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Physiochemical analysis of Ganga River at Kanpur in Uttar Pradesh, India

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Abstract
Physico-chemical analysis of water which was obtained as average during the years 2015-2016, which was obtained from Industrial area (A_1 and B_1) and Commercial area (A_2 and B_2) of Kanpur (U.P. India). The range of observations are as under; temperature ranges from 20.9°C to 32.8°C, pH of river water ranges between 7.4 to 9, Alkalinity from 260 to 284 mg/L, DO from 3.9 to 7.1 mg/L, COD from 98.0 to 143 mg/L, Chloride from 41.6 to 71.7 mg/L, Phosphate from 0.800 to 1.10 mg/L, and Nitrate 0.801 to 1.45 mg/L.

Keywords: river Ganges, Physico-chemical parameter, industrial area, commercial area

1. Introduction
The Ganga is the best example of the fresh water ecosystem originated from Gangotri (Uttaranchal) and after a large travelling a distance of 2525 km falls into the Ganga Sagar (W.B.) The river Ganga is the largest and is a very important river basin of the country India (Prasad, 2016) [1]. The river Ganga is a major river of India subcontinent and third largest river in the world by discharge arising. The Ganga then flows through the Himalayan valleys and emerges into the north Indian plain at the town of Haridwar (Beg & Ali, 2008) [2].
Gang flows through the nation of India and Bangladesh. Whereas it flows southeast through the Indian states of, Bihar, Uttar Pradesh and West Bengal. After entering the West Bengal, the river Ganga is divided into the river Hooghly which is also known as Aadi Ganga which flows through several district of the West Bengal and the river Padma which flows through Bangladesh and also into the bay of Bengal. Whereas in the central Bangladesh it is joined by the Meghna and Brahmaputra rivers. From the study of the researches it is found that the plane of Ganga is one of the most fertile and densely populated regions around the world (Ansari, *et al.* 2000) [3]. The Ganga passes through some of the most populous cities of India including Kanpur, Allahabad, Varanasi, Patna, and Kolkata (Jain, 2002) [4]. The rivers are considered as a main source of resources of fresh water (Khwaja, *et al.* 2001) [5].
Industries which residing on the bank of river, discharge their waste directly in to water. However government and laws decided quality parameters of waste water discharged into river but Industries does not follow the rules properly and they are greatly responsible for the alteration of the quality of river water.

2. Materials and Methods
The latitude of Kanpur, Uttar Pradesh, India is 26.449923, and the longitude is 80.331871. Kanpur, Uttar Pradesh, India is located at India country in the *Cities* place category with the gps coordinates of 26° 26' 59.7228" N and 80° 19' 54.7356" E. Kanpur elevation is 133 meters height, that is equal to 436 feet.

3. Sampling and Analysis
Collection and analyzation of data for improvement of water quality of Ganga River in Kanpur. Analyze available data and experimental data to find the present status of river. Water samples were collected for physico-chemical analysis from the Two different sampling site at two years. As per the norms of the APHA, Wide mouth plastic bottles of one liter size, D.O bottle and sterilised 250 ml glass bottle were used for collecting the samples. These are analysed using standard methods for physiochemical examination of water (APHA, 2005) [6]. Samples were collected in two years interval in a routine manner from the all sites of river Ganges at Kanpur. Sample were analysed for following physicochemical and biological parameters viz. Temperature, pH, Dissolved Oxygen (wrinkle`s method), COD (by dichromate method), alkalinity, Chloride, Phosphate, Nitrate (Argentometric method).

4. Result and Discussions
The present study evaluates the physico-chemical status of the Ganges River at Kanpur district. The estimation of 8 parameters (Temp, pH, Alkalinity, DO, COD, Chloride, Phosphate and Nitrate) with respect to mean ± SD values for surface water quality are summarized in Tables: 1 & 2. The physico-chemical status and their mean comparison among two sites are summarized and shown graphically.

Physico -Chemical Analysis of Water
Table 1 & 2 shows data regarding Physico-chemical analysis of water which was obtained as average during the years 2015-2016, which was obtained from Industrial area (A_1 and B_1) and Commercial area (A_2 and B_2) of Kanpur (U.P. India).

