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Research Article

INFLUENCE OF LAND USE PRACTICES ON THE QUALITY OF RECEIVING WATER BODY - A CASE STUDY OF HUSSAIN SAGAR LAKE

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ABSTRACT
Land use practices in the catchment area have a great impact on the quality of receiving water body. Lakes and streams located in and around areas are more prone to contamination due to rapid industrialization and urbanization within their catchment. This paper aims to explain the water pollution caused by different land use practices in the catchment area over a period of time and its influence on Hussain Sagar Lake located in the heart of Hyderabad city.
Water samples from four incoming nullahs, sixteen locations in the lake and two outlets have been collected and analyzed for key parameters of water quality and compared with the water quality tests carried out by several agencies/researchers in frequent intervals since 1977. It is observed from the results that the quality of lake water deteriorated over a period of time with the increase of human activities in the catchment area. It is further observed that Kukatpally nullah is the major source of industrial effluent and diversion of this nullah along with Picket nullah to downstream result in decrease of dissolved pollutants marginally. Pollutant concentrations in the inlet nullahs are very high when compared to lake water indicating accumulation of pollutants in the lake bed in the form of sediments causing potential threat to the surrounding ground water.

Key Words: *Lake Water, BOD, COD, Water Quality, Physicochemical Parameters*

INTRODUCTION
Hussain Sagar Lake is a manmade reservoir constructed in the year 1562 AD with a water spread area of 5.7 Sq.Km and catchment area of 240 Sq.Km. The volume of the lake is 28.6 M.cum with a shore line length of 14 Km and average depth of 5 m at full reservoir level. The water spread area in the dry season reduces to 3.1 Sq. Km.
Land use practices in the catchment area is divided in to Class I built up area with 90 Sq.Km, Class II built up area with 68 Sq.Km, Scrub forest with 18 Sq.Km, Crop land with 12.5 Sq.Km, Land with scrub with 35 Sq.Km, Land without scrub 8.5 Sq.Km and Water bodies with 8 Sq.Km. The catchment area map of Hussain Sagar Lake is shown in Fig.1
Lake water pollution poses one of the most serious environmental problems of modern times. Though this lake was originally built for irrigational purposes and provision of drinking water, at present it is only used for recreational purposes. The lake has now become dumping ground for various industrial and domestic waste waters. The lake is fed by four major nullahs viz., Kukatpally, Picket, Banjara and Balkapur Nullahs, the former two joining from the North West and North East respectively.
The Kukatpally nullah starts at the reservoir Parkichuru and has a length of 12.5 km before it joins the lake. Out of 240 Sq.Km of lakes catchment, Kukatpally nullah contributes a major share of 168 Sq.Km. It passes through Kukatpally and Sanathnagar industrial estates and at Fathenagar, North of Begumpet Airport, it joins wastewater originating from the industrial development areas, Jeedimetla and Balanagar. The discharge of industrial wastes from 102 polluting units and 726 non-polluting units of these industrial estates finds its way into the Kukatpally nullah. Apart from industrial effluent, it also carries domestic effluent from surrounding colonies. The Picket nullah has a catchments area of 7.779 Sq.Km. in northern and northwestern direction. This nullah carries surface run off during monsoon and sewage from residential colonies. Banjara Nullah also carries domestic effluent along with surface run off during monsoon. The Balkapur nullah is the historical primary feeder channel of Hussain Sagar. It is the only connection between river Musi in the upstream side and it carries domestic effluent.

Important limnological studies on Hussain Sagar lake have been conducted during 1998 (Reddy *et al.*, 1998), 2004 (Rao *et al.*, 2008), 2005 (Suneela *et al.*, 2008), 2007 (Chandrasekhar *et al.*, 2007), 2011 (Sulekh Chandra etal, 2012) and these studies have shown progressive deterioration in the quality of lake water. In 1992 EPTRI has estimated an inflow of settleable solids with the concentration of 280 mg/l in dry weather inflow of 25.73 M.Cum / year, the maximum siltation would be 3602 tons per year assuming only 50% of the solids are settled and the study further added that there is an inflow of 18 tons and 70 tons of phosphorus and nitrogen along with settleable solids.

