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Assessment of Physicochemical Properties of Ghaggar River

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ABSTRACT: The present study was carried out to determine the physico-chemical properties of Ghaggar River water from 20 different sampling sites throughout stretch of Ghaggar River. River water samples were collected from 16 sites out of 20 sites as the last four sampling sites were dried, during the month of May, 2015 and River water samples were taken to the laboratory and analyzed. The analysis was done for the 40 parameters like Turbidity, pH, Total Dissolved Solids, Electrical Conductivity, Total Hardness, Total Alkalinity, Chloride, Calcium, Magnesium, BOD, COD, DO, Iron, Nickel, Cadmium, total phosphorus pesticides and MPN. pH shows that Ghaggar River water is alkaline in nature. Turbidity and Total Dissolved Solids was found above the WHO permissible limits, iron is dominating heavy metal. All the sites were infected by Coliform.

Keywords: Ghaggar; River; Physicochemical and Water.

INTRODUCTION: Water is the most essential and prime necessity of life. It is an essential requirement for the life supporting activities. Surface water generally available in Rivers, Lakes, Ponds and Dams is used for drinking, irrigation and power supply etc. The usual source of drinking water is from streams, rivers, wells and boreholes which are usually not treated.[1] Quality of water generally refers to the component of water, which is to be present at the optimum level for suitable growth of plants and animals. Aquatic organisms need a healthy environment to live and have adequate nutrients for their growth. The productivity depends on the physicochemical characteristics of the water body. The maximum productivity obtained when the physical and chemical parameters are at optimum level.[7]

Ghaggar River is one of the major seasonal rivers passing through two most fertile states (Punjab and Haryana) of India. It receives domestic, industrial and municipal wastewaters/effluents all along its course. The base flow generated in the river system is utilized at various points for various purposes like drinking, irrigation and industrial. Water is pumped directly from the Ghaggar River and tributaries at several places for irrigational and drinking activities along its journey from upstream to downstream. Some industrial regions along with municipal councils committees/ corporations are discharging their wastewater and effluents directly or indirectly into the Ghaggar River water through different channels. Therefore, it is necessary that the quality of water should be monitored at regular time intervals. Furthermore, the protection and maintenance of water quality is emerging as a great public concern in all over the world.

MATERIAL AND METHODS:

Study Area: In the present study, the Ghaggar River was selected to evaluate the heavy metal characteristics of its surface water in upper reaches. The Ghaggar River originates from the Siwalik Hills of Himachal Pradesh and Haryana. It runs along the foot of the Siwaliks and flows through Haryana and Punjab to Rajasthan and then disappear itself in the sands of the Thar Desert. The selected study area falls within the boundaries of several states and covering parts of different districts of Haryana and Punjab and Rajasthan. At downstream sites various point sources viz., Medkhali Nallah, Sukhna Choe, Jharmal Choe, Dhabi Nallah, Dhakansu Nallah, Patiala Nadi, Markanda River, and Shaabaad Nallah are joining the Ghaggar River and discharging their untreated effluents into it.

The area under investigation lies between North latitudes 30˚45′5.93″ to 29°11′49.29″ and East longitudes 76˚54′36.79″ to 73˚13′26.88″ Area under investigation covers parts of different districts of Haryana, Punjab and Rajasthan like Panchkula, SAS Nagar (Mohali), Patiala, Ambala ,Kaithal, Fathehabad, Sirsa, Hanumangarh and Sri Ganganagar. The research area enjoys humid to sub- humid type of climate characterized by extreme summers and chilly winters with large seasonal fluctuations in both temperature and rainfall. The temperature may raise upto 47°C in hottest month and may drop to less than 1°C in winter. In the upper part of the Shivalik hills precipitation of 1000-1500 mm and in lower regions precipitation is only 200mm.

