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Water quality monitoring of river Ganga at Raiwala in Haridwar

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Abstract
In the present investigation water quality monitoring of river Ganga at Riawala, District Haridwar was studied during the period November 2008 to October 2009. Water quality parameters studied were Temperature, pH, free CO2, D.O., B.O.D, T.D.S., Acidity, Alkalinity, Hardness, Calcium, Chlorides and Conductivity. Statistical analysis of the analytical data was computed in the table.

Keywords- *Physicochemical parameter, River Ganga, Water quality*

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I. Introduction

Fresh water is the most precious resource on earth. Today, the easy availability of fresh water is a major problem as 80% rivers are getting polluted. Rivers are life line of human settlement but there are natural and anthropogenic factors which influence the water quality of river (Gupta and Chakarpani, 2007). There are many rivers in our India. But Ganga is one of the holiest river of India. The River Ganges, largest river of the Indian sub-continent with a total length of about 2525 km, originates from ice-cave '*Gaumukh*' ($30^0$55' N / 70 ^{0} 7' E) in the Garhwal Himalaya at an altitude of 4100 m and discharges into Bay of Bengal. At Haridwar Ganga cuts across the Shivalik hills. The water of river Ganga is pure due to presence of some micro-organism as a decade ago. Due to its religious importance million of people in India take holy dips in river Ganga especially on some auspicious occasions because it is believed that a holy dip in the same purges away all the sins. Day by day human's activities have polluted the river Ganga water. Due to unproportional growth of population and industries, water quality of river Ganga is degrading at a faster rate day by day therefore, regular monitoring of river Ganga is essential. With this aim, various studied have been conducted in the past on fresh waters related to various aspects. In the present investigation physicochemical parameter of river Ganga at Raiwala was done.

II. Materials And Method

Haridwar is one of the most holy cities of India. It lies in the foothills of Shivalik range. The position of city on the globe is on latitude 29º58'N and longitude 78 º 13′ E. Water samples were taken from different location of Raiwala in Haridwar district. Monthly sampling was done from November 2008 to October 2009. Samples were collected between 7.00 a.m. to 9.00 a.m. in borosil glass bottles of 300 ml capacity and plastic containers from each sampling sites. The analysis of all the parameter was done according to the methods of APHA (1998), Khanna & Bhutiani (2004).

III. Results And Discussion

The monitoring of the river water is an essential step to mark the trend pattern of pollutants and their effect on living systems in today's developing life. On the basis of analysis average value of various physico-chemical parameters are given in table 1 of different location of Raiwala.

Temperature is an important parameter, which is directly related with the chemical reaction in water and biochemical reactions in the living organisms. In the present investigation the maximum temperature (21.00±0.65) was recorded in June while minimum temperature (10.85± 0.36) in December. Similar results regarding to temperature was also observed by Yadav and Kumar (2011) in the river Kosi at Rampur district. pH is one of the important tool to measure acidity or alkalinity in water. Aquatic organisms are sensitive for pH change due to any change in the pH cause change in the structure of aquatic system. In this study, pH observed maximum (8.12±0.08) in the month of January and minimum (7.25±0.05) in the month of July. Similar observation was also observed by Khanna *et al* (2007) in river Ganga. Free CO_2 comes in water due to activity of aquatic organism. In the present investigation the value of free CO_2 vary from (1.06±0.14) minimum in the month of January to (2.48±0.25) maximum value in the month of August. This is similar findings of Khanna and Bhutiani (2005) in river Ganga. Acidity of water is quantitative capacity to react with a strong base to a designated pH. In the present study the concentration of acidity was found to be fluctuating between (9.92±0.29