Table 1: Physicochemical properties of River Ganga At Industrial Area of Jajmau, Kanpur (Average of two years 2015-2016)

S No.	Parameters	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1	Temperature	21.1 ±1.4	22.2 ±1.6	24.1 ±1.2	26.3 ±1.3	28.2 ±1.1	32.8 ±1.5	31.9 ±1.3	30.7 ±1.0	28.6 ±1.5	23.2 ±1.2	22.9 ±1.3	22.4 ±1.2
2	pH	9.0 ±0.8	8.8 ±1.0	8.4 ±1.1	8.2 ±1.0	7.8 ±0.6	7.5 ±0.5	7.8 ±0.4	8.0 ±0.3	8.4 ±0.5	8.3 ±0.6	8.6 ±0.6	8.9 ±0.8
3	Alkalinity	284 ±4.0	281 ±3.4	280 ±3.7	280 ±5.2	276 ±5.2	278 ±4.9	281 ±3.4	281 ±3.2	284 ±4.3	282 ±4.7	281 ±4.6	276 ±5.4
4	Dissolved oxygen	6.1 ±1.2	5.9 ±1.1	5.8 ±1.0	5.5 ±0.8	6.3 ±0.8	3.9 ±0.7	4.2 ±0.8	4.4 ±0.9	4.7 ±1.1	5.4 ±0.9	5.4 ±0.9	5.6 ±0.7
5	Chemical oxygen demand	109.8 ±5.4	120.0 ±4.2	132.6 ±4.1	139.6 ±4.0	142.6 ±5.1	143 ±0.8	136.6 ±4.1	139.4 ±4.2	130.4 ±5.3	121.6 ±5.0	120.9 ±5.5	109.0 ±5.2
6	Chloride (mg/L)	70.7 ±1.1	71.7 ±1.3	69.5 ±0.8	63.7 ±1.4	55.8 0.8	52.4 ±1.4	51.1 ±0.7	44.2 ±0.7	50.5 ±0.8	53.1 ±0.9	55.4 ±0.8	70.5 ±1.2
7	Phosphate	0.825 ±0.3	0.854 ±0.7	0.854 ±0.5	0.875 ±0.2	0.975 ±0.2	1.10 ±0.08	0.958 ±0.09	0.942 ±0.13	0.921 ±0.04	0.885 ±0.03	0.845 ±0.03	0.824 ±0.03
8	Nitrate	0.915 ±0.5	0.935 ±0.3	0.949 ±0.3	0.956 ±0.1	0.962 ±0.1.	1.50 ±0.07	1.45 ±0.07	1.22 ±0.02	1.12 ±0.02	1.01 ±0.03	0.900 ±0.03	0.854 ±0.01

Table 2: Physicochemical properties of River Ganga At Commercial Area of Bithoor, Kanpur (Average of two years 2015-2016)