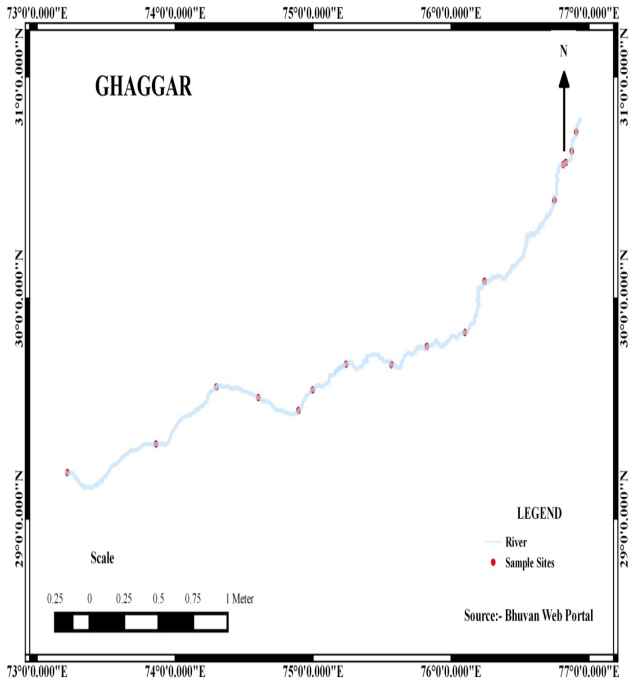

Figure 1: Study Area Map Ghaggar River.

The brief description of sampling stations is as follows:

1) ***S-1 (Amaravati Enclave):*** Sample was collected from Amaravati Enclave, here Ghaggar is known as Kaushalya River.

2) ***S-2 Chandi mandir:*** Here two streams meet, and from Here River is known as Ghaggar.

3) ***S-3 (Sec. 25 Panchkula):*** Further, downstream the Ghaggar River water was sampled near sec. 25 here another stream meets to Ghaggar river.

4) ***S-4 Daffarpur:*** Upstream to this sampling site Medkhali Nallah is joining the Ghaggar River course, so river water was collected from downstream side to check the impact of effluents.

5) ***S-5 (Mubarkpur):*** Here Baltana Drain meets Ghaggar River which carrying waste (industrial & sewage) Chandigarh and Panchkula.

6) ***S-6 (Bhagwanpur):*** this site is in-between Mubarkpur and tepla. Here there is no point source added into the Ghaggar river.

7) ***S-7 (Tepla):*** Here Jharmal Choe meets the Ghaggar River, which carrying industrial and domestic sewage of Derabasi, Lalru and Zirakpur.

8) ***S-8 (Surala):*** Here Dhakansu Drain meets the Ghaggar River which is a combined drain of Mohali, Chandigarh and Rajpura Industrial waste

9) ***S-9 (Ratnedi) downstream:*** Here Patiala River meets the Ghaggar River. Jacob drain meets the Patiala River which carries industrial waste from Patiala region. Patiala River itself carries the sewage and industrial waste from Patiala.

10) ***S-10 (Ratnedi) upstream.***

11) ***S-11 (Khanori, Punjab).***

12) ***S-12 (Jakhal):*** It is an agricultural area.

13) ***S-13 (Ratia):*** Ratia is a municipal town of Haryana. Sewage and industrial effluents (mainly soap factories) discharged into the Ghaggar River.

14) ***S-14 (Sardulgarh):*** Sardulgarh is a municipal town of Punjab. Sewage and industrial effluents (mainly soap factories) discharged into the Ghaggar River.

15) ***S-15 (Dabwali Road, Sirsa):*** Here Samsabad drain meets the River, which carries the Sewage and industrial waste (Mainly card board industries, Soap industries, Rice mills).

16) ***S-16 (Ottu Wier):*** The river water is blocked at weir; as such the river does not have any water downstream. All river water was diverted to canal in Haryana.

17) ***S-17 (Talwara Jheel):*** Sampling is not possible here due to dry bed of river.

