WATER QUALITY INDEX OF GANGA RIVER IN KANPUR, UP, INDIA

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Abstract: Ten important physico-chemical parameters were estimated to ascertain the seasonal effects on the water quality of Ganga river in Kanpur area. Weighted water quality index was developed from estimated parameters over two seasons to quantify the changes if any in portability of water. Physico-chemical parameters were, pH, TDS, chlorides, nitrate, sulphate, phosphate, alkalinity, hardness, BOD and DO. Minimum value of phosphate was observed in summer season i.e. 0.54 mg/L while maximum in rainy season i.e. 0.72 mg/l. Value of sulphate concentration ranged within 32.9- 45.5 mg/l. Dissolved oxygen varied from 5.6 – 4.9 mg/l. BOD values are 20 - 23 mg/l above the prescribed limits.

Keywords: Physico-Chemical parameters, Water Quality Index, Gangariver.

I. INTRODUCTION

Kanpur is known as industrial town of UP with large number oftanneries and cotton mills. These industries are major source of pollutionforwater of Ganga river. This river is life line of Kanpur as water is used for domestic, agriculture as well as forindustrial purposes. An effective maintenance of water quality is required via most appropriate measurements. Water quality monitoring has been identified as one with the highest priorities in environmental protection policy.More over the quality of water is defined in terms of its physico-chemical parameters. Several references in literaturehighlighted the water quality index as an appropriate measure of water quality for international and Indian rivers (Bora and Goswami 2016Samantray et al. 2009; Sharma and Kansal2011; Alam and Pathak2010; Sebastian and Yamakanamardi2013; Seth et al. 2014; Tyagi et al. 2013; Bhutiani et al. 2014; VishnuRadhan et al. 2015; Yadav et al. 2015; Dash et al. 2015; Krishnan et al. 2016; Kaviarasan et al. 2016). The main purpose of developing a WQI is to transform a complex set of water quality data into lucid and exploitable information by which a layman can know the status of the water source (Balan et al. 2012). WQI aims at giving a single value to the water quality of a source by translating the list of parameters and their concentrations present in a sample into a single value, which in turn provides an extensive interpretation of the quality of water and its suitability for various purposes like drinking, irrigation, fishing etc. (Abbasi2002).

(WQI) offers a useful representation of overall water quality of for public consumption as well as for any intended use. WQI reflects a composite measure reflecting influence of individual quality characteristics [Horton (1965). The physicochemical parameters of river water were estimated over two seasons i.e. rainy and summerin Kanpur. This index (WQI) provides a single number that express overall water quality at a certain location and time, based on considered several water quality parameters.

II. METHOD AND MATERIAL

Standards of drinking water quality recommended by the World Health Organization (WHO), Bureau of Indian Standards (BIS) and Indian Council for Medical Research (ICMR) had been utilized for this study. Important physico-chemical parameters were estimated byapproved procedures of APHA (2005).

Parameters	Abbreviations	Units	Analytical methods
Temperature	Water temperature	0^C	Centigrade thermometer
TH	Total hardness	mg/l	E.D.T.A
pH	Hydrogen Ion Concentration	pH unit	pH meter
DO	Dissolved Oxygen	mg /l	Winkler's Azide modification method
BOD	Bio-Chemical Oxygen Demand	mg /l	Dilution technique and seeding technique
COD	Chemical Oxygen Demand	mg /l	Open reflux method
Cl	Chloride	mg/l	Argentometric method
PO_4	Phosphate	mg/l	Stannous Chloride method
NO_3	Nitrate	mg/l	Phenol - di - sulphuric acid method
NH_4	Ammonia	mg/l	Nesslerization method
SO_4	Sulphate	mg/l	Turbidity method

`n` parameters were considered for this studyto findwater quality index and quality rating of nth parameterdenoted by q_n; which reflects the relative value of n-th parameter in the polluted water as compared to standard permissible value and calculated as :

$q_n = 100 [(V_n - V_{io}) / (S_n - V_{io})]$

q_n =Quality rating for the nth water quality parameter;

V_n = Estimated value of nth parameters at a given sampling station;

S_n = Standard permissible value of the nth parameters;