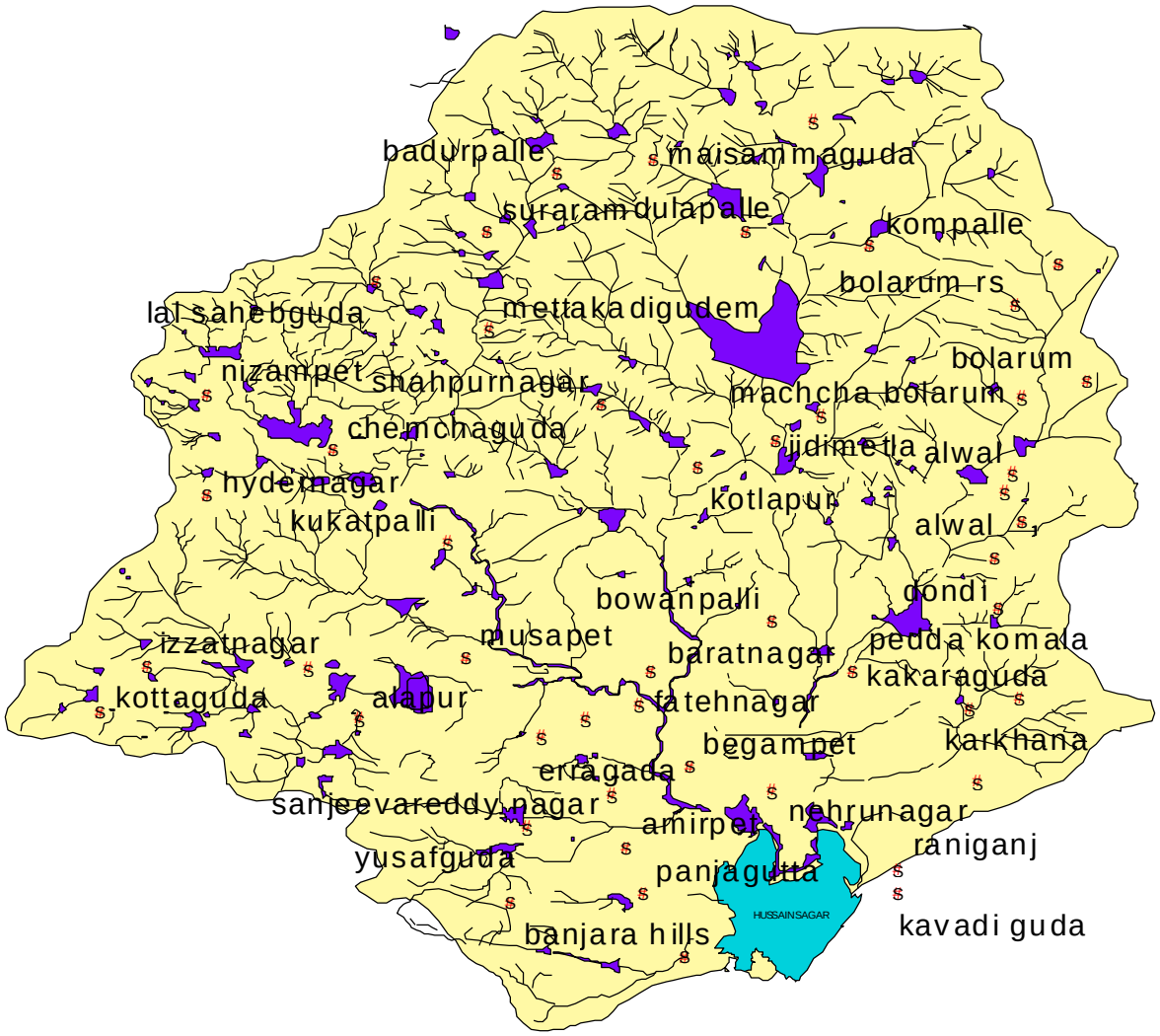


Figure 1: Catchment Area of Hussainsagar Lake

The studies conducted on the lake reveled that there has been considerable increase of contamination level since past four decades and accumulation of pollutants in the lake bed in the form of sediments pose a potential threat of contributing pollution load to the surrounding ground water.

