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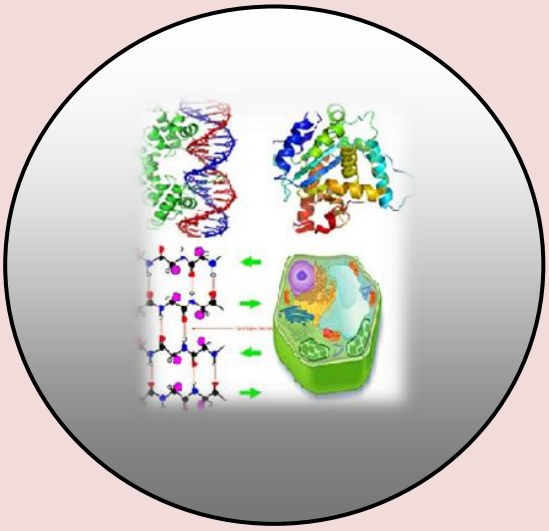

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# Studies on Physico-chemical parameters of Ganga, Sai and Bakulahi rivers water in Pratapgarh District (U.P.)

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## ABSTRACT

*The aim of the study is to assess the surface water quality of main rivers of Pratapgarh District of Uttar Pradesh. The river Ganga, Sai and Bakulahi are major rivers of Pratapgarh District which are heavily polluted. The surface water samples were collected from areas where the population depends upon the water sites of these rivers for survival. Surface water samples from 14 areas were collected from different sites i.e. temple Ghats, village Ghats of rivers for physico-chemical analysis. The samples were collected in winter (November-December 2017), summer (April-May 2018) and rainy (July-August month 2018). Physico-chemical parameters were analyzed, the main findings were that the lead and fluoride quantity are very high in surface water samples. Fluoride ion concentration is a cause of concern due to its effect on human health.*

*Keywords: Surface water, Polluted, Water Samples, Water quality and Physico-chemical Parameters.*

## INTRODUCTION

Pratapgarh district's main rivers are the Ganga, Sai and Bakulahi. The river Ganga which is known by different names such as Bhagirathi, Ganga maiya, Patit Pawni, Jahnvietc, originated from Gomukh at Gangotri glacier and falls into the Bay of Bengal. It is the third largest river in the world. The total length of the river is 2525 km. The river Ganga enters from Kalakankar area in Pratapgarh District and passes through Manikpur, Gotani, Karenti and Haudeshwarnath. The Ganga joins Allahabad District from Lalgopalganj. The total length of Ganga river is 38 Km (approx.) in Pratagarh Disrict. The main Ghats of river Ganga in the district are Kalakankar, Manikpur, Gotani, Karenti and Haudeshwarnath Ghats. The river Sai which is known as "Life-Line of Belha District" originates from Bijgwan village in Hardoi District and passes through Lucknow, Unnav, Rae Bareli, Pratapgarh and Jaunpur District. It joins river Gomti in Jaunpur District. The total length of river Sai is 70 km (approx.) in district. The famous Belhadevi Temple is situated on the bank of river Sai. The river Bakulahi whose historical name was Balkuni is the oldest river as mentioned in Vedas, it originate from Bharatpur Lake of Raibareli district ( Uttar Pradesh) and passes through the district and finally joins river Sai ( Tributary of Gomti river) in Kajurni village of Mandhata block. As most ancient civilizations grew along the bank of rivers, so also Pratapgarh district, it is washed by rivers Ganga, Sai and Bakulahi, Sakarni, Loni, Chamraura and some other small rivers which pass through the district. The population of the district depends upon these rivers for survival. The other sources of water are ponds, wells, bore wells and hand pumps. The rivers are heavily polluted by human activities. Organic and Inorganic chemicals are found in these rivers.

Surface water of rivers of the district is polluted from domestic sewage, agriculture chemical water, industrial polluted water, distilleries, slaughterhouses water and Leather industries water. The water is contaminated with Calcium, Magnesium, Iron, lead and Fluoride. Contaminated water is a cause of many infections and serious health hazards to the people living here.

