

## Evaluation of Physico- chemical parameters to determine the Water Quality Criteria in Kolleru Lake A.P, India

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### ABSTRACT

Present paper is to assess the water quality criteria in the sampling points of Kolleru Lake. The sampling points are selected on the basis of inlets of the lake, lake points and outlet of Kolleru Lake. The Physico chemical parameters such as  $P^H$  · Conductivity, COD, TDS, Chlorides, Fluorides, Total hardness, Total alkalinity, Dissolved Oxygen, Salinity were determined for the estimation of water quality during the period Oct 2015 to Sep 2016.. Water samples were collected from eight sampling stations of lake and analyzed by using AAS & ICP-OES Spectrometers. All the calculated concentrations of water quality parameters in studied sampling sites showed variations. The analysis of Physico-chemical parameters indicates that the water in the study area was polluted by Aqua cultural inputs, industrial inputs, agricultural wastes and domestic sewage from neighboring villages.

**Key words:** Aquaculture, Kolleru Lake, Pollution load, Physico -chemical parameters, Water quality.

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### I. INTRODUCTION

Water is a critical issue for the survival of all living organisms and it is a vital resource to any environment for their development. The fresh water environments include lakes and streams etc. such fresh water ecosystem is Kolleru and as the lake functions as a flood moderating reservoir between the Krishna and Godavari deltas and that it supports flora and fauna including several vulnerable species and a variety of resident and migratory birds. The Kolleru wetland was declared as a Wildlife Sanctuary, a RAMSAR site and also as an Important Bird Area (IBA). The aim of the paper is to estimate and interpretation of water quality parameters and the sources of contamination with the following objective.

Evaluate the Physico - Chemical parameters of the Kolleru Lake during October 2015 to September 2016, and assess the water quality.

Water is the most essential resource to mankind. Water quality is deteriorating in lakes due to addition of industrial wastes, agricultural runoff and Eutrophication. Contamination of fresh water and rivers was assessed by using pollution indices and multivariate statistical analysis [1] Anthropogenic pressures such as cultivation in the lake bed, lavish use of fertilizers and pesticides,

large-scale encroachment of lake bed for aqua farms, fishpond discharges, domestic wastes and sewage from municipalities, and discharge of industrial effluents and agricultural run-off carrying inorganic nutrients have vitally affected and altered the ecological character of the wetland. Untreated water input is the main reason for the deterioration of water quality [2]. Various channels and drains carry domestic waste into Kolleru Lake from neighboring cities and towns. If these wastes are not monitored then they will badly affect the water quality and will cause Eutrophication of the lake. Finally these pollutants enter the coastal waters through Upputeru drain and contaminate the water sources there also [3].Seasonal variations were noticed in Physico - chemical parameters of kolleru lake water by several researchers.

The water in Kolleru Lake is polluted due to discharge of untreated effluents from industries located around the lake. Further; the lake is polluted due to discharge of untreated effluents from industries located around the lake[4],[5].Organic rich wastes is another imp reason to deteriorate the water quality including depletion of oxygen levels leading to mortality of fishes [6].Distribution of pesticides like polycyclic aromatic hydrocarbons (PAHS) and heavy metals in water, sediments and

prawn ponds of kolleru lake and assessed the quality of prawn for human consumption and possible effects on aquatic environment indicate higher levels of metals in prawns are toxic to humans who consumed the contaminated prawns in Kolleru area. This is due to the source of water [7]. Highest sources of variation in water quality is due to anthropogenic activities, domestic waste water and agricultural activities [8]. Multivariate statistical techniques, including principal component analysis (PCA) and hierarchical cluster analysis (CA) are the advanced techniques to give information about the water quality [9]. For the last one decade; its ecosystem has been disrupted by the activities of man. The main factors are illegal encroachment of lake bed area for agriculture, construction of fish ponds, and release of industrial effluents from nearby industries and increase of aquatic weeds due to Eutrophication. At present, the lake is subjected to a lot of socioeconomic stresses like human settlement (anthropogenic activities), expansion of agriculture in the lake bed, utilization of unrestricted nitrogenous fertilizers and pesticides.

## II. STUDY AREA

Kolleru Lake is the largest fresh water lake in India of International importance. It is located between two major deltas of River Godavari on the East and the River Krishna on the West. The lake (Long 81° - 40' to 80° - 20' East, Lat 17° - 25' to 16° - 28' North) has an area of 954 Sq. Km . The lake was notified as a wild life sanctuary in Nov1999 and designated as Ramsar site in Nov and it was also identified as an "Important Bird Area" of India. The kolleru lake is connected mainly by a network of 3 main channels i.e. Tammileru, Ramileru and Budameru and have 20 channels connected the above 3 major channels. Due to its fresh water significance the lake is an important habitat for many resident and migratory birds, including Grey Pelican and many migratory birds.

