

Water Quality Studies of Kolleru Lake, Upputeru River and Enamaduru Drain

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Lakes are usually an integral part of a drainage basin. Lakes are either fresh water or salt water lakes. Kolleru lake is the largest freshwater lake in south India. Various physical and chemical inputs manifested through the hydrology of the catchment area will affect the quality and quantity of lake water. In the present study, an attempt was made to analyse the physical and chemical load of Kolleru lake, Upputeru river and Enamaduru drain joining into Upputeru. Emphasis was laid on studying some of the important chemical parameters, which are deemed to influence and have adverse impact on the biota of the lake. In author's opinion, this study is the first of its kind covering quality aspects of this fragile Kolleru lake, Upputeru river and Enamaduru drain.

KEYWORD

Water quality, Kolleru lake, Upputeru river, Enamaduru drain.

INTRODUCTION

The Indian fresh waters were under considerable threat owing to the fast pace of development, the country is undergoing in the past one (or) 2 decades. Although rivers are most important water resources in India, fresh water lakes are also very important. People use the stagnant water bodies in the form of lakes for various purposes, like drinking, irrigation, fisheries, washing, etc. The physico-chemical and biological characters of water depend upon several factors including location of water bodies, quantity of sewage and domestic waste being disposed, localised human population and their activities. The enrichment of nutrients occurs due to disposal of domestic and industrial effluents, which support the growth of variety of microphytic vegetation and microbes in the aquatic system. The present paper attempts to analyze the physico-chemical and biological characteristics of Kolleru lake, its out flows through Upputeru river and Enamaduru drain joining into Upputeru river. The water quality is influenced by prevailing environmental conditions.

