



A Study to Assess the Water Quality of Satluj River at Wajipur Kalan, Ludhiana, Punjab

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(Received 23 Oct, 2016; Accepted 02 Jan, 2017; Published 09 Jan, 2017)

ABSTRACT: Satluj river is a tributary of Indus River and is one of the longest river that flows through Punjab. Domestic wastes, municipal sewage, industrial effluents, agricultural run-off etc. influences the water quality of river directly or indirectly. This study was carried out at Wajipur Kalan, Ludhiana, a Point of confluence of Buddha Nala which drains into Satluj river after passing through highly populated Ludhiana of state Punjab during May, 2015 to April, 2016. For this study important water quality parameters such as pH, Electrical Conductivity (EC), Turbidity, Total Alkalinity, Chlorides, Phosphate, Nitrate, Total Hardness, Calcium & Magnesium Hardness, Sodium, Potassium, Iron, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Dissolved Carbon Dioxide and Heavy metals such as Copper, Cadmium, Chromium, Manganese, Nickel, Zinc and Mercury were analyzed. The analyses were carried out according to APHA, 2012 procedures. The results of the analysis shows that some of the parameters under investigation such as Turbidity, Phosphate, Sodium, COD, BOD, Cadmium and Chromium were beyond the permissible limits prescribed by Bureau of Indian Standards (BIS), 2012 and World Health Organization (WHO), 2011.

Keywords: Satluj river; Wajipur Kalan; Water quality and Heavy Metals.

INTRODUCTION: Water is a natural resource for the existence of all living organisms. Water is the most abundant on the planet as a whole, but fresh potable water is not always available for human or ecosystem use.^{1 & 2} Indian rivers are polluted continuously due to the domestic wastes, municipal sewage, industrial effluents, agricultural run-off etc.^{3-8 & 16} This analysis was carried out to assess the water quality of Satluj river at Wajipur Kalan, Ludhiana, a Point of confluence of Buddha Nala which drains into Satluj river after passing through highly populated Ludhiana of state Punjab, hence it is intended to investigate this water⁶⁻⁸. In this study river water samples were collected and analysed for physicochemical and heavy metals evaluation of pollution.

For this study important water quality parameters such as pH, Electrical Conductivity (EC), Turbidity, Total Alkalinity, Chlorides, Phosphate, Nitrate, Total Hardness, Calcium & Magnesium Hardness, Sodium, Potassium, Iron, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Dissolved Carbon Dioxide and Heavy Metals such as Copper, Cadmium, Chromium, Manganese, Nickel, Zinc and Mercury were analyzed. The water quality was studied monthly during May, 2015 to April, 2016. All analyses were carried out according to APHA, 2012² procedures.

From the results we observed significant variations in the analysis of the water quality compare to normal water which shows that the Satluj river water at wajipur kalan is polluted and not good for drinking purpose.

MATERIALS AND METHODS: To assess the water quality of Satluj river at Wajipur Kalan, Ludhiana, Punjab with reference to Physico-chemical parameters and Heavy Metals, river water samples were collected and analysed for evaluation of pollution⁹⁻¹⁵. The water samples were collected for twelve months from May, 2015 to April, 2016. The river water samples were collected in different sampling bottles as per standard method APHA, 2012². The pH, electrical conductivity and turbidity were estimated at sampling sites. The other parameters were measured by the procedure given by APHA, 2012 in the laboratory.

RESULTS AND DISCUSSION:

Results: The results of various physico-chemical and heavy metals analysis were recorded during from May, 2015 to April, 2016 in present study with Average values, standard deviation values, Maximum and Minimum values are presented in Tables 1 and 2. Comparison of various physico-chemical and heavy

metals analysis for month wise average values is presented in Figures 1 & 2.

Table 1: Physico-chemical analysis of Satluj River at at Wajipur Kalan, Ludhiana, Punjab during May, 2015 to April, 2016.