18) ***S-18 (Hanmungarh Bridge):*** Sampling is not possible here due to dry bed of river.

19) ***S-19 (Drishadvati Chautang) River:*** Sampling is not possible here due to dry bed of river.

20) ***S-20 (Annopgarh Bridge):*** Sampling is not possible here due to dry bed of river.

Sample Collection: Water samples from selected sites were collected during the months of May, 2015. The samples were collected from the surface water of the River in pre-cleaned polyethylene bottles.

Physico-Chemical Analysis: The collected samples were analyzed for major physical and chemical water quality parameter like pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Alkalinity (TA), Total Hardness (TH), Chloride (Cl^-), Calcium (Ca^{++}), Magnesium (Mg^{++}), Sodium (Na^+) , Potassium(K^+), heavy metals, pesticides, MPN etc. total 40 parameters were analyzed. The Chemical analysis was carried out by the following methods by standard methods of APHA (1995).[1]

RESULTS AND DISCUSSION: The results of the physicochemical parameters for water samples are presented in Table 1(a & b).

Colour: Pure water is colourless but water in nature is often coloured by foreign substances. Decaying vegetable matter, industrial waste, domestic waste and other waste materials contribute to colour in water. The colour of water is generally two types - apparent and true colour[4]. Apparent colour is caused by coloured particulates and refraction along with reflection of light on suspended particulate matters. Polluted water has quite a strong apparent colour. Natural minerals such as ferric hydroxide, manganese oxide and other compounds of transitional elements along with organic substances such as humic acid, tannin and humates give true colours to water. Natural water have colour from below 5 in very clean waters to 300 hazen in dark peaty waters.[4] The river water in the area of the study is colored, polluted and odours. It cannot be classified a healthy fresh water stream. Color ranges from 25 HU to 500 HU. Which shows river water is highly colored and it may affect the ecological productivity of the river.

Temperature: According to Welch (1952)[19], no other factor has so much influence as temperature. Water temperature controls the solubility of gases and salts in water and behavioral characteristics of organisms. Table shows that in the Ghaggar River, temperature ranges from a minimum of 27.8°C at Amravati Enclave to a maximum of 33°C at Tepla. During Study it was found that river water temperature is influenced by point sources where high temperature wastewaters/effluents mixing up into the Ghaggar water.

Turbidity: The turbidity in water is mainly caused by sand, silt, clay, phytoplankton, microorganism or organic material suspended or dissolver in it.[13] The turbidity values varied between 9.9 NTU to 33.7 NTU. The turbidity values for all the investigated samples were found to be greater than the value prescribed by WHO.[20]

Table 1 (a & b): Physico chemical Analysis of Ghaggar River (May 2015).

Site	Color	Temp.	Turbidity	pH	EC	TSS	TDS	Ca	Mg	Cl	SO_4	Total Alkalinity	Acidity	TH	Na	K	$CaCO_3$	Bicarbonate as $CaCO_3$	Residual Free Chlorine as Cl_2
1	25	27.8	0.54	7.62	0.559	11	364	54	34	30	23	205	0	276	6	3	0	205	0
2	28	27.8	0.85	7.5	0.51	12	321	53	32	32	21	212	0	283	8	5	0	189	0
3	30	27.9	0.85	7.69	0.487	13	302	53	34	29	18	203	8	270	9	4	0	203	0
4	121	30.2	241	7.3	0.622	65	411	51	41	32	21	200	16	276	12	6	0	201	0
5	250	32.3	279	7.23	0.822	82	537	48	43	63	32	210	26	301	14	8	19	210	0
6	181	32	181	7.2	0.773	65	450	65	42	69	32	202	25	298	16	7	16	198	0
7	150	33	199	7.32	0.973	92	626	64	47	261	42	302	20	353	19	11	6	302	0
8	150	31.2	258	7.28	0.691	72	451	61	45	47	29	292	16	340	13	7	6	292	0
9	500	32.1	44	7.4	1.501	118	849	69	39	143	61	289	10.9	341	21	19	5	278	0
10	287	32	78	7.28	0.973	71	511	41	23	211	32	334	23	331	21	9	0	302	0
11	200	30.1	202	7.16	1.701	162	1120	72	56	138	98.5	308	18.2	414	32	18	0	308	0
12	500	30.2	40	7.2	1.301	112	829	69	38	111	58	280	10.4	330	23	15	0	280	0
13	500	30.2	30	7.26	1.277	152	817	70	36	108	54	276	12	326	28	13	0	276	0
14	500	31.6	60	7.36	1.935	130	1275	66	38	104	49	277	11.2	324	24	18	12	277	0
15	500	31.2	44	7.3	1.401	116	821	61	37	117	59	290	10.6	334	19	16	12	278	0
16	250	28.6	65	7.31	1.035	145	692	58	48	97	48	300	13.2	346	21	14	0	302	0