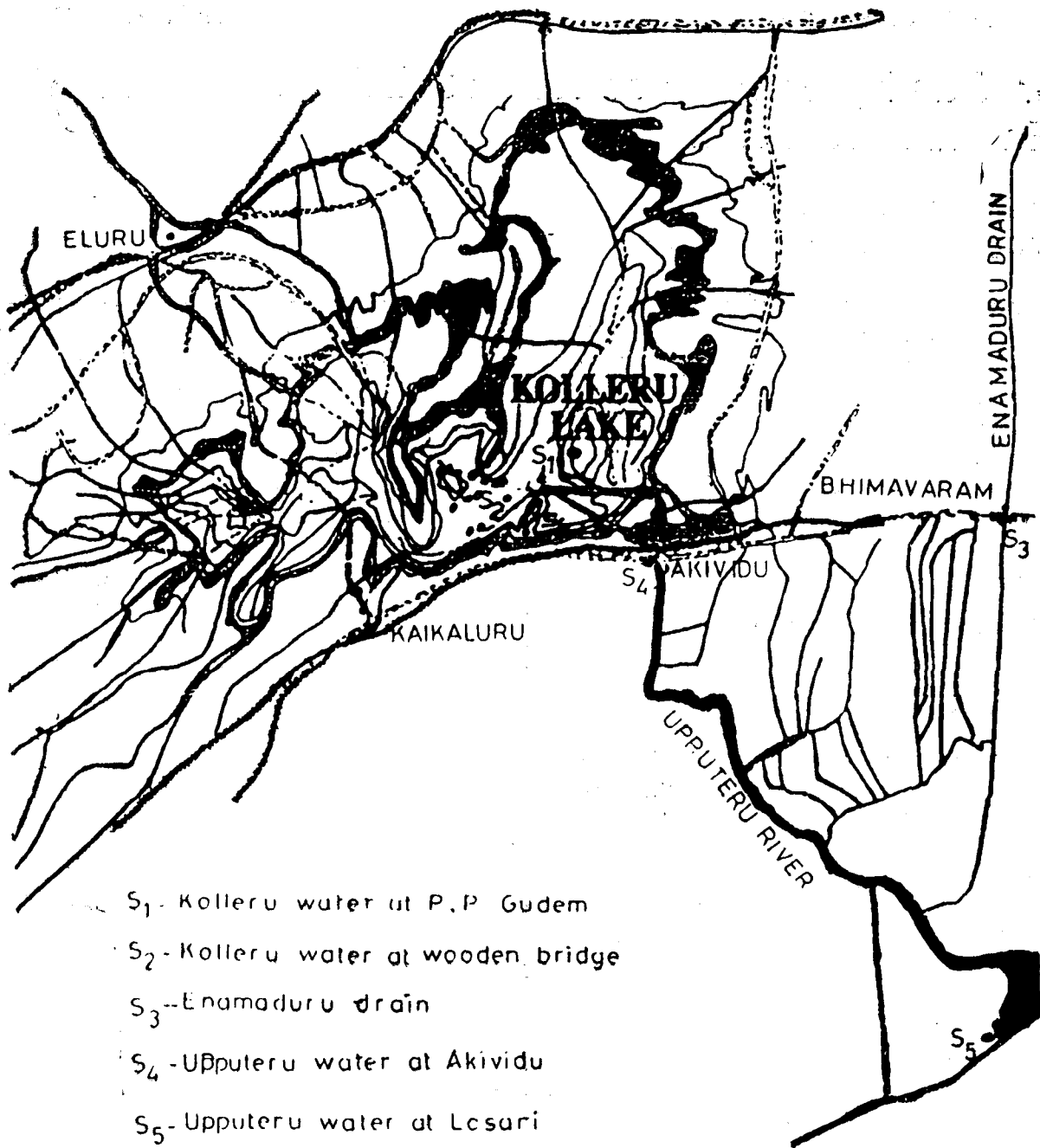
Description of site

Kolleru lake of Andhra Pradesh is the largest fresh water body in South India. It extends over about 954 km² from the 0 to 10.7 ft Contour MSL. It lies between longitudes of 81° 5' and 81° 20' east and latitudes of

16° 32' and 16° 51' north in the districts of Krishna and West Godavari. The catchment area being served by the water body, stretches over 4763 km², comprising 3405 km² of upland area and 1358 km² of agriculture delta areas mostly growing paddy and other cereals often accompanied by high doses of pesticides and chemicals. The only outlet of Kolleru lake into the Bay of Bengal is Upputeru, in the southeastern side of the lake, which has a discharge capacity of about 10000 cusecs. Enamaduru drain is bounded in between 81° 27' 30" E - 81° 40' E longitudes and 16° 25' N - 16° 52' 30" N latitudes Enamaduru drain flowing through Bhimavaram town joins Upputeru river at 29th mile straight cut of Upputeru.

MATERIAL AND METHOD

Surface water samples were collected in Kolleru lake at P.P. Gudam and at wooden bridge of Kolleru lake. Upputeru river surface water samples were collected at Akiividu bridge before Enamaduru drain joins the river and at Losari after Enamaduru drain joins the river. Surface samples of Enamaduru drain were also collected at Bhimavaram town. The sample locations of Kolleru lake, Upputeru river and Enamaduru drain were illustrated in figure 1. The sample collection in the lake, Upputeru and Enamaduru drain was done using a boat. The water samples were collected in different months covering all seasons, using depth sampler. Dissolved oxygen of all samples was fixed at the place of collection by adding 1 mL of manganous sulphate and 1 mL of alkali azide iodide. Samples were tested for pH, salinity, conductivity, TDS and temperature at the field using water analysis kit



- S₁ - Kolleru water at P.P Gudem
- S₂ - Kolleru water at wooden bridge
- S₃ - Enamaduru drain
- S₄ - Upputeru water at Akividu
- S₅ - Upputeru water at Lcsuri
- S₆ - Upputeru water at Down Stream of Wooden Bridge

Figure 1. Kolleru lake and water sampling locations

immediately after sample collection. Ammonia, free CO₂, BOD, COD, chlorides, alkalinity, nitrates, hardness, magnesium, Ca, phosphates were estimated using standard methods.

