# Seasonal Variation of Physico-Chemical Parameters in Kedilam River, Tamil Nadu, India

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**ABSTRACT**
The present investigation deals with the seasonal variation of physical-chemical parameters of three different stations ($S_1$, $S_2$ and $S_3$) during periods 2012-2013. The results of the study showed that all other parameters (Temperature, Turbidity, Electrical Conductivity, pH, Dissolved Oxygen, BOD, and COD) are exceed the permissible limit specified by WHO and BIS except Salinity, $CO_2$ and Ammonia. Statistically there is significant relation observed in Temperature, Turbidity, pH, DO and Salinity (P<0.01). Between the three seasons and stations the contamination level are in order of summer>Monsoon>winter and $S_1$>$S_2$>$S_3$ respectively.

## Introduction

Water quality assessment is one of the prime concerns and a major challenge in all over the world. Seasonal variation study of water quality parameters provides information about the health of the water over a period of time. Water is vital to health and it influences in socioeconomic development of human being. Increasing population growth, agriculture advancement, urbanization as well as industrialization made water pollution a great problem and depleting the availability of river water (Nabanita Haloi & Sarma., 2011).

Present investigation was undertaken to determine the impact of sugar mill activities on ecological integrity of Kedilam River. India is one of the largest growers of sugarcane (Singh, 2009). Sugar industries were been act as a major role in the economic development of India but the waste water which are generated from floor and equipment washing are highly contaminated (Memon et al. 2006). The water also become black and odourious due to the precipitation between hydrogen sulphide ($H_2S$) and iron with different types of salts which can be hazardious to aquatic ecosystem (Salequzzaman et al. 2008).

Pollution of river first affects its physico-chemical characteristics then destroys the ecology of aquatic system (Jindal & Sharma, 2011). Recent Studies has been reported the contamination of water and stress on fishes (Damodhar & Reddy, 2012; Anandhan et al., 2012). Thus the objective of this study was to evaluate the Physico-chemical parameters of sugar mill effluent and its impact on Kedilam River. The physico-chemical analysis of kedilam river water of the area is taken with a specific view to strengthen the national and regional water quality database and analyzing against standard value by WHO (1992) and BIS (1992). This is wishing to help the people to know about the safe river water.

## Materials and Methodology

The surface water samples were collection made for three different season like, summer (March-June 2012), monsoon (July-October 2012) and winter (November-February 2013) for the estimation of various physico-chemical parameters. In our present study monthly samples were collected during morning hours (8-10 A.M) throughout the year (2012-2013). For further analysis of different parameters samples were stored in precleaned plastic bottle and were transfer immediately to laboratory followed by Trivedy & Goel method (1986).

## Three stations are

$S_1$:- Point source near to sugar industry at Thiruvanthipuram.
$S_2$:- Right bank of the river dominated by domestic and municipal wastes at Thirupathiripuliyur.
$S_3$:- River entering in the sea area at Cuddalore town region. ($S_3$)

## Statistical analysis

The Correlation was calculated using SPSS packages (Version 15.0) and Statistical significance was calculated at *$P < 0.05$; **$P < 0.01$.

## Results and Discussion

The present studies of physico - chemical parameters of kedilam river water was determined at 3 different sites and seasons (Fig 1.0 & Table 1.1).

The temperature remains high (32.47°C at $S_1$) during summer and lowest (26.57°C at $S_2$) during winter. Temperature remains in the range of 26.57-32.47°C throughout the season. Temperature showed strongly negative correlation (Table 1.2) with DO and pH (r = -0.89; -0.88, P<0.01) while positively correlated with Salinity and $CO_2$ (r = 0.97; 0.87, P<0.01). Thus changes in temperature may be due to seasonal and topographical influences (Gupta & Roy, 2012).

Turbidity is remaining higher (22.10 at $S_2$) during monsoon and lowest (11.90 at $S_3$) during winter (Table 1.1) which is above the WHO (10 NTU) and BIS (10 NTU) standard. Turbidity is positively significant (Table 1.2) with EC(r = 0.95, P<0.01) and BOD(r = 0.69, P<0.05). In our present investigation turbidity was higher during monsoon because of heavy rain which brings sediments, bagasse and fly ash particle by point and nonpoint sources (Momon et al. 2006).

