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STUDY ON WATER QUALITY STATUS OF MAJOR LAKES IN VADODARA

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Abstract:- *Due to rapid increase in population, human intervention, industrialization and urbanization the problems of sewage disposal and contamination of surface water like lakes are increasing at a very high rate. The present study was carried out to examine the physico-chemical characteristics, presence of heavy metals, pesticides and phytoplankton in the water of the major lakes in Vadodara city .The lakes selected for the study are Sursagar, Harni and Gotri.*

Key Words: - *Water quality, Physico-chemical characteristics, Phytoplankton*

Introduction

Since ancient times, lakes have served as source of sweet water, which is also use for drinking purpose. Apart from this, lakes add scenic beauty to the landscape and sustain variety of flora and fauna. The increase in the population, prevalent illiteracy, increase of use of fossil fuels ,deforestation and lack of political as well as individual will to implement/adhere the laid down rules, has led to pollution of all spheres of the globe. The prominent ancient lakes of Vadodara city have also suffered degradation due to various reasons. The present paper aims to investigate the status of water quality in the major lakes across the city and identify the areas which are most affected due to the water contamination.

Study Area: Vadodara is located at latitude: 22 o 17’59 north latitude 73 o 15’18 east in western India at an elevation of 39 meters. The 18 th largest city of India with an area of 148.95km2 and 1.6 million population according to 2001 census. The city developed on the banks of Vishwamitri River and located on the fertile plain between the Mahi and Narmada rivers.
Considering the locational importance and spread three major lakes of Vadodara namely Harni, Sursagar and Gotri Lake are selected for comparative study.
Sursagarlake is in the heart of old city and has been subjected to human abuse since inception.
Gotri Lake was formerly on the out skirts of the city but now since last 50 years has seen rapid human residential colonization and is almost in the city.
Harnilake is still outside the city and has sparse human population in surrounding.

Sampling Locations: Samples were taken from the following major lakes of Vadodara city:

(1) Sursagar Lake (2) Gotri Lake (3) Harni Lake

Table 1: Salient features of the lakes:

Salient features of the lakes	**OBSERVATIONS**		
	Harni lake	**Sursagar lake**	**Gotri lake**
Location	Near Vadodara airport	Near mandvi area (core of Vadodara city)	Near Gotri village
Depth of Lake	3 to 4 Meter	9 Meter	3 to 4 Meter
Atmospheric Temperature At Sampling Time	32ºC	32ºC	36ºC

Preservation of water samples

Table 2: Sample Preservation Methods

Parameters	Preservation Method	Maximum holding period
Acidity	Refrigerate at 4°C	24h
Alkalinity	Refrigerate at 4°C	24h
BOD	Refrigerate at 4°C	6h
COD	2ml H_2SO_4/ L	7 days
Residual Cl_2	Analyze immediately	--
Colour	Refrigerate at 4°C	24h
DO	Analyze immediately or fix on site	6h
Fluoride	Not required	7 days
Metals	Acidify with $HN0_3$ to pH < 2.	6 months
NH_3-N	Analyze as soon as possible, add 2 mL 40% H_2S0_4 to pH < 2, refrigerate	24h
Nitrate	Analyze as soon as possible	--
N-Kjeldahl	Refrigerate, add H_2S0_4 to pH < 2	7 days
Phosphorous	40 mg HgCI/L, refrigerates at 4°C	24h
Sulphides	Refrigerate, add 2 mL 2N zinc acetate/100 mL; add NaOH to pH> 9,	7 days
Sulphate	Refrigerate at 4°C	7 days
Turbidity	Refrigerate at 4°C	--
Phytoplankton	Sample to be taken between 10:00 to 12:00 AM. Add 10 ml Lugol's Iodine / 1L sample	24h

Materials and Methods

Table 3: The below table shows the method and equipment of selected parameters.

PARAMETER	METHOD	EQUIPMENT
pH	Electrometric	pH
Conductivity	Electrometric	Conductivity meter
TDS	Filtration and evaporation at 105^oC	Hot Air Oven
TSS	Filtration and evaporation at 180^oC	Hot Air Oven
Sodium	Flame emission	Flame Photometer
Potassium	Flame emission	Flame Photometer
Total hardness(Ca & Mg)	Complexometric titration	-
Acidity	Acid-base titration	-
Alkalinity	Acid-base titration	-
Chloride	Argentometric titration	-
Fluoride	SPADNS spectrophotometric method	Spectrophotometer
Sulphate	Turbiditimetric/$BaCl_2$ method	Spectrophotometer
Nitrate-Nitrogen	Chromatotrophic acid method	Spectrophotometer
Nitrite-Nitrogen	NEDA	Spectrophotometer
Phosphate	Stannous chloride method	Spectrophotometer
Ammonical Nitrogen	Nessler's method	Spectrophotometer
Chemical Oxygen Demand(COD)	Digestion followed by titration with FAS	COD Digester
Presence of plankton	Sedgwick-Rafter (S-R) Cell Method	Light microscope