RESULT AND DISCUSSION

The analysis results were presented in tables 1, 2, 3, 4, 5 and 6.

Kolleru lake

At P.P. Gudem : The physical parameters, conductivity (1.4-2.4 mmhos), temperature (14.8-19.6 °C), TDS (836-1342 mg/L), pH (5.8-8.7) and salinity (1.13-2.4 ppt) varies seasonally and also with the inflow of effluents. High pH was observed in Oct 2003, may be due to aquaculture effluents. The chemical parameters, ammonia (6.3-29.4 mg/L), free CO₂ (4-17.5 mg/L), chemical oxygen demand (31.2-56.2 mg/L), biochemical oxygen demand (26.3-45.8

Table 1. Water quality of Kolleru water at P.P. Gudem, in mg/L

Parameter	Month of sampling											
	Dec, 01	Feb, 02	Mar, 02	May, 02	Jun, 02	Aug, 02	Dec, 02	Feb, 03	Apr, 03	Oct, 03	Jun, 03	Aug, 03
Conductivity, mmhos	1.46	1.8	1.51	2.3	2.1	1.60	1.67	2.30	2.40	1.79	2.40	1.80
Temp., °C	14.9	15.6	16.1	19.6	18.7	17.2	14.8	16.5	18	17.8	16.7	16.2
Total dissolved solids	836	1020	899	1342	1294	952	945	1326	1410	1023	1496	1074
pH	6.2	7.2	6.4	5.8	6.4	7.3	6.6	6.7	5.9	8.1	6.2	7.2
Salinity, ppt	1.13	1.64	1.35	2.1	2.2	1.3	1.54	2.4	2.1	2.25	2.12	1.56
Chlorides	49.7	156.3	146.1	124.2	181.3	150.1	262	145.3	99.5	216.5	156.3	127.5
Alkalinity	150	126	130	190	188	173	156	145	132	100	192	184
Free CO ₂	6.4	7.1	16.75	17.5	10.6	5.1	8.73	9.23	7.5	8.8	11.6	9.6
H ₂ S	21.2	16.3	19.1	21.8	32.4	10.4	10.8	16.4	14.3	13.7	12.4	10.3
Ammonia	6.3	10.9	17.5	29.4	15.6	12.3	24.1	15.3	7.1	7.21	10.2	9.6
Nitrates	0.92	0.68	1.1	0.74	0.92	0.91	0.59	0.58	0.62	0.91	0.85	0.61
Hardness	200	235	350	132.5	121.7	184	500	483	455	410	130	176
Magnesium	37.7	150	265.9	38.4	47.5	115	402	280	266	373.93	50.1	74
Calcium	162.3	85	84.1	94.1	74.2	69	98	203	189	36.07	76	72
Phosphates	0.58	0.45	0.64	0.91	1.1	0.78	0.65	0.94	1.3	0.48	0.78	0.96
Chemical oxygen demand	47.6	43.1	48	41.6	36.2	45.6	31.2	35.1	52.1	42.3	42.6	46.2
Dissolved oxygen	5	4.6	4.2	5.4	4.8	5.2	5.4	4.5	4.2	5.3	5.2	5.3
Biochemical oxygen demand	36.4	33.1	36.4	35.8	29.4	35.1	26.3	29.4	40.3	36.4	31.6	35.8

mg/L), nitrates (0.59-1.1 mg/L), phosphates (0.45-1.1 mg/L) and DO concentrations shows that the water is contaminated with biodegradable organic matter and nitrogenous fertilizers. The lake water can be used for aquaculture after treatment.

