

Impact of Pollution on Physico-Chemical Features of Song River in Doon Valley (Uttarakhand)

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Abstract

In the present study water samples were collected on monthly basis from three sampling sites of Song river viz. Raiwala (S1), Lacchiwala (S2) and Chhidarwala (S3). The evaluation of various physico-chemical parameters such as Temperature, pH, Velocity, Transparency, Free CO₂, DO, Turbidity, Total dissolved solids, Alkalinity, Hardness, Calcium, Magnesium, Chloride, Phosphate, Nitrate, Sodium and Potassium were analysed has been carried out in selected sites. The physico-chemical conditions were favourable for growth and survival of aquatic organisms.

I. Introduction

Water is essential for the existence of life on earth, its quality and quantity significantly influences the metabolic activities of all living organisms. It is also very vital and important recyclable natural resource for providing better living conditions for human beings (Kumar Om, 1986). About 97% of earth's water supply is in the ocean which is unfit for human consumption and other uses because of its high salt content. The remaining 2% is locked in the polar ice caps, and 1% is available as fresh water in rivers, lakes, streams, reservoirs and ground water, which is suitable for human consumption. (Charklis et al. 1979).

Water can be obtained mainly from two sources namely surface and ground water, surface water is any water that travels or is stored on top of the ground. This would be the water in rivers, lakes, streams reservoirs and even the oceans (Molenaar 1989). Many studies have shown that some portion of the available water is taken up by plants and animals to be ultimately released into the atmosphere or on to the land surface (Bhatia 1988). The cycle is then completed with its return to the atmosphere by evaporation or transpiration or it may return to the sea through stream underground seeps or as precipitation. (Cornish, P.M. 1980)

River water is the purest form of natural water, since it is obtained as a result of evaporation from the surface water. However in its down-wards journey of industrial gases like CO₂, NO₂, SO₂ etc. and suspended solid particles both organic and inorganic origin. (Shukla et al. 2018).

Water pollution is a global threat that varies in magnitude and type from one region to another. Rapid industrialization plays an important role in polluting the environment and causes severe degradation in pedosphere, hydrosphere and atmosphere (Talsma et al. 1982). Water used in industries creates a waste that has potential hazard for our environment because of the introduction of various contaminants such as heavy metals into soil and water resources (Fouzia et al. 2013).

The municipal and industrial waste water discharges constitute the constant polluting source of river water quality. The surface run-off during the rainy season also affects river water quality (Grover 1991). Seasonal variations in precipitation, surface run-off, ground water flow and interception of river water have marked effect on concentration of river water pollutants (Sharma 1986). The hydro-geochemistry of river water is controlled by a series of factors such as climate, vegetation, topography and geology of the catchment area. The river water ecosystem is affected by fluctuations in physical and chemical characteristics of river (Gupta 2008, Trivedi et al. 1984).

Study area

Doon Valley is an unusually wide, long valley within the Shiwalik hills and the lesser Himalayas, in the Indian states of Uttarakhand. It is bounded on all sides by mountains, with northern range running from Kalsi in the west to Muni ki Reti in the east with Mussoorie at the centre in a semi-circular arc; and southern range at south from Paonta Sahib in the West to Haridwar in the east. The valley also forms a watershed between the Yamuna and Ganges river system. It occupies an area of about 1200 sq.km between 77°33' 10" and 77°18'30" Longitude and 29°58'40" and 31° 24' N Latitude (east). Several rivers and a number of streams flow through the valley, having their sources in either the Mussoorie Hills or the Shiwalik Hills. The Song river originates from foot hills of Mussoorie range, which enters the valley at Mal Devta and receives all along its course a number of tributaries from Himalayan and Shiwalik ranges.