Compilation of results

Table 4:

Sample observations									
	Harni Lake			**Sursagar Lake**			**Gotri Lake**		
Parameter	2017-18	2016-17	2015-16	2017-18	2016-17	2015-16	2017-18	2016-17	2015-16
Odour	Fishy	U/O	NA	Pungent	Pungent	NA	Fishy	Fishy	NA
Temperature (°C)	28.5	24	29.6	28.8	24	29.3	28.3	26	29.7
Conductivity (µs)	1720	1553	590	3656	865	2127	1254	1016	960
pH (pH unit)	8.54	8.64	7.45	7.73	7.61	7.38	8.65	9.26	7.62
Turbidity	3.9	1.7	4.5	21.9	6.7	23.3	15.8	15.6	9.6
Acidity (mg/L)	8.5	4	10	19.7	14	20	10.6	2	10
Alkalinity (mg/L)	242	212	250	248	210	160	365	344	200
Calcium hardness (mg/L)	115.8	94.5	69	710	1197	145	137	105	106
Magnesium hardness (mg/L)	240.2	65.5	21	577	223	143	156	91	174
Total hardness (mg/L)	320	160	260	1287	1420	950	293	196	280
Total suspended solids (mg/L)	12.3	6.25	14	35.4	28.7	10	42.8	46.2	15
Total dissolved solids (mg/L)	1036	910	352	2852	2854	1524	815	616	628
Total solids (mg/L)	1053	916.25	366	3092	2882.7	1534	920	662.2	643
Sulphate (mg/L)	185	181.39	106	1615	1543.4	727	207	57.83	231
Phosphate (mg/L)	0.015	0	0.006	0.045	0.034	0.016	0.535	0.433	0.025
Sulphide (mg/L)	0.201	0.192	NA	0.36	0.208	NA	0.387	0.336	NA
Chloride (mg/L)	301	266	114	137	85.505	105	188	171	146
Fluoride (mg/L)	1.65	1.87	0.43	3.85	4.08	0.73	1.54	1.61	0.93
BOD (mg/L)	19.5	10.5	22	28.5	12.4	26	21.7	24.5	7
DO mg/L	7.8	8.7	5.7	4.4	3.7	6.8	3.8	2.5	6
COD (mg/L)	82.5	60.86	72	115.8	84.37	80	125	151.7	35
Na+ Concentration (mg/L)	215	282.4	86.4	203	192	132.6	186	170.2	163.4
K+ Concentration (mg/L)	11.2	10.5	9.7	87.7	89.5	64.9	17.9	8.2	11.9
TKN (mg/L)	3.2	2.8	3.5	42.2	39.2	37.7	13.6	42	28.5
Ammonical nitrogen (mg/L)	0.85	0.46	0.55	3.3	1.32	1.25	5.1	5.09	6.3
Nitrate (mg/L)	0.52	0.45	<0.1	0.86	0.31	<0.1	0.76	0.47	<0.1
Lead(Pb) (mg/L)	0.0124	0.0198	0.03	0.055	0.0462	0.06	0.044	0.05	0.05
Iron(Fe) (mg/L)	0.016	0.0231	0.01	0.23	0.376	0.16	0.312	0.01	0.01
Cadmium(Cd) (mg/L)	BDL	BDL	0.001	BDL	BDL	0.001	BDL	0.001	<0.001
Nickle (Ni) (mg/L)	BDL	BDL	0.009	BDL	BDL	0.053	BDL	0.041	0.041
Zinc(Zn) (mg/L)	0.0475	0.0379	0.013	0.056	0.0438	0.023	0.2234	0.015	0.015
Manganese(Mn) (mg/L)	0.0546	0.0798	0.014	0.343	0.2642	0.041	0.2799	0.022	0.022

Note-BDL-Below detectable limit, NA- Not analyzed

Pesticide analysis:

Table 5: Presence of pesticides

Pesticides	Harni Lake	Sursagar Lake	Gotri Lake
α – BHC	ND	ND	ND
β – BHC	ND	ND	ND
γ – BHC	ND	ND	ND
Aldrin	ND	ND	ND
α – endosulfan	ND	ND	ND
Dicldrin	ND	ND	ND
β – endosulfan	ND	ND	ND
2-4 , DDT	ND	ND	ND