At wooden bridge : High variation was observed in conductivity (2.1-15.5 mmhos), total dissolved solids (1490-10354 mg/L) and salinity (3-17.5 ppt) parameters. This variation reveals that the backwater effect is observed even at wooden bridge in Kolleru lake. The other parameters, hardness, ammonia, H₂S, COD and BOD are above the permissible limits. This is due to the inflow of polluted drains and aquaculture effluents. The water quality analysis further reveals that the water is not suitable for agricultural and domestic purposes and it can be used for brackish aquaculture.

Upputeru river

Upputeru, at down stream of wooden bridge : The water samples were collected from Upputeru river at down stream of wooden bridge. The high variation in conductivity (2.0-16.16 mmhos), total dissolved solids (1230-9126 mg/L), salinity (1.94-15.64 ppt), chlorides (450-2245) is due to the ba-

ck flow effect of seawaters. Upputeru wooden bridge is the starting point of Upputeru river and end point of Kolleru lake. The free CO₂ concentration is found in high concentration in the months June 02 (11.9 mg/L) and June 03 (10.9 mg/L) due to dissolution of atmospheric CO₂ and CO₂ released from the decomposition of organic matter. Slight variation of ammonia (2.2-2.8 mg/L), COD (24-44.8 mg/L) and BOD (19.4-33.9 mg/L) can be attributed to seasonal changes occurring in the water. Ammonia, COD and BOD concentrations are due to decomposition of organic matter entered into the river from agricultural effluents, domestic effluents and aquaculture effluents. The magnitude of change in all the parameters is less due to high quantity of water available for dilution.

Upputeru at Akividu Bridge : The total dissolved solids concentration varies from 1228 to 11,500 mg/L. This high variation is due to effect of back flow of seawater during the months of December to June. The high amount of ammonia (6.5-32.6 mg/L), COD (28.9-86.4) and BOD (23.4-61.4) are due to the discharges from Kolleru lake and Akividu town. Most of the time the Upputeru water is brackish water and is not suitable for irrigation or domestic pur-

Table 2. Water quality of Kolleru lake at wooden bridge, in mg/L

Parameter	Month of sampling				
	Dec, 01	Feb, 02	Mar, 02	May, 02	Jun, 02
Conductivity, mmhos	2.3	2.1	14.28	15.5	10.3
Temp., °C	14.3	17.5	19.6	20.1	16.2
Total dissolved solids	1560.4	1490.1	9539	10354	5640
pH	7.02	8.05	8.8	9.2	8.4
Salinity, ppt	3.1	3.04	16.33	17.5	12.1
Chlorides	288.1	260.4	856.7	964.1	623.1
Alkalinity	175	198	80	100	174
Free CO ₂	6.4	10.4	12.5	17.5	11.9
H ₂ S	13.4	14.2	22.2	17.4	20.3
Ammonia	16.8	21.5	15.4	21.7	24.7
Nitrates	1.02	0.96	0.89	0.34	0.41
Hardness	1000.6	750.3	1120.5	1235	820
Magnesium	665	486	726	850	510
Calcium	335.6	264.3	394.5	385	310
Phosphates	0.56	0.78	0.78	0.41	0.54
Chemical oxygen demand	35.6	32.1	24	44.8	32.4
Dissolved oxygen	7.2	6.5	6.1	5.3	6.8
Biochemical oxygen demand	25.3	22.4	18.7	34.6	24.7

Table 2. (continue)

Month of sampling						
Aug, 02	Dec, 02	Feb, 03	Apr, 03	Oct, 03	Jun, 03	Aug, 03
2.00	13.10	6.07	13.88	2.27	6.80	2.41
16.1	14.9	18.6	19	15.5	17.4	16.8
1240	8514.4	3883.8	8882	1483.8	3850	1620
8.31	6.54	7.8	8.6	8.9	7.8	7.8
3.01	15.5	10.73	15.7	3.2	4.3	3.6
447.3	856.1	603.5	756.1	287.15	584	320
80	100	145	50	90	173	126
3	5.82	7.2	4.2	7.2	6.1	5.3
18.6	15.5	16.2	12.4	11.9	12.3	15.1
10.5	17.6	23.4	12.4	11.2	10.4	12.5
0.59	0.57	0.63	0.64	0.94	0.57	0.62
373	1230.65	1025	1256.33	490	510.23	310
277	810	674	823	321	335	205
98	420.65	351	433.33	169	175.23	105
0.82	0.69	0.58	0.78	0.48	0.54	0.56
26.1	28.6	24.3	41.2	36.5	26.7	21.8
7.3	8.4	6.8	5.8	7.1	7.1	7.2
15.5	20.4	16.4	31.6	28.7	16.7	14.8