Months/ Parameters	May, 2015	June, 2015	July, 2015	August, 2015	Septem- ber, 2015	Octo- ber, 2015	Novem- ber, 2015	Decem- ber, 2015	January, 2016	February, 2016	March, 2016	April, 2016	Maxi- mum	Mini- mum	Mean	SD (σ)
pH	6.95	6.55	6.22	7.18	7.01	6.82	7.17	7.11	6.92	6.99	7.23	6.99	7.23	6.22	6.92	± 0.2887
EC (μ mhos/ cm)	329	330	303	313	330	881	1368	986	903	398	255	305	1368	255	558.41	± 372.4016
Turbidity (NTU)	34	33	31	28	55	60	52	76	80	65	59	51	80	28	52	± 17.4616
Total Alkalini- ty (mg/l)	115	103	111	118	143	147	367	345	178	165	152	139	367	103	173.58	± 88.2202
Chloride (mg/l)	21	21.5	22	22	46	117	232	189	126	56	51	49	232	21	79.37	± 71.1148
Phosphate (mg/l)	0.39	0.44	4.58	8.2	6.88	1.99	6.5	5.45	2.16	2.11	1.85	1.2	8.2	0.39	3.47	± 2.7057
Nitrate (mg/l)	4.9	2.5	1.9	1.4	6.9	13	28	18	17	14	6.8	5.5	28	1.4	9.99	± 8.1124
Total Hardness (mg/l)	140	136	112	116	165	180	319	312	245	188	174	166	319	112	187.75	± 69.4303
Calcium Hardness (mg/l)	40	38	38	35	43	48	88	78	62	57	52	44	88	35	51.91	± 16.7411
Magnesium Hardness (mg/l)	9.7	7.9	7.1	6.8	14.8	15	24	27.7	21	16	13	11.5	27.7	6.8	14.54	± 6.7501
Sodium (mg/l)	24	18	15.5	15	67	85	199	203	115	94	62	41	203	15	78.2	± 66.1106
Potassium (mg/l)	4.7	4.2	4.4	4.5	4.2	4.2	13	6.4	3.5	2.8	2.6	3.4	13	2.6	4.82	± 2.7571
Iron (mg/l)	0.19	0.18	0.16	0.16	0.17	0.19	0.08	0.17	0.21	0.2	0.22	0.21	0.22	0.08	0.17	± 0.0368
COD (mg/l)	41	68	72	87	68	41	230	158	41	58	45	48	230	41	79.75	± 57.4299
BOD (mg/l)	2	1.5	3.2	4	3.1	2	41	15	1.9	1.8	1.9	2.2	41	1.5	6.63	± 11.4391
Dissolved Carbon Dioxide (mg/l)	28	24	16	10.8	24.5	28	60	45	27	29	25	21	60	10.8	28.19	± 12.9356

SD – Standard Deviation; COD – Chemical Oxygen Demand; BOD – Biological Oxygen Demand; EC – Electrical Conductivity.

Table 2: Heavy metals analysis of Satluj River at at Wajipur Kalan, Ludhiana, Punjab during May, 2015 to April, 2016.

Parameters/ Months	Cop- per(mg/ l)	Cadmi- um(mg/l)	Chromi- um(mg/l)	Manga- nese(mg/l)	Nickel (mg/l)	Zinc (mg/l)	Mercur- y(mg/l)
May, 2015	0.0029	0.0011	0.0147	0.0232	0.0138	0.0457	BDL
June, 2015	0.0025	0.0056	0.0142	0.0231	0.0125	0.0458	0.0007
July, 2015	0.0052	0.0084	0.0142	0.0154	0.0131	0.0365	0.0003
August, 2015	0.0076	0.0123	BDL	0.0156	0.0115	0.0116	0.0008
September, 2015	0.0064	0.0072	0.0142	0.0202	0.0132	0.0325	0.0009
October, 2015	0.0029	0.0011	0.0147	0.23	0.0138	0.0457	BDL
November, 2015	BDL	0.0042	BDL	0.0248	0.0146	0.0355	BDL
December, 2015	0.0026	0.0035	0.146	0.024	0.0148	0.0404	0.0003
January, 2016	0.0028	0.001	0.146	0.023	0.0137	0.0456	BDL
February, 2016	0.0026	0.0011	0.0147	0.0238	0.0132	0.0456	0.0001
March, 2016	0.0024	0.0009	0.0142	0.0232	0.013	0.0458	0.0001
April, 2016	0.0025	0.001	0.0142	0.023	0.0134	0.0457	BDL
Maximum	0.0076	0.0123	0.146	0.23	0.0148	0.0458	0.0009
Minimum	0.0024	0.0009	0.0142	0.0154	0.0115	0.0116	0.0001
Mean	0.0036	0.00395	0.052	0.0391	0.0133	0.0397	0.0004
SD (σ)	±0.0018 3	±0.00374	±0.00554	±0.0601	±0.0008 0	±0.0100	±0.00033

BDL – Below Detection Limit; SD – Standard Deviation.

