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WATER QUALITY STUDY OF GHAGGAR RIVER IN ZIRAKPUR REGION, MOHALI DISTRICT, PUNJAB

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Abstract: ***Ghaggar, one of the significant streams of northern India originating in external Himalayas and coursing through the states of Punjab, Haryana and Rajasthan is put to different uses. It receives discharge from various cities and runoff from agricultural lands. In this study an attempt has been made to present an extensive investigation of physico-chemical and biological parameters of water samples of Ghaggar River. Water samples under examinations were gathered from River close Zirakpur, Punjab at the interim of 15 days from four unique locales each at 4 km separate. The physico-chemical parameters incorporate temperature, pH, turbidity, EC, Total hardness, total dissolved solids, total alkalinity, dissolved oxygen, biological oxygen demand. All these are most significant parameters contributing to water quality variations and are responsible for water quality variations were compared with standard values provided by world health organization (WHO).As per results obtained by examining different physico-chemical parameters of Ghaggar River in Zirakpur city most extreme BOD was recorded at S1 and least at S4 while greatest DO was seen at S4 and least at S1. Reasons of abnormal state of contamination at Shatabgarh is credited to the transfer of untreated sewage into the waterway. Regular monitoring of Ghaggar stream water quality is important to have a keep an eye on surface water contamination for safe living of human.Correlation coefficient were ascertained between various sets of parameters to distinguish the exceptionally associated and interrelated water quality parameters.***

Index terms: Physico-chemical properties, BOD, Correlation, Ghaggar.

I. INTRODUCTION

Water is surely God's greatest gift to mankind. Water is required to sustain life on earth. It covers 71% of the earth surface. Oceans hold 97% water, 1.6% water is below ground,2.4% as glaciers and 0.001% in the air as vapors and clouds. Water pollution by chemicals and biohazards is a major problem which causes changes in the physical, chemical and biological conditions of water which creates hazardous conditions in environment and disrupts the balance of the ecosystem of water. Unpolluted water contains organic as well as inorganic compounds and some microbes to such a small extent that it does not affect human health. The water has been polluted by domestic and industrial wastes. Various pollutants such as carbon dioxide,ammonia,suspended solids, variety of inorganic substances, some toxic materials are responsible for water pollution. Human exercises are additionally a central point for crumbling of the quality of surface and ground water through atmospheric contamination, effluent discharges. Polluted water is really very dangerous for aquatic as well as human life. World health organization (WHO) has been reported that 80% of the diseases are due to unhygienic condition and unsafe drinking water.

The present study was aimed to investigate the water of River Ghaggar, an important river of Haryana state situated in northern part of India, this river originated from outer range of mountain Himalaya. The Ghaggar, a major river of Haryana originates from the Shivalik Hills of Himachal Pradesh and Haryana.The Ghaggar River streams from east to west and after that take a south westerly course. Amid its westbound voyage, various streams, streamlets, channels and tributaries debouch their heap into the Ghaggar.Subsequent to moving through Morni Hills before entering the fields, the Ghaggar River is joined by the Kaushalya Nadi in the lower regions zone.This stream is vital for farming purposes too otherworldly qualities. The little streams viz. Kaushalya, Jhajra and Ghaggar get consolidated together close Chandimandir to shape the principle Ghaggar River.Further, at downstream locales different point and non-point sources are joining the Ghaggar River and releasing their untreated effluents into it.

II. MATERIALS AND METHODS

Selection of site

Zirakpur city in Haryana state of India is situated on the bank of river Ghaggar in the foot Hills of Shivalik mountain range of Himalaya. The area under investigation lies between 30.65°N latitude 76.82°Elongitude.

Collection of sample

The samples were collected in glass bottles which were thoroughly washed thrice with water to be analyzed. The samples were collected by keeping and opening the mouth of containers. Samples were collected from four different points which were identified and having 4 km distance. Then the samples were transported to the laboratory for detailed analysis for Physical and chemical properties. All the samples were analyzed within 2-4 hour of collection. In case of delay, the necessary steps were taken to ensure the biological activity as given in standard methods as described by American Public Health Association.