poses.

Enamaduru drain : The water samples collected from this drain at Bhimavaram town and analyzed for all water quality parameters. The physical parameters conductivity (1.6-9.26 mmhos), TDS (760-5556

mg/L) and salinity (1.2-7.2 ppt) are very high. Backwater effect was observed in Enamaduru up to Bhimavaram town. Due to this, drain water is becoming brackish. Chemical parameters ammonia (5.4-33.6 mg/L), chemical oxygen demand (35.4-61.8 mg/L), biochemical oxygen demand (27.6-46.3 mg/L

Table 3. Water quality of Upputeru at down stream of wooden bridge, in mg/L

Parameter	Month of sampling				
	Dec, 01	Feb, 02	Mar, 02	May, 02	Jun, 02
Conductivity, mmhos	10.19	12.32	14.41	16.16	15.24
Temp., °C	12.6	15.2	16.8	17.9	18.9
Total dissolved solids	5910	7315	8724	9784	9126
pH	7.1	7.4	7.6	8.1	8.4
Salinity, ppt	9.62	11.78	13.12	15.64	14.91
Chlorides	1624	1886	1116	2245.5	2177.6
Alkalinity	210	180	170	185	165
Free CO ₂	5.3	8.5	9.25	8.75	11.9
H ₂ S	4.5	4.2	4.7	4.3	4.8
Ammonia	2.4	2.6	2.8	2.4	2.7
Nitrates	0.48	0.52	1.17	0.54	0.74
H ⁺ rdness	393	287	305.6	131	117.6
Magnesium	208	173	200.2	96.1	84.3
Calcium	185	114	105.4	34.9	33.3
Phosphates	1.02	0.42	1.03	0.57	0.63
Chemical oxygen demand	34.4	26.8	24	44.8	32.4
Dissolved oxygen	5.9	4.2	4.4	5.1	4.7
Biochemical oxygen demand	27.5	21.4	19.4	35.8	25.9

Table 3. (continue)

Month of sampling						
Aug, 02	Dec, 02	Feb, 03	Apr, 03	Oct, 03	Jun, 03	Aug, 03
2.00	13.10	11.42	14.91	2.27	14.80	2.10
18.6	15	19.4	16.3	17.8	17.4	17.4
1280	8384	6841	8924	1452	8192	1290
∞31	6.54	7.2	7.4	8.4	8.1	7.41
1.94	11.76	10.56	13.45	2.76	13.71	1.96
447.3	2008	1816	2140	587.15	2011.5	450.7
215	284	196	185	155	180	175
8.2	5.82	9.53	12.28	9.72	10.9	6.3
4.7	4.9	4.5	4.6	4.4	4.2	4.5
2.5	2.6	2.8	2.7	2.5	2.6	2.2
0.47	0.56	2.16	1.35	0.56	0.58	0.55
184	660	453	563	450.1	117.6	186
106	524	283	364	305.92	84.5	107
78	136	170	199	95.08	33.1	79
0.45	0.49	0.81	0.98	0.47	0.43	0.48
31.4	34.1	24.8	42.4	32.1	34.2	32.1
4.9	5.4	4.3	4.1	5.6	4.2	4.7
25.1	27.2	19.8	33.9	25.6	27.3	25.6

L) and dissolved oxygen (3.8-4.3 mg/L) concentrations are not in the desirable range. The high ammonia concentrations were due to decomposition of proteins and aquacultures effluents. High H₂S (Olsen and Sommerfeld, 1977) is due to the decomposition of sewage entering into the drain from Bhimava-

ram town. High oxygen demanding water and low DO was (Bhasal *et al.*, 1994) also due to the sewage contamination. This water is not at all useful for any purpose.

