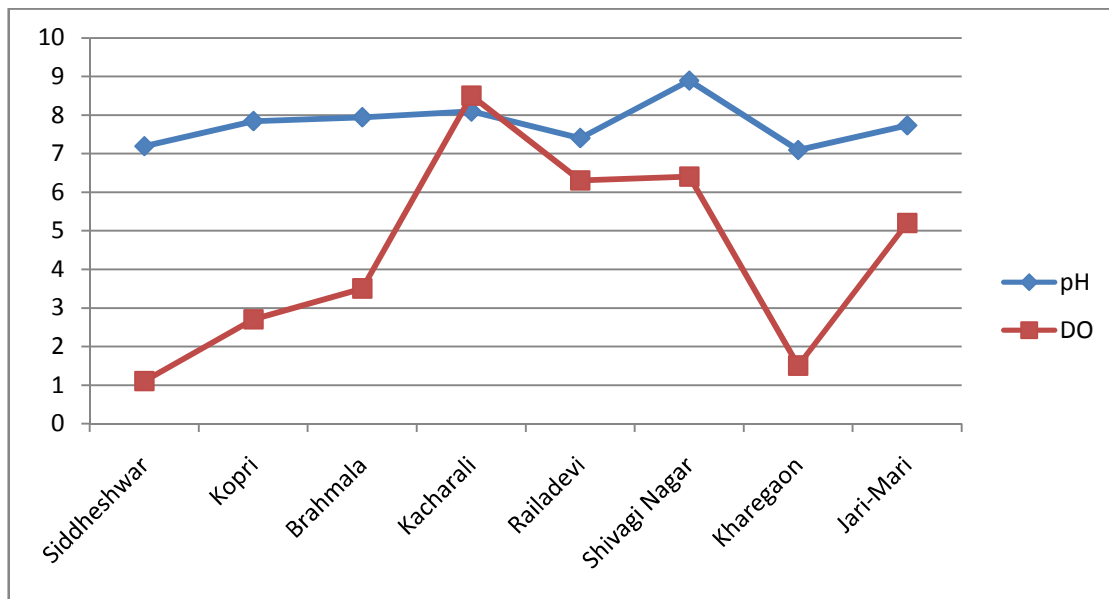


Figure-1

Variations in pH and Dissolved Oxygen of water samples collected from s1 to s8 sampling stations in the Period of March 2013 to February 2014

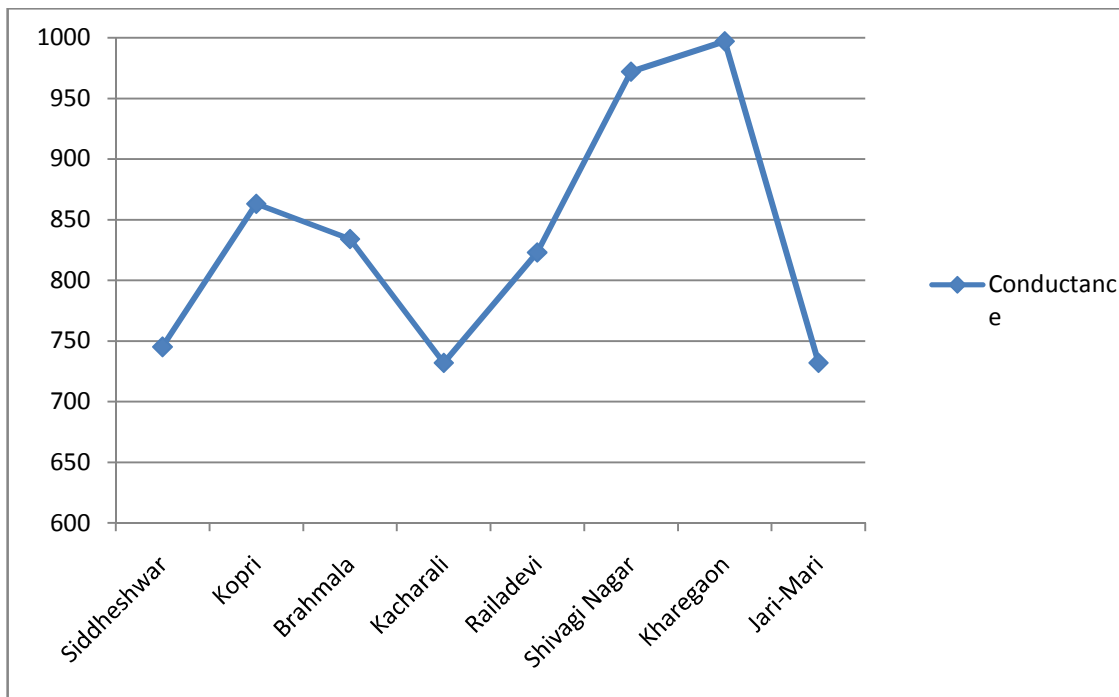


Figure-2

Variations in electrical conduction of water samples collected from s1 to s8 sampling stations in the Period of March 2013 to February 2014