to 18.92±0.41). This maximum (18.92±0.41) and minimum (9.92±0.29) concentration of Acidity was observed in the month of August and February respectively. A more or less similar trend has been observed by Rai *et al* (2010) in river Ganga at Varanasi. Alkalinity is due to presence of Carbonate and Bicarbonate ions. Alkalinity of water found to be maximum (78.62±4.13) in the month of January and minimum (42.96±2.93) in the month of August. Sarkar *et al* (2007) observed similar trend for Alkalinity. Hardness indicates the concentration of calcium and magnesium ions. Hardness of water is due to the presence of chloride, Nitrate, sulphate and bicarbonate of calcium and magnesium. (Kumar *et al* 2010) The maximum (150.82±9.56) hardness of water observed in the month of August while minimum (70.82±4.17) in month of January. Mishra (2003) observed hardness in river Ganga at Haridwar and found more or less trend in their study. The concentration of Calcium was found to be maximum (21.50±1.56) in the month of August while minimum (11.70±1.00) in the month of January. Similar findings were observed by Khajuria and Dutta (2009) in the river Tawi, Jammu. In natural water sometimes chloride may be due to leaching of rocks. In the present study the concentration of chloride was found to be fluctuating between (5.02±0.36 to11.30±0.52). This maximum (11.30±0.52) and minimum (5.02±0.36) concentration of chloride was observed in the month of Julyt and February respectively. Similar observation was also observed by Vishnoi *et al* (2008) in river Ganga at Kangri village. DO is one of the most important factors, which depends on physical, chemical and biological activities of water body. In the present investigation maximum (12.35±0.70) value of DO was recorded in the month of January while minimum (8.45±0.41) in the month of June. Khanna *et al* (2009) reported the similar trend in river Panv Dhoi . Conductivity is the measure of the ability of an aqueous solution to carry electric current. Conductivity of Ganga river water fluctuates from (120.47±9.00 to 261.20±13.36). The concentration of Conductivity was found to be maximum (261.20±13.36) in the month of August while minimum (120.47±9.00) in the month of February. Khanna *et al* (2007) also reported the similar trend on Song river at Dehradun. Total dissolved solids or filterable residue are those solids, which left after evaporation of the filterable sample. TDS indicate the total amount of inorganic chemicals in the solution. In the present study the concentration of Total dissolved solids was found to be fluctuating between (104.94±5.85 to 207.64±10.71). This maximum (207.64±10.71) and minimum (104.94±5.85) concentration of TDS was observed in the month of August and January respectively. Khanna (1993) also observed similar trend for total dissolved solid. The biochemical oxygen demand is the amount of oxygen required to degrade the organic compound biologically. The concentration of BOD increases with the increase in chemical pollution of the water body. In the present investigation maximum (2.65±0.17) value of BOD was recorded in the month of June while minimum (1.48±0.14) in the month of December. The similar conclusion was supported by Khanna and Bhutiani (2005).

The correlation coefficients among the different parameters are presented in the table-2. The analysis shows high degree positive correlation between temperature and CO_2, temperature and chloride, temperature and acidity, temperature and calcium, temperature and hardness, temperature and conductivity, temperature and TDS, temperature and BOD. pH and DO, pH and alkalinity. CO_2 and acidity, CO_2 and hardness, CO_2 and calcium, CO_2 and chloride, CO_2 and conductivity, CO_2 and TDS, CO_2 and BOD. Acidity and hardness, acidity and calcium, acidity and chloride, acidity and conductivity, acidity and TDS, acidity and BOD. Alkalinity and DO. Hardness and TDS, hardness and conductivity, hardness and calcium, hardness and BOD, hardness and chloride. Calcium and conductivity, calcium and TDS, calcium and chloride, calcium and BOD. Chloride and BOD, chloride and TDS, chloride and conductivity. Conductivity and TDS, Conductivity and BOD, TDS and BOD.