The river Ganga is not a river, but good luck for our country and blessing of God. It is our responsibility to clean every river as every river is sacred and is worshiped in our country. The first Prime Minister Pt. Jawaharlal Nehru named river Ganga as "National river of India". Many research studies on various parameters such as $P^H$, concentration of cations and anions, heavy metals, Total Dissolve Solid, Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Turbidity, and Salinity etc. in past have been performed Saxena et. al, (1966) reported that the Ganga river is much polluted at Kanpur. Chattopadhyayet.al, (1984) have also reported the pollution of river Ganga. Mishra and Tiwariet.al, (1985) reported that the river Ganga water was severely polluted at Garhmukteshwar. Sinha et.al, (1989) analyzed physico-chemical characteristics of Ganga river at Kalakankar in Pratapgarh District. Payalet.al, (1997) observed the effects of domestic sewage on the water quality of upper Ganga canal at Haridwar. Khwaja et.al, (2001) studied effect of tannery waste on the physico-chemical characteristics of Ganga water and its sediments at Kanpur. Tare, V. et.al, (2003) investigated that the nitrogen level is higher in Ganga river water at Kannauj-Kanpur stretch of Ganga. Tiwari et.al, (2005) analyzed physico-chemical status of Ganga water and reported that the BOD, COD, TDS, etc. value are very high in Patna (Bihar). Beg et al, (2008) investigated that Phaphamau Ganga site which was highly polluted. Joshi, D.M. et. al, (2009) analyzed the physic-chemical parameters to assess the Ganga water quality at Haridwar and found the river Ganga water are not safe for drinking. J. Pandey et al. (2010) investigated the mid-stream water quality of river Ganga influenced by heavy metals at Varanasi. Choudhary et al. (2012) studied that the quality of the river Ganga water has substantially declined. Ruby Pandey et al. (2014) reported minimum value of BOD found at sangam in Allahabad. Kumari, V. et. al. (2015) found that the river Sai water is much polluted. Sharma et. al. Studied the heavy metal pollution of River Ganga in the Mirzapur District. Chaturvedi and Pandey et al. analyzed physicochemical parameters as well as few toxic metals of river Ganga at Vindhyachal Ghat of Varanasi. According to their study, this site was polluted and the water is not suitable for domestic, irrigation, and other purposes.

## LITRATURE SURVEY

## THE STUDY AREA

Pratapgarh is a district of largest state Uttar Pradesh of India also known as state of rivers. This district situated is between 25°34' and 26° 11' latitudes and between 81° 19' and 82° 27'longitudes. Total area of district is 3717 km² and is divided in five tehsils-sadar, kunda, Lalganj, Patti and Raniganj and 17 Blocks, they are Aspurdevsara, Babaganj, Baba Belkharnathdham, Bihar, Gaura, Kalakankar, Kunda, Lalganjajhara, Lakshmanpur, Mandhata, Mangraura, Patti, Rampur sangramgarh, Sadar, Sandwachandrika, Sangipur and Shivgarh. Water samples were collected from different sites of three rivers, the Ganga, Sai and Bakulahi, from where maximum amount of water is used for survival.

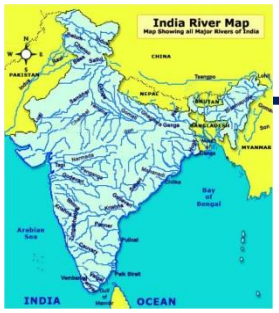



Fig. 1 India River Map

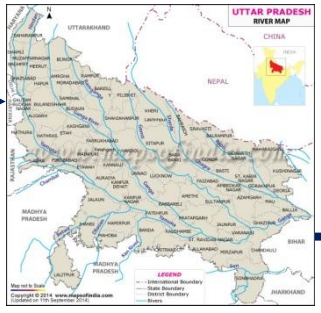



Fig.2 Uttar Pradesh River Map

Fig. 3 Rivers Map of Pratapgarh District

**Table 1.**

| Sr. No. | Sample no. | Sample Sites | Place/ Area | Sampling time |
|---|---|---|---|---|
| | | THE GANGA RIVER | | Nov-Dec./Apr-May/July-Aug |
| 1 | 01 | KALAKANKAR | Village ghat | ″ |
| 2 | 02 | MANIKPUR | Village ghat | ″ |
| 3 | 03 | GOTANI | Village ghat | ″ |
| 4 | 04 | HAUDESHWARNATH | Haudeshwarnath Temple ghat | ″ |
| | | THE SAI RIVER | | ″ |
| 5 | 05 | GHUSHMESHWARNATH | Ghushmeshwar Temple ghat | ″ |
| 6 | 06 | RAMPPUR | Village Area | ″ |
| 7 | 07 | SANDWA CHANDRIKA | Village Area | ″ |
| 8 | 08 | PRATAPGARH CITY | Belhadevi Temple ghat | ″ |
| 9 | 09 | JAMTALI | Village Area | ″ |
| | | THE BAKULAHI RIVER | | ″ |
| 10 | 10 | SANGRAMGARH | Sangramgarh Market Sai river Bridge | ″ |
| 11 | 11 | CHOURANG | Village Area | ″ |
| 12 | 12 | PEENG | Village Area | ″ |
| 13 | 13 | ANJANI | Anjani Bridge | ″ |
| 14 | 14 | BIHAR | Bihar Market | ″ |