S No.	Parameters	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1	Temperature	20.9 ±1.4	22.0 ±1.6	23.8 ±1.2	26.1 ±1.3	27.6 ±1.1	32.0 ±1.5	30.0 ±1.3	29.5 ±1.0	28.1 ±1.5	23.1 ±1.2	22.1 ±1.3	22.2 ±1.2
2	pH	8.5 ±0.8	8.3 ±1.0	8.0 ±1.1	7.5 ±1.0	7.4 ±0.6	7.4 ±0.5	7.5 ±0.4	7.7 ±0.3	7.9 ±0.5	8.0 ±0.6	8.2 ±0.6	8.3 ±0.8
3	Alkalinity	274 ±4.0	270 ±3.4	265 ±3.7	266 ±5.2	260 ±5.2	266 ±4.9	270 ±3.4	271 ±3.2	278 ±4.3	274 ±4.7	272 ±4.6	265 ±5.4
4	Dissolved oxygen	7.1 ±1.2	6.9 ±1.1	6.9 ±1.0	6.4 ±0.8	7.2 ±0.8	5.3 ±0.7	5.3 ±0.8	5.4 ±0.9	5.7 ±1.1	6.4 ±0.9	6.5 ±0.9	6.7 ±0.7
5	Chemical oxygen demand	99.8 ±5.4	110.0 ±4.2	122.6 ±4.1	128.6 ±4.0	133.6 ±5.1	133 ±0.8	126.6 ±4.1	128.4 ±4.2	119.4 ±5.3	112.6 ±5.0	109.9 ±5.5	98.0 ±5.2
6	Chloride (mg/L)	65.0 ±1.1	66.5 ±1.3	64.2 ±0.8	59.5 ±1.4	52.1 0.8	48.2 ±1.4	46.3 ±0.7	41.6 ±0.7	46.1 ±0.8	48.2 ±0.9	52.1 ±0.8	66.2 ±1.2
7	Phosphate	0.815 ±0.3	0.834 ±0.7	0.848 ±0.5	0.855 ±0.2	0.960 ±0.2	0.988 ±0.08	0.942 ±0.09	0.905 ±0.13	0.904 ±0.04	0.869 ±0.03	0.832 ±0.03	0.800 ±0.03
8	Nitrate	0.814 ±0.5	0.833 ±0.3	0.848 ±0.3	0.855 ±0.1	0.961 ±0.1.	1.00 ±0.07	0.944 ±0.07	0.912 ±0.02	0.900 ±0.02	0.880 ±0.03	0.833 ±0.03	0.801 ±0.01

Temperature

It is an important factor which influence the biochemical, chemical and biological characteristic of the aquatic system (Rice *et al* 2012)[7]. The present investigation reveals that the temperature varied from a minimum in January and to maximum in June in both industrial and commercial area. Whereas the temperature of industrial area was comparatively higher as compared to commercial area. It was found that the temperature was maximum in the month of June was 32.8°C (Industrial area) and minimum value was 20.9°C in the month of January (Commercial area) of Kanpur.

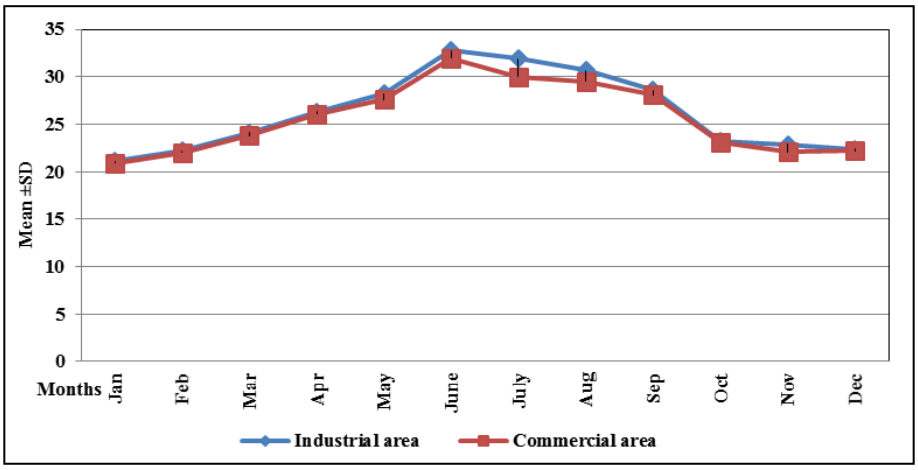

Fig 1: Temperature at the Ganga River at Kanpur (Industrial and Commercial area)

pH

The adverse effect of most of the acids appears below 5 and alkalis above the pH 10.0. Most of the biochemical and chemical reactions are influence by the pH which is of more practical importance. The pH values were significantly higher in March to May and September, November and December with the highest value. The pH observed about 9.0 in the month of January and 7.5 in the month of June in the industrial area. The pH value of water at sewage discharge points were usually lower than that of the river water (Agrawal *et al.* 2009 and Sukumaran *et al.* 2014) [8, 9].