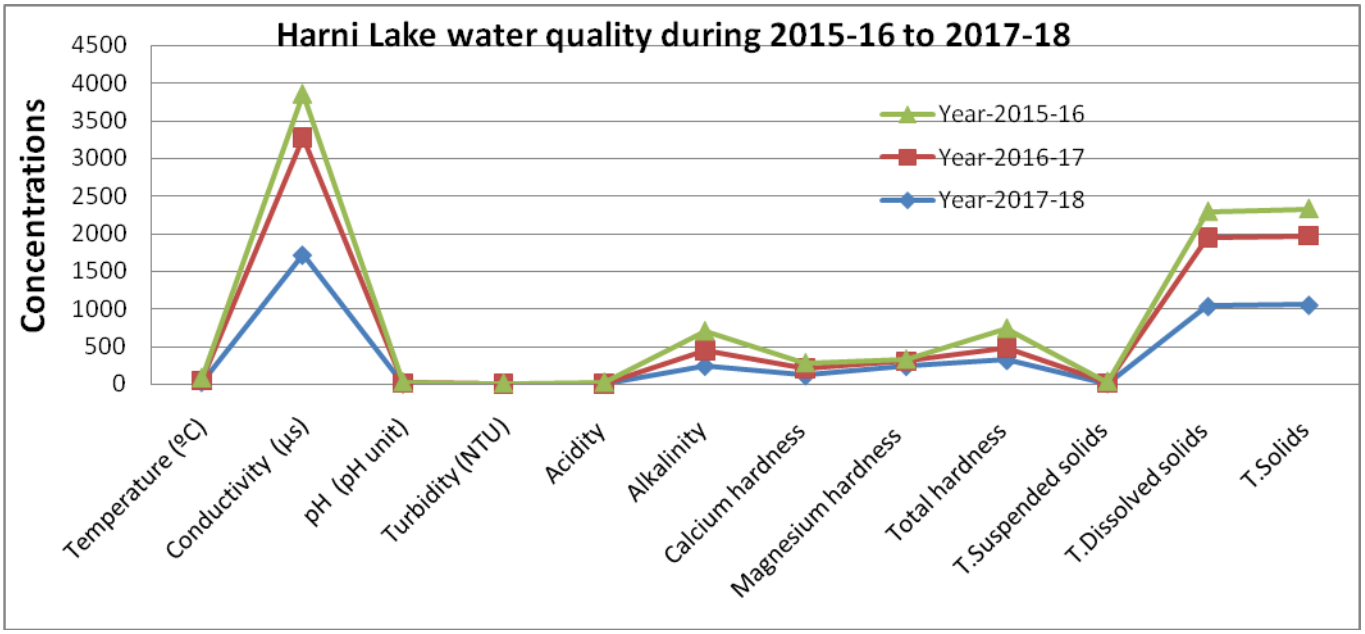
ND (not detected)

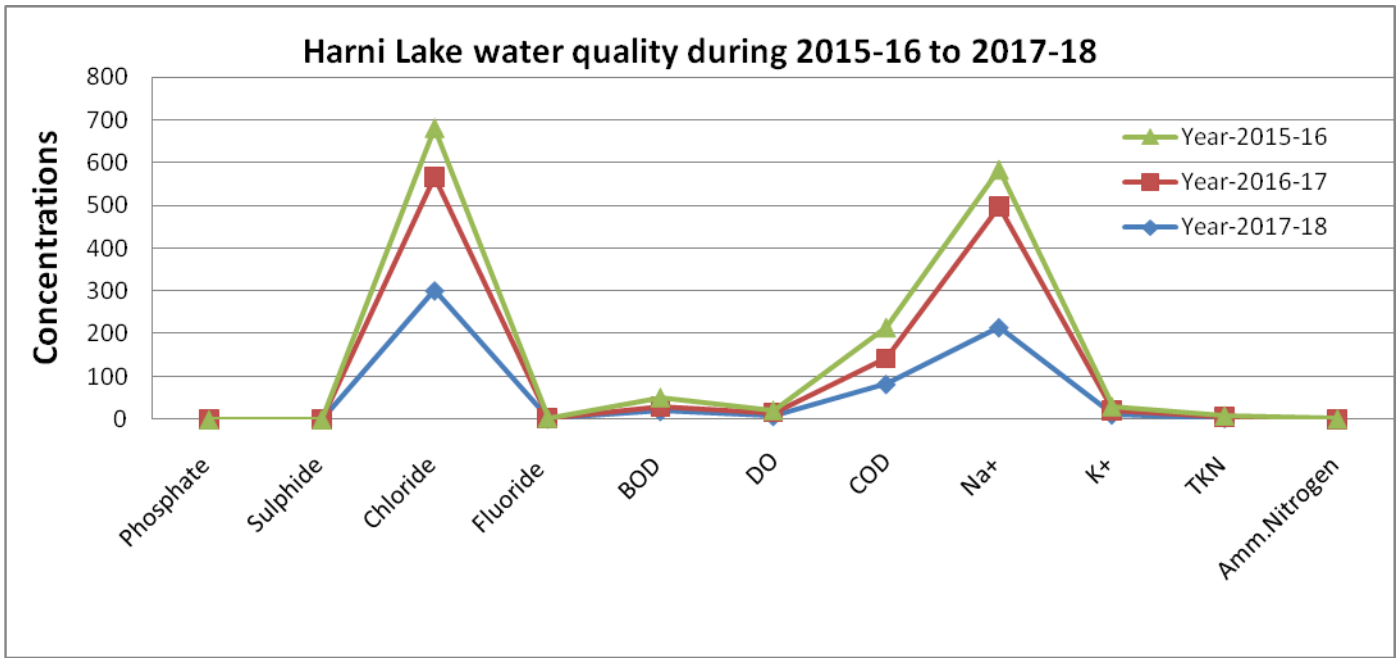
Biological Analysis:

Table 6 : Observed Phytoplankton Species

HARNI LAKE	SURSAGAR LAKE	GOTRI LAKE
Cryptomonas	Cryptomonas	Cryptomonas
Mallomonas	Euglena	Mallomonas
Merismopedia	Gomphonema	Monoraphidium sp.
NaviculaBory	Mallomonas	Nitzschia
Nitzschia	Nitzschia	
Pleurosigma	Oscillatoria	
	Synedra	

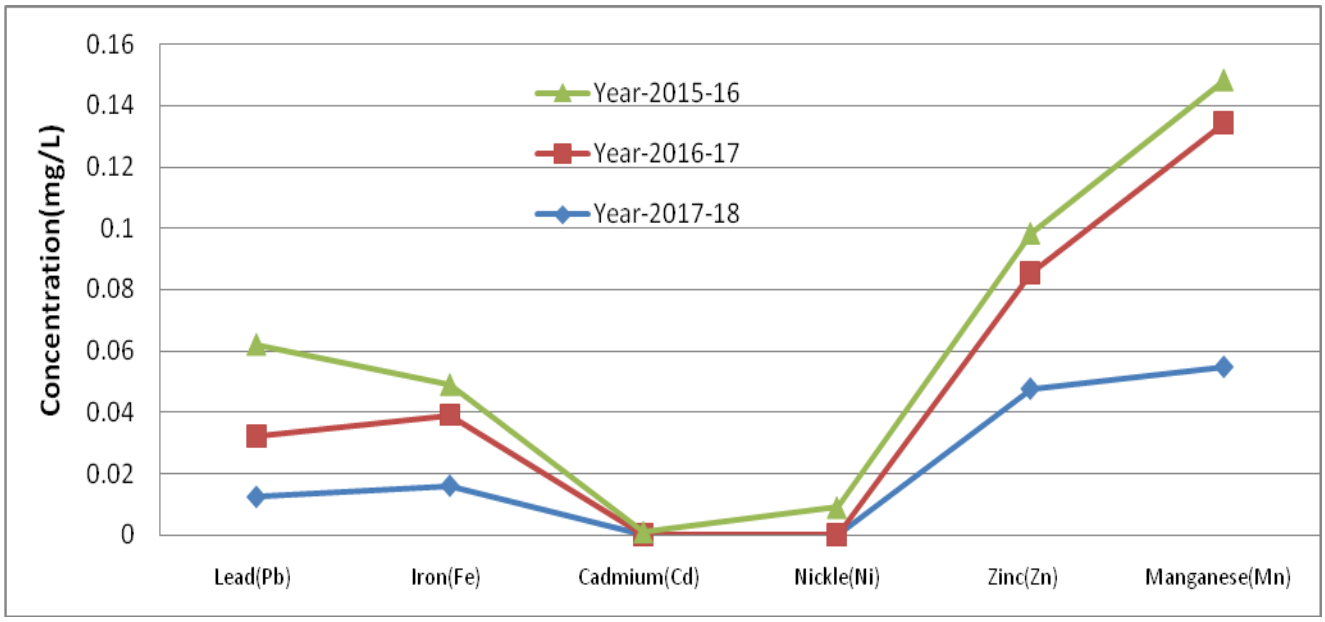
Results and Discussion:



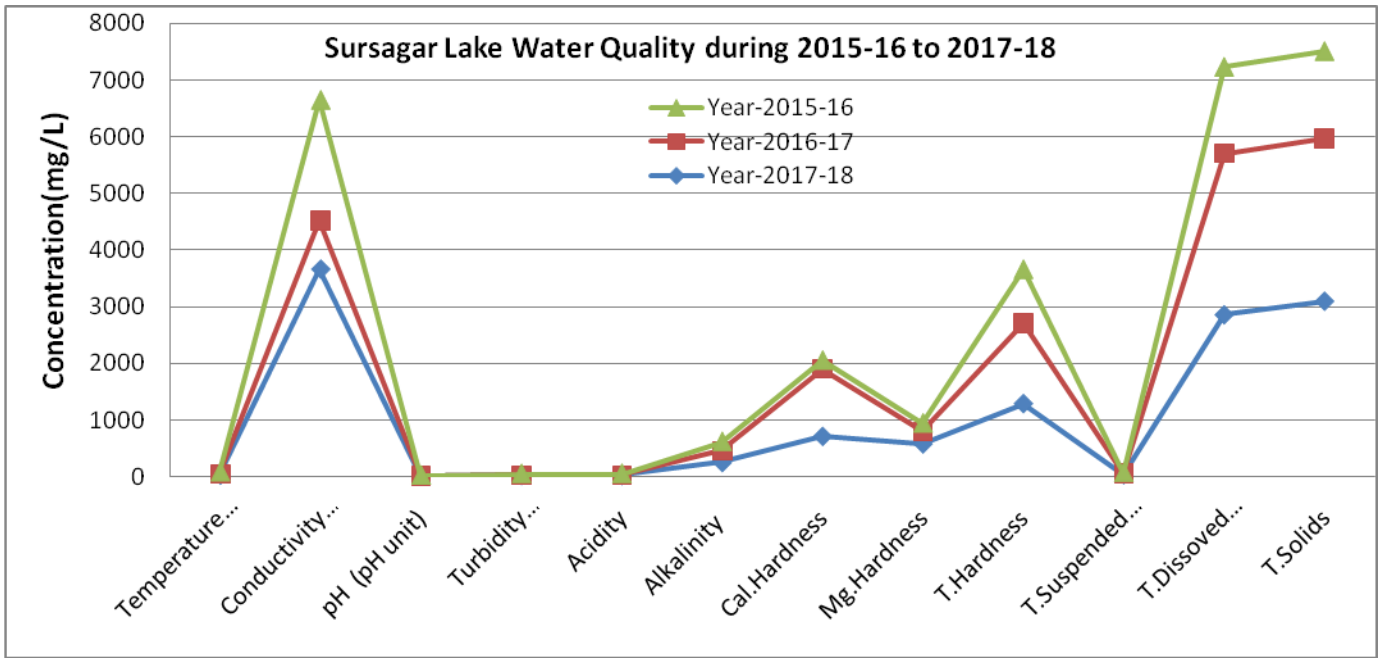


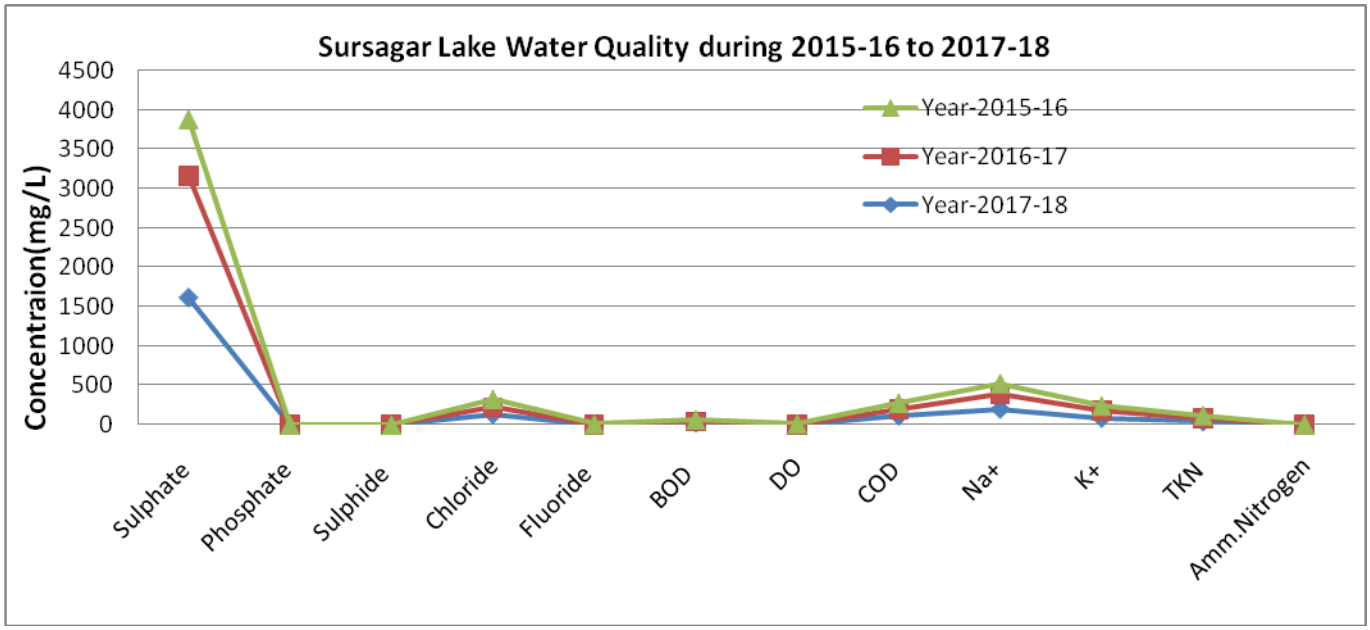
The above graph shows the annual variations in physico-chemicals parameters of the water quality in Harni Lake during 2015-16 to 2017-18.

