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INFLUENCE OF INLET – DRAINS ON THE WATER QUALITY OF LAKE KOLLERU

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ABSTRACT

Kolleru Lake is an ecological sensitive freshwater RAMSAR wetland site ($16^{\circ}32^{'} and\ 16^{\circ}47^{'} N$ and $81^{\circ}5^{'}$ and $81^{\circ}21^{'} E$) is getting depleted fast causing a threat to the environment. Thousands of fish tanks were dug up effectively converting the lake into mere drain. The area of the lake at +5' MSL (Mean sea level) contour, crosses +18' during high floods and very frequently attains +15' MSL contour. The Lake receives water from rivulets viz, Budameru, Ramileru, Tammileru, Gunderu and 32 drains formed from the irrigation channels of Godavari and Krishna rivers. This paper represents the result of chemical characteristics such as DO, BOD, COD during January 2014 to December 2014, one year at inlet and lake proper points of Kolleru. It is observed that drain waters are having high TDS, low DO, high COD due to domestic sewage and industrial effluents. The ranging of pH and temperature are 7.46 - 8.05 and 22 C - 24 C respectively. The pH was found above 7.0 in all the selected sampling points making them alkaline that may be due to the presence of alkaline substances detergents as a component of industrial effluents and household sewage. A pH range of 7.4 to 8.0 is considered to be safe for aquatic life and to maintain productivity. Temperature of water is a regulating factor and it is important in biological ecosystems. It affects the concentration of DO and can influence the activity of bacteria and toxic chemicals in water (220C) increase and temperature not only reduces oxygen availability and increases oxygen demand. Parameters DO, BOD, COD at all selected sampling points were tabulated in a table 3 ranging of DO values are from 0.5 – 6.0 mg/L, BOD values are 1.2 – 4.4. mg/L, COD values are 16 – 44 mg/L respectively. It was found higher values attained in summer, the high DO is due to high algal pollution.

Keywords: Water Quality - Inl Upputeru et drains, Budameru, Tammileru, Chandraiah drain, Paedaedlagadi, Kolletikota

INTRODUCTION

Kolleru lake (Kolla=many, eru=channel) drainage system has naturally developed in between deltas of river Krishna and Godavari. The natural drainage pattern, design and mechanism has been grossly interfered with constructing high bunds around the fish farms. The wetland international (2008), has found the need to erect 339 vents to facilitate water flow. The elevated water level will remain for a longer period as it is to be drained only by narrow outlet "Upputeru" (64 km long-link between Lake and Sea) Around 26km. of the lake area in Eastern zone is effected by high tides particularly in summer(Amaraneni et.al 2004). Blocking of drains by the sand dunes from the soil eroded in the catchment area of the lake happens to destruction of the free cover in the upstream of the lake. Waste water from agriculture, factories and sewage from municipalities has been

polluting the lake through 11 major drains (1. Budameru(The Sorrow of Vijayawada) 2. Tammileru, 3. Chandraiah , 4. Polaraj, 5. Pedaedlagadi, 6. Chinaedlagadi, 7. Circar canal, 8. Srungavarappadu, 9. Narasannapalem, 10. Kolletikota and 11. Upputeru). Untreated municipal sewage from Vijayawada, Gudivada, Eluru, A.P domestic sewage from other human habitations on the sides of the inlets flows in to the lake. Eluru Municipal Corporation alone discharges around 24 MLD (million liters per day)]. 42% of the 245 km^2 lake was occupied by aquaculture, while agriculture was 8.5%, 1050 fish ponds and 38 dried up fish ponds covered an area 103 km^2. Organic rich wastes cause various changes in water quality including depletion of oxygen levels leading to fish kills and bacterial contamination. Faecal waste in water leads to the proliferation of pathogens such as Salmonella, E.coli and Vibro cholerae. Total catchment area of Kolleru comes to 8923.99 sq.km (Direct 4039.47 sq km + in direct Yerrakalava 4039.47 + Kolleru lake proper 863.24 sq.km at 10' MSL (N. Srinivas & P. Anil Kumar[8] 2013) Numerous fertile islets called Lanka's like Srungavarappadu, Gummalapadu, Kotalanka, Kolletikota, Lakshmi puram, Gokarnapuram and many small ones are submerged during floods. No clear water could be found in satellite images and rest of the lake is being diminished by water diversions, Budameru diversion channel was constructed from Velagaleru to ioin Krishna river upstream of Prakasam Barrage. The lake is drinking water source for the people living in the vicinity of the Kolleru But, back flow of waters and joining in drain is common (Venkata Rao & Malleswara Rao 2009) because of the low effective hydraulic heads.