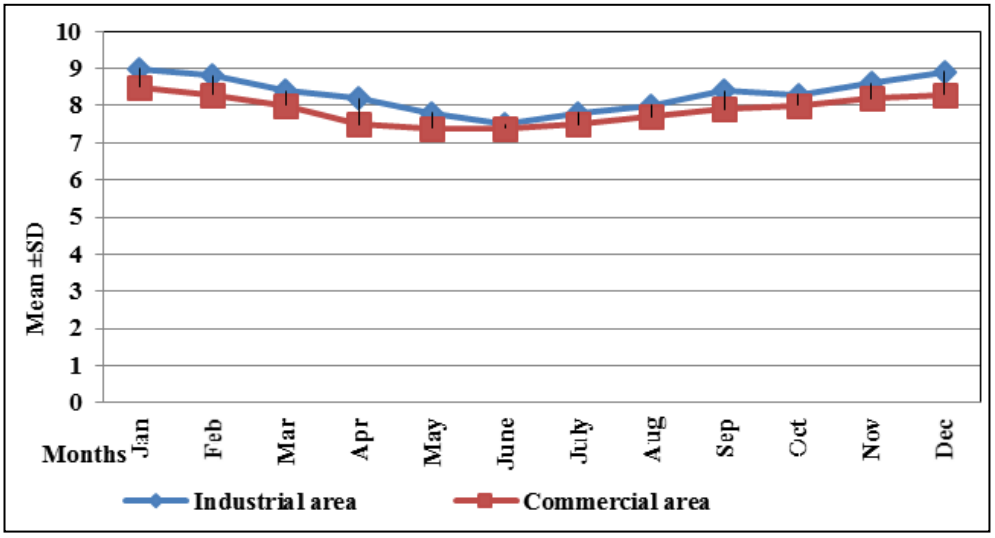

Fig 2: pH at the Ganga River at Kanpur (Industrial and Commercial area)

Alkalinity

It constitutes an important factor in determining the quality of the river water. A variation in alkalinity values were recorded as a minimum of 276 in the month of December and May in the industrial area and 260 in the month of May in the commercial area. Furthermore the total alkalinity was higher near the industrial are due to the injection of untreated waste into the river. The high values of alkalinity may also be due to increase in free carbon dioxide in the River Ganges which ultimately results in the increase in alkalinity at site 3 & site 4 (Singh, 2010 and Praveen *et al.* 2013)[10, 11].

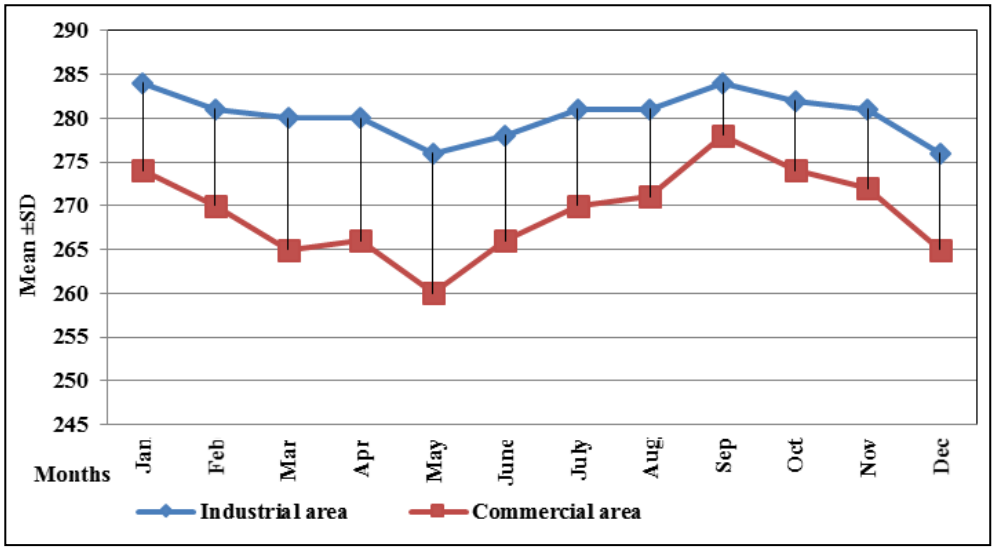

Fig 3: Alkalinity at the Ganga River at Kanpur (Industrial and Commercial area)