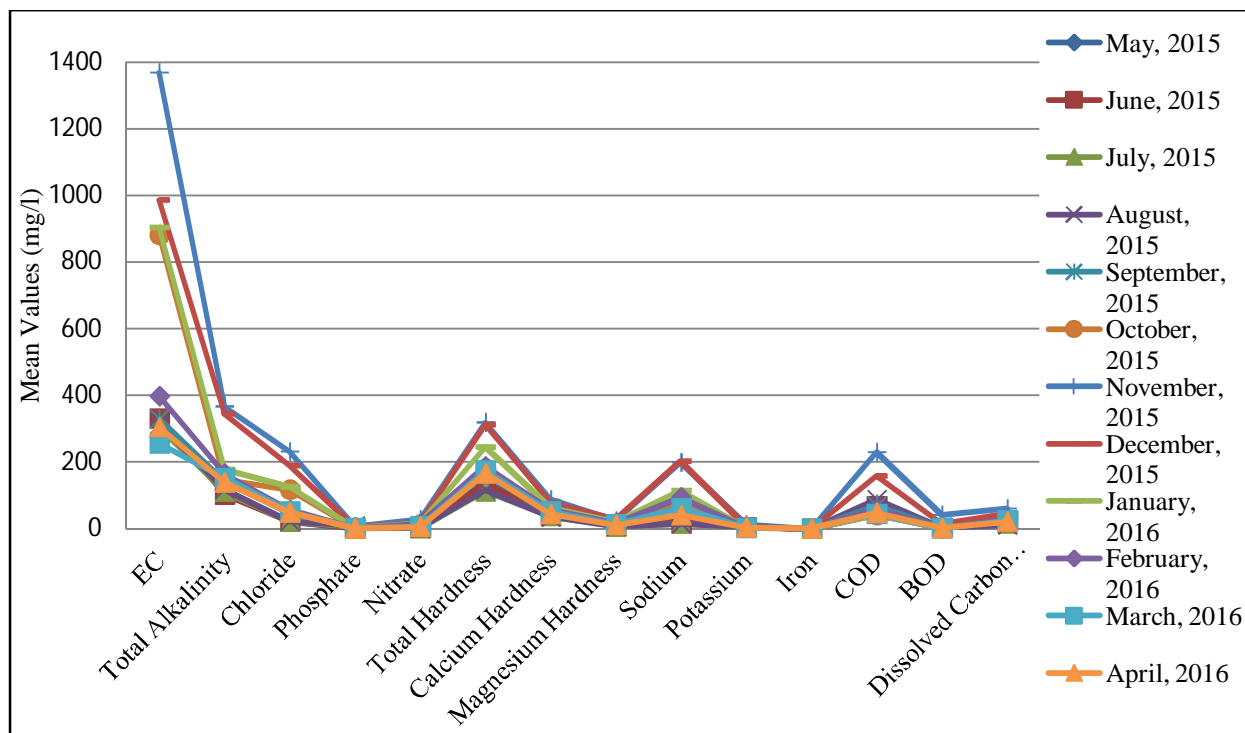


Figure 1: Graph showing month wise variation in physico-chemical parameters analysis.