**Table 1.2**
Correlation among Physico-chemical parameters during the period (2012-2013) in Kedilam River, Tamil Nadu, India.

| | Temperature | Turbidity | EC | pH | DO | BOD | COD | Salinity | CO2 |
|---|---|---|---|---|---|---|---|---|---|
| Temperature | 1 | | | | | | | | |
| Turbidity | -0.112 | 1 | | | | | | | |
| EC | 0.028 | 0.952** | 1 | | | | | | |
| pH | -0.884** | 0.357 | 0.241 | 1 | | | | | |

| Parameter | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DO | -0.893** | 0.468 | 0.377 | 0.944** | 1 | | | | |
| BOD | 0.240 | 0.696* | 0.789* | 0.188 | 0.141 | 1 | | | |
| COD | -0.356 | 0.602 | 0.606 | 0.694* | 0.632 | 0.772* | 1 | | |
| Salinity | 0.980** | -0.024 | 0.150 | -0.830** | -0.811** | 0.357 | -0.225 | 1 | |
| CO2 | 0.869** | 0.172 | 0.378 | -0.602 | -0.601 | 0.638 | 0.092 | 0.937** | 1 |
| Ammonia | -0.011 | 0.178 | 0.235 | 0.337 | 0.122 | 0.614 | 0.542 | 0.001 | 0.258 |

**.Correlation is significant at the 0.01 level (2-tailed)

*.Correlation is significant at the 0.05 level (2-tailed)

In present investigation electrical conductivity (Fig. 1.0) are in the range of (305.77-445.63) which is above the permissible limit (Table 1.3) by WHO (300 μmhos/cm). Higher and lower conductivity observed during monsoon (445.63 μmhos/cm) and winter (305.77) at $S_3$ throughout the year. EC is positively significant (Table 1.2) with BOD(r = 0.78, P<0.05). EC and BOD relationship showed the presence of waste water coming from industries are main factor for aquatic pollution. Similar types of results are also observed by Salequzzaman et al. (2008).
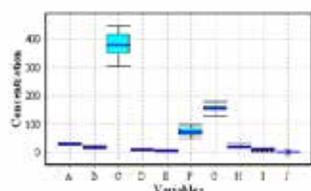


Fig. 1.0 Box plot showing variation of physico-chemical parameters in Kedilam River during 2012-2013
A - Temperature(°C), B - Turbidity (NTU), C - Electrical Conductivity(μmhos/cm), D - pH, E-DO(mg/l), F - BOD(mg/l), G - COD(mg/l), H - Salinity (ppt), I - CO2(mg/l), J - Ammonia (ppm)

pH was alkaline throughout monsoon and winter but less during summer. The ranges of pH are 6.22-8.55 which is slightly higher than the WHO and BIS standard (Table 1.3). pH showed negative correlation (Table 1.2) with salinity(r = -0.83, P<0.01) and CO2(r = -0.60) and positively significant with DO(r = 0.94, P<0.01) and COD(r = 0.69, P<0.05). Negative relationship with salinity indicated that other than salts, industrial and agricultural run-off are dominated all the stations. Higher pH during summer is due to the uptake of free $CO_2$ for respiration of organisms at higher temperature photosynthesizing organisms (Jindal & Rumana, 2000).

Maximum BOD and COD values are observed during monsoon (Fig. 1.0, Table 1.1). The highest BOD (95.87 mg/l) and COD (177.85mg/l) values were observed at $S_1$ which are above the permissible limit by WHO (5 mg/l) and BIS (30-100) standard (Table 1.3). BOD is significant (Table 1.2) with COD(r = 0.77, P<0.05). Higher BOD and COD observed during monsoon (July-October 2012) this was due to the heavy rain, there was remarkable decrease in temperature and high water current which washout the drains contains the industrial, agricultural, municipal organic matters to the river basin. Similar results are observed by Jindal & Sharma (2011). Between the three stations the BOD and COD values are in order of $S_1>S_2>S_3$. Salinity is varies in the range of 13.31-32.08. Higher and lower salinity was observed during summer (32.08 ppt) and winter (13.31 ppt) at $S_1$, $S_3$ respectively. There is a significant correlation with $CO_2$(r = 0.93, P<0.01). Between the three stations higher salinity observed at $S_1$ which is under the permissible level of WHO (120 ppm) and BIS (200 ppm) standard for drinking water (Table 1.3).

Free $CO_2$ were higher (13.16 mg/l at $S_1$) during summer and lower in winter (3.52 mg/l at $S_3$). Between the three stations the values are in order of $S_1>S_2>S_3$ (Table 1.3). The reason is the high temperature which enhances the oxidation and reduction process resulting addition of more amount of $CO_2$ to the water (Jindal and Sharma, 2011). Similar results are observed by Nath & Srivastava (2001) and Chopra et al. (2012).