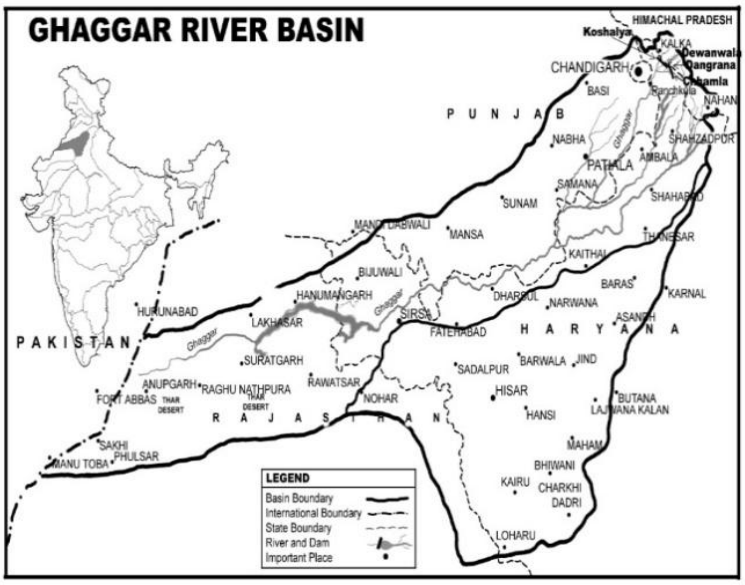

Figure 1:Ghaggar River Basin

Analysis of Physico-Chemical parameters

Physical and Chemical analysis of water samples were measured as described by APHA, 1998.6 some of physicochemical characteristics were analyzed at the site like pH, temperature. In Physical parameters color of water samples were identified by visualization. Temperature of samples was analyzed by thermometer. Conductivity, turbidity, salinity, alkalinity, pH of water samples were analyzed by water analyzer. All other Physical and Chemical analysis like Dissolved Oxygen (DO), Analysis of Hardness, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD) were done as described by APHA, 1998.

III. RESULTSAND DISCUSSION

Countless topographical conditions impact the connections between various sets of Physico-chemical parameters of water samples directly or indirectly. In the present study, various Physico-chemical and biological properties were studied to evaluate variations in surface water quality of Ghaggar River. Physical and chemical properties of water samples were highly affected by contaminants. Samples were collected from four different points which were identified and having 4km distance at time interval of 15 days. Different parameters were studied and compared with standard values provided by W.H.O.

Table 1: Methods used for Analysis of Physico-chemical parameters of River Ghaggar Water of Zirakpur City in year of 2017-2018

S.No.	Parameter	Method
1.	pH	pH meter
2.	Temperature ^{0}C	Thermometer
3.	EC (µS/cm)	Conductivity meter
4.	Turbidity (NTU)	Nephelometer
5.	Total Hardness (mg/L)	Titration Method
6.	Total Dissolved Solids (mg/L)	Gravimetric Method
7.	Total Alkalinity (mg/L)	Titration Method
8.	Dissolved Oxygen (mg/L)	Winkler Method
9.	Biological Oxygen Demand (mg/L)	Winkler Method

Table 2: WHO Standard of physico-chemical parameters

S. No.	Parameter	Drinking water WHO standard	
		HDL	MPL
1.	pH	6.5-8.5	No relaxation
2.	Temperature (^{o}C)	-	-
3.	EC (µS/cm)	-	-
4.	Turbidity (NTU)	5	10
5.	Total Hardness (mg/L)	300	600
6.	Total Dissolved Solids (mg/L)	500	2000
7.	Total Alkalinity (mg/L)	200	600
8.	Dissolved Oxygen (mg/L)	2	6
9.	Biological Oxygen Demand (mg/L)	-	6

(HDL: Highest desirable limit; MPL: maximum Permissible Limit)

Temperature (^{o}C)

The present investigation reveals that the temperature increases more rapidly within given interval period i.e. 15 days, at the site 1 due to major disposal of untreated sewage and industrial effluents, which rise the temperature maximum at 24.6^{o}C on the 75th day of investigation period.