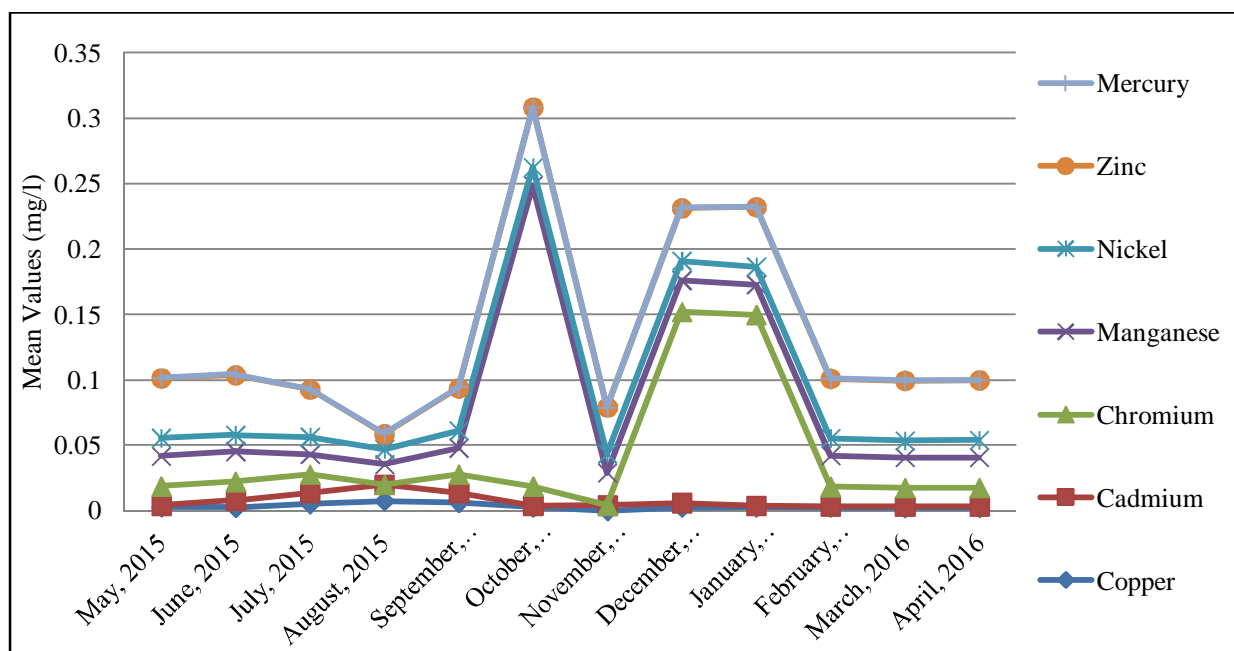


Figure 2: Graph showing month wise variation in Heavy metals analysis.

Discussion: Water qualities provide the primary assessment of the pollution status and it can be determined through the assessment of various parameters as physico-chemical and Heavy metals.

pH: pH is very important parameter which evaluating the acid-base balance of the water. The BIS (Bureau of Indian Standards)⁵ limit of pH for drinking water is 6.5-8.5. During this study it was recorded that pH varied from 6.22 to 7.23. Thus the pH obtained in the river waters was within the permissible ranges. In general, the domestic sewage and agricultural run-off are usually alkaline in nature due to presence of ammonical compounds whereas industrial waste can be acidic or alkaline.

Electrical Conductivity (EC): EC is the measure of capacity of a substance or solution to conduct electrical current through the water. In the present study, electrical conductivity values varied between 255 and 1368 $\mu\text{S}/\text{cm}$. It was seen that the EC was found maximum in the months of October to December and minimum in the months of March to July which can be attributed to lesser flow of water or gathering of domestic, industrial sewage etc around the sampling site.

Turbidity: Turbidity influences the light penetration. The turbidity values of Satluj river water at wajipur kalan was found to be in the range of 28 - 80 NTU was found maximum in the months of October to December and minimum in the months of March to July which was beyond the permissible limit of 10 mg and 25 mg/l prescribed by BIS, 2012 and ICMR respectively.

Total Alkalinity: In this study, the total alkalinity ranged between 103mg/l and 367mg/l, which were maximum in the months of October to December. Results of this analysis show that total alkalinity was within the permissible limit of 600 mg/l prescribed by BIS, 2012.

Chloride: Chloride concentration in water indicates the presence of organic waste in water, main sources of chloride in river waters are domestic or industrial sewage, sediments, effluents etc. The BIS suggested the standard of chloride is 250 mg/l. The concentration of Chloride in Satluj river water at Wajipur Kalan was found to be in the range of 21-232 mg/l. which was within the permissible limits.

Phosphate: Main source which are responsible for phosphate concentration in water are domestic sewage, agriculture effluents, industrial waste waters etc. The concentration of phosphate in Satluj river water at Wajipur Kalan, Ludhiana was recorded from 0.39 in the month of May, 2015 to 8.2 mg/l in the month of August, 2015. High concentration of phosphate therefore is the indication of pollution in the river.

Nitrates: Source of nitrates in river water is nitrogen which is constituent of proteins, chlorophyll and many other biological compounds. The mean value of nitrate in river water was 9.99 ± 8.11 mg /l, which was within the permissible limit of 50 mg and 45 mg/L prescribed by WHO, 2011¹⁷ and BIS, 2012 respectively.

Total Hardness: Total hardness of the water is a measure of soap consuming capacity of water. Total

hardness of the Satluj river water at Wajipur Kalan, Ludhiana fluctuated between 112 mg/l and 319 mg/l. The results indicate that the Satluj river water at Wajipur Kalan, Ludhiana which was within the permissible limit of 600 mg/l prescribed by BIS, 2012. The hardness was relatively less showing their suitability for drinking but limits its use for industrial purposes where hardness of less than 1 mg/l is required, as it may cause scaling in boilers. So this water without treatment cannot be used for industrial purposes.