Materials & Methods:

Sampling locations:

Monthly water samples were collected from six stations i.e., 3 inlet drain points Budameru [Flows through the mandals of Vijayawada - 65 km, Gannavaram, Gudivada and Kaikaluru]. Tammileru (Bethupalli in Khamman District passing through Nagireddy gudem reservoir in Chintalapudi mandal West Godavari). Chandriah drain (Gudivada) and 3 lake proper points pedaedlagadi Circar canal and Kolletikota (Heart of Kolleru lake).

Names of the stations considered for water quality monitoring and their locational details.

	Sampling Station	**Location**	**Latitude**	**Longitude**
Inlet Drain	Budameru	Arugolanu/puttagunta	E80°57.507"	N16°30.594"
	Tammileru	Gurukulapadu	E80°07.960"	N16°39.539"
	Chandriah	Gudivada	E80°59.644"	N16L26.808"
Lake proper	Pedaedlagadi	Eluru/Kaikaluru	E81°09.781"	N16°36.858"
	Circar Canal	Alapadu runoff	E81°18.545"	N16°36.820"
	Kolleti Kota	Temple area/Pandillapalli	E81°18.554"	N16°36.774'

Water Quality Analysis :

A detailed procedure and validation of results were discussed [T.Vidya Sagar a, 2015 APPCB, Vijayawada.] Dissolved Oxygen of water was analyzed by method (APHA 1989 / IS 3025 (Pan 38) :1989). To determine BOD, samples were incubated at 27 ^{c} C for 3 days (IS 3025 (Part 44) :1993) and COD was carried out according to standard methods (IS 3025 (Part 58) : 2006). pH, TDS, NO_3^- and PO_4^- were analyzed by Potentiometry, Gravimetry and Spectrophotometric methods. All the water samples were collected in 1 litre plastic cans, in addition, 3 more samples were taken into DO bottles to study the parameter dissolved oxygen. The samples were analyzed for the following parameters which can be categorized into physical and chemical assessments. Around 72 sample results are taken in this document to present the status of Kolleru Lake.

Water quality parameters and analytical methods

Physical assessments **Scale/unit. Method**

Temperature ^{0}C Celsius. Thermocouple probe, Mercury Expansion.

pH $-\log_{10}[H^+]$ ranging 1-14, Potentiometric.

Total Dissolved Salts (TDS) mg/L. Gravimetric.

Salinity Percent wt/wt

Chemical assessments

Dissolved oxygen [DO] mg/L. Winkler's iodometric titration.

Biological oxygen demand [BOD] mg/L. Consumed DO 3day incubation at 27°C.

Chemical oxygen demand [COD] mg/L. Complexometric titration.

Nitrate as Nitrogen mg/L. Spectrophotometric.

Phosphates mg/L. Spectrophotometric.

The physical parameters such as temperature and turbidity play an important role in lake productivity. The levels of chemical parameters including the pH, dissolved gases, dissolved nutrients, minerals decide the quality of lake water. Recent standard methods for examination of water & waste water was followed by APHA 2005 – IS10500.

Results and Discussion

The water samples taken from Budameru, Tammileru, Chandraih, Pedaedlagidi, Circar Canal and Kolleti Kota were light greenish yellow in colour .The pH and temperature were in the range 6.6 to 8.6 and 22 – 25°C for all sampling points. The pH was found to be above 6.6 to 8.6 making the water alkaline that may be due to the presence of alkaline substances, detergents as a component of industrial effluluents and household sewages.