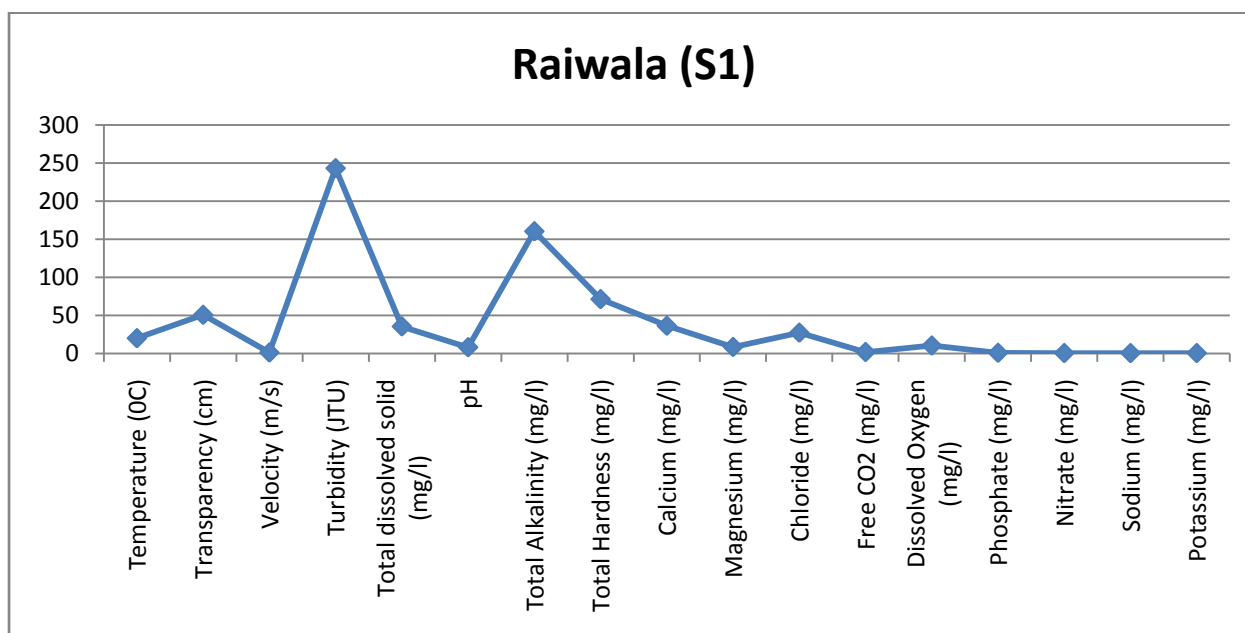
II. Materials and Methods :

The present study was conducted on Song river covering a stretch of approximately 44 km from upstream to downstream. Three sites were selected along the river which includes Raiwala (S1), Lacchiwala (S2), Chhidarwala (S3). The study was carried out for a time period of one year on monthly basis. Water samples were collected every month. They were analysed for Physico-chemical parameters like Temperature (°C), pH, velocity (m/s), Transparency (cm), Free CO₂ (mg/l), Turbidity (JTU), DO(mg), Total Solids (mg/l), Total alkalinity (mg/l), Total hardness (mg/l), Sodium (mg/l), Potassium (mg/l), Nitrate (mg/l), Phosphate (mg/l), Calcium (mg/l), Magnesium (mg/l), Chloride (mg/l) were analysed in laboratory by following methodology of APHA (2005).

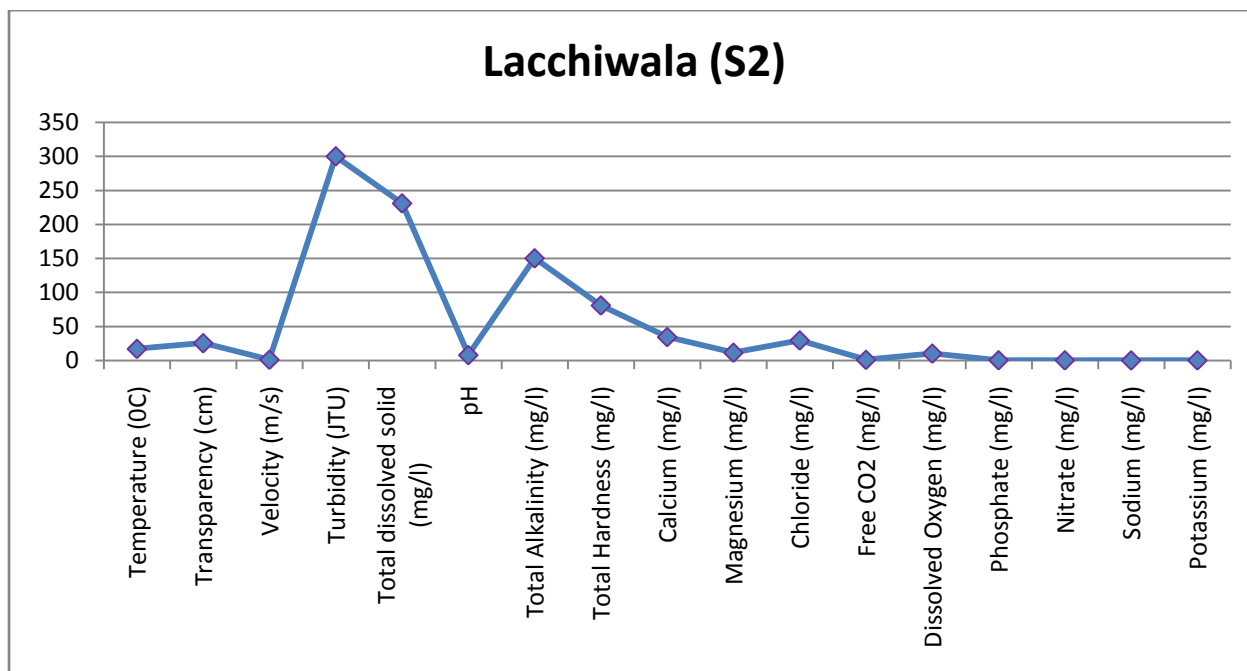
The temperature, velocity and transparency was measured by using Celsius thermometer, flowmeter and Secchi disc. Turbidity and pH were measured by using Jackson turbidity unit and digital pH meter. Phosphate and Nitrate were analysed by using UV-Vis spectrophotometer and Sodium and Potassium by Flame photo-meter. Total solids and total dissolved solids were measured volumetric analysis. Alkalinity, Total hardness, Calcium, Magnesium, Chloride, Free CO₂, Dissolved Oxygen were analysed by titration methods.