Upputeru water at Losari : Upputeru water was

Table 4. Upputeru water at Akivedu bridge, in mg/L

Parameter	Month of sampling				
	Dec, 01	Feb, 02	Mar, 02	May, 02	Jun, 02
Conductivity, mmhos	10.9	10.4	10.1	10.7	10.4
Temp., °C	15	17	20	20.4	18
Total dissolved solids	2940	3240	6010	6420	3240
pH	7.4	7.8	7.5	7.1	8.4
Salinity, ppt	9.4	9.2	10.23	10.52	9.52
Chlorides	461.2	641.3	1356.2	1450	136.2
Alkalinity	215	190	80	115	159
Free CO ₂	5.2	5.6	5.6	6.1	6.2
H ₂ S	21.2	12.5	19.1	13.4	15.6
Ammonia	8.4	6.5	18.9	28	32.6
Nitrates	1.21	1.3	1.12	0.6	0.72
Hardness	800	950	1130	1450	864
Magnesium	600	670	820	910	610
Calcium	200	280	310	540	254
Phosphates	0.98	1.3	0.93	0.23	0.34
Chemal oxygen demand	40.8	45.3	41.2	36.4	28.9
Dissolved oxygen	6.4	6.82	6.3	6.4	5.4
Biochemical oxygen demand	31.8	35.7	34.6	31.4	23.4

Table 4. (continue)

Month of sampling						
Aug, 02	Dec, 02	Feb, 03	Apr, 03	Oct, 03	Jun, 03	Aug, 03
4.20	12.92	17.98	17.74	1.91	9.20	4.10
16.2	15	16	20.6	17.8	18.1	16.5
2520	1228.8	11507.2	11352	1221.4	3104	2140
7.7	7.7	8.91	8.89	8.34	8.1	7.4
8.4	11.95	14.62	14.06	2.72	8.92	8.2
610	401	1597.5	1888.6	230.75	710	620
130	140	175	45	85	155	135
5.8	5.9	6.1	5.6	5.1	5.2	5.6
14.3	12.5	11.9	15.3	15.3	10.5	9.6
12.5	21.1	12.4	11.7	24.4	12.4	10.8
1.2	0.94	2.16	1.26	0.98	0.64	0.85
550	555	1543	1400	500	850	530.4
340	437	1172.3	1239.68	416.96	620	350.2
210	118	370.7	160.32	38.07	230	180.2
0.78	0.86	0.71	1.14	0.93	1.3	0.96
86.4	46.3	78.6	59.4	62.4	78.4	46.5
5.1	7.7	6.6	6.1	6.8	5.3	6.8
64.5	38.2	63.8	46.7	48.6	61.4	36.8

sampled at **Lbani** and analyzed for physical, chemical and biological parameters. The high amount of conductivity (13.2-19.82 mmhos), total dissolved solids (7986-11,886 mg/L), salinity (11.9-16.82 ppt) and chlorides (1900-2850 mg/L) are due to seawater intrusion. In all the seasons and in all the

samples, the water is saline. High hardness (1121-1200 mg/L) and magnesium (745-1205 mg/L) is due to presence of high quantities of Mg in seawater. Ammonia (12.4-21.6 mg/L), COD (31.4-68.4 mg/L) and BOD (24.3-55.5 mg/L) reveal the presence of organic matter.

