International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 09 | Sep -2017 www.irjet.net p-ISSN: 2395-0072

EVALUATION OF WATER QUALITY OF KHARUN RIVER STRETCH NEAR THE RAIPUR CITY

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Abstract - In the same means that no 2 human bodies are alike, no 2 bodies of water are a similar. Ponds across a street from one another will usually have completely different physical and chemical characteristics even supposing they're separated by solely some feet. Very similar to tests performed at a doctor's workplace, skilled environmentalists will use water quality parameters to assess the health of a water body and confirm what every specific water body may have. Water is vitally important to each facet of our lives. Observance of the quality of surface water can facilitate defend our waterways from pollution. Water quality problems influence human and environmental health, therefore the more we monitor our water the better we will be able to recognize and prevent contamination issues. The assessment of water quality of Kharun River becoming important because of various reasons. So many studies have suggested the water quality improvement programs for the Kharun River. Still the Kharun river has been neglected. In the present study, it is found that the river stretch near the Jamrao has severely polluted whereas the river stretch found of good quality near Jheet ufra area.

Key Words: Water quality, physico-chemical assessment, physico-chemical parameters, Water pollution, Kharun River

1.INTRODUCTION

Rivers are the utmost important water resources for domestic, industrial and irrigation purposes. Importance of water, in maintaining a healthy as well as a prosperous nation in healthy environment is understood from the existence of the civilization on this globe. Water resources are primarily accustomed satisfying the daily desires of living world in and around them. The stream receives domestic and different wastes frequently. The largest source of water pollution in India is untreated sewage. Other sources of pollution include agricultural runoff and unregulated small scale industry. Rivers have transitioned from being the arteries of this life supporting system to changing into the stagnant storehouses of our development waste, that has led a few rivers to even stop flowing. Environmental Flows as a concept evolved for this very crisis management, which brings in the voices of the voiceless backed by the developments in the scientific understanding of our ecosystem.

The assessment of water quality of Kharun River becoming utmost important because of various reasons like rapid urbanization, agricultural and industrial waste, sewage water comprises of domestic, medical and other wastes due to anthropogenic activities. Open defecation is another reason behind the pollution of river water. More than a half of the population living near the river defecates in open and takes bath in the river bank. Rapid urbanization and industrialization have pessimal contribution to the polluted state of Raipur city, because of which it gained third rank in the list of polluted cities of India. . Raipur's 'Smart City' proposal document mentioned that the Kharun river is being threatened by pollution from the industries which are on the outskirts of the city. Raipur is the major commercial center and upcoming business hub of Chhattisgarh. Thus, the Kharun River stretch was selected for the study.

Surface water inflow into the State of Chhattisgarh (India) is through four major interstate rivers Ganga, Mahanadi, Godavari, and Narmada. The river waters are utilized for irrigation, urban water supply and aquaculture. The estimated surface water available for use is around 41,720 Million Cubic Meter (MCM). In Chhattisgarh, surface water is mostly of good quality, but pollution is increasing in major towns due to increasing urbanization. Rivers such as Shivnath, Hasdeo, Indrawati, Kharun etc. are found to be polluted at different stretches due to industrial, domestic and agricultural pollution.

2. MATERIALS AND METHODS

2.1 Study area

Kharun river basin forms a part of Seonath (A tributary of Mahanadi) river basin. It is situated inside the Seonath basin of well-known Mahanadi river basin in Chhattisgarh. It is a non-perennial river, originating from village Petechua of Balod Tehsil in the south-east of Durg district and after flowing about 164 km joins Seonath river near Somnath in the north. The total catchment area of Kharun river is 4191 km^2, lying upstream to the point where the river merges with Seonath river and is situated between

the geographical co-ordinates 20°33'30" - 21°33'38"N latitude and 81°17' 51" E - 81°55' 25" E longitude.

2.2 Sampling and Analysis

The study area for the Kharun river water quality assessment was taken along its stretch of 25 kilometers, depending upon the site conditions, the importance of the site and access to those sites for sampling purpose. For the water sampling of Kharun river in Raipur, total 7 locations (named as in Table 2.1) were fixed along the stretch falling under the urban area. Depending upon the site conditions, Kharun river stretch is divided into multiple stretches. Each of the stretch is identified with all point sources which can be industrial effluent outfalls, domestic sewage outfalls etc. Characterization is done by sample collection and analysis. The water samples were collected for three seasons viz., Summer, Post-monsoon, Winter, and samples were analyzed for 13 physicochemical parameters. The parameters like pH, Electrical conductivity and Dissolved oxygen, TDS were monitored on site using portable measuring devices and other parameters were analyzed in the laboratory. Water samples were collected in stopper fitted polyethylene bottles and refrigerated at 4°C in order to be analyzed as soon as possible.