V_{io} = Ideal value of nth parameters in pure water. i.e. 7.0 for pH, 14.6 mg/l for DO and 0 for all other parameters and Ideal value of pH is 7.0 where 8.5 is the permissible value of water (i.e. polluted water), quality rating for pH is calculated as $q_{pH} = 100 [(V_{pH} - 7) / (8.5 – 7)]$; V_{pH} = observed value of pH.Quality rating of DO calculated as $Q_{DO} = 100 [(V_{DO} – 14.6 / (5 – 14.6)]$

Calculation of unit weight: $W_n = K / S_n$

$W_n$andS_n are unit weight and standard value for the nth parameter with K as constant of proportionality. The water quality Index was calculated as $WQI = \sum q_n W_n / \sum W_n$

III. RESULTS AND DISCUSSION

Table 3 showed the estimated values of physicochemical parameters as well as water quality index. Water quality indexshowed large variation with changes in seasons of studied period i.e. rainy season and winter season are **193.5**and **211.9**respectively, which very much supported the poor quality of scared water in the studied area[9]. This in turns supported by estimated values of physicochemical parameters of the study. The TDS values observed in the range 450.2 to 559.8 mg/lslightly above the prescribed limits of ICMR and ISI i.e. 500mg/l. The pH of the water indicates as an alkaline nature it varies between 8.1 and 8.3. The recommended value of it by ISI is 6.5 to 8.5 and by ICMR 7.0 – 8.5. Higher chlorides concentrationinduces salty taste of water and sometime higher concentration responsible for laxative effect to the human beings. The concentration of chloride varied between 24.4 – 27.1 mg/l which were quite below the prescribed limits of WHO. The nitrates are the end product of the decomposition of organic waste present in the fully oxidized water and had harmful effects at values more than 45 mg/L.The present study observed lower levels of nitrate in the water well below the cited permissible limits.

The average statistic vis-à-vis seasonsshowed maximum hardness value in summer season i.e. 388.2 while maximumBOD in rainy season reached to 23. These estimated values were higher than prescribed limits. Sulphatemay have laxative effect if coupled with equivalent concentration of magnesium ion [9]. The value of sulphate concentration ranged within 32.9- 45.5 mg/l.The present study estimated sulphate concentration well below permissible limits. The alkalinity up to 120mg/lfor domestic supply of water is not harmful to the human beings though higher limitsseen during study period. The total alkalinity values were within the 162 – 183.8 mg/L. The hardness values were recorded as 311 – 388 mg/l, higher value of hardness were observed during summer which may be due to the low water level, this values are above the desired limits of WHO (< 300mg/L) dissolved oxygen varied from 5.6 – 4.9 mg/l .The BOD values are 20 - 23 mg/l above the prescribed limits indicates highly pollutedwater.

CONCLUSION

WQI showed the seasonal effects in the present study as difference observed in water quality with changes in season. Index in the summer are lesser than rainy season due to obvious reasons. WQI ranged between 359 and 405 as ascertained extremely poor-quality water, not even suitable for agricultural as well as industrial use. The drinking use is recommended only after through suitable treatment.

ACKNOWLEDGMENTS

The authors are grateful to the Principal, Christ College Kanpur India, for providing the all the required facilities to complete the study.

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Table 1:Water quality rating for drinking & other purposes

WQI level	Grading	Water quality rating	Possible water use
0-25	A	Excellent	All purpose like potable, industrial, agricultural
26-50	B	Good	Domestic & Agricultural
51-75	C	Poor	Agricultural & Industrial
76-100	C	Very poor	Agricultural
>100	E	Unfit for drinking	Not useful even for agricultural purpose

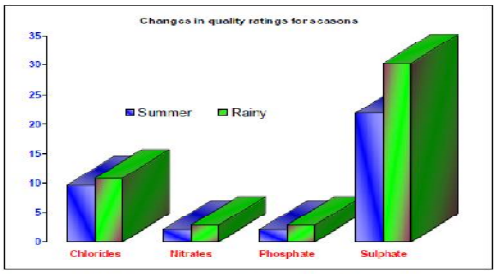
Table 2: Drinking standard recommended by agencies and unit weights