(a)

Site	DO	BOD	COD	Fe	Hg	As	Pb	Cu	Zn	Cd	Ni	Cr	Nitrate (as N)	Total Nitrogen (as N)	Phosphate (as P)	Total Phosphorus (as P)	Aldrin, Dieldrin, Endosulfan	DDT (o,p&p,p-isomers of DDT, DDE & DDD)	MPN
1	7.9	7	57	0.156	0	0	0.021	0	0	0	0	0	3.65	1.32	0.04	0.04	BDL	BDL	56,000
2	7.8	7	59	0.184	0	0	0	0	0	0.018	0	0	3.85	1.58	0.04	0.04	BDL	BDL	85,000
3	8	6	53	0.156	0	0	0	0.023	0.023	0	0	0	3.88	1.68	0.03	0.12	BDL	BDL	101,000
4	6	16	54	1.11	0	0	0	0.016	0.045	0	0	0	3.21	6.23	1.23	0.98	BDL	BDL	98,000
5	2.8	18	60	1.21	0.081	0.002	0.039	0.015	0.044	0.034	0	0	7.35	9.98	7.27	10.86	BDL	BDL	112,000
6	5.5	16	116	0.85	0.058	0.003	0	0.025	0	0.012	0	0.04	6.21	6.21	5.12	2.2	BDL	BDL	112,000
7	7.7	9	82	2.13	0	0.002	0.062	0.062	0.013	0	0	0	6.58	12.32	7.11	11.67	BDL	BDL	1,200,000
8	4.23	21	54	1.23	0	0.002	0.071	0.052	0.058	0.021	0	0.023	7.72	10.62	6.44	9.45	BDL	BDL	950,000
9	2	29	205	0.69	0	0	0	0.036	0.03	0.022	0	0.05	8.03	24.18	11.8	12.69	BDL	BDL	2,310,000
10	4.2	12	81	0.31	0	0	0	0	0.012	0	0	0	5.12	11	8.11	12.21	BDL	BDL	211000
11	7.2	29	236	0.9	0	0	0	0	0	0	0	0	11.65	26.32	22.48	34.54	BDL	BDL	21,000
12	7.5	17	137	0.6	0	0	0	0	0	0	0	0	8.03	20.39	10.9	12.72	BDL	BDL	213,000
13	7.4	16	133	0.49	0	0	0	0	0	0	0	0.086	7.36	20.42	13.29	16.59	BDL	BDL	110,000
14	7.6	15	127	0.66	0	0	0.075	0.019	0.0225	0	0	0.011	9.23	22.63	12.47	16.98	BDL	BDL	2,300,000
15	7.4	21	148	0.71	0	0	0.028	0	0.026	0	0	0	8.03	24.18	12.8	13.48	BDL	BDL	4,300,000
16	7.6	16	131	0.4	0	0	0	0.011	0.013	0.031	0.0125	0.018	8.43	21.3	8.59	14.85	BDL	BDL	1,110,000

(b)

pH: pH is the scale of intensity of acidity and alkalinity of water and measures the concentration of hydrogen ions. The pH of water samples ranged between 7.3-7.7. The pH of water samples is slightly alkaline and found within the limit prescribed by World Health Organization.[20]

Electrical Conductivity: Conductivity is the measure of capacity of a substance or solution to conduct electrical current through the water. EC values were in the range of 990µmhos/cm to 1285µmhos/cm. High EC values indicating the presence of high amount of dissolved inorganic substances in ionized form.