Table 3: Samples were collected on different months, Dates, Sites and Temperature (^{o}C)

Day	S1-Shatabgarh	S2-Jangipur	S3- Bahori	S4-Hansala
1st	18.2	18.4	19.3	20.7
15th	20.8	20.2	20.5	21.2
30th	21.4	20.5	20.6	20.7
45th	21.9	21	21.2	21
60th	23.7	20.1	20.8	20.5
75th	24.6	21.8	22	22.3

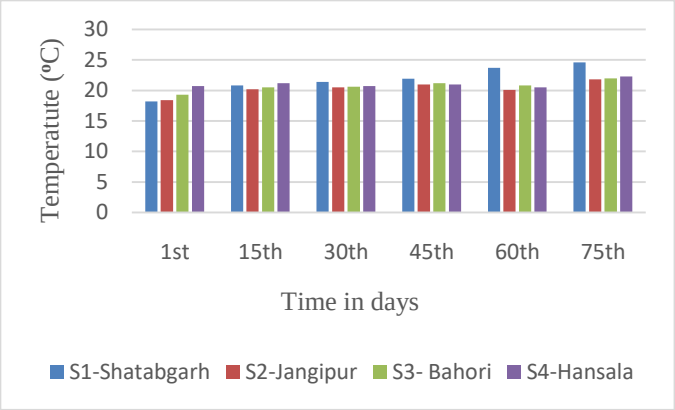

Figure 1: Variation of temperature with time and site

pH values

The present investigation reveals that lowest values of pH was found at site-1 within taking time period, whereas site-4 have maximum pH values in comparison to all sites and it increases with time. The estimations of pH increments from December-February might be because of expanded photosynthesis of the algal biossoms coming about into the precipitation of carbonates of calcium and magnesium from bicarbonates. This pH esteems having higher fixation when contrasted with WHO standards prescribed.

Table 4: Changes in pH at different sites of Zirakpur along Ghaggar River taken at different time intervals

Day	S1-Shatabgarh	S2-Jangipur	S3- Bahori	S4-Hansala
1st	6.94	7.00	7.3	7.43
15th	6.92	7.14	7.3	7.48
30th	7.00	7.20	7.35	7.45
45th	7.12	7.20	7.44	7.64
60th	7.24	7.42	7.45	7.75
75th	7.10	7.34	7.36	7.54

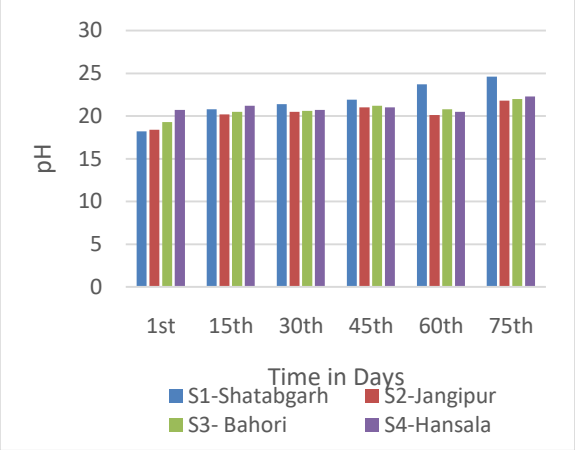

Figure 2: Variation of pH with time and site

EC (µmho/cm)

The electrical conductivity of water estimates the total amount of solids dissolved in water -TDS, which stands for Total Dissolved Solids. TDS is measured in ppm (parts per million) or in mg/l. The present investigation reveals that 1st day of taking time period i.e. on 15 December EC has maximum values, and it decreases with passes time period i.e. it minimum at 75th day of time period (28 February).

Table 5: Changes in EC at different sites of Zirakpur along Ghaggar River taken at different time intervals

Day	S1-Shatabgarh	S2-Jangipur	S3- Bahori	S4-Hansala
1st	510	580	610	642
15th	503	565	597	636
30th	501	553	568	615
45th	496	536	548	655
60th	492	541	568	585
75th	480	538	560	590