Table 5. Water quality of Enamaduru drain, in mg/L

Parameter	Month of sampling				
	Dec, 01	Feb, 02	Mar, 02	May, 02	Jun, 02
Conductivity, mmhos	3.21	4.52	8.41	9.26	8.21
Temp., °C	16	17	19	20.4	18
Total dissolved solids	1926	2712	4810	5556	4926
pH	7.4	8.1	8.2	7.2	7.8
Salinity, ppt	2.1	2.5	6.1	7.2	6.2
Chlorides	511.8	720.6	1350.1	1479.1	1311.4
Alkalinity	225	120	175	145	215
Free CO ₂	15.5	9.8	13.2	10.5	10.9
H ₂ S	23.3	16.3	12.7	13.2	17.6
Ammonia	10.5	14.8	24.5	33.6	14.6
Nitrates	1.76	0.78	0.98	0.93	1.06
Hardness	240	320	280	800	645
Magnesium	166.9	220	177.8	600	425
Calcium	78.1	100	102.2	200	220
Phosphates	1.08	0.89	1.6	0.57	0.81
Chemical oxygen demand	50.2	49.6	52.8	61.8	50.9
Dissolved oxygen	5.8	4.12	4.8	4.1	4.3
Biochemical oxygen demand	42.3	38.4	41.6	46.3	41.3

Table 5. (continue)

Month of sampling						
Aug, 02	Dec, 02	Feb, 03	Apr, 03	Oct, 03	Jun, 03	Aug, 03
1.80	9.70	6.36	2.04	1.60	8.22	1.79
17.3	14.9	16.4	20.6	17.6	18.2	17.2
912	6208	4070.4	1305.6	760	5010	965
8.05	6.31	7.78	8.56	7.34	7.3	7.78
1.98	7.3	4.3	3.92	1.2	5.31	1.56
286.8	1545.9	1013.6	325.1	261.5	1316.1	285.4
155	215	210	310	150	220	154
11.5	13.81	11.14	11.48	14.2	11.2	10.4
12.75	14.4	14.6	16.57	23.37	18.3	12.6
7.7	20.6	13.5	14.7	5.4	14.3	12.3
1.3	0.85	2.17	1.42	1.12	0.96	0.81
250	550	900	915	430	756	250.6
170	430	689.58	806.78	299.94	510	170.2
80	120	210.42	108.216	130.06	246	80.4
0.68	0.72	0.83	1.27	0.91	0.85	0.56
6.12	42.3	49.2	52.4	35.4	46.3	48.2
4.2	4	4.1	4.1	4.4	4.23	4.6
47.6	32.8	37.6	42.5	27.6	36.4	39.4

DISCUSSION

High contents of free CO₂ in Kolleru lake at P.P. Gudem can be attributed to non-utilization of CO₂ in photosynthesis by macrophytic vegetation. Free CO₂ is generally influenced by pH of the water. Hutchin-

son (1957) stated that at above pH 8, complete absence of free CO₂ might result. A natural clean water body is supposed to have a COD value below 20 ppm. Invasion of CO₂ in the water can increase total alkalinity due to increase in bicarbonates and carbonates. A higher concentration of these ions is

Table 6. Water quality of Upputeru at Losari, in mg/L

Parameter	Month of sampling				
	Dec, 01	Feb, 02	Mar, 02	May, 02	Jun, 02
Conductivity, mmhos	13.2	14.5	16.21	19.82	14.4
Temp., °C	15.3	16.5	16.8	17.3	17.1
Total dissolved solids	7920	8700	9720	11886	8640
pH	6.4	6.8	7.9	6.8	6.41
Salinity, ppt	14.12	15.21	15.19	16.82	12.82
Chlorides	1900	2088	2330	2850	2070
Alkalinity	45	55	70	60	55
Free CO ₂	6.1	5.4	6.7	7.2	6.3
H ₂ S	5.8	5.6	5.4	5.7	5.2
Ammonia	12.4	10.5	21.6	18.3	14.6
Nitrates	1.2	0.96	1.1	0.85	1.3
Hardness	1190	1266	1296	1811	1252
Magnesium	791	882	861	1205	835
Calcium	399	384	435	606	417
Phosphates	0.96	0.85	1.3	0.98	1.1
Chemical oxygen demand	45.3	56.4	42.7	52.4	62.4
Dissolved oxygen	6.3	6.1	5.9	5.7	5.5
Biochemical oxygen demand	46.5	55.5	33.4	46.5	45.8