Trace Metals in Harni Lake during 2015-16 to 2017-18



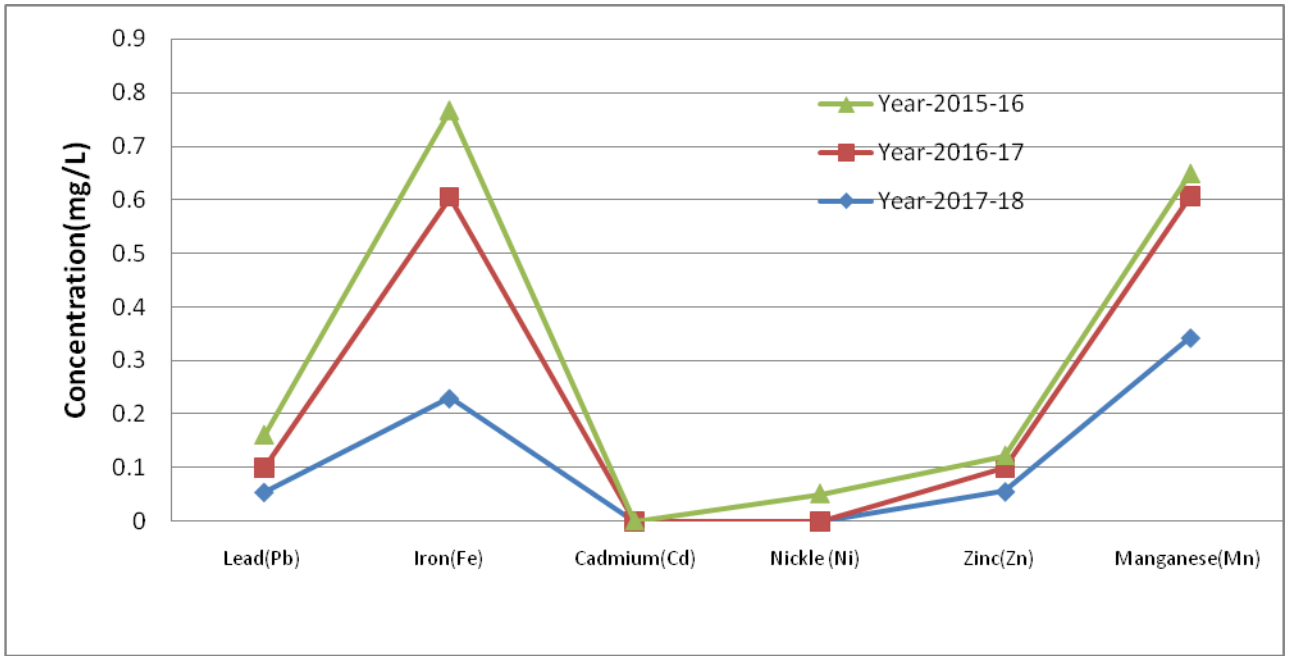
The above graph shows the annual variations of trace metals in Harni Lake during 2015-16 to 2017-18