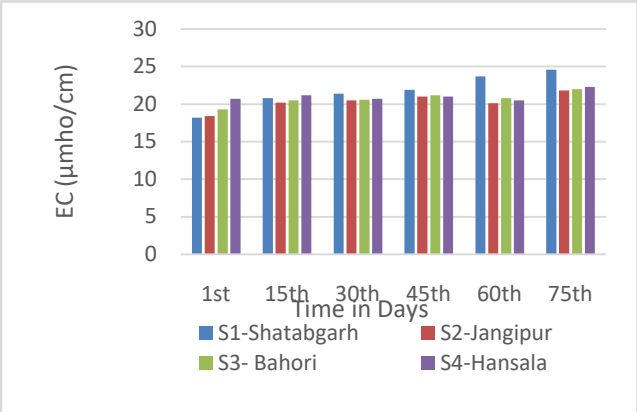

Figure 3: Variation of EC with time and site

Hardness (mg/L)

Hard water will be water that contains abnormal amounts of dissolved calcium, magnesium and other mineral salt, for example, iron. High measure of disintegrated minerals in the water causes progressively the water hard. Hardness of water is due to the concentration of multivalent metallic ions of calcium and magnesium. Results shown that site-1 is highly hard in compare to other sites. This Hardness values having lower concentration as compared to WHO standards recommended.

Table 6: Changes in Hardness at different sites of Zirakpur along Ghaggar River taken at different time intervals

Days	S1-Shatabgarh	S2-Jangipur	S3- Bahori	S4-Hansala
1st	246	245	236	224
15th	242	239	230	222
30th	234	227	221	215
45th	223	219	216	212
60th	220	223	216	212
75th	218	215	214	210

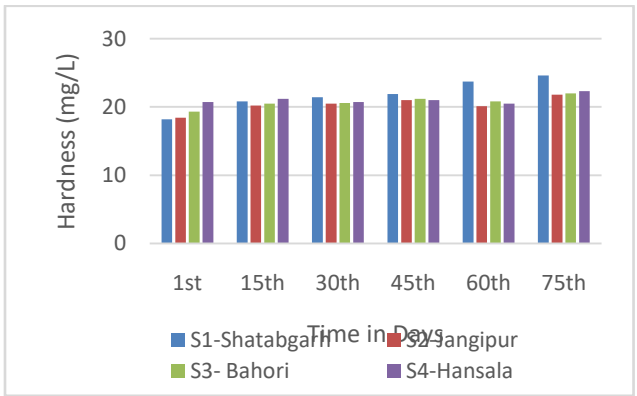

Figure 4: Variation of Hardness with time and site

Turbidity (mg/L)

Turbidity is the measure of relative clarity of a liquid. It is an optical characteristic of water and is an expression of the amount of light that is scattered by material in the water when a light is shined through the water sample. It is considered as a good measure of the quality of water. Results shown that site-1 is highly turbid in compare to other sites due to extreme runoff from industrial and agricultural sites. This Turbidity values having higher concentration as compared to WHO standards recommended.

Table 7: Changes in Turbidity at different sites of Zirakpur along Ghaggar River taken at different time intervals.

Day	S1-Shatabgarh	S2-Jangipur	S3- Bahori	S4-Hansala
1st	550	532	524	518
15th	555	543	535	523
30th	560	545	527	525
45th	574	550	536	530
60th	580	565	546	525
75th	585	570	556	538

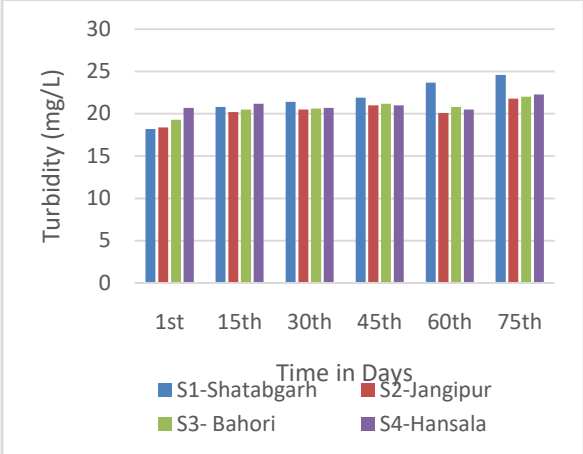

Figure 5: Variation of Turbidity with time and site

TDS (mg/L)

Dissolved solids refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates) and some small amounts of organic matter that are dissolved in water. Results shown that site-1 contains maximum TDS due to huge discharges of industrial effluents without or partial pre-treatment. This TDS values having lower concentration as compared to WHO standards recommended.