Table 6. (continue)

Month of sampling						
Aug, 02	Dec, 02	Feb, 03	Apr, 03	Oct, 03	Jun, 03	Aug, 03
14.1	15.40	13.31	15.52	14.81	13.90	13.20
14.3	14.9	14.5	15.3	14.6	17.2	14.5
8460	9850	7986	9312	8886	8440	8100
7.2	6.92	7.1	7.2	7.4	6.21	6.9
12.96	13.26	12.6	13.1	12.9	11.92	11.91
2030	2217	1920	2230	2130	2011	2011
62	25	45	40	65	50	60
7	5.8	6.4	7.3	6.2	6.1	7.1
5.8	5.9	5.6	5.3	5.8	5.4	5.7
16.4	13.5	12.4	15.6	23.1	14.6	13.4
1.42	0.85	0.98	0.64	0.57	0.87	1.2
1211	1281	1170	1288	1278	1250	1121
802	852	779	856	851	835	745
409	429	391	432	427	415	376
0.56	0.64	1.1	0.56	0.78	0.65	0.98
31.4	47.6	68.4	64.8	56.4	42.5	51.3
6.6	6.8	5.3	5.1	6.2	5.2	6.1
24.3	38.4	55.4	52.4	46.5	34.5	42.7

considered to provide buffering action to the water. However, pollution can increase the levels of total alkalinity of waters, which was evident by the high levels of total alkalinity in the present study.

According to Ganapathi (1960) the non polluted

water are generally deficient in nitrate and phosphate content, but certain factors, such as discharge of surface runoff from agriculture fields and sewage are responsible for increase of nitrate and phosphate concentrations. Several authors in India have observed greater fluctuations in nitrate content, from total ab-

sence to very high levels (Alikunhi, 1955). Non-polluted waters are deficient in nitrates, but the factors, like discharge of sewage, run-off and nitrogen fixation may increase the concentrations. Reid (1961) showed that mean phosphate content of most lakes ranges from 0.3 ppm. In the present study high levels of phosphates are may be due to human activities, like washing and bathing which includes usage phosphate and nitrate made detergents, waste discharge and agricultural operations. The high chloride content in the lake may be due to organic pollution particularly sewage discharge. High chloride content in present study conforms eutrophication status of the lake. According to Wetzel (1975) NH_3 ranges from 0.5 ppm in unpolluted surface waters and well above 10 ppm in anaerobic waters of eutrophicated waters. In the present study, a high level of NH_3 (above 10 ppm) indicates organic condition of lake due to heavy pollution.

CONCLUSION

1. From results it is observed that high variation in conductivity, total dissolved solids and salinity levels for samples collected from Kolleru lake at Wooden bridge, Enamaduru drain, Upputeru at Akiveedu and Upputeru at wooden bridge.
2. The results further indicated that the sea back flow effect is up to Kolleru lake. Due to increase in the salinity of the lake, the survival of fresh water fish and other organism will be affected. To prevent the salt-water intrusion into the lake, it is suggested to construct an out fall sluice across Upputeru at a suitable point.
3. The results reveal that lake has been seriously affected due to imbalance in salinity levels. This is attributed to lack of balance between freshwater from the inland catchment of the lake and entry of the seawater into the lake at the mouth of the estuary. It is also reveals that agricultural runoff from farms, where the use of chemical fertilizers and DAP (diammonium phosphate) is very common and also receiving the waste from the surrounding input intensive aquaculture ponds, through different drains.

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