The analysis shows the high degree negative correlation between temperature and DO, temperature and pH. pH and acidity, pH and CO_2, pH and hardness, pH and calcium, pH and chloride, pH and conductivity, pH and TDS, pH and BOD. CO_2 and alkalinity, CO_2 and DO. Acidity and alkalinity, acidity and DO. Alkalinity and calcium, alkalinity and hardness, alkalinity and chloride, alkalinity and TDS, alkalinity and BOD, alkalinity and DO, alkalinity and conductivity. Hardness and DO. Calcium and DO. Chloride and DO. DO and TDS, DO and BOD. DO and Conductivity.

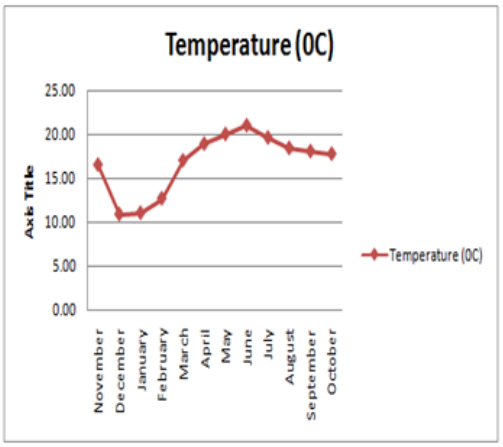
Table-1: Average value of physiochemical parameter of river Ganga from November 2008 to October 2009

	Temperature (^{0}C)	pH	Free CO_2 (mg/l)	Acidity (mg/l)	Alkalinity (mg/l)	Hardness (mg/l)	Calcium (mg/l)	Chloride (mg/l)	D.O. (mg/l)	Conductivity (µmhos/Cm^2)	T.D.S. (mg/l)	B.O.D. (mg/l)
November	16.50±0.47	7.78±0.09	1.62±0.17	11.50.±036	61.58±3.80	77.75±4.71	13.02±1.09	8.38±0.49	9.94±0.53	154.87±9.46	115.80±6.78	1.65±0.15
December	10.85±0.36	7.91±0.07	1.21±0.18	11.00±0.31	73.80±4.16	74.20±4.95	12.38±1.05	7.62±0.38	11.25±0.69	138.90±8.41	111.47±6.59	1.48±0.14
January	11.00±0.36	8.12±0.08	1.061±0.14	10.94±0.31	78.62±4.13	70.82±4.17	11.70±1.00	6.84±0.40	12.35±0.70	129.03±8.24	104.94±5.85	1.54±0.10
February	12.65±0.58	8.02±0.06	1.45±0.20	9.92±0.29	74.90±3.78	78.50±4.87	13.80±1.04	5.02±0.36	11.40±0.56	120.47±9.00	118.68±6.03	1.95±0.17
March	17.00±0.50	7.98±0.05	1.68±0.22	10.56±0.31	70.58±3.82	82.35±5.20	14.50±1.17	7.18±0.41	10.20±0.53	142.80±10.21	122.07±6.96	1.70±0.15
April	18.90±0.65	7.71±0.06	1.71±0.21	11.30±0.38	72.80±4.08	84.05±5.54	15.37±1.33	8.45±0.44	9.00±0.45	158.76±10.83	123.85±7.11	1.95±0.17
May	20.00±0.66	7.65±0.07	1.90±0.22	12.40±0.41	69.20±3.29	99.82±6.11	15.75±1.37	8.58±0.42	8.60±0.63	173.85±11.31	146.09±7.86	2.00±0.18
June	21.00±0.65	7.42±0.06	2.00±0.24	15.86±0.40	55.80±3.38	104.05±6.52	16.52±1.39	10.15±0.51	8.45±0.41	183.42±11.49	153.40±8.02	2.65±0.17
July	19.60±0.59	7.25±0.05	2.48±0.25	17.45±0.42	44.80±3.55	137.49±7.86	19.72±1.55	11.30±0.52	8.62±0.47	192.09±12.11	180.65±9.62	2.45±0.20
August	18.40±0.56	7.33±0.05	2.20±0.23	18.92±0.41	42.96±2.93	150.82±9.56	21.50±1.56	11.00±0.48	8.80±0.52	261.20±13.36	207.64±10.71	2.43±0.19
September	18.05±0.50	7.48±0.06	2.16±0.20	18.00±0.39	52.40±3.45	144.70±8.30	20.48±1.34	10.98±0.42	9.05±0.41	255.25±12.73	190.30±9.82	1.98±0.18
October	17.75±0.52	7.60±0.05	1.80±0.17	16.20±0.38	60.80±3.53	106.91±7.05	17.38±1.23	10.57±0.37	9.50±0.49	177.62±11.77	148.50±8.83	1.83±0.17
Average±S	16.81±3.46	7.69±0.28	1.77±0.41	13.67±3.33	63.19±12.05	100.96±28.73	16.01±3.22	8.84±1.98	9.76±1.29	174.02±45.03	143.62±33.78	1.97±0.37