Total Suspended Solid: The total suspended solids can float and form unsightly scum layers or sink and cause sediment buildup. The suspended solids may consist of inorganic, organic and immiscible liquids. Inorganic solids such as clay silt and other soil constituents are common in surface water. Organic materials such as plant fibers and biological solids of algal cell and bacteria are also common constituents of surface water. The total suspended solids are always objectionable in respect of aesthetic purposes[17]. The total suspended solids in water of the Ghaggar River are ranges from 11mg/l to 162 mg/l.

Total Dissolved Solids: The palatability of drinking water rated by panels of tasters in relation to its TDS level is as follows: unacceptable, greater than 1200 mg/1; poor, between 900 and 1200 mg/1; fair, between 600 and 900 mg/1; good, between 300 and 600 mg/1; and excellent, less than 300 mg/1[20] also proposed that total dissolved solids TDS greater than 1000 mg/1 resulted in taste complaints. TDS indicates the general nature of salinity of water. Water with high TDS produces scales on cooking vessels and boilers. The TDS values varied from 302 mg/l to 1275 mg/l. River water vary from a minimum of 302 mg/1 at S3 to a maximum of 1275 mg/1 at S14. The TDS value of Ghaggar River is fluctuating due to addition of various point and non point sources.

Calcium and Magnesium: The sources of Ca and Mg in natural water are various types of rocks, industrial waste and sewage. There is a evidence that hard water plays a role in heart diseases. Higher concentration of Mg makes the water unpalatable and act as laxative to human beings.[6] The calcium concentration was ranged from 72.8 mg/l to 86.4 mg/l and magnesium concentration was ranged between 13.6 mg/l to 24.3 mg/l.

Chloride: Chloride concentration in water indicates presence of organic waster particularly of animal origin.[3] Chloride concentration varied from 180 mg/l to 218 mg/l. All the samples were found within the permissible limit prescribed by WHO.[20]

Sulphate: Sulphate is naturally present in water as SO_4. It is stable and oxidized form of sulphur and is readily soluble in water. WHO has suggested a highest

desirable limit of 200 mg/1 and a maximum permissible limit of 400 mg/1 for sulphate in drinking water. According to R.K.Trivedy (1986)[18] sulphates causes gastrointestinal irritation if exceeded 250 mg/1 value. The excess of sulphate (more than 250 mg/1) may also reason bitter taste and may have laxative effect to human beings and livestock at further high levels of sulphates have been associated with some brain disorders in livestock. Table: 1 (a & b) reveals that in the research area river water, value of sulphate is varied from a minimum of 18 mg/1 at Panchkula sector-25 to a maximum of 98.5 mg/1at Khanori. In this observation, sulphate concentration was not much influenced by point and non-point sources wastewaters and effluents. Fluctuations in sulphate value were also limited.

Total Alkalinity: Total Alkalinity is the measure of capacity of water to neutralize the acids. Alkalinity increases as the amount of dissolved carbonates and bicarbonates increases. Alkalinity level varied from 200 mg/l to 334 mg/l with an average of 261.25 mg/l in the Ghaggar River. It shows that Alkalinity is greater than the limit prescribed by IS 10500-91.[2]

Total Hardness: Waters become hard primarily due to excessive presence of bicarbonate, chloride and dissolved sulphate in water primarily. Total Hardness values ranged from 270 mg/l to 414 mg/l and found within the permissible limit of WHO.[20] According to some classification, water having hardness upto 75 mg/l is classified as soft, 76-150 mg/l is moderately soft, 151-300 mg/l as hard and more than 300 mg/l as very hard.[14] On the basis of classification the water of Ghaggar River can be considered as Very hard (avg. 321.44).