**Table No. 1.1**
**Seasonal fluctuations in physicochemical parameters at three stations ($S_1$, $S_2$, $S_3$) of Kedilam River, Cuddalore from March 2012 to February 2013**

| PARAMETER | SUMMER | | | MONSOON | | | WINTER | | |
|---|---|---|---|---|---|---|---|---|---|
| | $S_1$ | $S_2$ | $S_3$ | $S_1$ | $S_2$ | $S_3$ | $S_1$ | $S_2$ | $S_3$ |
| Temperature(°C) | 32.47±1.25 | 31.43±0.81 | 31.60±1.13 | 27.73±0.68 | 27.30±0.46 | 26.70±0.56 | 26.77±0.40 | 26.57±0.49 | 27.13±0.61 |
| Turbidity (NTU) | 14.10±0.26 | 15.73±0.45 | 16.27±0.45 | 19.20±0.30 | 22.10±0.52 | 21.20±0.08 | 12.33±0.35 | 12.66±0.45 | 11.90±0.20 |
| Electrical Conductivity(EC) | 375.47±4.70 | 384.90±3.97 | 374.33±1.84 | 415.57±4.75 | 435.20±4.23 | 445.63±4.66 | 348.89±6.30 | 326.97±7.97 | 305.77±5.40 |
| pH | 6.62±0.25 | 6.22±0.12 | 6.43±0.07 | 8.55±0.10 | 8.35±0.12 | 8.02±0.24 | 7.97±0.22 | 7.76±0.12 | 7.70±0.20 |
| DO(mg/l) | 3.73±0.10 | 3.34±0.11 | 3.64±0.12 | 6.38±0.11 | 6.92±0.15 | 7.33±0.12 | 6.30±0.13 | 5.64±0.28 | 5.37±0.09 |
| BOD(mg/l) | 85.95±3.31 | 73.32±1.97 | 63.54±2.05 | 95.87±2.13 | 86.97±1.84 | 74.19±1.07 | 61.12±5.26 | 56.45±1.64 | 49.16±1.03 |
| COD(mg/l) | 161.00±5.68 | 140.87±2.10 | 127.16±2.00 | 177.85±2.55 | 172.41±2.59 | 162.44±2.52 | 146.83±7.60 | 148.82±1.58 | 143.83±2.14 |
| Salinity (ppt) | 32.08±2.78 | 27.28±1.92 | 26.20±1.68 | 17.15±1.75 | 17.02±1.46 | 16.02±0.34 | 15.14±0.18 | 13.85±0.34 | 13.31±0.44 |
| CO2(mg/l) | 13.16±0.10 | 10.39±0.73 | 9.00±0.30 | 8.48±0.25 | 7.02±0.24 | 6.56±0.28 | 5.98±0.25 | 4.50±0.19 | 3.52±0.17 |
| Ammonia (ppm) | 0.09±0.01 | 0.06±0.01 | 0.03±0.01 | 0.07±0.03 | 0.02±0.01 | 0.02±0.01 | 0.07±0.02 | 0.04±0.01 | 0.02±0.01 |

(Note: Mean ± SD)

(Highest and lowest values at various stations are in bold letter)

**Table No. 1.3**

**Different analytical water quality parameters guideline values as per WHO and Indian standard (ISI)**

| PARAMETER | WHO | BIS Indian Standard | BIS FOR IRRIGATION |
|---|---|---|---|
| Temperature (°C) | -- | 40 | -- |
| pH | 6.5-8.5 | 6.5-8.5 | 5.5-9.0 |
| Electrical Conductivity (µmhos/cm) | 300 | -- | -- |
| Turbidity (NTU) | 10 | -- | 10 |
| DO(mg/l) | 5.0 | 3.0 | |
| BOD(mg/l) | 5.0 | 30.00 | 100 |
| COD (mg/l) | 10.00 | -- | 250 |
| Salinity (ppm) | 120.00 | 200.00 | 600 |
| CO2 (mg/l) | -- | -- | -- |
| Ammonia (ppm) | 0.3 | 0.5 | -- |

Ammonia is highly toxic to aquatic organisms and its value should be below 0.2 mg/l (Yousafzai et al. 2008). Present values are below the standard level by WHO (0.3 ppm) and BIS (0.5 ppm). There is no significant relationship found in present study.

## Conclusion

The present data on physico-chemical parameters in river water indicates that the local environment is totally different from natural ecosystem. Except some of the parameters (Salinity, $CO_2$ and Ammonia) all the other parameters are above the limit by WHO and BIS standard. Among the three stations pollution status are in order of $S_1>S_2>S_3$. Between the three stations $S_1$ is dominated by sugar and distillery industries where as $S_2$, $S_3$ is contaminated by domestic and urban run-off. Regular and continuous monitoring is most needed to prevent the aquatic pollution. Industry should dispose properly so that the effluent rich in nutrient which could be useful in agriculture as a fertilizer.

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