Parameters	Standard (S_n)	Recommended agency	Unit weight(W_n)
TDS	500	ICMR	0.0037
pH	7-8.5	ICMR/BIS	0.2190
Chlorides	250	ICMR	0.0074
Nitrates	45	ICMR	0.0412
Phosphate	25	ICMR	0.0618
Sulphate	150	ICMR	0.0103
Alkalinity	120	ICMR	0.0155
Hardness	300	WHO	0.0051
BOD	5	ICMR	0.3723
DO	5	ICMR	0.3088

Values are expressed in mg/L

Table 3: Variation in Water quality index for Ganga river

			Summer	Rainy		Summer		Rainy	
Parameters	Standard (S_n)	Recommended agency	Observed value	Observed value	Unit weight (W_n)	Quality Rating(q_n)	W_nq_n	Quality Rating (q_n)	W_nq_n
TDS	500	ICMR	450.16	559.83	0.0037	90.032	0.3331	111.966	0.4143
pH	7-8.5	ICMR/BIS	8.33	8.05	0.2190	88.66667	19.4180	70.00	15.3300
Chlorides	250	ICMR	24.38	27.07	0.0074	9.752	0.0722	10.828	0.0801
Nitrates	45	ICMR	0.95	1.29	0.0412	2.111111	0.0870	2.866667	0.1181
Phosphate	25	ICMR	0.54	0.72	0.0618	2.16	0.1335	2.88	0.1780
Sulphate	150	ICMR	32.93	45.52	0.0103	21.95333	0.2261	30.34667	0.3126
Alkalinity	120	ICMR	162.30	183.8	0.0155	135.25	2.0964	153.1667	2.3741
Hardness	300	WHO	388.16	311.42	0.0051	129.3867	0.6599	103.8067	0.5294
BOD	5	ICMR	20.18	23.00	0.3723	403.60	150.2603	460.00	171.2580
DO	5	ICMR	5.62	4.99	0.3088	93.54167	28.8857	100.1042	30.9122
		Total of unit weights ΣW_n			1.0451		202.17		221.51
WQI				$\Sigma W_nq_n/\Sigma W_n$			193.45		211.95



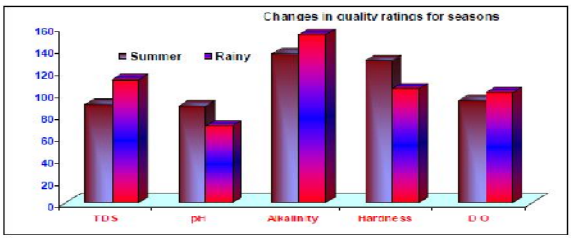
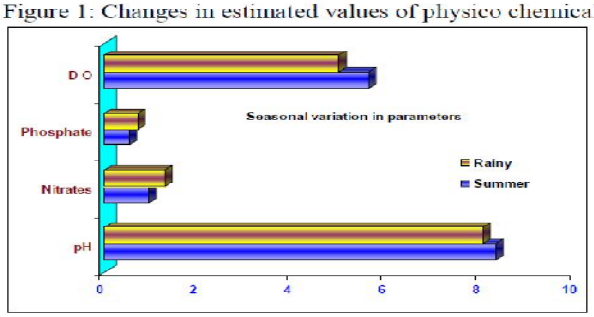
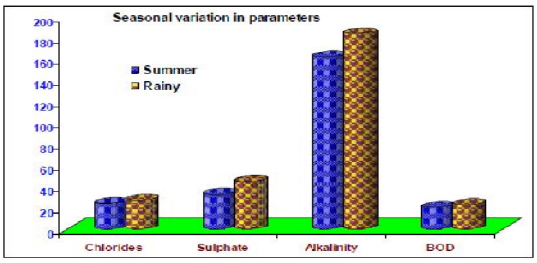


Figure 1: Changes in estimated values of physico chemical parameters





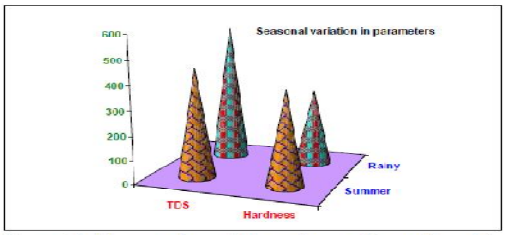


Figure 2: Seasonal variations in quality rating of water quality parameters