MATERIALS AND METHODS

In the present paper an effort is made to analyze change in the water quality of lake over a period of time since 1977. Water samples from four Inlet nullahs, sixteen locations in the lake and two outlets have been collected and analysed as part of research project sponsored by All India Council for Technical Education (AICTE). The sampling locations of lake and nallas are shown in Figure 2, Sample collection, preservation; Physico-chemical analysis was carried out as per standard methods (APHA, 1998 and US EPA SW-846) at Environmental Engineering Laboratory of CBIT.

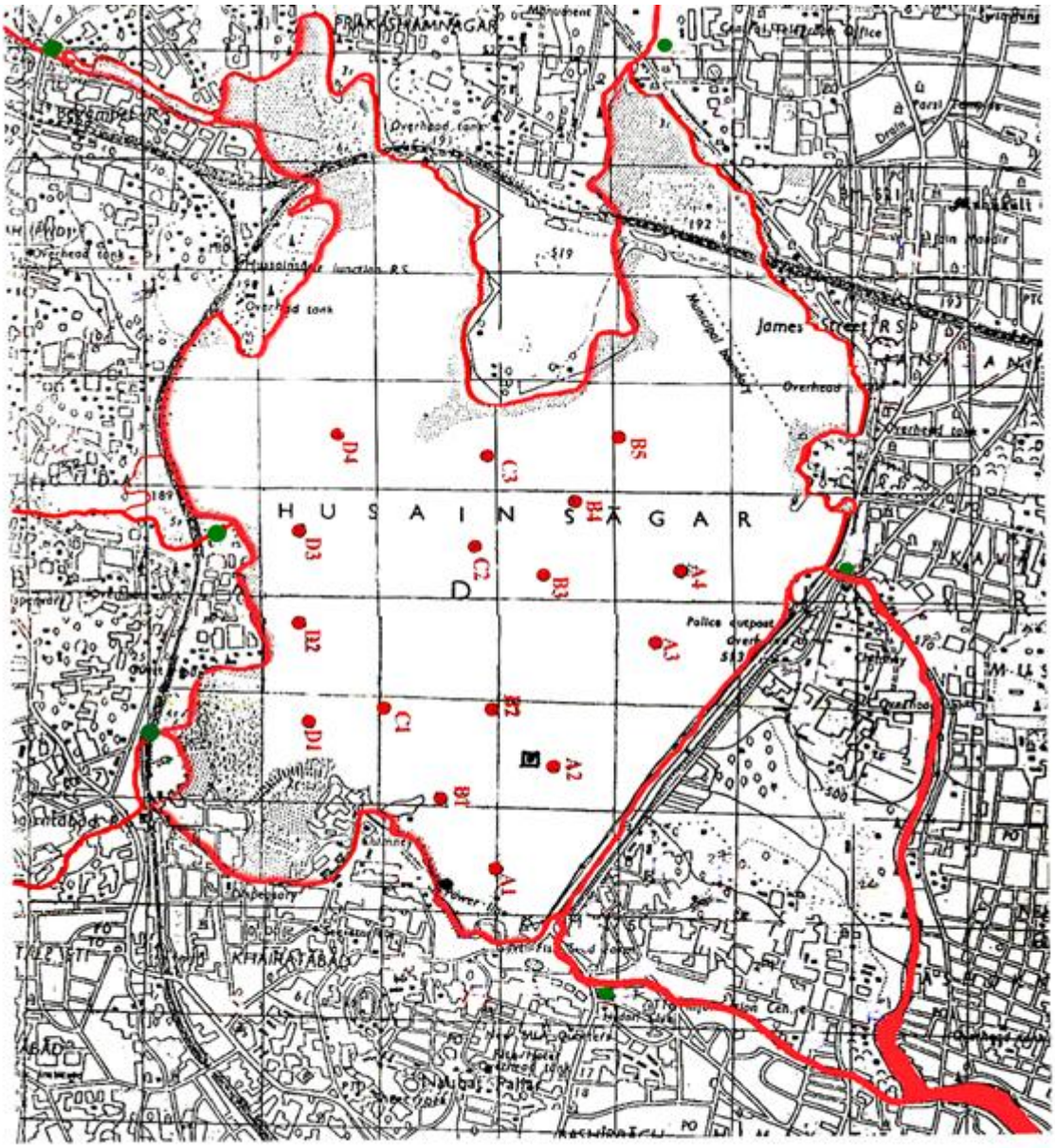


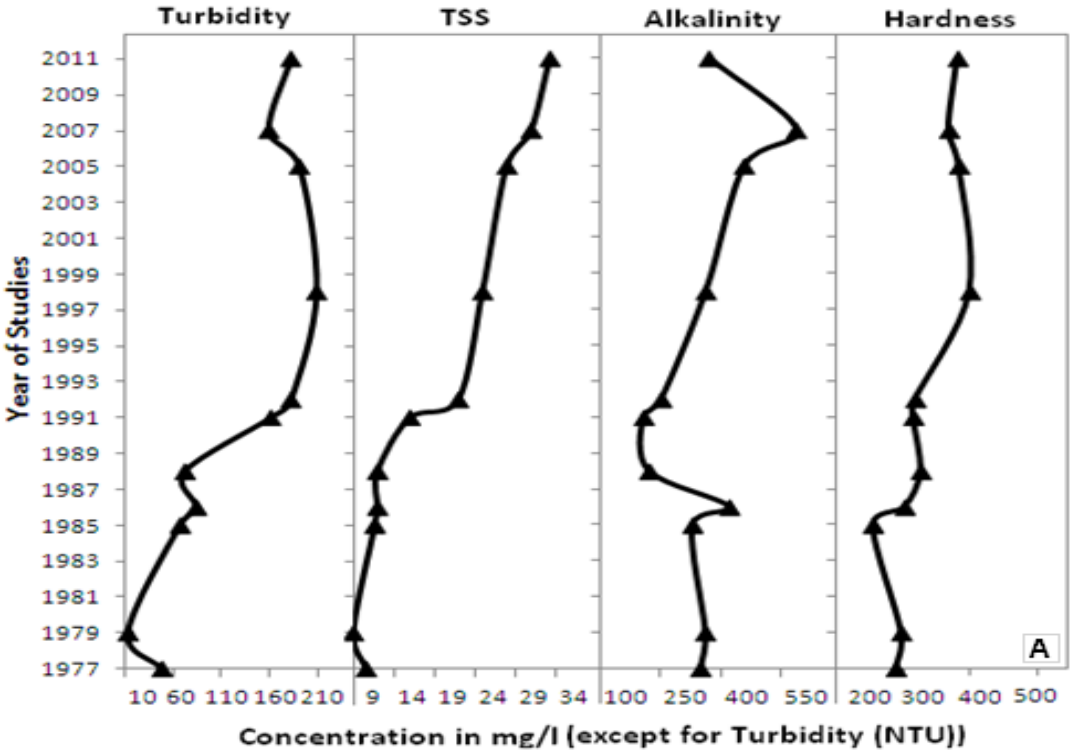
Figure 2: Water Sampling Location in Hussainsagar Lake, Inlet and Outlet Nullahs

These experimental results were compared with the results carried out in the frequent intervals from 1977 by several organizations and researchers.