The D.O. Concentration was 6-7 mg/L in Tammileru which was slightly higher than the Budameru and in Chandraiah drain was 4.9 mg/L. So, there was no difference in water quality of inflowing drains as well as lake proper points (compared with IS: 10500 2005 water standards) both water resources based on basic water analysis standards. The DO levels were depleted in the range of 6 mg/L may be due to algae. The D.O levels are result of photo synthesis, surface dissolution of Oxygen from Atmosphere and the respiration of living things in the lake. Hence DO values were depleted from 1 mg/L to 6 – 7 mg/L. Generally at morning times the DO values in and stand still water would be low to aerobic respiration of Fish, Plankton & micro organisms.

The further water quality analysis was measured to evaluate the pollutants including Organic Carbon (COD), Nitrates & Phosphates. The results are shown in fig, For inlet Budameru the highest concentration of 44 mg/L COD was and in all inflowing drains decreased in Tammileru and Chandraiah 24 mg/L, because of heavy pollution from industries, domestic sewage, effluents and low water flow. Similarly total dissolved salts (TDS) concentration was highest 800 minimum and 3990 mg/L maximum in Budameru decreased in Tammileru and Chandraiah -1080mg/L These results reveal that the agricultural area affects the water quality by increasing Organic Carbon and no effect on habitation.

The main Nitrogen pollutant was Nitrate (NO_3^-N which was from the oxidation process and it was analyzed and the results are present in Table). The highest Nitrate pollutant was 1.16 mg/L of Chandraiah drain and less in Budameru & Tammileru – 0.98 mg/L may be due to agricultural runoff. The PO_4^- P mg/L 2.15 mg/L the relatively high in all sampling points. High PO_4^- P value in the months of September & October indicate algae and micro organisms. The T-coli, where human activity and villages are as its part, is insignificant.

According to the ISI standard for surface water – the organic compound concentration in all 3 inlet points highly exceded the standard, however the NO_3^-N concentration was acceptable values. In terms of Phosphrous there was no limited concentration required for both inlet & standards. From the table it can be summarized that the quality of 3 inlet drains were shown pollutants. However further study and periodical checkup is required to measure the F-coli & T-coli which are predominant faecal pollution.

The present observations are in agreement with earlier studies as reported by (singh et.al Bandela et.al & surve P.R et.al) comparing the observations with the standered permissible limits (BIS & WHO 1992[3]) it is noted that inflowing drains water quality is suitable for irrigation, domestic purpose and survival of aquatic life

but not for drinking. Leaching and runoff. Estimated ¼ th of the fertilizers will end up in the lake (Gopala Krishnayya 1999[5]).

Conclusion:

The water quality at inflowing as well as lake proper points are found to be polluted. Sewage inflow from the towns of Eluru, Gudivada and even Vijayawada and industrial effluents, pesticides and fertilizers from Krishna and Godavari Delta region contaminate the lake. So depleted DO levels, high TDS, COD, BOD, Po_4^- and NO_3^- are the result of effluents or sewage loads in drains deprives aquatic species. The water quality monitoring results obtained from APPCB indicated that the feceal pollution, as shown by high BOD, high T.Coliform density continue to be the predominant source of pollution in drains.

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Table:1 Water quality parameters of three inlet drain (Budameru, Chandraih and East Tammileru) and three Kolleru lake sites (Pedaadlagadi, Circar Canal and Kolletikota) during 2014.