***Sample sites and Sampling time**

Water samples were collected in three different seasons, winter (November-December 2017), summer (April-May 2018) and rainy (July-August month 2018).The seasonal changes in water quality of the rivers were due to seasonal effects and catchment characteristics. Like during monsoon, several water quality parameters show considerable changes due to increased runoff from the catchments and other seasonal factors. Multivariate discriminant analysis defined a few parameters responsible for temporal variation in water quality. Water samples were collected from the sites shown in Table 1.

**Table 2.**

| S. No. | Parameters | Methods / Instruments |
|---|---|---|
| 1 | Temperature | Digital Thermometer |
| 2 | pH | Digital pH meter |
| 3 | Total Dissolved Solid | Digital TDS meter |
| 4 | Alkalinity | Acid-Base Titration |
| 5 | Turbidity | Turbidity meter |
| 6 | Electrical Conductivity | Conductivity meter |
| 7 | Fluoride ion | Fluoride electrode |
| 8 | Lead ion | Lead electrode |
| 9 | Dissolved Oxygen | Winkler's method |
| 10 | Biological Oxygen Demand | Winkler's method |
| 11 | Chemical Oxygen Demand | Oxidation method |

***Methods for physico-chemical parameters**

## MATERIAL AND METHODS

**Analysis of physico-chemical parameters of water sample**

For the analysis of physio-chemical properties of river water, specialized sampling and sample handling procedure are required. The water samples were analyzed for various parameters like temperature, pH, total dissolved solid, alkalinity, turbidity, electrical conductivity, dissolved oxygen, biological oxygen demand and chemical oxygen demand and concentration of lead and fluoride ions. Laboratory analysis was done by following standard methods shown in Table 2-

## RESULT AND DISCUSSION

The present study was devoted to the evaluation of different physico-chemical parameters of the three rivers. Seasonal variations of the parameters were studied at fourteen different places of the rivers and the results are shown in the tables and graphs.

**Table 3.**

| Parameters ► | Temp. | PH | TDS | Alkalinity | Turbidity | E. C. | Fluoride ion | Lead ion | DO | BOD | COD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard Value ► | °C | 6.5-8.5 (WHO) | 1000 mg/L (WHO) | 600 mg/L (WHO) | NTU | Mv | 1.5 mg/L (WHO) | mg/L | 6.0 mg/L (BIS) | 5.0 mg/L (ICMR) | 200 mg/L(WHO) |
| Sample No.▼ | | | | | | | | | | | |
| 1. | 20 | 8.1 | 230 | 22 | 0.3 | 59.4 | 3.8 | 1.35 | 8.1 | 3.9 | 10.1 |
| 2. | 20 | 8.4 | 232 | 26 | 0.5 | 58.9 | 3.9 | 1.34 | 8.0 | 4.2 | 9.8 |
| 3. | 20 | 8.5 | 228 | 25 | 0.4 | 53.2 | 3.2 | 1.37 | 7.9 | 5.5 | 10.2 |
| 4. | 20 | 8.8 | 231 | 29 | 0.7 | 70.8 | 6.5 | 1.39 | 8.0 | 4.8 | 10.5 |
| 5. | 20 | 8.6 | 209 | 34 | 0.2 | 117.0 | 4.3 | 5.52 | 8.7 | 5.4 | 13.4 |
| 6. | 20 | 8.5 | 212 | 32 | 0.5 | 116.5 | 4.5 | 4.67 | 8.3 | 5.3 | 15.2 |
| 7. | 20 | 8.2 | 207 | 35 | 0.6 | 115.8 | 5.3 | 5.12 | 8.6 | 5.4 | 15.7 |
| 8. | 20 | 8.8 | 206 | 36 | 0.8 | 119.2 | 7.5 | 5.24 | 7.8 | 5.8 | 17.1 |
| 9. | 20 | 8.7 | 210 | 39 | 1.0 | 120.3 | 5.5 | 5.60 | 8.8 | 5.1 | 14.7 |
| 10. | 20 | 8.3 | 225 | 44 | 0.8 | 61.7 | 2.1 | 3.68 | 8.9 | 4.1 | 6.6 |
| 11. | 20 | 8.5 | 228 | 46 | 1.2 | 22.1 | 2.21 | 3.62 | 8.7 | 4.4 | 7.8 |
| 12. | 20 | 8.4 | 226 | 48 | 0.1 | 21.8 | 2.29 | 3.64 | 9.0 | 4.2 | 7.6 |
| 13. | 20 | 8.6 | 227 | 52 | 1.1 | 22.0 | 2.31 | 3.70 | 9.2 | 4.3 | 8.9 |
| 14. | 20 | 8.1 | 222 | 58 | 1.3 | 21.6 | 2.48 | 3.72 | 9.1 | 4.6 | 9.1 |