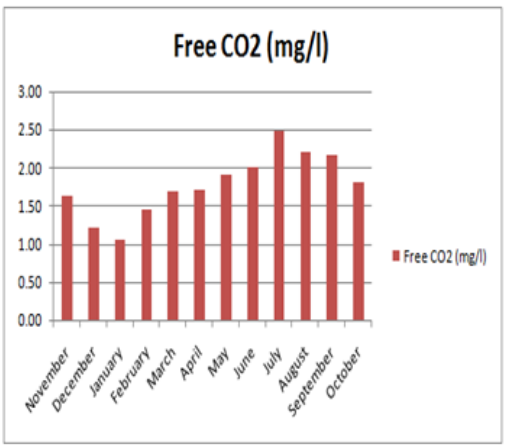
Table-2: Correlation between physicochemical parameters during November 2008 to October 2009

	Temperature	pH	CO2	Acidity	Alkalinity	Hardness	Calcium	Chloride	DO	Conductivity	TDS	BOD
Temperature	1	-0.78956	0.845848	0.586111	-0.63369	0.591721	0.671756	0.702862	-0.96536	0.579764451	0.622294	0.734313
pH		1	-0.92928	-0.90215	0.92126	-0.87718	-0.88478	-0.92579	0.878221	-0.818836365	-0.8863	-0.82451
CO2			1	0.823485	-0.89012	0.88297	0.909529	0.823235	-0.8866	0.781955027	0.88526	0.804965
Acidity				1	-0.92607	0.948771	0.927376	0.93029	-0.66979	0.908600014	0.943561	0.696708
Alkalinity					1	-0.91132	-0.8879	-0.87936	0.714042	-0.852585438	-0.91171	-0.73905
Hardness						1	0.981167	0.849817	-0.6852	0.940635284	0.993745	0.691971
Calcium							1	0.842673	-0.75047	0.921509039	0.980978	0.723044
Chloride								1	-0.78376	0.843565049	0.838448	0.612085
DO									1	-0.684566539	-0.7144	-0.74281
Conductivity										1	0.947495	0.584893
TDS											1	0.734962
BOD												1

Fig 1-12: Showing Monthly fluctuation in physio chemical parameters of River Ganga



(Fig.1)



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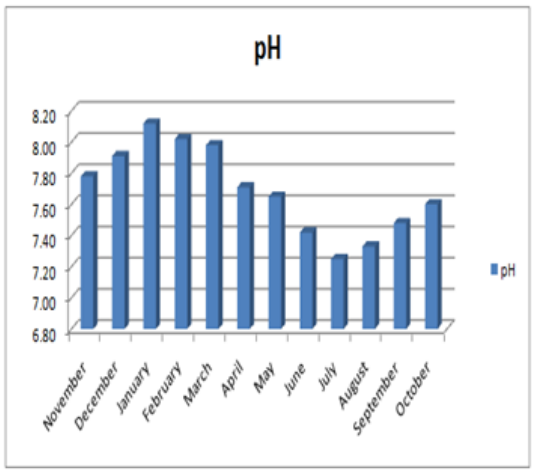