Para-meters	Sampling Points	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
pH	Budameru	6.78	7.81	7.61	7.78	7.18	7.24	6.91	7.47	6.85	7.05	7.35	7.20
	E.Tammileru	7.61	7.89	7.74	8.67	7.30	7.33	7.23	7.44	7.04	6.94	7.37	7.22
	Chadraiah	6.8	6.6	7.12	7.98	7.23	7.43	6.89	7.24	6.98	7.03	7.53	6.97
	Pedaedlagadi	7.18	7.68	7.15	7.94	7.35	7.35	7.01	7.25	7.06	7.03	8.35	7.23
	Circar Canal	7.48	7.59	7.65	7.30	7.38	7.39	7.25	7.48	7.44	7.45	7.59	7.43
	Kolleti kota	7.51	7.76	7.58	7.48	7.23	7.58	7.50	7.65	7.19	7.48	7.66	7.30
TDS	Budameru	1590	660	820	640	840	1140	890	720	605	585	3990	845
	E.Tammileru	355	435	440	420	1080	780	500	630	390	380	365	480
	Chadraiah	1480	600	660	440	890	1160	760	695	855	500	505	455
	Pedaedlagadi	1130	1320	1410	515	1340	1380	1560	1720	750	690	830	1020
	Circar Canal	960	1250	1320	1615	1283	1510	1620	1490	965	315	955	1515
	Kolleti kota	910	1290	1320	1610	1306	1620	1570	1790	810	355	985	1160
DO	Budameru	1.2	2.1	1.8	6.0	3.0	0.5	5.2	3.5	4.0	3.8	4.1	5.0
	E.Tammileru	6.3	5.8	5.6	6.2	6.4	3.0	2.5	7.2	3.6	3.2	5.0	7.1
	Chadraiah	3	3.5	3.2	3.5	3.3	3.0	3.3	2.8	0.5	2.8	1.5	4.9
	Pedaedlagadi	6.5	5.8	4.8	5.4	4.2	4.4	3.8	4.2	2.3	2.3	2.6	3.5
	Circar Canal	2.6	2.1	2.5	4.0	2.0	2.5	4.1	3.8	6.5	5.2	6.3	1.2
	Kolleti kota	3.7	3.5	2.6	4.0	2.6	2.6	3.9	3.6	6.2	5.2	6.0	4.4
BOD	Budameru	4.4	3.8	3.6	1.2	4.2	4.2	2.5	3.6	3.2	2.6	1.8	1.2
	E.Tammileru	0.8	0.7	1.0	1.0	1.2	2.1	4.5	1.0	2.8	3.2	1.2	0.8
	Chadraiah	3.8	3.8	3.5	3.1	4.5	4.8	3.2	3.8	4.4	2.1	4.5	1.5
	Pedaedlagadi	1.8	1.2	1.4	1.2	4.2	4.2	4.8	4.1	4.1	4.3	4.5	4.1
	Circar Canal	2.8	2.8	2.8	3.1	4.2	4.5	2.5	4.6	1.2	1.3	1.4	4.6
	Kolleti kota	2.2	2.1	3.8	3.2	4.8	4.1	4.5	4.2	1.4	1.1	1.2	1.3
COD	Budameru	28	16	24	28	16	24	20	24	20	28	44	32
	E.Tammileru	16	12	20	16	16	24	16	16	24	20	16	20