Dissolved Oxygen

Dissolved oxygen data are valuable in determining the water quality criteria of an aquatic system. It constitute a important factor in determining the quality of water. Temperature play a important role in determining the quality criteria of water of an aquatic system. In the system where the rate if respiration and organic decomposition are high, the DO values remain lower than those of the system where the rate of photosynthetic activity is high (Verma *et al.* 2017) [12]. The temperature also plays an important role in determining DO of an aquatic system. A high pollution load may also decrease the DO values to considerable level. The values of DO were always lower in the industrial area in all month as compared to the commercial area. The lower value of DO during summer may be attributed to the high temperature and its consumption due to the activities and

growth of the microorganisms. The DO value range from a minimum of 3.9 mg/L in the month June and maximum of 5.9 mg/L in the month of June. The DO value of the commercial area was more than as compared to the industrial area.

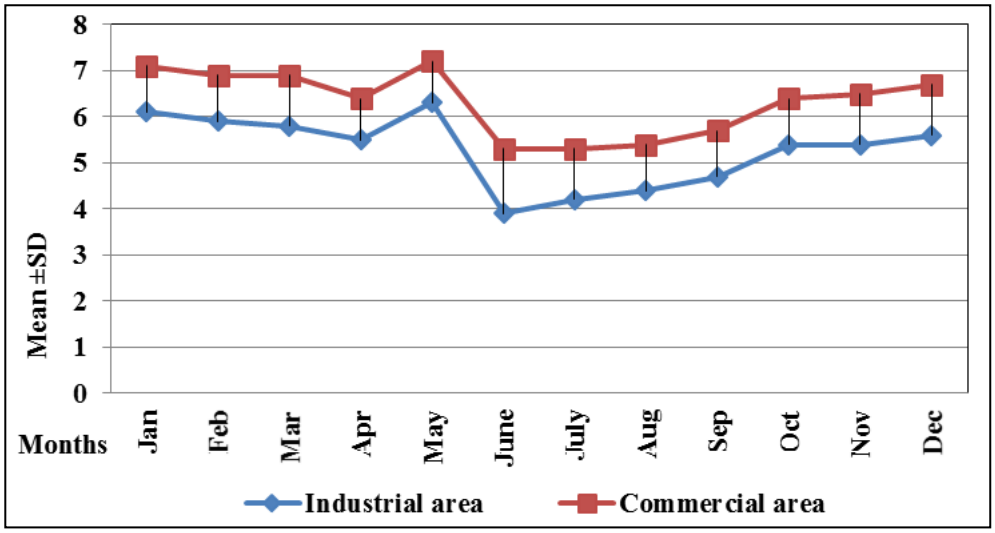

Fig 4: Dissolved Oxygen at the Ganga River at Kanpur (Industrial and Commercial area)

Chemical Oxygen Demand

The value of COD also gives the qualitative and quantitative information about the pollution load present in the water. COD determines the amount of oxygen required for the chemical oxidation of organic load using a strong chemical oxidant such as potassium dichromate under the reflux conditions. The COD values were always higher at the industrial area as compared to commercial area. The COD value achieve a maximum in the month of June of 143 mg/L and minimum of 109.8 in the month of January. The highest values of COD indicate that most of the pollution in study zone in caused by industrial units like carpet industry, metal industry and automobile industries etc. (Singh *et al.* 2012 and Singh, 2013)[13, 14].