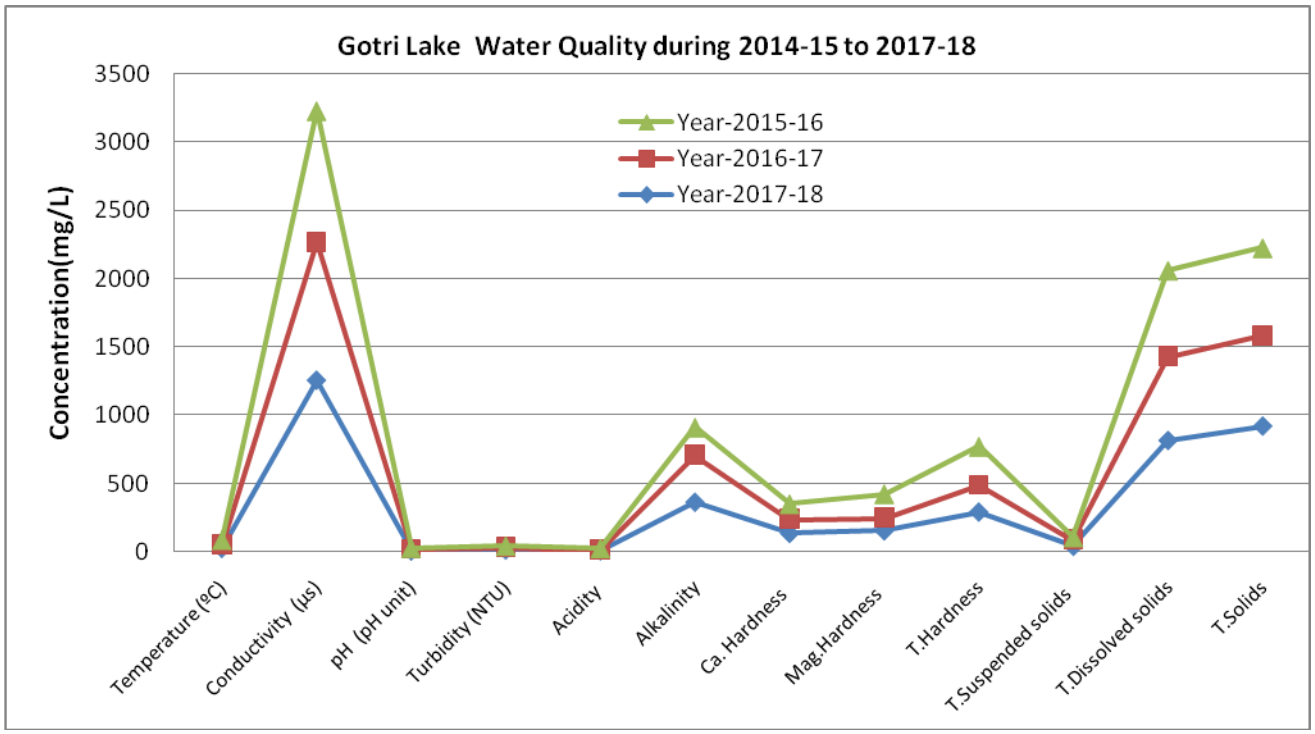


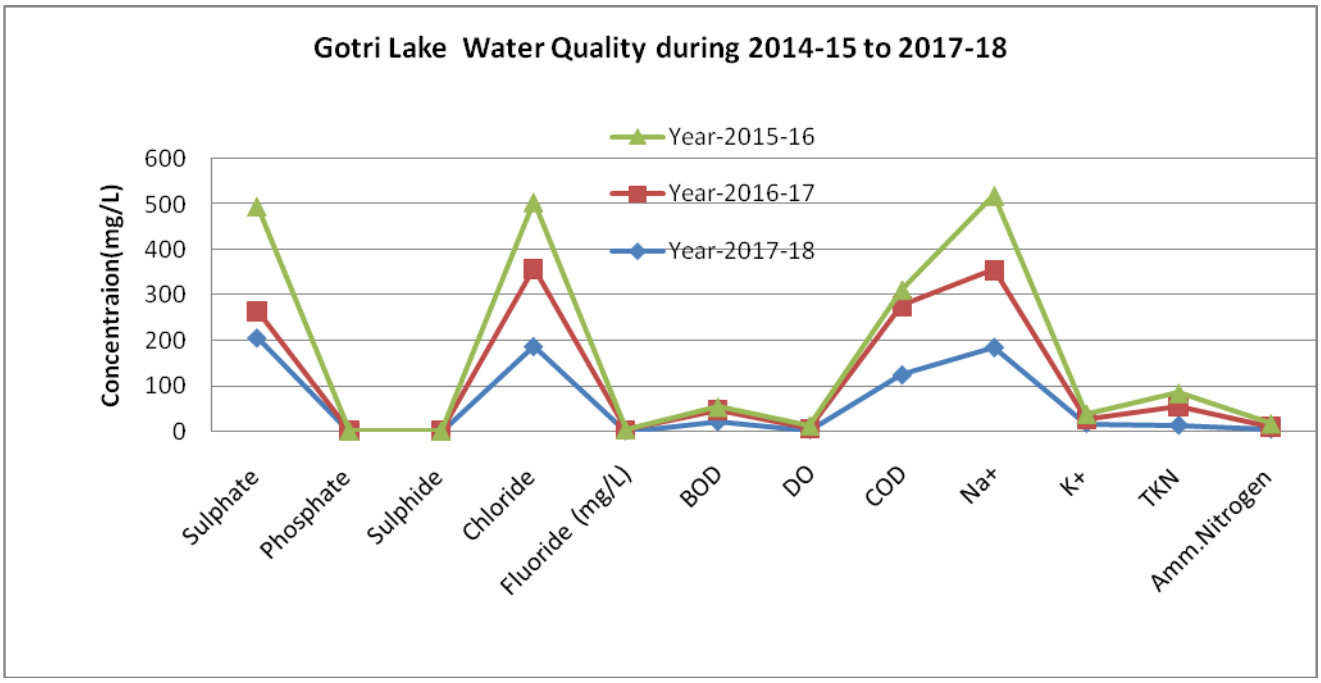
The above graphs shows the annual variations in physico-chemicals parameters of the water quality in Sursagar Lake during 2015-16 to 2017-18