Table 2.1: List of Sampling locations

Location	Notation
Near Jheet ufra	RK1
Near Raweli	RK2
Near Jamrao	RK3
Near Mundara	RK4
Near kathadih	RK5
Near Gughwa Ufra	RK6
Near Keshav Farms	RK7

The water samples were analyzed for the following 13 water quality parameters: (1) pH (2) Electrical Conductivity (EC) (3) Total dissolved solid (TDS) (4) Turbidity (5) Total Alkalinity (6) Total Hardness (7) Dissolved oxygen (DO) (8) Chemical oxygen demand (COD) (9) Biochemical oxygen demand (BOD). (10) Sulfate (11) phosphorous (12) Ammonia nitrogen (13) Nitrate nitrogen.

pH of the water sample was carried out using Thermo Scientific Orion Star 3-Star Plus benchtop meter. The DO, EC, TDS of the water sample were evaluated using Hach HQ30d portable multiparameter meter with their respective probes. The turbidity of water sample was measured using Hach 2100P IS Portable turbidimeter. Alkalinity of sample is determined by titration method, whose procedure is in accordance to Central Pollution Control Board (CPCB) guide manual for water and waste-water analysis. Hardness is determined by the EDTA method. The Chemical Oxygen demand of the water sample is determined using titrimetric and colorimetric method using COD digester. The concentration of Ammonia Nitrogen is determined using Ammonium Probe. The concentration of Nitrate Nitrogen in water is determined using Cadmium Reduction Method. The sulfate concentration is determined by SulfaVer4 Hach method. The total phosphate concentration is determined by Acid Persulfate digestion method.

3. RESULTS AND DISCUSSION

The water samples from the Kharun River are collected and analyzed for different water quality parameters during different seasons. The results are shown in tables 3.1, 3.2 and 3.3.

The pH of water samples of seven monitoring stations is measured for three seasons viz., summer, post-monsoon and winter. It was observed that although there is slight variation in pH, but it is within the prescribed limits. The results of pH varied from 6.98 to 8.3 (Chart - 3.1) may be due to joining of untreated municipal sewage with the river water, the pH indicates that the water samples are almost neutral to sub-alkaline in nature. The average value for Kharun river found 7.64. The highest pH value 8.3 was observed in RK1 sample in summer.

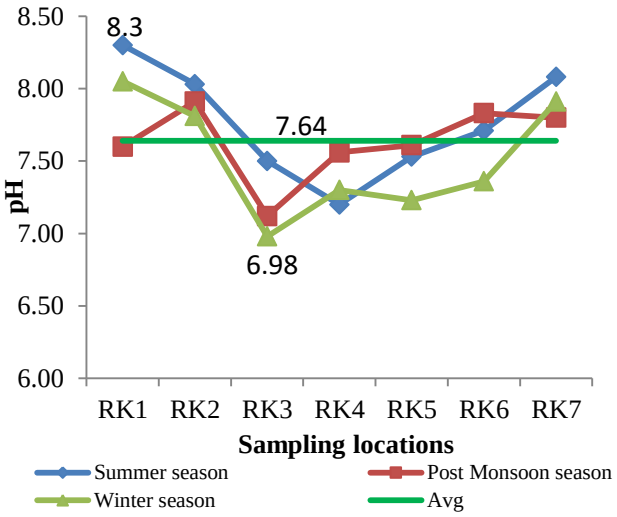
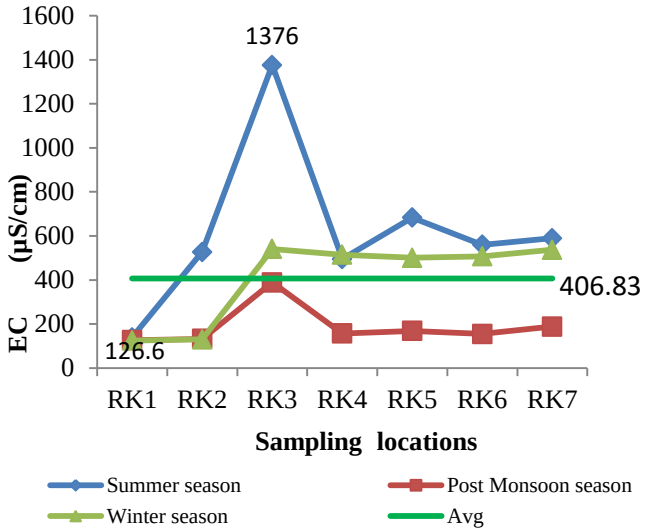