Eight sampling stations are selected for the present study during Oct 2015 to Sep2016. Sampling stations are Atapaka, Pedayadlagadi, Kolletikota, Singaralathota, Gudivakalanka, Upputeru – Panchekalamarru, Upputeru – Kottada, Mondukodu drain.

**Table -1 Geographical Location and Ecological Features of field stations in Kolleru Lake**

S.No.	Field Station	Mandal	Geographical location & Ecological features
1	Atapaka	Kaikaluru mandal of Krishna Dt.	Open waters with small islands of muddy flats which have colonized by Reed swamps, Acacia species. Eco tourism spot. Preferable area for bird watching.
2	Pedayadlagadi	Eluru	The Area includes aquaculture ponds and agriculture fields.
3	Kolletikota	Kaikaluru	Deep shallow lake bed areas with an average water depth ranges from 1 to 3 meters with submerged hydrophytes. Ecotourism spot. It contains bridge made up of wood, connect kollitikota and Alapadu.
4	Singaralathota	Kaikaluru	The water depth is 1 to 2 meters and mainly used for fishing.
5	Gudivakalanka	Eluru	The Water depth is 85 cm, Open waters with small islands of muddy flats which have colonized by reed swamps and other aquatic vegetation. Avifaunal diversity is less.
6	Upputeru - Panchekalamarru	Kaikaluru	It is a one point of Upputeru outlet ,where some drains together joins to it.
7	Upputeru Kottada	Kaikaluru	The only outlet of Kolleru that mingles with sea water is slightly saline.
8	Mondukodu drain	Eluru.	Belongs to West Godavari district, Major inlet of the lake.

## III. MATERIALS AND METHODS.

Eight Water samples were collected monthly from different locations of Kolleru Lake during Oct 2015 to Sep 2016. Water Samples were collected in one liter sterilized water bottles and preserved by the addition of few drops of

Concentrate Hno<sub>3</sub> and further analyzed in the lab. Sample preparation and the analysis of Physic chemical parameters were followed standard procedures noted in “Standard methods for the examination of water and waste water”, by Andrew

D. Eaton et al., 19<sup>th</sup> Edition 1995, [14] and values measured by AAS & ICP-OES spectrometers

#### IV. RESULTS

High variations observed in Conductivity, Total alkalinity, COD, TDS, Chlorides, Fluorides, Total hardness, DO, Salinity & P<sup>H</sup> in the water samples from Kolleru Lake. Results of water quality parameters from eight sampling stations are presented in Table 2

##### 4.1 P<sup>H</sup>

Negative logarithm of Hydrogen ion concentration plays a significant influence on all aquatic organisms. The P<sup>H</sup> in water samples was in the range of 6.9 to 7.6. Higher P<sup>H</sup> levels 7.56 in Kolietikota may be due to rich organic matter in water. Low P<sup>H</sup> value was noticed in Pedayadlagadi was due to decreased level of water in this area. Overall in all the sampling sites, P<sup>H</sup> levels suggested that slightly alkaline conditions and favorable for the growth of aquatic macrophytes.

##### 4.2 Conductivity;

Conductivity is used as indicator to the quality of water. Conductivity values were recorded above the normal range in all the sampling sites. High conductivity was reported at pedayadlagadi 12562.5  $\mu\text{s/cm}$ , which shows the high rate of anthropogenic input like agricultural wastes and municipal wastes from Vijayawada, Eluru, Guduwada municipalities. Low rate of conductivity was noticed in Gudiwakalanka 1045.83, may be due to its vast area with natural ecology. Throughout the study period high values of conductivity was recorded in all the sampling sites.

##### 4.3 Chemical oxygen demand (COD)

Chemical Oxygen Demand of all the water samples collected from Kolleru Lake ranged from 304.33mg/l -26mg/l which is beyond the limit. Highest value COD of was noticed in Upputeru-panchekalamarru 304.33 due to dumping of domestic sewage, surface runoff, waste discharges as it is the outlet of the lake. Lower value of COD was reported in Gudiwakalanka due to it is a agricultural based area because most of the area is under agriculture and it is a lake point.

##### 4.4 TDS

Total Dissolved Solids is the useful parameter to know the quality of water. TDS in water samples were ranged between 883.66mg/l to 9745.58mg/l. High TDS was noticed in Pedayadlagadi due to discharge of sewage from minor drains, because it is a large area and connected by small drains and channels which carries excess fertilizes from agricultural fields. Higher values of dissolved solids in water may affect the water quality and aquatic life in the lake. Low value of TDS was reported in Gudiuakalanka due to negligible disturbances of anthropogenic activities.