Table 8: Changes in TDS at different sites of Zirakpur along Ghaggar River taken at different time intervals

Day	S1-Shatabgarh	S2-Jangipur	S3-Bahori	S4-Hansala
1st	650	610	510	480
15th	655	615	525	490
30th	660	630	527	500
45th	670	625	536	490
60th	680	620	546	520
75th	710	640	556	525

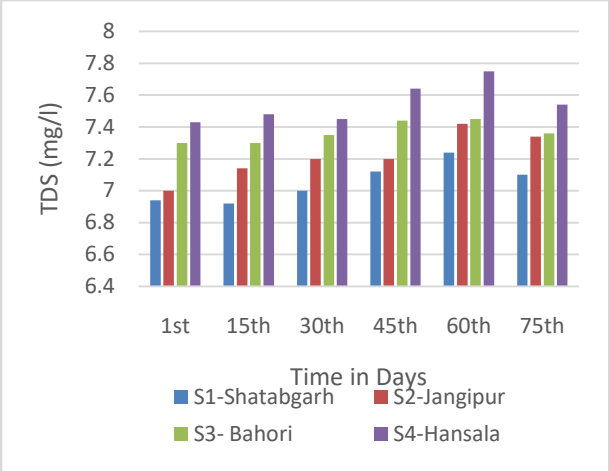

Figure 6: Variation of TDS with time and site

Alkalinity (mg/L)

Alkalinity refers to the capability of water to neutralize acid. Increase in dilution of river water may be responsible for lower values of alkalinity in rainy seasons. The present investigation reveals that site-1 has highest alkalinity values and at site-4 shows minimum values whereas site-2 and site-3 reveals intermediate values of alkalinity. The high value of alkalinity indicates the presence of weak and strong base such as carbonates, bicarbonates and hydroxides in the water body. The high values of alkalinity may also be due to decrease in free carbon dioxide in the River Ghaggar by which bicarbonate ions converted into carbonate ,which ultimately result in the increase in alkalinity at site -1 in comparisons to other both sites. This Alkalinity values having lower concentration as compared to WHO standards recommended.

Table 9: Changes in Alkanity at different sites of Zirakpur along Ghaggar River taken at different time intervals

Day	S1-Shatabgarh	S2-Jangipur	S3- Bahori	S4-Hansala
1st	141	133	120	115
15th	150	145	134	125
30th	168	160	146	136
45th	186	146	136	125
60th	210	160	146	138
75th	238	186	154	130

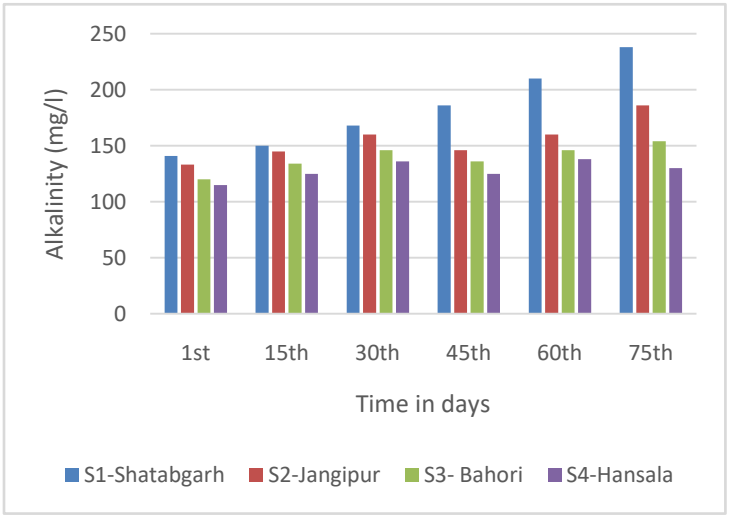

Figure 7: Variation of Alkanity with time and site

DO (mg/L)

The estimation of DO gives a prepared assessment of virtue of water. The measure of dissolved oxygen is a measure of the biological activity of the water masses and is generally utilized as a part of water quality examinations and routine task of water reclamation facilities. Results reveal that Hansala has maximum DO due to maximum flow rate of water than other sites. The DO values having higher concentration as compared to WHO standards recommended.