Chart - 3.1: Seasonal Variation of pH



The EC value is an index that represents the concentration of soluble salts in water. The EC variation is shown in chart - 3.2. The highest value 1376µS/cm is found in RK3 sample during summer season may be due to low flow during summer and inflow of a wastewater nallah near the site and lowest value 126.6 µS/cm found at RK1 site. The average EC 406.83 µS/cm of all the samples and of all the seasons found greater than the prescribed limit.

Chart - 3.2: Seasonal Variation of EC

Table 3.1: Concentrations of water quality parameters of Kharun River for Summer season

Sr. No.	Parameters	Sampling sites							Min	Max	Mean	SD	CV%
		RK1	RK 2	RK3	RK4	RK5	RK6	RK7					
1	pH	8.3	8.03	7.5	7.2	7.53	7.71	8.08	7.2	8.3	7.76	0.39	5.00
2	EC (µS/cm)	138.8	527	1376	495	683	559.4	589.2	138.8	1376	624.06	373.24	59.81
3	TDS (mg/L)	69.3	77.9	433	326.8	329.4	281.3	295	69.3	433	258.96	135.65	52.38
4	Alkalinity (mg/L as CaCO3)	61.1	85	357	208	183.5	187.7	143.9	61.1	357	175.17	97.03	55.39
5	Hardness(mg/L as CaCO3)	56.8	143	276	281	157	183.1	183.5	56.8	281	182.91	77.95	42.61
6	COD (mg/L)	8	12	88	49	68	43	21	8	88	41.29	29.82	72.23
7	BOD (mg/L)	7.5	9.3	43.3	22.6	43.4	28.3	9.8	7.5	43.4	23.46	15.58	66.44
8	DO (mg/L)	8.7	8.1	1.7	7.7	5.3	6.9	10.7	1.7	10.7	7.01	2.87	40.85
9	Sulfate (mg/L)	0.3	1.3	4.9	5.6	7.9	7.7	23.4	0.3	23.4	7.30	7.67	105.13
10	Ammonical Nitrogen(mg/L)	0.13	1.66	24.4	10.3	10.7	2.2	1.9	0.13	24.4	7.33	8.67	118.37
11	Nitrate Nitrogen (mg/L)	0.6	1.9	9.3	2.3	1.6	3.6	1.5	0.6	9.3	2.97	2.94	98.80
12	Phosphorous (mg/L)	0.27	3.56	0.4	2.33	2.73	2.81	1.13	0.27	3.56	1.89	1.29	68.16
13	Turbidity (NTU)	6.6	3.77	17.9	5.3	11.2	0.7	5.1	0.7	17.9	7.22	5.67	78.48

Table 3.2: Concentrations of water quality parameters of Kharun River for Post - monsoon season

Sr. No.	Parameters	Sampling sites							Min	Max	Mean	SD	CV%
		RK1	RK2	RK3	RK4	RK5	RK6	RK7					
1	pH	7.6	7.91	7.12	7.56	7.61	7.83	7.8	7.12	7.91	7.63	0.26	3.44

2	EC (µS/cm)	126.6	132.1	389.3	157	169.1	155.3	188.7	126.6	389.3	188.30	91.11	48.38
3	TDS (mg/L)	88.1	88.3	253	101.7	105	101.9	128.7	88.1	253	123.81	58.56	47.29
4	Alkalinity (mg/L as CaCO3)	89.2	93	213	101	108	103	108	89.2	213	116.46	43.16	37.06
5	Hardness(mg/L as CaCO3)	84	99	178	99	104	99.2	117	84	178	111.46	30.90	27.72
6	COD (mg/L)	3	6	35	28	30	21	13	3	35	19.43	12.39	63.79
7	BOD (mg/L)	3.3	4.5	19	12.7	19.8	13.4	5.8	3.3	19.8	11.21	6.81	60.74
8	DO (mg/L)	7.3	6.9	1.3	8.4	6.7	8.3	7.7	1.3	8.4	6.66	2.45	36.79
9	Sulfate (mg/L)	1	1	9.3	1.7	2.4	2.3	2.6	1	9.3	2.90	2.90	99.86
10	Ammonical Nitrogen(mg/L)	0.21	0.27	6.2	0.69	0.79	0.5	0.33	0.21	6.2	1.28	2.18	169.61
11	Nitrate nitrogen (mg/L)	1.5	1.1	3.5	1.4	1.4	1.2	1.9	1.1	3.5	1.71	0.83	48.27
12	Phosphorous (mg/L)	0.22	3.51	0.4	2.66	2.97	3.44	1.38	0.22	3.51	2.08	1.40	67.32
13	Turbidity (NTU)	7.6	1.4	6.7	3	5.2	1.8	6.3	1.4	7.6	4.57	2.49	54.54