***Physico-chemical analysis observation table (In Winter season) of water samples**

**pH:** The pH of a water body is very important in determination of water quality since it affects other chemical reactions such as solubility and metal toxicity. Maximum pH was recorded in winter and minimum in monsoon during the study period. In general pH was within the limits of WHO standard value. For drinking water, a pH range of 6.0-8.5 is recommended.

**Total Dissolved Solids**: - The quantity of TDS is in general proportional to the degree of pollution. TDS were found maximum in winter 228 mg/l at Chourang Village area (Table-3) and minimum in monsoon 137 mg/l at Rampur Village area **(Table 5)** Theses values were within limits prescribed by WHO.

**Table 4.**

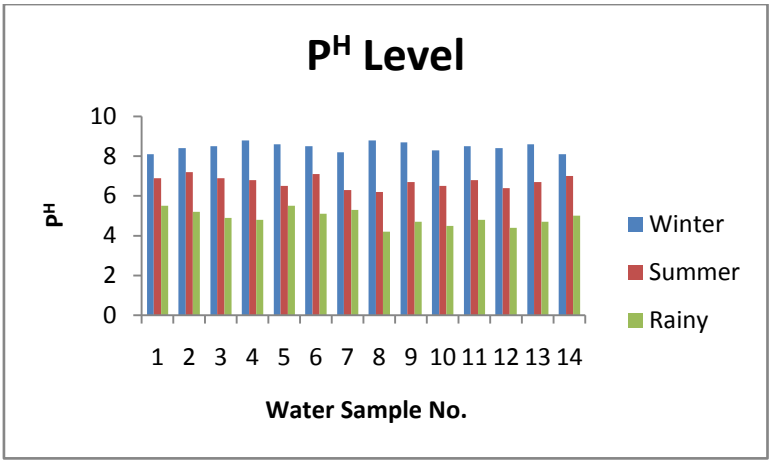
| Parameters ► | Temp. | PH | TDS | Alkalinity | Turbidity | E. C. | Fluoride ion | Lead ion | DO | BOD | COD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard Value ► | oC | 6.5-8.5 (WHO) | 1000 mg/L (WHO) | 600 mg/L (WHO) | NTU | Mv | 1.5 mg/L (WHO) | mg/L | 6.0 mg/L (BIS) | 5.0 mg/L (ICMR) | 200 mg/L (WHO) |
| Sample No.▼ | | | | | | | | | | | |
| 1. | 38 | 6.9 | 139 | 42 | 2.3 | 21.7 | 5.97 | 1.9 | 4.9 | 3.8 | 5.3 |
| 2. | 38 | 7.2 | 142 | 44 | 2.6 | 10.4 | 5.4 | 1.76 | 8.9 | 6.2 | 7.9 |
| 3. | 38 | 6.9 | 145 | 46 | 2.5 | 15.6 | 6.54 | 1.86 | 6.2 | 5.7 | 6.6 |
| 4. | 38 | 6.8 | 185 | 52 | 3.4 | 5.3 | 10.1 | 1.60 | 4.2 | 3.3 | 7.9 |
| 5. | 38 | 6.5 | 221 | 65 | 3.6 | 1.1 | 12.0 | 2.11 | 5.5 | 4.3 | 6.6 |
| 6. | 39 | 7.1 | 218 | 67 | 3.3 | 10.4 | 8.12 | 1.60 | 3.6 | 3.0 | 3.9 |
| 7. | 39 | 6.3 | 216 | 61 | 3.6 | 6.3 | 10.7 | 1.20 | 4.1 | 3.1 | 5.3 |
| 8. | 39 | 6.2 | 231 | 58 | 3.5 | 5.9 | 8.2 | 1.3 | 3.9 | 2.8 | 6.5 |
| 9. | 38 | 6.7 | 209 | 65 | 3.3 | 7.3 | 5.1 | 1.76 | 4.3 | 3.4 | 7.8 |
| 10. | 38 | 6.5 | 332 | 82 | 3.4 | 75.7 | 5.37 | 2.96 | 4.0 | 3.1 | 5.4 |
| 11. | 38 | 6.8 | 423 | 88 | 3.6 | 75.5 | 5.39 | 3.01 | 7.0 | 5.9 | 11.9 |
| 12. | 38 | 6.4 | 386 | 84 | 3.8 | 78.2 | 4.20 | 3.06 | 6.1 | 5.3 | 10.6 |
| 13. | 38 | 6.7 | 354 | 83 | 3.6 | 78.7 | 5.40 | 3.03 | 4.6 | 3.5 | 8.0 |
| 14. | 38 | 7.0 | 374 | 84 | 3.4 | 79.0 | 5.41 | 2.96 | 4.2 | 3.8 | 6.7 |