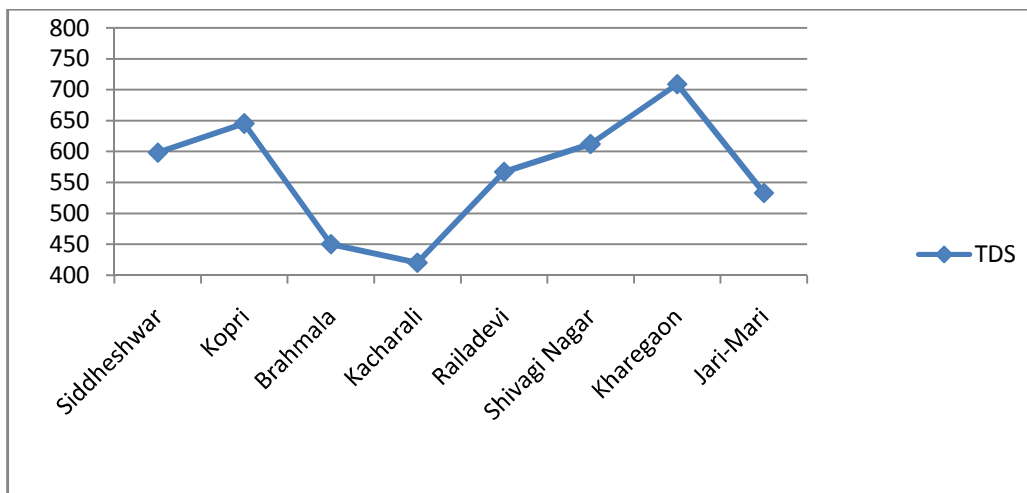


Figure-3

Variations in Total dissolved solid of water samples collected from s1 to s8 sampling stations in the Period of March 2013 to February 2014

Table-5
 Correlation matrix of physico-chemical parameters in water samples of different lakes

	pH	Conductance	TDS	DO	BOD	COD	TH	Total alkalinity	salinity
pH	1								
Conductance	0.174088	1							
TDS	-0.31774	0.673297	1						
DO	0.608003	-0.24877	-0.60857	1					
BOD	-0.66213	0.274288	0.799962	-0.90521	1				
COD	-0.72621	-0.08462	0.183876	-0.8086	0.689196	1			
TH	-0.40214	0.063941	0.197074	0.025675	0.161768	-0.00459	1		
Total alkalinity	0.675341	-0.19697	-0.60106	0.616765	-0.6779	-0.34199	-0.6276	1	
salinity	0.69491	0.564816	0.209693	0.307766	-0.19475	-0.46405	-0.36869	0.478104	1

Dissolved Oxygen: Most waste water contains more oxygen demanding material than the amount of DO available in air saturated water. Low level indicates an excessive demand on the oxygen in the water. The minimum dissolved oxygen limit for fish growth is 4.0 mg/l⁵. The lowest dissolved oxygen for maintaining fish in oxygen depletion during monsoon may be due to reduction in the photosynthetic activity.¹¹ Relatively higher values of dissolved oxygen during summer probably as a result of photosynthetic activity¹². Similar type of observation was made¹³. Lower values below 5mg/l indicating that it has higher organic matter.^{13,22} Low level of DO in Brahmala, Kopri, Siddheshwar Jail and Makhamali lake indicates large amount of pollutants present in the water body. In the present study the average DO content is vary between 1.1 mg/L to 8.5 mg/L. (table-3)

Chemical Oxygen Demand: In the present study the average COD values varies from 194 collected from water sample of Jail lake which is highest and that of kacharali lake is 22 (Table no 3) which is lowest are above the permissible limits.

Biological Oxygen Demand: In the present study, High BOD values indicate presence of large no. of organic matter which indicates a high level of pollution in lake water bodies³.

The greater the BOD, more the rapidly oxygen is depleted in the stream. This means less oxygen is available to higher forms of aquatic life. The consequences of high BOD are the same as those for low DO in which aquatic organism become stressed, suffocate, and die¹³. The BOD of Jail lake is 132 which is very high and 15 (table-3) of Kacharali lake which is low in present study which are much above the permissible limits.

Correlation Analysis: Correlation analysis shows that pH is positively correlate with electrical conductance, dissolved oxygen, total alkalinity and salinity. pH is negatively correlate with total dissolved solid, hardness, BOD and COD.

Heavy metal analysis Heavy metals are a special group of trace elements which have been shown to create definite health hazards when taken up by plants.

Copper: Copper is an essential inorganic element for living organisms, since it activates certain enzymes concerned with oxidation processes, particularly in plants. Copper in excess, however is through extensive use of fungicides, insecticides and discharge of wastes from metallurgical and ceramic industries. In the present study the average concentration of Cu in water samples vary from 0.106 to 0.267 (table-4) which is within the permissible limits of standard institution.

Iron: Iron is an essential element; its major function in the animal body is the formation of haemoglobin. But high doses are toxic and clearly detrimental to health⁴. High Fe concentration causes scaling in plumbing fixtures⁴. In the present study the average concentration of Fe in water samples vary from 0.125 to 0.346 (table-4) which is very much above the permissible limits of standard institution

Hg: Mercury is toxin and has no known function in human physiology. The average Hg was observed to be very with average value which was higher than the maximum permissible concentration of 0.001 mg/l Hg as per standard (table-4)

Arsenic: Arsenic poisoning through water can cause liver and nervous system damage, vascular diseases and also skin cancer. Arsenic poisoning has become a worldwide public health concern. The average arsenic was observed to be very with average value 0.011 (table-4) which is within the limits as per standard.

Conclusion

From the result of the studies shows that the physico-chemical quality (BOD, COD, Conductivity) of lake water sample found above the permissible limits as per the Indian standard institution. This indicates the pollution load on the lake water body. The heavy toxic metal content in water indicates that water is contaminated by heavy metal. It was observed that heavy metals like Hg, and Fe are present in relatively high concentration as compared to their permissible limits. Hence periodical monitoring of the water quality is required to assess the condition of surface water and immediate steps should be taken to improve the quality of water which will help to save the lakes getting polluted. Hence assessment and monitoring is useful parameter to check the present quality and strength of lake water.

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