Trace Metals in Sursagar Lake during 2015-16 to 2017-18



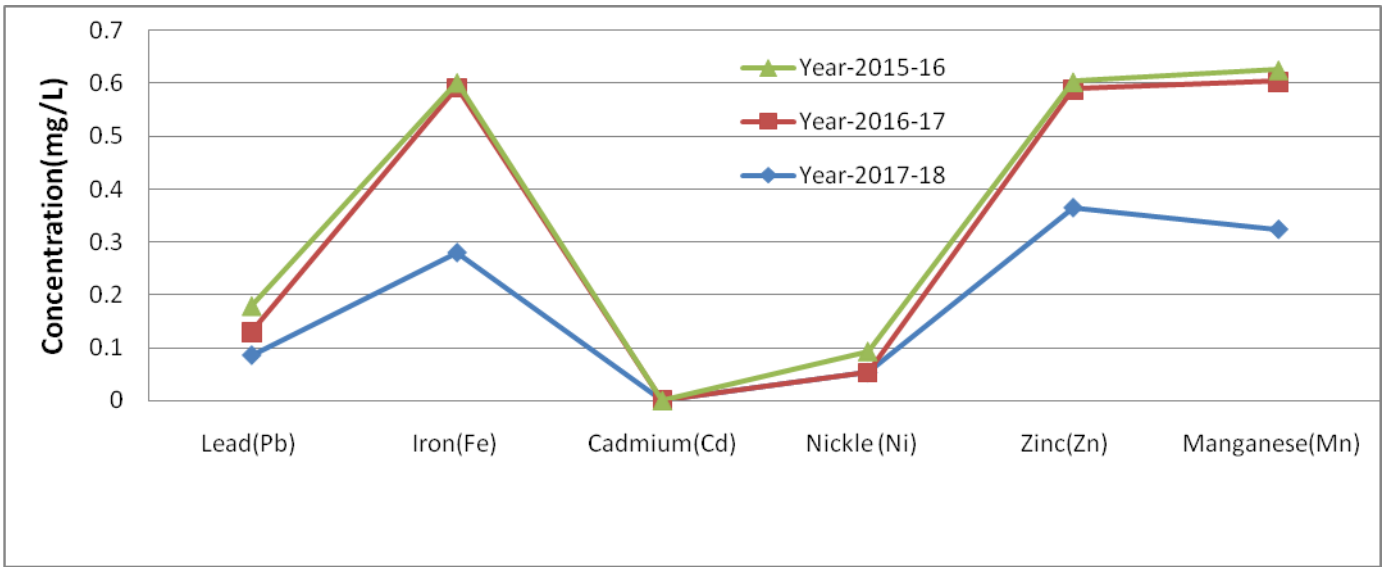
The above graph shows the annual variations of trace metals in Sursagar Lake during 2015-16 to 2017-18





The above graphs shows the annual variations in physico-chemicals parameters of the water quality in Gotri Lake during 2015-16 to 2017-18

Trace Metals in Gotri Lake during 2015-16 to 2017-18



In the present investigation, we reviewed that due to presence of impurities in the lake, the value of physico-chemicals parameters like Conductivity, Solids, Total Hardness, Calcium Hardness Magnesium Hardness, Chlorides, BOD, COD and TKN are increasing during the last three year. The trace metals like Lead, Iron, Zinc and Manganese are also increasing. So this kind of changes would affect the aquatic environment as increase in nitrogen content would result in eutrophication naturally which leads to decrease in the oxygen level. The phytoplankton like Cryptomonas, Gompjonema, Euglena, Mallomonas, Oscilettoria, Nitzschia and Pleurosigma species present in the lakes. The presence of available phytoplankton indicates and green surface over the water indicates the lakes are fully rich of nutrients and eutrophication is there. The analyzed pesticides are not found in all the lakes is indicates there are no agricultural lands discharges meeting into the lakes. The physico-chemicals changes and presence of some toxic metals in all the samples of lakes shows the waste water runoff from the city is meeting into the lakes which is coming during monsoon seasons and washes from motor garages. The open

defecations and washing of cloths near the lakes also observed during the collection of samples, which is increasing the pollutants levels in lakes. The water level is decreasing gradually in all the lakes due to low rains and improper provisions to store rain waters in the lakes.

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