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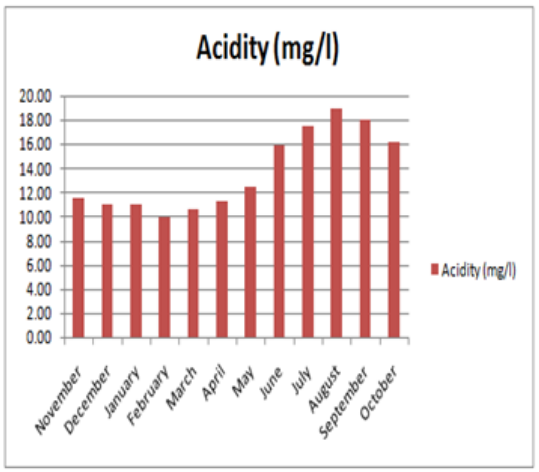
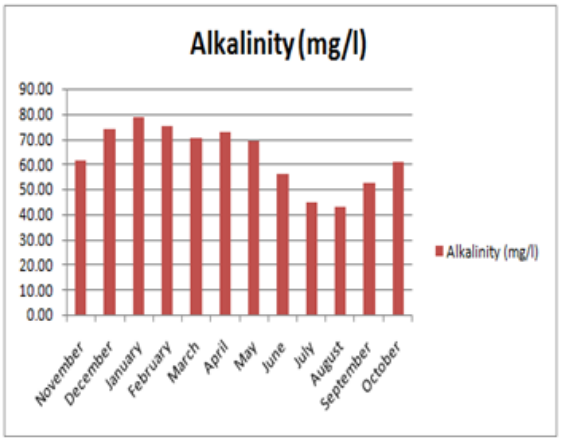


(Fig.4)



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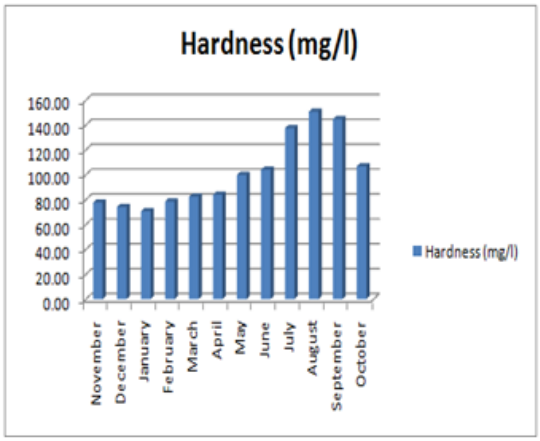

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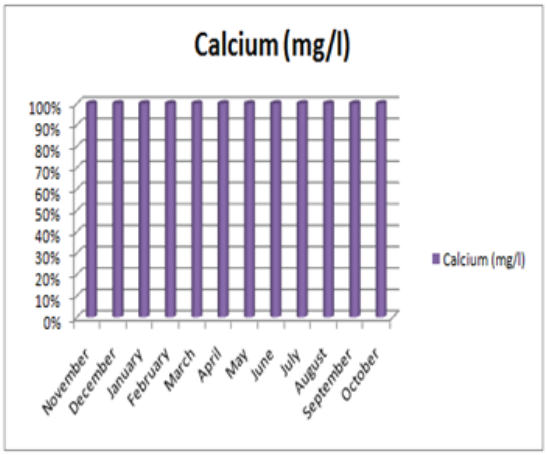

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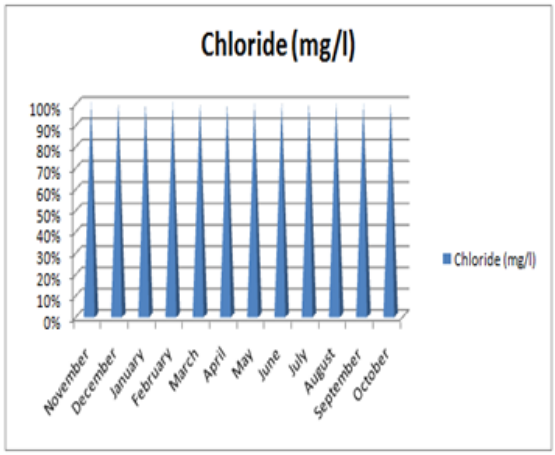