Table 10: Changes in DO at different sites of Zirakpur along Ghaggar River taken at different time intervals

Day	S1-Shatabgarh	S2-Jangipur	S3- Bahori	S4-Hansala
1st	6.70	7.90	8.80	9.00
15th	5.60	6.45	8.60	8.90
30th	5.30	6.30	7.80	8.40
45th	5.20	5.90	6.90	7.80
60th	5.15	5.45	6.75	7.45
75th	4.65	5.30	6.48	7.26

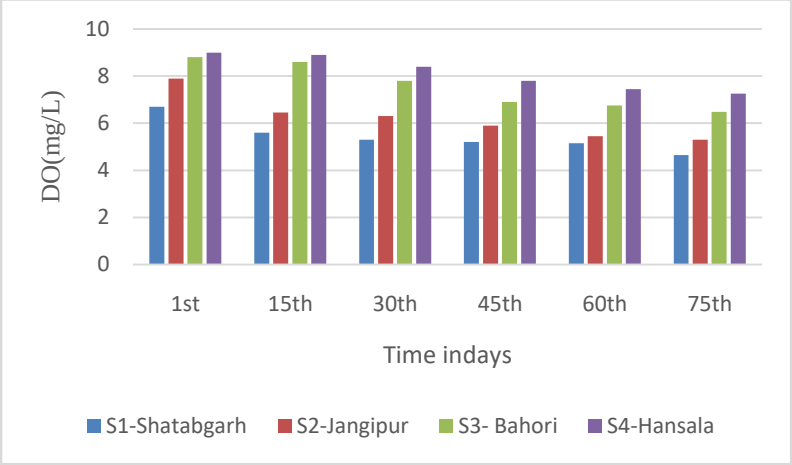

Figure 8: Variation of DO with time and site

BOD (mg/L)

BOD is the quantity of oxygen required by bacteria and other microorganisms during the biochemical degradation and transformation of organic matter present in wastewater under aerobic condition. It is valuable parameter for assess of water quality. Results shown that site-1 has maximum pollutional index in compare to other sites.

Table 11: Changes in BOD at different sites of zirakpur along Ghaggar River taken at different time intervals

Day	S1-Shatabgarh	S2-Jangipur	S3-Bahori	S4-Hansala
1st	5.6	5.4	4.9	4.2
15th	5.2	4.8	4.1	3.7
30th	4.7	3.8	3.2	2.8
45th	5.5	4.5	2.8	2.5
60th	5.85	4.7	2.6	2.1
75th	5.7	4.6	3.1	2.5

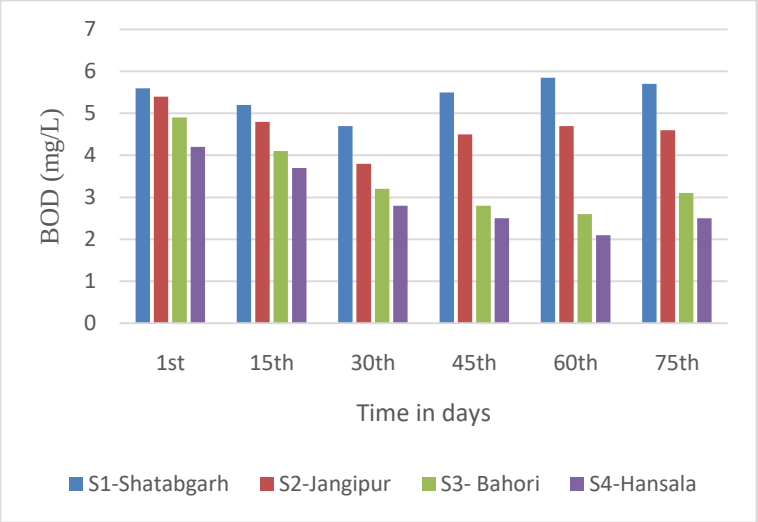

Figure 9: Variation of BOD with time and site

Table 12: Correlation matrix among various water quality parameters of site S1 (significant level at 0.05)