Table 3.3: Concentrations of water quality parameters of Kharun River for Winter season

Sr. No.	Parameters	Sampling sites							Min	Max	Mean	SD	CV%
		RK1	RK2	RK3	RK 4	RK 5	RK6	RK7					
1	pH	8.05	7.81	6.98	7.3	7.23	7.36	7.91	6.98	8.05	7.52	0.40	5.34
2	EC (µS/cm)	125.2	130.1	541	515	501	507.6	537	125.2	541	408.13	192.16	47.08
3	TDS (mg/L)	61.9	65.5	278.6	263	267	259	261.5	61.9	278.6	208.07	98.83	47.50
4	Alkalinity (mg/L as CaCO3)	53.1	54	165	187	173	177	131	53.1	187	134.30	57.87	43.09
5	Hardness(mg/L as CaCO3)	54	63	163	157	155	166.3	161	54	166.3	131.33	49.96	38.04
6	COD (mg/L)	4	10	74	41	53	34	19	4	74	33.57	24.87	74.07
7	BOD (mg/L)	4.5	7.8	33.6	19.5	30.5	22.6	8.8	4.5	33.6	18.19	11.50	63.24
8	DO (mg/L)	9.2	8.7	0.9	6.5	5.4	7.9	12.9	0.9	12.9	7.36	3.71	50.39
9	Sulfate (mg/L)	0	1.4	4.5	4.7	7.1	7.5	23	0	23	6.89	7.62	110.61
10	Ammonical Nitrogen(mg/L)	0.117	0.149	3.8	2.89	3.1	2.59	1.42	0.117	3.8	2.01	1.47	72.96
11	Nitrate nitrogen (mg/L)	0.45	1.6	7.8	2.8	1.7	2.2	0.9	0.45	7.8	2.49	2.47	98.92
12	Phosphorous (mg/L)	0.2	3.2	0.33	2.49	2.77	2.61	1.28	0.2	3.2	1.84	1.23	66.61
13	Turbidity (NTU)	5.3	3	16.2	4.9	10.7	0.96	4.4	0.96	16.2	6.49	5.21	80.28

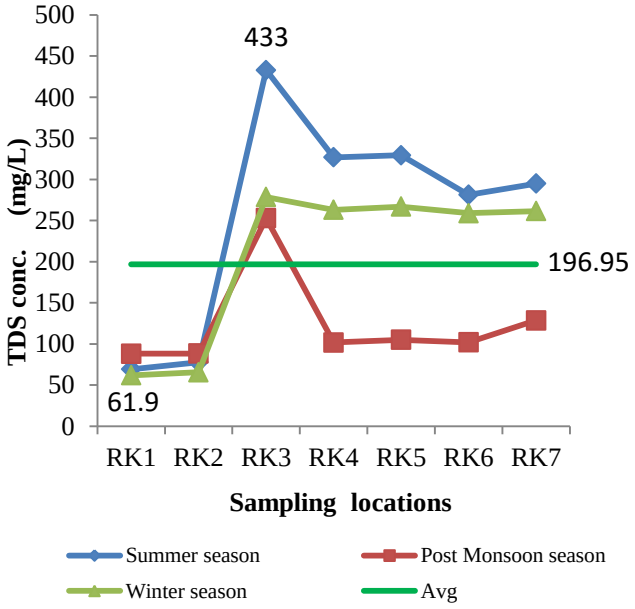


Chart – 3.3: Total dissolved solids

A high concentration of dissolved solids greatly affects the taste of the drinking water. The observed values of TDS nowhere exceeded the prescribed limits. The variation is shown in Chart-3.3. The highest value 433 mg/L is found for RK3 sample during summer season and lowest value 61.9 mg/L is found in RK1 sample in winter. The average value for Kharun River found 196.95 mg/L which is below the limit. Comparatively the highest values are found during summer season because of reduction in water flows during summer. TDS during each season were almost same for samples of RK4, RK5, RK6 and RK7.