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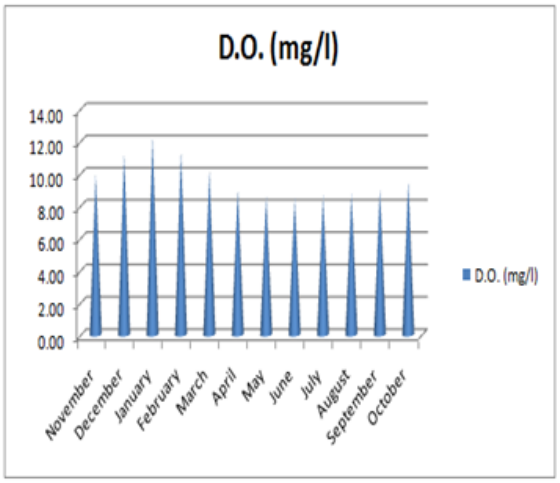

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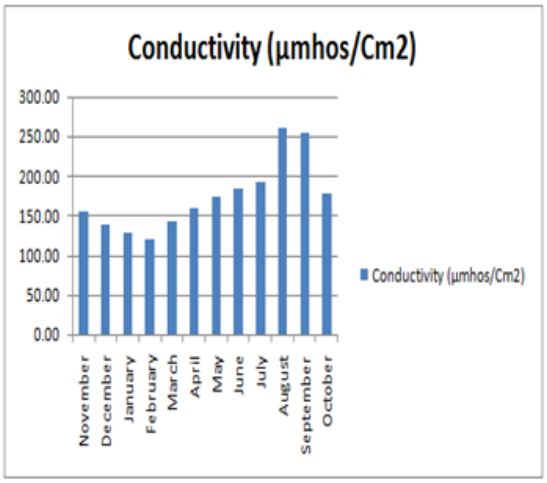

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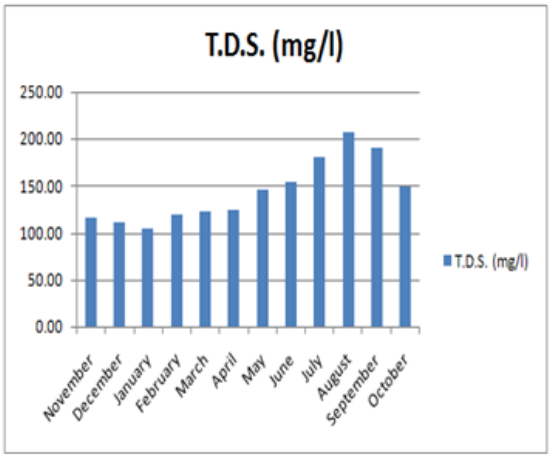

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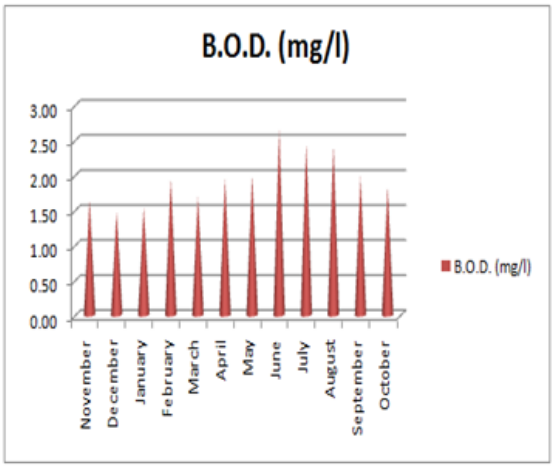

(Fig.12)

References:

[1]. APHA-AWWA-WPCF 1998. *Standard methods for examination of water and wastewater*. 20th Eds. American Public Health Association; 1015, Fifteen street, New Washington. pp: 1-1134.