***Physico-chemical analysis observation table (In summer season) of water samples**

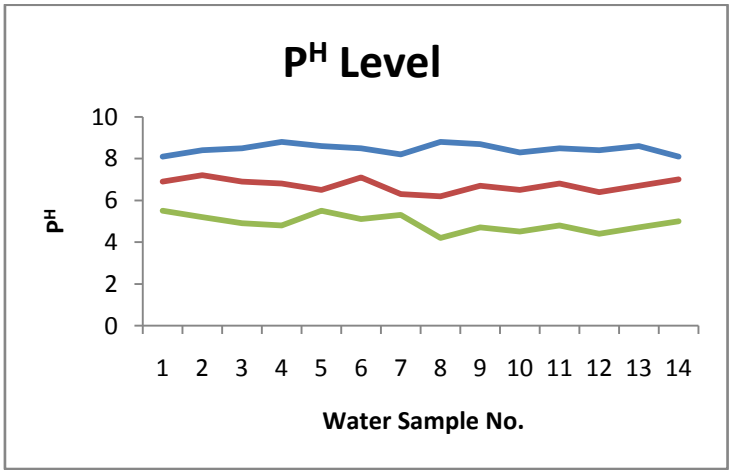
**Table 5.**

| Parameters ► | Temp | PH | TDS | Alkalinity | Turbidity | E.C. | Fluoride ion | Lead ion | DO | BOD | COD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard Value ► | oC | 6.5-8.5 (WHO) | 1000 mg/L (WHO) | 600 mg/L (WHO) | NTU | Mv | 1.5 mg/L (WHO) | mg/L | 6.0 mg/L (BIS) | 5.0 mg/L (ICMR) | 200 mg/L(WHO) |
| Sample No.▼ | | | | | | | | | | | |
| 1. | 32 | 5.5 | 144 | 3.5 | 15.0 | 54.3 | 2.9 | 2.6 | 4.0 | 3.2 | 4.9 |
| 2. | 32 | 5.2 | 143 | 3.3 | 15.6 | 55.2 | 4.89 | 3.7. | 7.5 | 4.6 | 6.8 |
| 3. | 31 | 4.9 | 155 | 3.1 | 17.5 | 55.6 | 3.5 | 1.8. | 5.2 | 3.9 | 5.9 |
| 4. | 32 | 4.8 | 152 | 3.5 | 15.7 | 56.3 | 4.7 | 3.6 | 3.8 | 2.6 | 7.2 |
| 5. | 32 | 5.5 | 138 | 3.3 | 17.6 | 19.0 | 3.1 | 2.1 | 4.5 | 3.2 | 6.1 |
| 6. | 32 | 5.1 | 137 | 3.4 | 18.3 | 17.4 | 3.5 | 1.6 | 3.2 | 2.6 | 3.0 |
| 7. | 31 | 5.3 | 142 | 3.9 | 14.6 | 16.9 | 5.6 | 1.2 | 3.8 | 2.9 | 5.1 |
| 8. | 31 | 4.2 | 148 | 4.4 | 15.5 | 32.1 | 5.8 | 1.3 | 3.2 | 2.3 | 5.9 |
| 9. | 32 | 4.7 | 141 | 4.9 | 14.3 | 28.5 | 2.2 | 1.7 | 3.9 | 2.5 | 7.2 |
| 10. | 30 | 4.5 | 138 | 3.2 | 16.4 | 26.8 | 2.7 | 2.9 | 3.8 | 3.0 | 5.1 |
| 11. | 32 | 4.8 | 143 | 3.1 | 16.6 | 33.4 | 3.1 | 3.01 | 6.5 | 4.6 | 9.9 |
| 12. | 32 | 4.4 | 146 | 3.1 | 15.8 | 32.8 | 2.9 | 3.6 | 5.4 | 3.9 | 10.6 |
| 13. | 31 | 4.7 | 144 | 3.6 | 15.6 | 32.5 | 3.1 | 3.3 | 4.2 | 3.1 | 7.8 |
| 14. | 30 | 5.0 | 147 | 4.0 | 17.4 | 31.9 | 3.7 | 2.96 | 3.7 | 3.0 | 5.7 |