##### 4.5 Chlorides & Fluorides

Chloride concentration in the sampled waters ranged between 4536.08mg/l to 489.66. Chlorides concentrations were found higher in Pedayadlagadi due to mixing of sewage, industrial effluents from nearby places, urban runoff from Vijayawada, Eluru, Guduwada. High values of Chlorides indicated the indicator of Eutrophication. Low Chloride in Pedayadlagadi due to low level of human activity. Traces of Fluorides were reported in all the samples ranged from 0.57 to 0.14 mg/ l. The values are within the permissible limits.

**Table 2** Average values of Physico chemical characteristics of water at 8 sampling stations of Kolleru Lake.

Sl. No	Parameters	Atapaka	Pedayad lagadi	Kolleti Kota	Singarala Thota	Gudivakalanka	Upputeru-Panchekalamarru	Upputeru Kottada	Mondikodu Drain
1	pH	6.94	6.94	6.95	7.55	7.26	7.29	7.37	7.55
2	Conductivity( $\mu\text{s/cm}$ )	7064.16	12562.5	4251.66	4174.16	1045.83	7171.66	3507.5	4626.66
3	Chemical Oxygen Demand	97.16	148	75.5	118.16	26	304.33	67.41	70.16
4	Total Dissolved Solids at 105 <sup>o</sup> C	4872.58	9745.58	2864	2778.25	883.66	5976.9	2766.5	4204.75
5	Chlorides as $\text{Cl}^-$	2500.16	4536.08	3419.58	3166.16	489.66	1595.83	765.91	1193.75
6	Total Hardness as $\text{CaCO}_3$	746.08	3336.33	446.66	451.58	162.25	843.66	455	514.5
7	Calcium Hardness	182.16	1676.5	183.83	234.75	125.5	324.4166	176.33	171.5
8	Magnesium Hardness	563.91	1659.83	263.33	216.83	36.75	519.25	278.66	343
9	Total Alkalinity	262.58	159.41	279.66	392.5	187.83	341.75	265.33	374.66
10	Fluorides as $\text{F}^-$	0.15	0.57	0.01	0.14	0.17	0.22	0.21	0.38
11	Dissolved Oxygen	9.75	9.45	7.26	6.10	3.51	4.36	4.31	7.72
12	Salinity	2.58	11.83	2.66	2	0	4.16	3.16	3.58

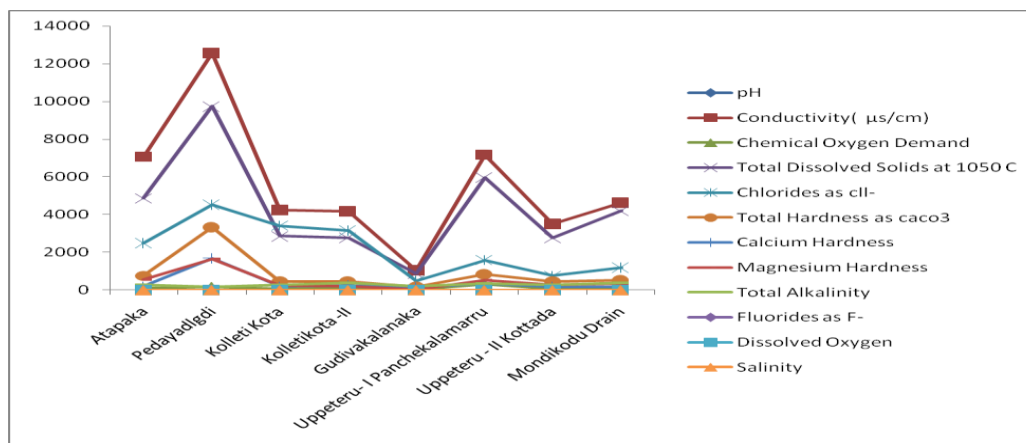


Figure.1 variations among physico-chemical parameters in kolleru lake.

#### 4.6 Total Hardness, Calcium Hardness, and Magnesium hardness.

Hardness is very important characteristic of water for various life processes. Total hardness is the total measurement of concentration of Calcium and Magnesium ions in water. Total hardness was reported in sampled water ranged from 3336.33mg/l to 162 mg/ l. High value of Total Hardness was noticed in pedayadlagadi due to sewage waste, agricultural waste. Low value of Hardness was in Gudivakalanaka (162.25mg/l) suggested low anthropogenic activities.