Calcium Hardness: Calcium is important micronutrient in an aquatic environment. The concentration of Calcium Hardness in Satluj river water at Wajipur Kalan, Ludhiana was found to be in the range of 35 mg/l to 88 mg/l as shown in Figure 1. The results indicate that the Calcium hardness of Satluj river water at Wajipur Kalan, Ludhiana was within the permissible limit of 200 mg/l prescribed by BIS, 2012.

Magnesium Hardness: The concentration of magnesium hardness in Satluj river water at Wajipur Kalan, Ludhiana varies from 6.8 to 27.7 mg/l during the period of study. The results indicate that the magnesium hardness of Satluj river water at Wajipur Kalan, Ludhiana was within the permissible limit of 100 mg/l prescribed by BIS, 2012.

Sodium: The concentration of the sodium in irrigation water and soil is of great interest as high sodium contents makes soil hard to plough and unsuitable for seedling emergence. Satluj river water at Wajipur Kalan, Ludhiana had sodium concentration from 15 to 203 mg/l, results shows their moderate but harmless concentration. High sodium value may have been due to confluence of Satluj river with Buddha Nala.

Potassium: Potassium is found virtually in all foods and drinking water. The mean value of Potassium in study area of Satluj river water at Wajipur Kalan, Ludhiana was 4.82 ± 2.75 mg/l and was within the permissible limit i.e. 20 mg/l prescribed by BIS, 2012.

Iron: Iron is one of most abundant metal in earth's crust, found in natural water and is essential element in human nutrition and metabolism but in excess quantities results in toxic effect like hemochromatosis in tissues. The mean value of iron in the water of Satluj river in study area was 0.17 ± 0.03 mg/l, which was at par with acceptable limit of 0.3 mg/l prescribed by BIS, 2012.

Chemical Oxygen Demand (COD): The highest value was noted 230 mg/l in the month of November and minimum 41 mg/l in the month of May. The dilution by the increase in volumes of river water due to rainy water could also be responsible for the lower COD values. Higher value in maximum months show-

ing the confluence of Satluj river with Budha nala which is full of sewage water, garbage dumping and industrial discharges etc.

Biochemical Oxygen Demand (BOD): The maximum value of BOD was observed 41 mg/l in the month of November and minimum 1.5 mg/l in the month of June. The unpolluted water has BOD value of 3 mg/l or less and industrial waste water has BOD value 25000 mg/l. The value of BOD in the present study was highest in month of November and December which indicates that heavy pollution occurred in these months.

Dissolved Carbon Dioxide: The highest value for Dissolved Carbon Dioxide was noted 60 mg/l in the month of November and minimum 10.8 mg/l in the month of August. The mean value of Dissolved Carbon Dioxide in study area of Satluj river water at Wajipur Kalan, Ludhiana was 28.19 ± 12.93 mg/l and was within acceptable limits.

Heavy Metals: During this study heavy metals such as Copper, Cadmium, Chromium, Manganese, Nickel, Zinc and Mercury were analysed. Out of all Cadmium and Chromium were found beyond permissible limit of 0.003 mg/l limits prescribed by BIS, 2012 and WHO, 2011. The pollution of water with cadmium is caused by contamination from mining, fertilizers and industrial effluents. The mean value of Cadmium was 0.0039 ± 0.0037 mg/l, which was slight higher than the permissible limit. The copper is both essential nutrient and drinking water contaminant. Copper is used in making pipes, valves and is present in alloys and coatings. The mean value of copper in Satluj river water at Wajipur Kalan, Ludhiana was 0.052 ± 0.005 mg/l, which was also slight higher than the permissible limit. Due to higher values of Cadmium and Chromium water of Satluj river water at Wajipur Kalan, Ludhiana, Punjab was found polluted.

CONCLUSION: Form this study, the available data was helpful to understand the contamination of Satluj river water at Wajipur Kalan, Ludhiana, Punjab and draw conclusions. Most of the parameters analyzed for Satluj river water at Wajipur Kalan, Ludhiana, Punjab were within the permissible/acceptable range except EC, Turbidity, Phosphate, Sodium, COD, BOD, Cadmium & Chromium and hence this Satluj river water of study area cannot be used for household and commercial purposes.

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