Sodium: The major source of sodium in natural fresh waters is the weathering of various rocks. Many industrial waste and domestic sewage are rich in sodium increase its concentration in natural waters after disposal.[18] The value of sodium was varied between 6 mg/l to 32 mg/l.

Potassium: In the present investigation, the potassium concentration was ranged between 3 mg/l to 19 mg/l.

Carbonate: The presence of carbonate and bicarbonate in water is unwanted for municipal water supply and objectionable to use in various industries. Water quality limits to contents of carbonate and bicarbonate has not been recommended yet. However WHO (2011)[20] have not recommended any limit for carbonate and bicarbonate in drinking water. The concentration of carbonate in the river water ranges from 0 to 19 mg/1. During this season, carbonate contents were absent at most of the sampling sites of the river except sampling sites S5 to S9 and S14 to S-15.

Bicarbonate: Surplus bicarbonate adds to the water salinity and total solids contents and at high temperature tends to form scale deposits on taps and valves. This is also called temporary hardness of water because heating generally removes it. When water is heated, bicarbonate breaks down into carbonate and forms solid particles that can stick inside the pipes. The presence of considerable quantity of bicarbonate in irrigation water is harmful due to the propensity of bicarbonate to precipitate calcium and magnesium from the earth in the form of calcium and magnesium carbonates. This brings a change in the ration between sodium and total amount of cations, so increasing the sodium hazard. High bicarbonate also results in increase in pH of the soil rendering it to a condition known as black alkali soil.[16] Table 1 (a & b) shows that bicarbonate contents in the Ghaggar River water varied from 189-308 mg/1 with an average of 256.3.

Residual free Chlorine: At all the sampling sites residual chlorine was not found.

DO: The dissolved oxygen is essential to all forms of aquatic life along with those organisms responsible for the self-purification processes in natural waters. Dissolved oxygen is generally a most important parameter in evaluation of water quality. Dissolved oxygen varies with temperature, salinity, turbulence, photosynthetic activity of algae and other aquatic plants along with atmospheric pressure. The fluctuation ranges of dissolved oxygen are 2.00-8.00mg/l in Ghaggar River in the study period. The dissolved oxygen is above 6.00 at the source of the Ghaggar River and hence it indicates better water quality in terms of dissolved oxygen. The dissolved oxygen is lessened at S6, S7. At Site S9 the DO level is only 2 mg/l as the Patiala River meets the Ghaggar River here which carries the wastewater from Patiala and Sunam district of Punjab. Dissolved oxygen in this stretch is always lower than 6.00mg/l which is required for healthy river system. The CPCB and ISI prescribed the limit of dissolved oxygen about 6.00 for Class- A water, 5.00 for Class-B, 4.00mg/l for Class-C and D water respectively.[2]

BOD: The BOD range found in the study period in Ghaggar River is 6-29 mg/l. It may be mentioned that it is not allowed to contain any biodegradable organic matters present in drinking water. The CPCB and ISI have prescribed the limit 2.00mg/l of BOD for Class-A, 3.00 for Class-B and Class-C waters respectively for classification of inland surface waters.[2] The BOD

value has been found to be more or less normal at the source of the river but found to increasing gradually from S4 to S11 Sites after receiving effluent from the various drains, Nallah and Patiala River.

It indicates that BOD values in Ghaggar River are high at all sampling. High BOD value influences Eutrophication in the river system depleting the dissolved oxygen and finally aquatic fauna are unable to sustain in the river environment.