Parameters	*Temp.*	*pH*	*EC*	*Hardness*	*Turbidity*	*Alkalinity*	*DO*	*BOD*	*TDS*
Temp.	1								
pH	0.390739	1							
EC	-0.81981	-0.67534	1						
Hardness	-0.74077	-0.89546	0.904502	1					
Turbidity	0.719566	0.871702	-0.94381	-0.98721	1				
Alkalinity	0.735063	0.784948	-0.98052	-0.94415	0.974898	1			
DO	-0.68419	-0.61435	0.498766	0.673041	-0.58991	-0.49019	1		
BOD	-0.11424	0.572226	-0.41012	-0.43865	0.529909	0.490151	0.168372	1	
TDS	0.738878	0.633576	-0.98323	-0.85771	0.913837	0.973181	-0.33865	0.487903	1

Table 13: Correlation matrix among various water quality parameters of site S2 (significant level at 0.05)

Parameters	*Temp.*	*pH*	*EC*	*Hardness*	*Turbidity*	*Alkalinity*	*DO*	*BOD*	*TDS*
Temp.	1								
pH	0.652418	1							
EC	-0.85091	-0.83181	1						
Hardness	-0.87909	-0.80376	0.97613	1					
Turbidity	0.750166	0.94836	-0.83852	-0.85286	1				
Alkalinity	0.799324	0.769128	-0.67889	-0.77966	0.86934	1			
DO	-0.78131	-0.73434	0.647408	0.624937	-0.67055	-0.7283	1		
BOD	-0.61345	-0.4005	0.546695	0.562105	-0.28398	-0.46962	0.737901	1	
TDS	0.886931	0.595239	-0.73996	-0.85364	0.71127	0.905165	-0.65929	-0.6514	1

Table 14: Correlation matrix among various water quality parameters of site S3 (significant level at 0.05)

Parameters	*Temp.*	*pH*	*EC*	*Hardness*	*Turbidity*	*Alkalinity*	*DO*	*BOD*	*TDS*
Temp.	1								
pH	0.495828	1							
EC	-0.82733	-0.79719	1						
Hardness	-0.88702	-0.79935	0.952354	1					
Turbidity	0.839312	0.437397	-0.53392	-0.72886	1				
Alkalinity	0.855042	0.44442	-0.72291	-0.85717	0.750117	1			
DO	-0.8564	-0.77067	0.981195	0.980312	-0.62256	-0.8099	1		
BOD	-0.76847	-0.87465	0.926186	0.96005	-0.59604	-0.79488	0.927568	1	
TDS	0.922602	0.618517	-0.75848	-0.90712	0.94678	0.880067	-0.83125	-0.80978	1

Table 15: Correlation matrix among various water quality parameters of site S4 (significant level at 0.05)

Parameters	*Temp.*	*pH*	*EC*	*Hardness*	*Turbidity*	*Alkalinity*	*DO*	*BOD*	*TDS*
Temp.	1								
pH	-0.1484	1							
EC	-0.25193	-0.38117	1						
Hardness	-0.34952	-0.65849	0.54898	1					
Turbidity	0.806491	0.309156	-0.41375	-0.8285	1				
Alkalinity	-0.05694	0.511433	-0.73625	-0.69388	0.369993	1			
DO	-0.38429	-0.303	0.848628	0.802167	-0.68789	-0.82236	1		
BOD	-0.13119	-0.78102	0.583429	0.959938	-0.66916	-0.81474	0.767049	1	
TDS	0.44499	0.531681	-0.93044	-0.78217	0.694902	0.750513	-0.90293	-0.77339	1

IV. CONCLUSION

The above observations clearly stated that water of Ghaggar River was highly polluted. The main cause of this pollution was discharge of the mining activities into the river near river bank. The sampling sites S-1 (Shatabgarh)and S-2 (Jangipur) were found to be most polluted. During the present study, it was observed that there is no treatment of domestic sewage in the region before safe discharge into the river which is reflected in the high value of BOD. Some anthropogenic activities like disposal of treated and untreated waste effluents from industries along with agricultural wastes and human wastes has resulted in deterioration of water quality of Ghaggar river system. Correlation matrix among various water quality parameters revealed that DO negative correlation with almost all parameters except EC and hardness, thus it can be served as a single index of water quality, as with rise in the value of most of these parameters decreases the DO concentration. To improve the quality of water there should be continuous monitoring of pollution level.

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