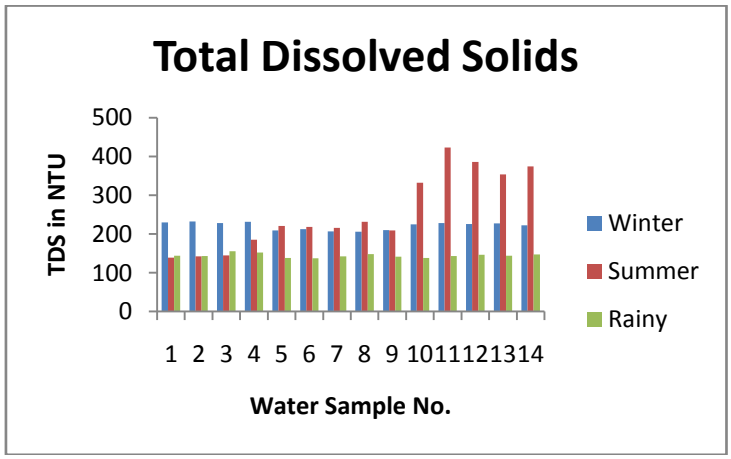
***Physico-chemical analysis observation table (In Rainy Season) of water samples**



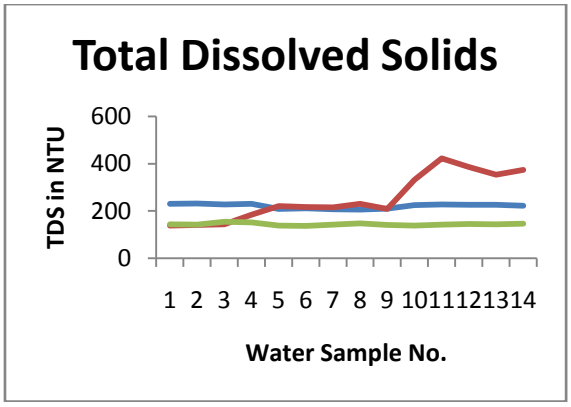

Graph No.1.1




Graph No. 1.2




Graph No. 2.1



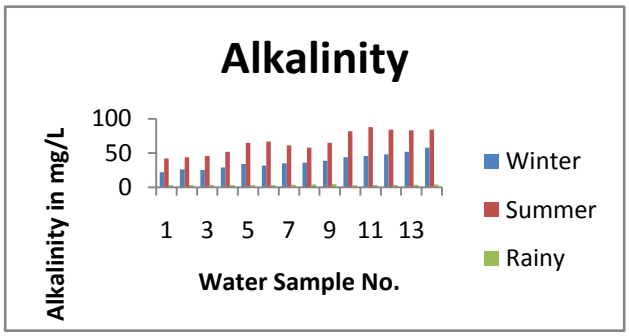

**Graph No. 2.2**

**Total Alkalinity**: - The value of total alkalinity provides an idea of natural salts present in water.It is primarily caused by the carbonate and bicarbonate ions. Its highest noted value was 88 mg/l in summer at Chourang Village area and minimum 3.1 mg/l in monsoon at more than one place. These values are within limits prescribed by World Health Organization standard. The TA fluctuated in accordance with the fluctuation in the pollution load**.** Seasonally; the values were highest in summer followed by winter and monsoon.

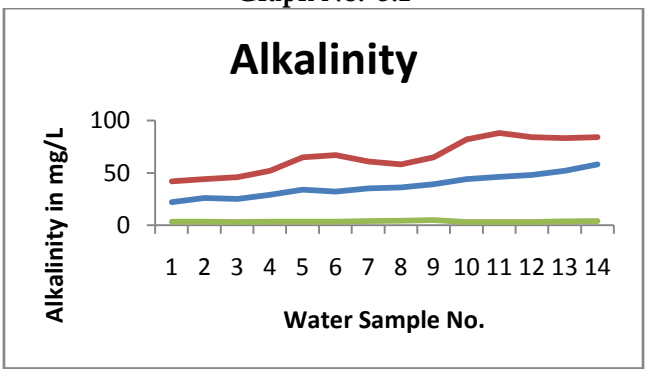
**Lead**: -The concentration of lead in river water is the cause of many diseases in human body. During the analysis it was observed that the lead concentration in water was in the range 1.2- 8.6 mg/l which is very high than the permissible concentration. Contaminated water of sugar and chatni mills of Rae Bareli pollute to the river Sai. Lead concentration in the surface water samples in summer season was high.