COD: The chemical oxygen demand shows the oxygen equivalent of the organic matters that can be oxidized by using strong oxidizing agent. The COD is widely used as a measure of susceptibility to oxidation of organic and inorganic materials present in water bodies. The COD in surface water ranges from 20.00mg/l or less in unpolluted water to higher than 200.00mg/l in water receiving effluents or waste water[4]. The high values of COD indicate the presence of considerable amount of chemically oxidisable organic matters (Lal and Bhattacharya, 1989; Shaw et al., 1991).[11 & 15] The COD value in Ghaggar River water has been observed to be high on account of receiving waste materials. The COD of Ghaggar River varies in the range of 53 to 236 mg/l.

Heavy Metals: These constituents are usually present in trace amounts in water. Increased concentrations of heavy metals in water can be attributed to both natural and manmade sources. Some of the heavy metals or trace elements are essential for physiological functions of living tissue and regulate many biochemical processes. The deficiency of heavy metals is harmful. The deficiencies of heavy metals in human beings and animals have been identified.[5] The same metals, however, at increased level may have severe toxicological effects on human beings[4]. They are generally responsible for various health hazards when present in excessive amounts. Kaushik et al and Sukhdev Kundu also studied the heavy metals in upper regions of Ghaggar River.[8 & 10] In the selected research area, the Ghaggar River is receiving the domestic, industrial and municipal wastewaters/effluents all along its course. All in all, the dominancy of the analyzed heavy metals in the surface water of Ghaggar followed the sequence: Fe> Zn > Ni > Cu > Cd > Cr >Pb > Hg >As.

Total Nitrogen: Nitrogen is generally an useful indicator of organic pollution and hence high concentration indicates fresh pollution in the river system.[4] Most sensitive indicator of sewage pollution in a river water is sudden increase in its ammonia content which gradually decreases through aerobic oxidation into nitrites and then into nitrates. In Ghaggar river total nitrogen varies from 1.32 mg/l to 28.32 mg/l.

Phosphate: Phosphate is a very important pollutant in a water system. It induces natural growth of microscopic plants in the surface water producing a second form of pollution. Phosphates are not toxic and not a direct health threat to human and other aquatic organisms but indicate a serious indirect threat to water quality.[12] The fluctuation ranges of phosphate are 0.03-22.48 in Ghaggar River during the study period. The content of phosphate is minimum at first three sites that is from S1 to S3 and then gradually increases. due to receiving of effluent, domestic waste water, sewage and other waste materials from various sources.

Total Phosphorous: Phosphorus is an essential nutrient for aquatic organisms and exists in water system as both dissolved and particulate matters. The phosphorus occurs mostly as dissolved orthophosphate and polyphosphate along with organically bound phosphates. The total phosphorus in water of the Ghaggar River ranges from 0.04 mg/l to 34.54 mg/l which shows partially deteriorated the quality of Ghaggar River in terms of total phosphorus.

Pesticides: Samples were analysed for Aldrin, Dialdrin, Endo-sulfan and DDT, though in all the samples pesticides were below detection limit. Kaushik et.al. did similar study in 2010[9], he found that Aldrin and Dildrin were below detection limit but the concentrations of HCH and DDT in all the samples were above the permissible limits prescribed by the European Commission Directive for drinking purposes.

MPN: The fairly high values of total coliform were indicative of increasing pollution of the Ghaggar River by organic means particularly through the discharge of sewage and domestic effluents into the ponds. All the sites were infected by coliform with an average of 830563 mg/l.

CONCLUSION: This study assessed the physicochemical properties of Ghaggar River water from twenty different locations. In the present investigation, it was found that the maximum parameters were at the level of pollution except few parameters like pH, total hardness and chloride. The results of water quality are presented in Table 1 (a & b). It clearly indicates that river water is not suitable for domestic purposes. Ranges of key water quality parameters, e.g. DO, BOD, COD and TDS, were several times higher than the prescribed standards for inland water bodies.

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