Table-1: Physico-chemical parameters of Song River at Raiwala (S1), Lacchiwala (S2), Chhidarwala (S3)

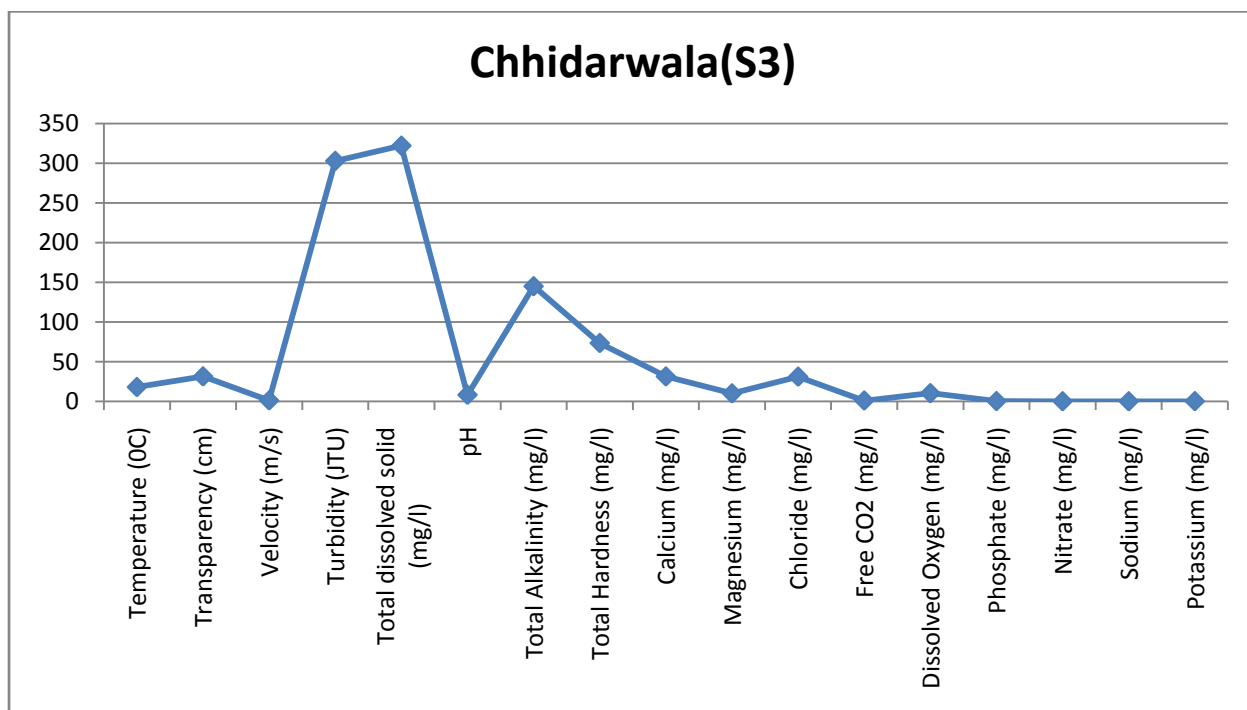
S.No.	Parameters	Site1	Site2	Site3
1	Temperature (°C)	19.88	17.21	18.2
2	Transparency (cm)	50.5	25.6	31.6
3	Velocity (m/s)	1.02	1.26	1.32
4	Turbidity (JTU)	243.0	300.1	303.0
5	Total dissolved solid (mg/l)	35.32	231.0	322.15
6	pH	8.00	8.10	8.41
7	Total Alkalinity (mg/l)	160.21	150.25	145.12
8	Total Hardness (mg/l)	71.12	81.00	73.61
9	Calcium (mg/l)	36.17	34.62	31.52
10	Magnesium (mg/l)	8.33	11.61	10.20
11	Chloride (mg/l)	27.12	29.61	31.30
12	Free CO ₂ (mg/l)	1.71	1.10	1.20
13	Dissolved Oxygen (mg/l)	10.21	10.31	10.51
14	Phosphate (mg/l)	0.64	0.50	0.48
15	Nitrate (mg/l)	0.33	0.38	0.28
16	Sodium (mg/l)	0.26	0.28	0.22
17	Potassium (mg/l)	0.30	0.37	0.39