**Electrical conductivity**: - The EC of water is a measure of capacity of a solution to conduct electrical current through it and depends on the concentration of ions and load of nutrients. As most of the salts in water are present in ionic forms, they make water capable for conducting current. The conductivity, thus serves as a good and rapid measure of the total dissolved solids in water. The conductivity values of different rivers vary greatly. Electrical conductivity was observed to be in the range 5.3 -119.2 mv. The values of Electrical Conductivity indicate that rivers water is highly polluted. The increased in EC values of water indicates that there is a source of dissolved ions in the vicinity. Higher the value of dissolved solids, greater the amount of ions in water. Increasing levels of conductivity and cations are the products of decomposition and mineralization of organic materials .

**Dissolved Oxygen**: - DO is an important limnological parameter indicating level of water quality and organic pollution in the water body. The value of DO is remarkably significant in determining the water quality criteria of an aquatic system. In the system where the rates of respiration and organic decomposition are high, the DO values usually remain lower than those of the system, where the rate of photosynthesis is high**.** The present study reveals a gradual decrease in DO from winter to monsoon. The seasonal variation of DO in water depends upon the temperature of the water body which influences the oxygen solubility in water. Seasonally, the values were highest in winter and lowest in summer and intermediate values were recorded in monsoon.
The value of DO during summer months is lower due to higher temperature and high rate of microbial decomposition of organic matter. Maximum values of DO in winter might be due to the fact that the solubility of DO increases with the decrease in water temperature. DO levels are important in the natural self- purification capacity of the river.



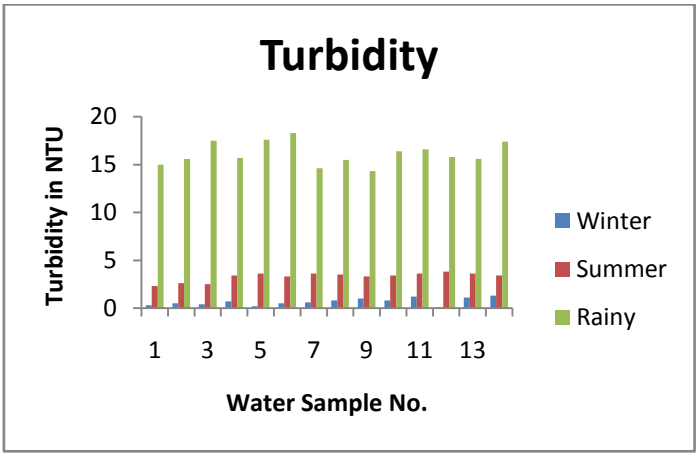

**Graph No. 3.1**




**Graph no. 3.2**

**Biochemical Oxygen Demand**: - The biodegradation of organic materials exerts oxygen tension in the water and increases the biochemical oxygen demand. The range of BOD is in the range 3.2 -5.9 mg/L in river water. The different Ghats having higher concentration of dissolve oxygen making it unsafe for drinking and other purposes.

**Chemical Oxygen Demand**: - The Chemical Oxygen Demand (COD) is a measure of the oxygen equivalent of that portion of organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant. The range of COD found in the range3.0 - 17.1 mg/l.

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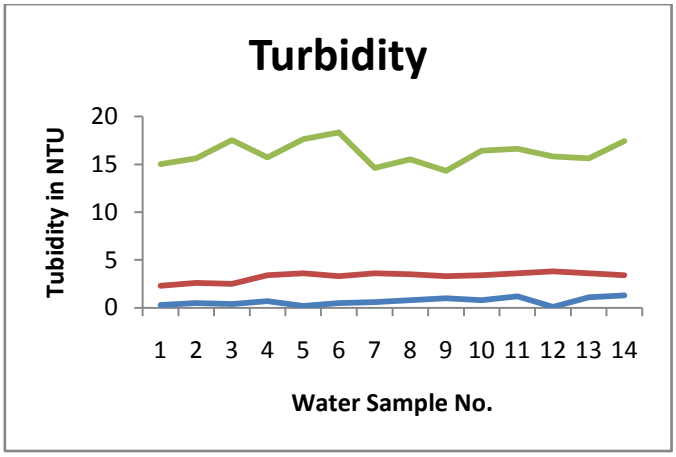