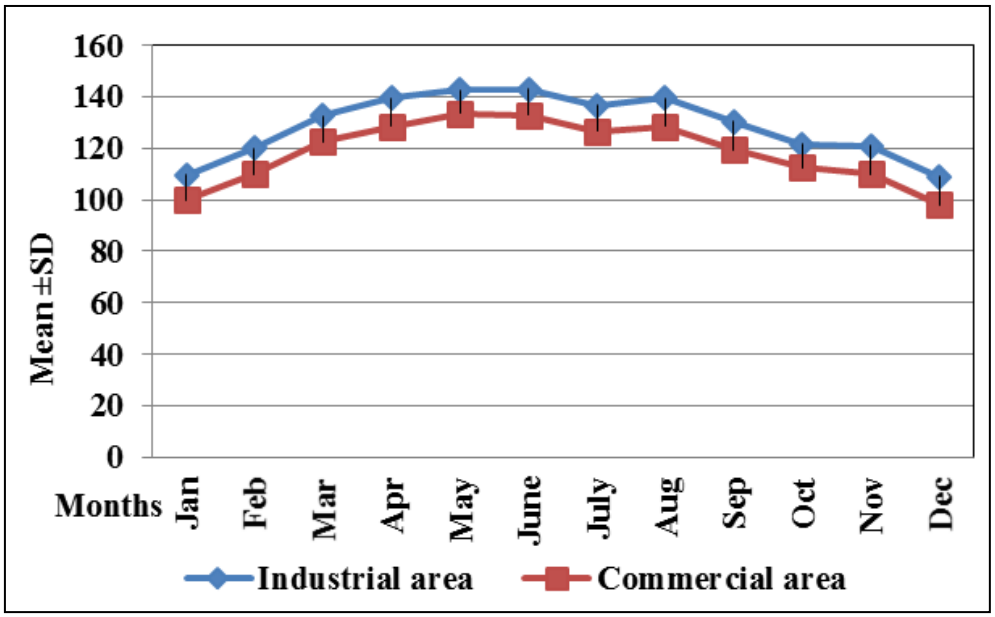

Fig 5: COD at the Ganga River at Kanpur (Industrial and Commercial area)

Chloride

It is a major inorganic anion present in the water and waste water. The values of chloride were always higher in the rainy season. The chloride content shows variation with range of maximum of 71.7 mg/L in February and a minimum of 44.2 mg/L in August. Chlorides in River Ganges waters can be attributed to discharge of local effluents or domestic sewage disposal at different points which may result in moderate increase in levels of chlorides (Mishra, 2010) [15]

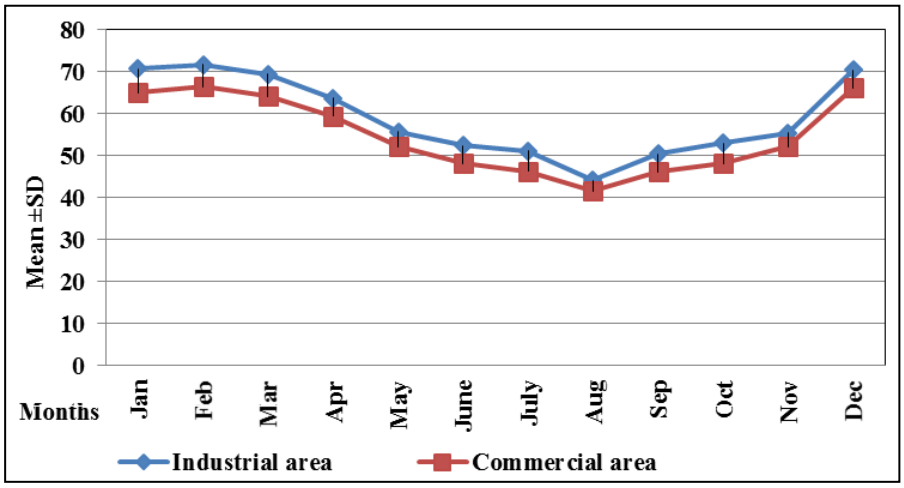

Fig 6: Chloride at the Ganga River at Kanpur (Industrial and Commercial area)

Phosphate

Phosphate is an important plant nutrient and play a role of limiting factors among all other plant nutrients so its determination s useful. The maximum nitrate value was found 1.10 mg/L at the industrial area and minimum of 0.800 in the commercial area.