Showing physico-chemical parameters at Raiwala (S1)



Showing physico-chemical parameters at Lacchiwala (S2)



Showing physico-chemical parameters at Chhidarwala (S3)

III. Result and Discussion

The physico-chemical parameters values recorded from three sites of Song River is given in Table-1. From the results the temperature noted at S2 was minimum (17.21⁰C) and at S1. It was found maximum (19.88⁰C). The highest values of transparency was observed at S1 (50.5 cm) and lowest at S2 (25.6 cm). The highest value of velocity was noted at S3 (1.32 m/s) while the lowest value of velocity found at S1 (1.02 m/s). Highest value of turbidity at S3 (303.0 JTU) and lowest at S1 (243.0 JTU). The pH recorded at S1 was minimum (8.00) and it was found maximum S3(8.41). The total alkalinity was found to be highest at S1 (160.21 mg/l) and it was found minimum at S3 (145.12 mg/l). The concentration of dissolved oxygen was recorded to be

maximum at S3 (10.51 mg/l). The total hardness was found to be highest at S2 (73.61 mg/l), and lowest at S1 (71.12 mg/l). The other parameters like Calcium, Magnesium, Free CO₂, Sodium, Potassium, Chloride, Nitrate and Phosphate showed onirregular trend and a very little variation in their concentration from S2 to S1 during the study period.

The Physico-Chemical variables are important factors of water in which all the biological communities are dependent on each other. The most common physical assessment of water quality is measurement of temperature according to the present study. The temperature recorded in Song river ranged from 17.21 to 19.88 respectively. However the temperature recorded every month and every season at all sites was found slightly higher which had a strong effect on both chemical and biological parameters of water. The total alkalinity of the river water recorded was revealed that it increases in pH from 8.00 to 8.41. This increase in pH could be due to either increased Concentration of carbonates or increased photosynthetic activity of producer (Trivedi and Goel, 1984). During rainy season the total dissolved solids was found relatively in higher level and this may be the cause of soil erosion during heavy rainfall. Hardness of water is also an important factor for the decrease in the toxicity of poisonous elements. The value of hardness ranged from 71.12 to 81.00 mg/l. Hardness values may attribute to the presence of high Calcium and Magnesium levels in aquatic ecosystem (Gupta et. al. 2008). The high range of the dissolved Oxygen concentration in Song river was from 10.21 to 10.51 mg/l which indicates that the water quality is in better conditions. In rainy season the transparency was minimum while turbidity was maximum. Heavy rainfall during rainy season brings soil and other sediments resulting in less penetration of light. Hence there is a decrease in the photosynthesis of light which further results in the decrease of photosynthetic activity of aquatic flora which means there will be low concentration of dissolved Oxygen during rainy season. The concentration level in Song river of phosphate and nitrate varied between 0.48 to 0.64 mg/l and 0.28 to 0.38 mg/l. Dilution effect was the cause of the relatively low concentration of Chloride in Song river. The level of Sodium and Potassium in Song river ranged from 0.22 to 0.28 mg/l and 0.30 to 0.39 mg/l.

IV. Conclusion

In the present study, while correlating the data, it was noted that a single factor only is not responsible for change in the value of parameters but there may be numerous factors which may cause a change in the physical and chemical nature of river water. It is also suggested that Song river in Doon Valley, Uttarakhand has to be preserved for its planned use, a sustainable and entire management planning is necessary for conservation of this aquatic ecosystem.

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