[2]. Gupta, Harish and Chakarapani, G.J., 2007. Temporal and spatial variation in water flow and sediment load in Narmada river. *Current Science*, 92(5): 679-684.

[3]. Khajuria, M., and Dutta, S.P.S., 2009. Physico-chemical charaterstics of raw water of river Tawi, near Sitlee water treatment plant,Jammu. *Env.Con.J.* 10(3): 45-52.

[4]. Khanna, D.R. and Bhutiani, R., 2004. *Water analysis at a glance.* ASEA Publication, pp: 1-115.

[5]. Khanna, D.R., 1993. *Ecology and pollution of Ganga river*. Ashish Publication House, N. Delhi. pp: 1-241.

[6]. Khanna, D.R. and Bhutiani, R., 2005. Benthic Fauna and its Ecology of river Ganga from Rishikesh to Haridwar (Uttranchal) India. *Env.Con.J.* 6(1): 33-40.

[7]. Khanna, D.R., Singh, V., Bhutiani, R., Kumar, Satish Chandra, Matta, G., and Kumar, D., 2007 A study of Biotic and abiotic factors of Song river at Dehradun, Utttrakhand. *Env.Cons.J.*, 8(3) :117-126.

[8]. Khanna, D.R., Sarkar, P., Gautam, A., and Bhutaini, R., 2007. Fish scales as indicator of water quality of River Ganga. *Env.Monit.Assess.* 134: 153-160.

[9]. Khanna, D.R., Bhutiani, R., Matta, Gagan., Kumar, Dheeraj., Singh, V., and Ashraf, J., 2009. A study of zooplankton diversity with special reference to their concentration in river Ganga at Haridwar. *Env.Cons.J.*, 10(3): 15-20.

[10]. Khanna, D.R., Ashraf, J.,Chauhan, B., Bhutiani, R., Matta, Gagan., and Singh, V., 2009. Water quality analysis of River Panv Dhoi in reference to its physico-chemical parameters and heavy metals. Env.Cons.J., 10(1&2): 159-169.

[11]. Kumar, A., Bisht, B.S., Talwar, A., and Chandel, D.,2010. Physicochemical and microbial analysis of Ground water from different regions of Doon valley. *Int.J.Appl.Env.Sci.* 5(3): 433-440.

[12]. Mishra, S., and Joshi, B.D., 2003. Assessment of water quality with few selected parameters of river Ganga at Haridwar. *Him.J.Env.Zool*. 17(2):113-122.

[13]. Rai, P.K., Mishra, A., and Tripathi, B.D., 2010. Heavy metal and microbial pollution of the river Ganga: A case study of water quality at Varanasi. *Aquatic Eco.Health and management*, 13(4): 352-361.

[14]. Sarkar, S.K., Saha, M., Takada, H., Bhattacharya, A.K., Mishra, P. and Bhattacharya, B.,2007. Water quality management in the lower stretch of the river Ganges, east coast of India; an approach through environmental education. *J. of Cleaner. Production.* 15: 1559-1561.

[15]. Vishnoi, U., Kaur ,J. and Pathak, S.K., 2008.Water quality of river Ganga in respect of physicochemical characteristics at Kangri village, District Haridwar. *Env.Cons.J.* 9(1&2): 145-147.

[16]. Yadav, S.S., and Kumar, R., 2011. Monitoring water quality of Kosi river in Rampur District, U.P.,India*AppliedSci.Res.*2(2):197-201.

Sneh Lata, et. al. "Water quality monitoring of river Ganga at Raiwala in Haridwar." *IOSR Journal of Applied Chemistry (IOSR-JAC)*, 13(10), (2020): pp 32-37.