RESULTS AND DISCUSSION

The mean values of water quality parameters of the lake was analyzed for all the sixteen samples collected from various locations of the lake was analyzed and compared with the analytical results conducted in different years and are listed in Table 1. The pH value ranges from 7.1 to 9.3 over a period of 35 years. There is a gradual increase of EC from 1157 µmhos/cm in 1977 to a maximum of 3780 µmhos/cm in 1986 and the value at present 1120 µmhos/cm, which is lowest among the results. There is a gradual increase in Turbidity from 12.5 NTU in 1979 to 183 in the recent analysis. There is an increase in TSS concentration from 9 to 33.33 mg/l. TDS value increases form 935 mg/l in 1977 to 1242 in 2007 and at present the value is as low as 281 mg/l. Alkalinity and Sulphates ranges from 206

mg/l to 587 mg/l and from 75.6 mg/l to 159.2 mg/l respectively indicating neither increasing nor decreasing trend over a period of 35 years. Chlorides concentration shows steady growth from 166 mg/l in 1977 to 390 mg/l in 2007. Total hardness increases from 288 mg/l in 1977 to 380 in 2011. The nutrients Total nitrogen and phosphorus values increases from 0.37 mg/l to 13.7 mg/l and 1.05 mg/l to 13.6 mg/l respectively from 1977 to 2007. The COD concentration increases from 81.33 mg/l in 1985 to 237 mg/l in 2007 and corresponding levels of BOD increases from 30.33 mg/l to 85 mg/l in the same period. Graphical representation of variation in concentrations of Physico-chemical parameters is given in Figure 3.



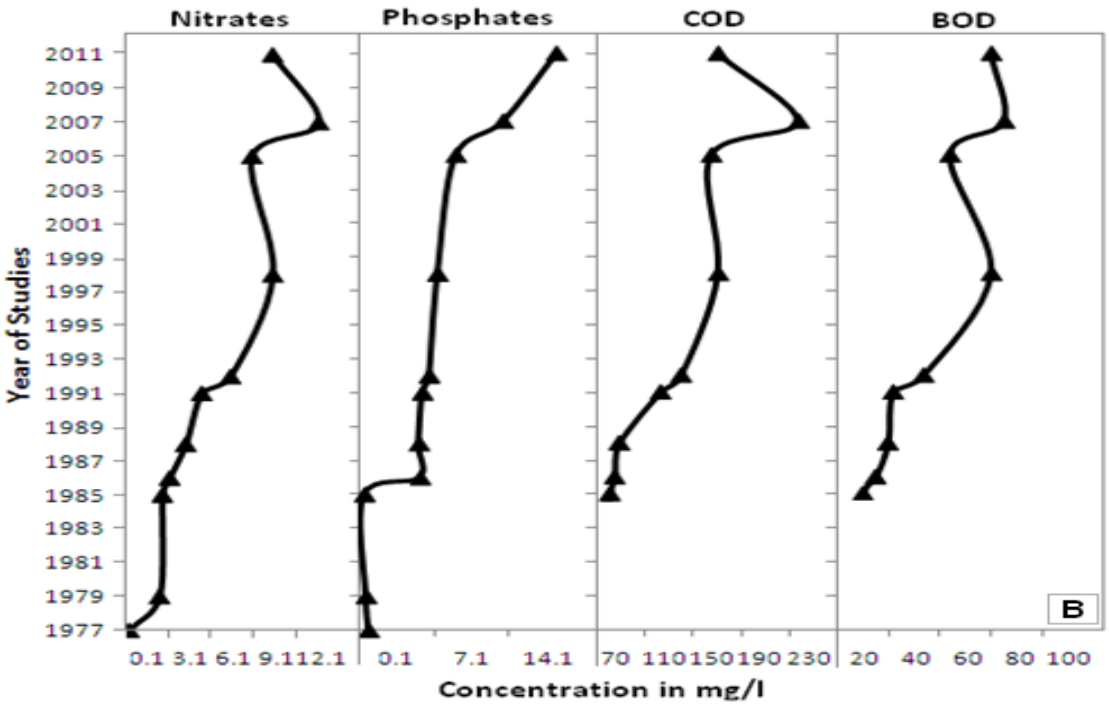


Table 1: Physico-Chemical Characteristics of Hussain Sagar Lake during the different Surveys