The alkalinity of water is its capacity to neutralize acid. The amount of a strong acid needed to neutralize the alkalinity is called the total alkalinity. The observed values of Alkalinity nowhere reached the prescribed limits. The variation is shown in chart - 3.4. The highest value 357 mg/L is found for sample RK3 in summer season may be due to the discharge of domestic sewage at RK3 site, which puts certain amounts of alkaline ions into the river system. The lowest value 53.1 mg/L is found for RK1 sample.

Hardness of water is an essential parameter considered in drinking water for satisfying potability. As water moves through soil and rock, it dissolves very small amounts of minerals and holds them in solution. The observed Total hardness values vary from 54 to 281mg/L (chart - 3.5). The highest value is found for sample RK4 in summer season and lowest value is found in RK1 sample in winter. The average value 141.9mg/L falls below the prescribed limits.

DO is the dissolved gaseous form of oxygen. It is essential for respiration of fish and other aquatic organisms. When the water is polluted with large amount of organic matter, a lot of dissolved oxygen would be rapidly consumed in the biological aerobic decay which would affect the water quality; the decreased dissolved oxygen in water would affect the aquatic lives. The highest value 12.9 mg/L is found in RK7 sample due to the lowest temperature in winter season and the lowest 0.9 mg/L is found in RK3 sample after the confluence of a wastewater nallah which discharges large amount of Organic matter into the river. The values of DO for RK3 are very less and thus the COD and BOD values are highest in the particular sample. BOD values indicate a possibility of Organic pollution effect on the water body. Almost All the values of BOD are found highly exceeding the limits. BOD_5 values of RK3 and RK5 are found very high in every season after confluence of a nallah at both the sites. The highest BOD value 43.4 mg/L is found for RK5 sample in summer and the lowest value 3.3 mg/L is found in RK1 sample in post monsoon season due to greater distance from the point of contamination hence the Organic content get dissolved. The average values for DO, BOD and COD are higher than the prescribed limits. Their variation is shown in chart 3.6, 3.7, 3.8 respectively.

All the COD values except for RK1 & RK2 for all seasons are higher than the permissible limits. The highest value 88mg/L is found for RK3 site in summer season and lowest value 3 mg/L is found in post-monsoon.