	Chadraiah	20	20	16	20	24	20	16	20	24	24	20	24
	Pedaedlagadi	32	28	24	20	24	22	32	32	32	36	28	36
	Circar Canal	24	20	24	32	32	24	32	28	28	20	20	32
	Kolleti kota	16	16	24	28	28	24	24	28	32	20	28	28
NO_3^-	Budameru	0.92	0.82	0.72	0.62	0.85	0.95	0.78	0.68	0.72	0.85	0.75	0.68
	E.Tammileru	0.56	0.52	0.48	0.32	0.66	0.75	0.57	0.52	0.63	0.58	0.51	0.45
	Chadraiah	0.81	0.75	0.65	0.76	0.56	0.78	0.65	0.52	1.16	0.75	0.65	0.72
	Pedaadlagadi	0.75	0.65	0.75	0.86	0.75	0.82	0.85	0.66	0.95	0.92	0.65	0.82
	Circar Canal	0.71	0.62	0.68	0.72	0.65	0.85	0.88	0.92	0.42	0.56	0.85	0.86
	Kolleti kota	0.82	0.78	0.62	0.68	0.88	0.78	0.67	0.85	0.56	0.48	0.92	0.58
PO_4^-	Budameru	2.72	2.58	2.32	1.95	1.56	2.20	1.56	1.85	1.48	1.25	1.85	1.72
	E.Tammileru	0.68	0.71	0.62	0.50	0.92	2.15	0.92	0.75	0.62	1.25	0.62	0.6
	Chadraiah	1.05	1.78	1.62	1.82	1.76	2.56	1.85	2.56	2.75	2.46	2.32	1.65
	Pedaadlagadi	0.72	0.82	0.74	1.56	1.82	2.15	1.62	2.58	2.85	2.92	2.85	2.15
	Circar Canal	1.86	1.96	1.85	1.58	2.56	2.15	2.56	2.12	1.76	1.45	0.75	2.92
	Kolleti kota	2.22	2.15	2.25	2.15	2.82	2.25	2.88	2.65	1.85	1.62	0.75	1.82

All results are expressed in mg/l except pH, T-coli & F-coli expressed in MPN/100 ml.

FIGURES A TO D SHOWING MONTHLY VARIATIONS IN WATER QUALITY PARAMETERS DURING 2014

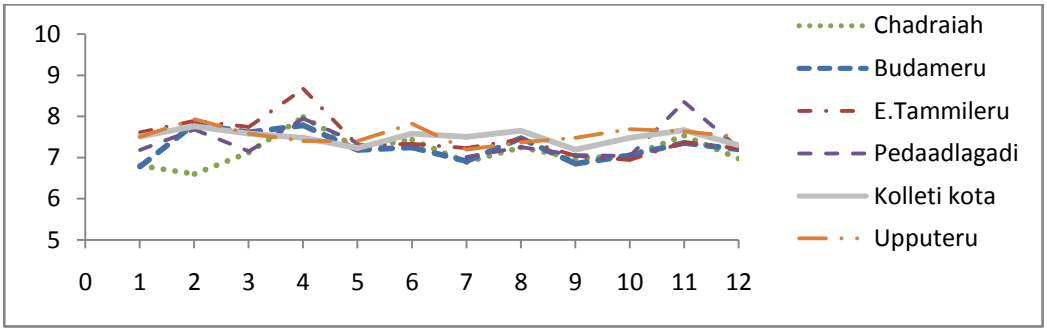

Figure 1: pH of Kolleru monitoring points in 2014.