S. No	Parameters	Year of Studies										
		1977	**1979**	**1985**	**1986**	**1988**	**1991**	**1992**	**1998**	**2005**	**2007**	**2011**
1	pH	8.7	8.1	7.1	8	7.5	8	8	7.4	9.3	7.56	8
2	Electronic Conductivity (µmho's/cm)	1567	2314	2687	3780	3310	1899	2310	1516	1480	2133	2156
3	Turbidity (NTU)	48	12.5	67	84	72	162	183	210	192	160	183
4	Total Suspended Solids (mg/l)	10.6	9	11.67	12	12	16	22	25	28	31	33.33
5	Total Dissolved Solids (mg/l)	935	1254	1363.33	1023	1352	1234	1037	974	1134	1242	281.33
6	Alkalinity (mg/l)	347.8	360	328	420	220	206	250	361	457	587	369
7	Chlorides (mg/l)	166.2	183	263.3	390	260	201	245	293	312	390	244
8	Total Hardness (mg/l)	288	296	254	301	325	314	317	398	382	367	380
9	Nitrates (mg/l)	0.37	2.5	2.7	3.22	4.35	5.48	7.5	10.47	9	13.7	10.47
10	Sulphates (mg/l)	117	108	137.3	159.2	120	137.9	90	75.6	92.58	136	75.6
12	Phosphates (mg/l)	1.05	0.82	0.66	5.85	5.75	6.08	6.7	7.5	9.2	13.6	0.22
13	Chemical Oxygen Demand (mg/l)	-	-	81.33	85.2	89	123	140	170.67	165	237	170.67
14	Biological Oxygen Demand (mg/l)	-	-	30.33	35.2	40	42	53.75	80	64	85	80

Table 2: Analysis of Samples Collected from the four Nullahs and the Lake

S. No	Parameters	Kukatpally Nullah	Balkapur Nullah	Banjara Nullah	Picket Nullah	Hussain Sagar Lake
1	pH	7.3	7.8	6.9	7.2	8
2	Alkalinity (mg/l)	556	432	480	560	369.3
3	Sulphates (mg/l)	67	38	26	80	75.6
4	Chlorides (mg/l)	148	112	256	160	244
5	Nitrates (mg/l)	85	40	35	60	10.47
6	Chemical Oxygen Demand (mg/l)	1120	496	560	1008	170.67
7	Biological Oxygen Demand (mg/l)	373.3	235	225	270	80
8	Total Suspended Solids (mg/l)	490	340	150	540	33.33
9	Temperature (°C)	26	26	28	25	27.6
10	Total Dissolved Solids (mg/l)	133	205	239	225	281.33
11	Oil and Grease	16	20	30	30	68
12	Phosphates (mg/l)	0.125	0.019	0.18	0.125	0.22