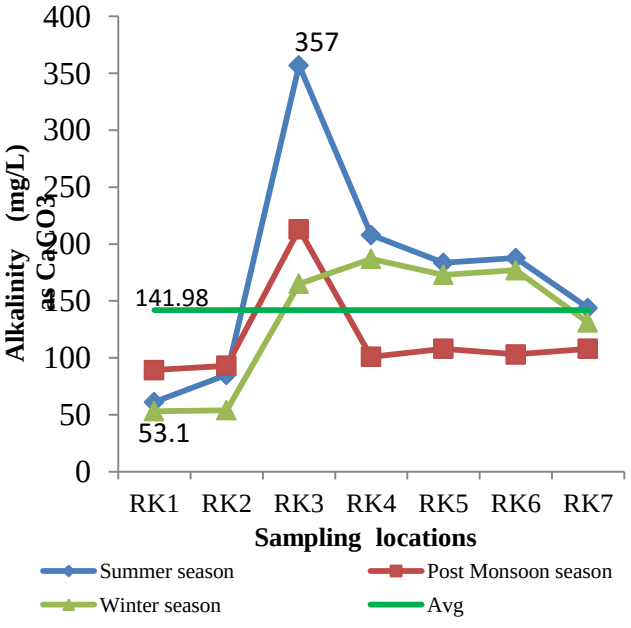


Chart - 3.4: Seasonal Variation of Alkalinity

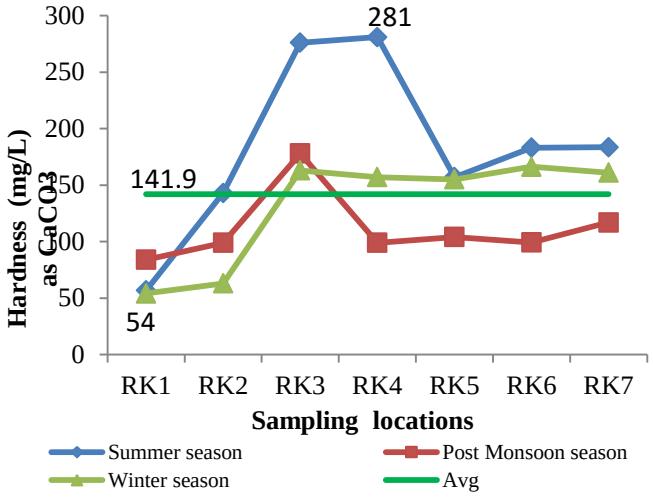


Chart - 3.5: Seasonal Variation of Total Hardness

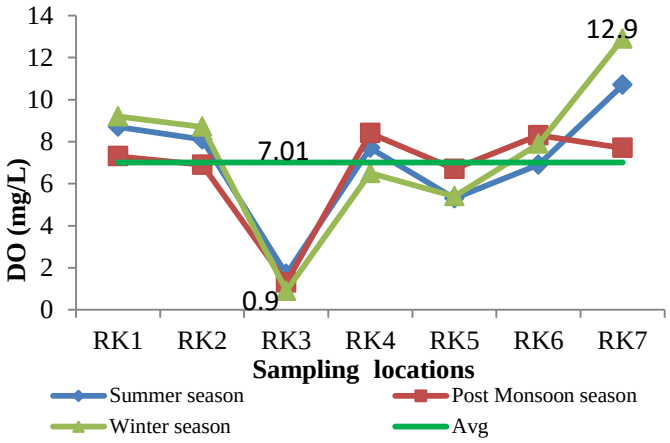


Chart - 3.6: Seasonal Variation of DO

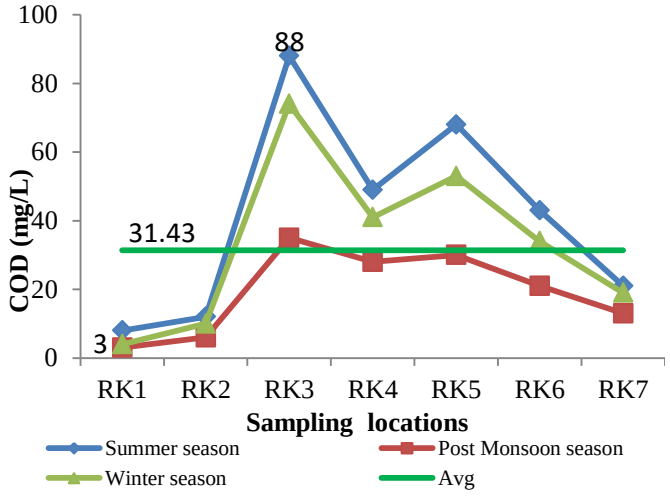


Chart - 3.8: Seasonal Variation of COD

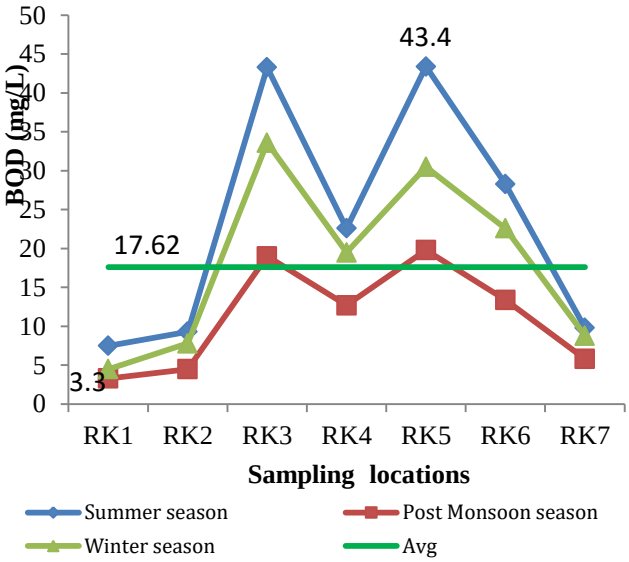


Chart - 3.7: Seasonal Variation of BOD

Sulfate is naturally existed in surface water as SO_4^{2-}. Biological oxidation of reduced Sulfur species to sulfate increases its concentration in the water body. Discharge of industrial wastes and domestic sewage in waters tends to increase its concentration. The values of Sulfate concentrations have nowhere reached the critical values (Chart - 3.9). The higher value 23mg/L is found in RK7 sample during summer and winter seasons and it is found that sample RK1 is completely free from sulfate contaminations.