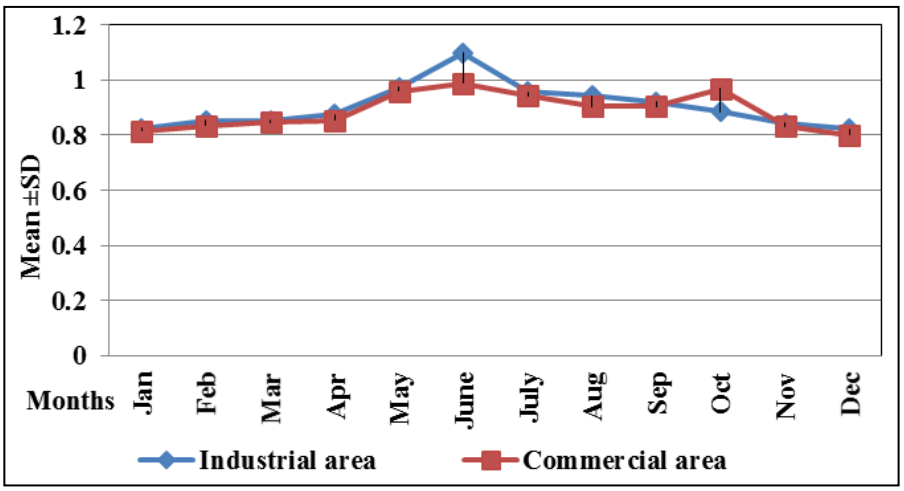

Fig 7: Phosphate at the Ganga River at Kanpur (Industrial and Commercial area)

Nitrate

It represents the end product of oxidation of Nitrogenous matter and its concentration depends on the denitrification and nitrification activities of microorganisms. The recorded values were significantly higher in July to September and January. The maximum nitrate value was found 1.50 mg/L at the industrial area and minimum of 0.801 in the commercial area.

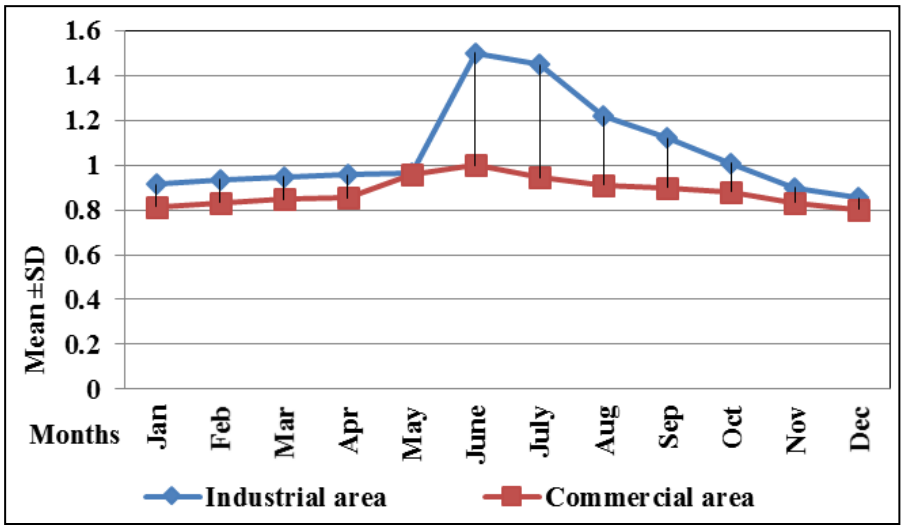

Fig 8: Nitrate at the Ganga River at Kanpur (Industrial and Commercial area)

5. Conclusion

The temperature values were significantly higher in April to July and lower in October to December. The pH values were significantly higher in March to May and September, November and December with the highest value. Alkalinity constitutes an important factor in determining the quality of the river water. Furthermore the total alkalinity is higher near the industrial were due to the injection of untreated waste into the river as compared to the commercial area located near the river bank of the river Ganga. The values of DO are always lower in the industrial area in all month as compared to the commercial area. The lower value of DO during summer may be attributed to the high temperature and its consumption due to the activities and growth of the microorganisms. it was concluded that the COD values were always higher at the industrial area as compared to commercial area. The COD value achieves a maximum in the month of June and minimum in the month of January. A very little variation exists between the phosphate concentration during the entire months of a particular period i.e. either 2015 or 2016 in the entire commercial area and the industrial area.

6. References

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