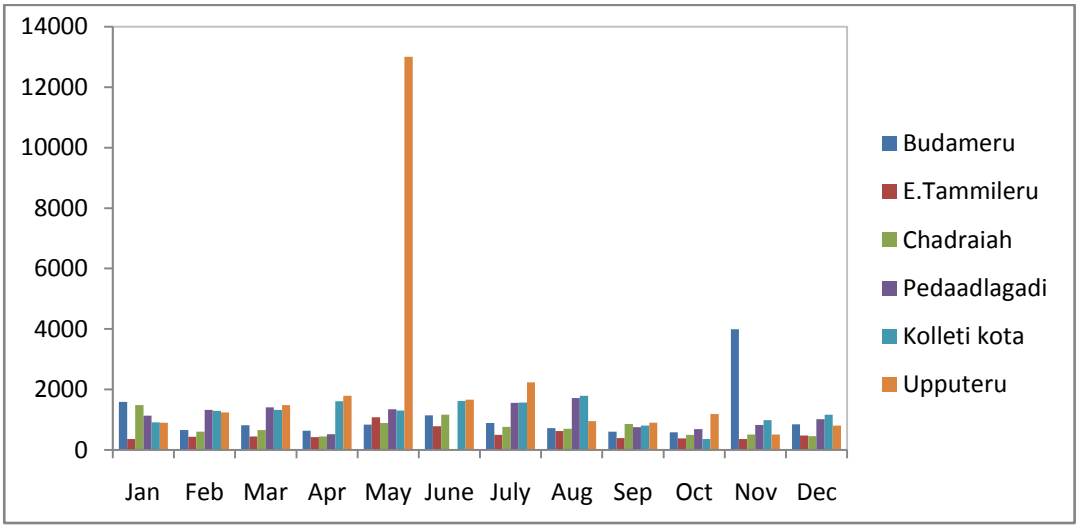

Figure 2: TDS values of Kolleru monitoring points in 2014

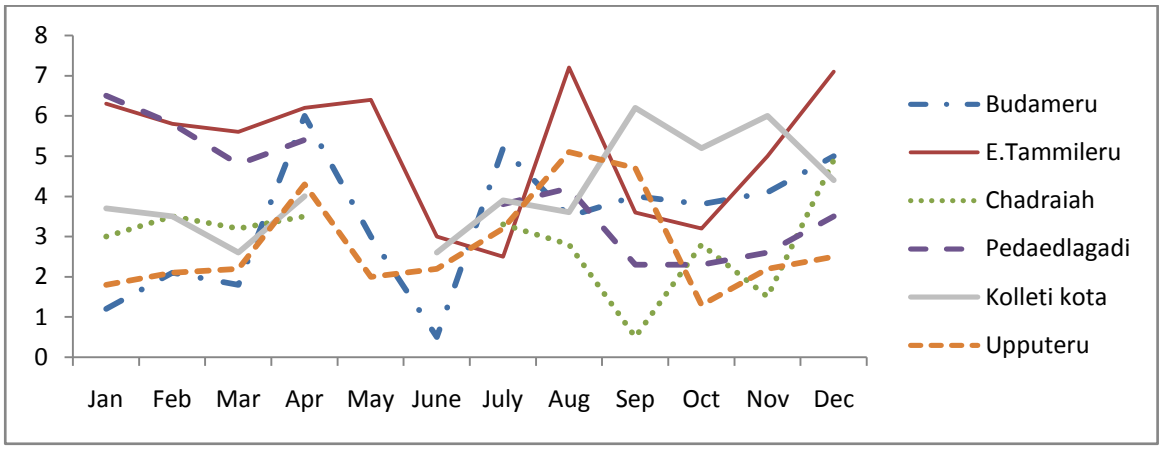

Figure 3: DO values of Kolleru monitoring points in 2014

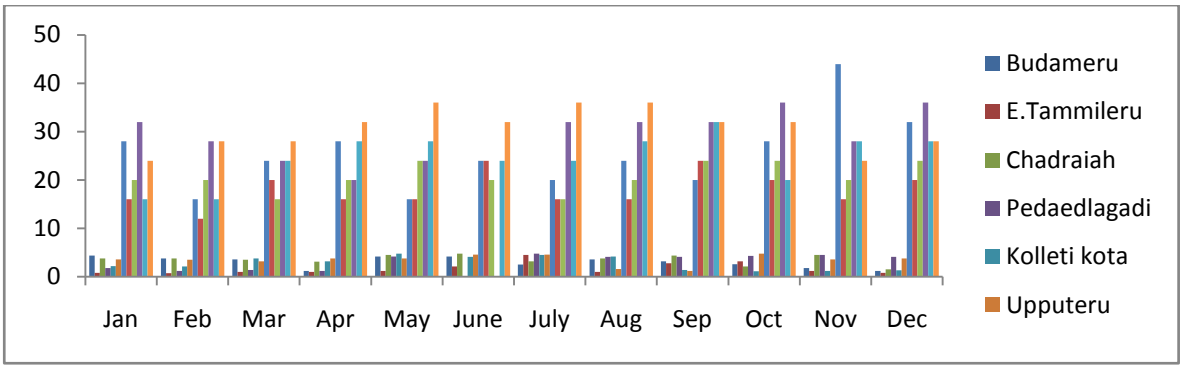

Figure 4: COD and BO D values of Kolleru monitoring points in 2014

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