Nitrogen, in the forms of nitrate, nitrite, or ammonium, is an essential nutrient for plant growth. Ammonia is an indicator for elevated pollution from Organic substances. Excess nitrogen can cause overstimulation of growth of aquatic plants and algae. Excessive growth of these organisms, in turn, can clog water intakes, use up dissolved oxygen as they decompose, and block light to deeper waters. Lake and reservoir eutrophication can occur, which produces unsightly scums of algae on the water surface. The high levels of nitrate and nitrite in drinking water may cause serious illnesses such as methemoglobinemia or "blue baby syndrome", cancer risks, increased starchy deposits, and hemorrhaging of the spleen.

The results of Nitrate Nitrogen are found very less and within the limits. The site RK3 which is near to the source of contamination has the higher value 9.3mg/L. The lowest value 0.45mg/L is found in RK1 sample.

The average result of Ammonia nitrogen is found exceeding the prescribed limits. The highest value 24.4mg/L is found in RK3 sample in summer season shows high level Organic contamination near the site. The sample RK1 has the lowest value within the limits.

The variation of NH_3-N, NO_3-N concentrations are shown in fig. 3.10, 3.11.

As Phosphorus concentration in the water increases, the growth of aquatic vegetation increases. The direct effects of the excessive growth of aquatic vegetation can include a reduction in the transmission of solar radiation and production of toxins. A secondary effect is a decrease in the dissolved oxygen in the water, when bacteria utilize the oxygen while decomposing the increased amounts of dead aquatic vegetation. These effects associated with increased aquatic vegetation growth often have detrimental effects on fish and other aquatic life. This process is a form of eutrophication.

The results of total phosphate are also within the permissible limits (Chart-3.12). The higher value 3.56mg/L is found in RK3 sample as a result of confluence of a nallah near the site. The lowest value found in RK1 sample. The average value 1.96mg/L is also below the limits.

Turbidity is widely concerned as an important parameter for assessing the water quality. It is a measure of the relative clarity or cloudiness of water. The occurrence of turbidity may be permanent or seasonal. The observed values of turbidity are found very high and almost equal in summer and post monsoon seasons (chart-3.13). The highest value 17.9NTU is found in RK3 site during the summer season due to low flow in summer and joining of a wastewater nallah at the site. The average value 6.10NTU found more the than prescribed limit.