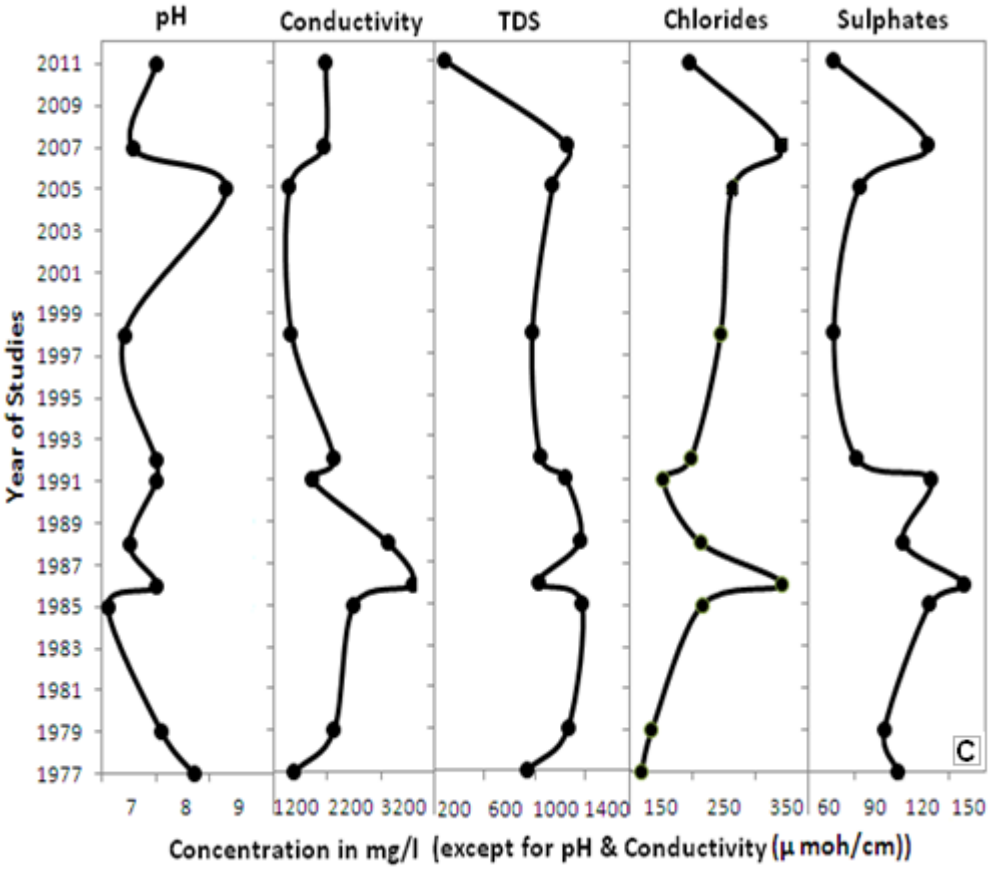


Figure 3: Variation in Physico-Chemical Parameters of Hussain Sagar Lake water during different years, A, B- Pollutants with increasing Trend. C- Pollutants with Random Trend

All the water quality parameters discussed above shows steady growth from 1977 to 2007 except Alkalinity and Sulphates showing uneven concentrations over the period under consideration. The increasing trend of pollutant concentration indicates increased human activities in the catchment area.
Analytical results of water quality of four incoming nullahs and mean values of water quality of lake are shown separately to highlight the difference in concentrations of various parameters between incoming water and lake water are listed in Table 2. Concentrations of TSS, COD, BOD, Nitrogen and Alkalinity are higher in the incoming nullahs and considerably low in the lake water indicating settlement of these pollutants in the form of sediments as the water body acts as a settling basin. The concentrations of TDS, Sulphates, and Chlorides are marginally lower in the incoming nullahs than lake indicating non-settleable nature of dissolved solids. The concentration of Phosphorus is marginally higher in lake than incoming water indicates growth of aquatic plants on water surface of lake. Concentration of Oil and Grease is much higher in lake than in incoming nullahs and is attributed to the floating nature of pollutant.

Conclusion

The study on water quality parameters of incoming nullahs and lake water indicates a steady growth of pollutant levels over a period of time indicating increased human activity in the catchment area and the measures undertook to abate pollution of the lake are inadequate. Further to this the lake acts as a sink for the pollutants entering through incoming nullahs. Pollutants in the form of lake sediments pose a threat to the surrounding ground water as there is a chance of leaching through the aquifer.

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