#### 4.7 Total Alkalinity

Alkalinity showed variations between sampling sites ranged between 159.41 mg/l to 392.5 mg/l. High value of alkalinity was reported in Kolletikota , Singaralathota was due to high pH 7.56 which favours the growth of aquatic macrophytes like *Phragmitis*, *Ipomea*, *Azolla* and their decomposed organic matter increases nutrient contents which further leads to higher alkalinity in the sampling site. Low alkalinity in Pedayadlagadi was due to low nutrient input.

#### 4.8 Dissolved Oxygen;

Maximum value of DO was recorded in Atapaka 9.75 mg/l due to monitoring of water by kolleru board as it is meant for ideal habitat for many migratory and resident birds. DO was recorded in all the sampled sites ranged between 3.5 mg/l to 9.7 mg/l. Ranking order of sampling stations are Atapaka > Pedaeadlagadi > Mondukodu drain> Kolletikota > Singaralathota > Upputeru - Panchekalamarru> Upputeru - Kottada> Gudivakalanaka. DO was reported low in Gudivakalanaka due to addition of high amount of Agricultural wastes, Sewage, Surface runoff. Low value of DO is not suitable for the growth of aquatic organisms especially fishes and prawns. High variations were also observed in the sampling sites

indicate fluctuations in the values of DO is not preferable for the fish ponds. Untreated sewage from municipalities entered into lake is another reason for low level of DO. DO decrease in kolletikota is due to rich beds of aquatic macrophytes.

#### 4.9 Salinity

Salinity was noticed in Kolleru Lake ranged between 2.5 to 11.8. High values of salinity was recorded in Upputeru - Kottada , Upputeru - Panchekalamarru ,Pedayadlagadi due to high amount of salts. Upputeru water may back flow entering into kolleru lake is another reason for high value of salinity in Upputeru. Lower value of Salinity in Gudivakalanaka suggested low amount of salts.

### V. DISCUSSION

The water in Kolleru Lake is contaminated in various sampling places with high values of physico-chemical parameters. Conductivity variations in River Yamuna water sources indicated that poor water quality criteria. Abrupt increase in PH and conductivity in water, affect the water quality and did not support aquatic life [10].

Similarly high levels of Conductivity in Pedayadlagadi of Kolleru Lake indicate highly polluted site. Reporting water quality in rivers and lakes is a useful path to classify the water quality status & to be control water pollution. Multivariate Analysis techniques are effective for fresh water classification.[11].The water is not preferable for the public consumption when Physico chemical parameters TDS, P<sup>H</sup>, Alkalinity, Total Hardness, Mg, Ca, and DO values exceeding the permissible limits [12].Similar results in the present study shows high TDS, Total Hardness in Pedayadlagadi indicate that water is not suitable for domestic use. Excessive nutrient loading leading to a rich eutrophic status which causes the loss of biodiversity [13].Aquacultural potential is rapidly expanding in kolleru area and agricultural land and lake area are

decreasing. It also shows that there are a no of illegal and encroachment and shrinkage of Lake Area in and around kolleru [4]. Seasonal variations of Physico chemical parameters influenced zooplankton abundance in Kolleru Lake [5]. Anthropogenic activities & high metal sources in water of kolleru lake indicate that the fish are contaminated with metal and not advisable for human consumption.[3].

The samples collected from the Upputeru contain high COD which is due to the decomposing organic matter. The Dissolved Oxygen (DO) was very low in water from Gudivakalanka, due to contamination from sewage. Similarly at various locations in the lake, p<sup>H</sup> increase in Singaralathota, high values of Conductivity, Chlorides and TDS in Pedayadlagadi, the water is contaminated with biodegradable organic matters, nitrogenous fertilizers and sewage matters. An Ecosystem like Kolleru has to be considered as a natural, renewable resource generating infrastructural asset. Aquaculture, anthropogenic activities have pressure and badly affected water quality, there by affecting the ecosystem of their showing impact on lake.

## VI. CONCLUSION

The Lake Kolleru is largely a freshwater body, now the water may turn brackish particularly during summer months due to salt water ingress through Upputeru. Variations observed in physico-chemical parameters of my study indicate that, exploitation of the Kolleru area has evidently resulted in depletion of many of the ecological goods and services conventionally derived from it leading to unwanted flooding and other negative consequences. Necessary actions are taken soon to restore the fresh water lake and improve the water quality. Therefore there is urgent need of monitoring of water quality for conservation of habitat for resident and migratory birds and also the need for the people live in bed and belt villages.

So the health and fresh water nature of Kolleru Lake depend on management Plan. This study provides the interpretation of water quality of the Kolleru Lake and identified pollution sites and sources. It also useful for the management practices towards the improvement of water quality and protection of the lake.

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