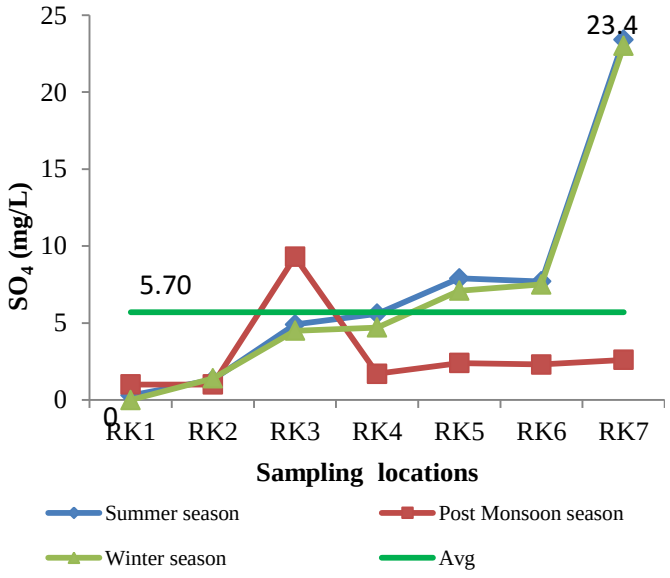


Chart - 3.9: Seasonal Variation of Sulfate

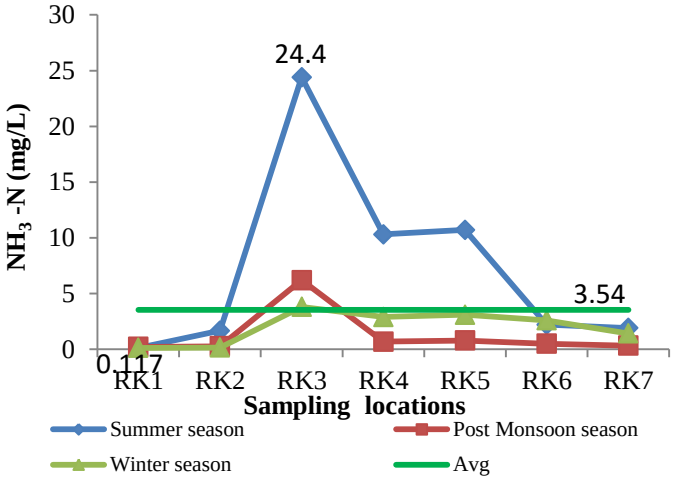


Chart - 3.10: Seasonal Variation of NH_3-N

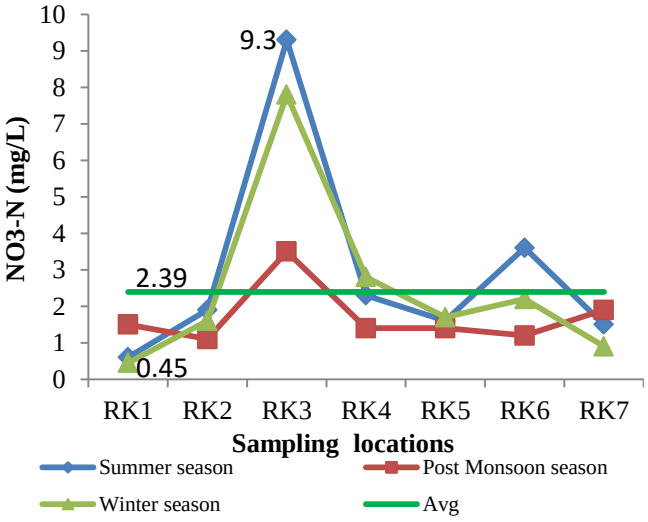


Chart - 3.11: Seasonal Variation of NO_3-N

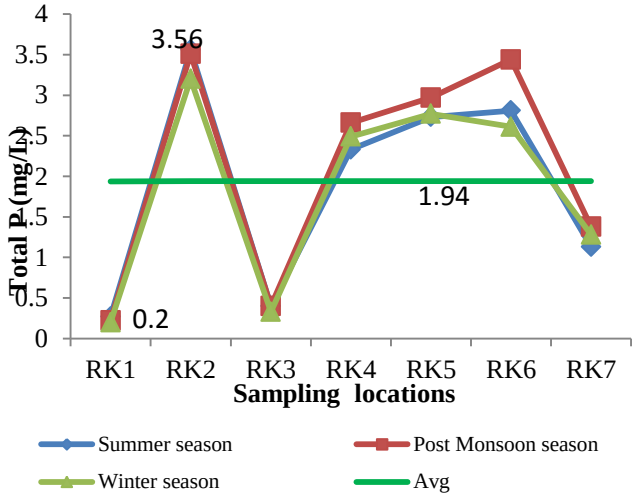


Chart - 3.12: Seasonal Variation of Total Phosphate

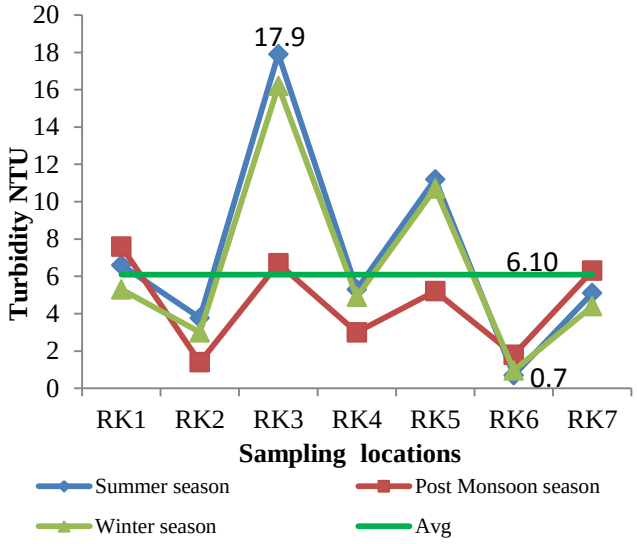


Chart - 3.13: Seasonal Variation of Turbidity

4. CONCLUSIONS

On observing the seasonal variation, it can be concluded that the Kharun River is heavily polluted during the summer than other seasons. The flow reduction during the summer season contributes to the deterioration of water quality. The Kharun River near Jamrao is severly polluted because of joining of a wastewater nallah near the site. And it is found that the water quality is good near Jheet ufra. Finally, it can be implied that the preventative measures taken by the local authorities are still not sufficient; it is clear that the domestic discharge and activities on the banks of river are the major threats to Kharun river's water quality.

ACKNOWLEDGEMENT

I express my sincere respect and gratitude to my guide who has given his valuable support, cooperation and suggestions from time to time in successfully completing this project and also towards my family, friends for their ceaseless motivation and encouragement.

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