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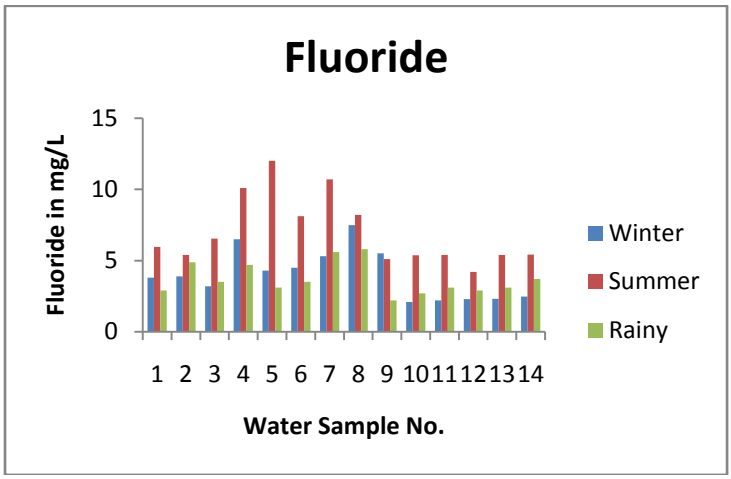


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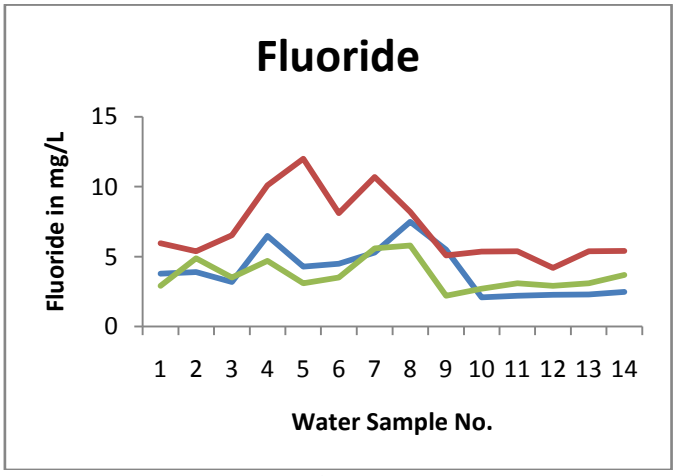
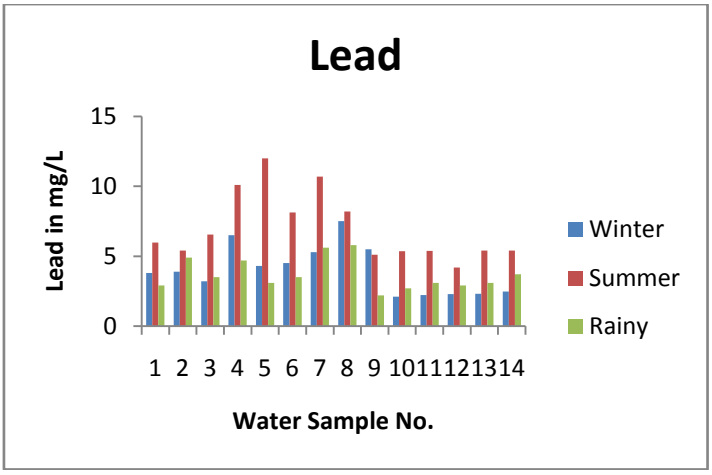
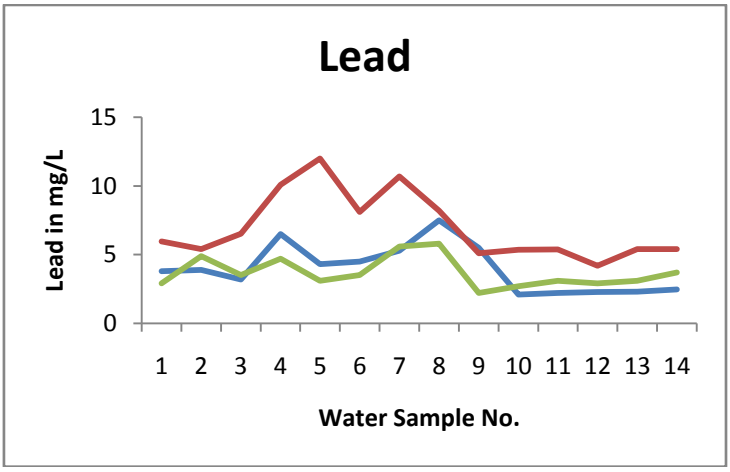



Graph No. 5.2




**Graph No. 6.1**




**Graph No. 6.2**

## CONCLUSION

Water is elixir of life, water is necessary for drinking, agriculture, gardening, fisheries, industrial purposes, manufacturing, and other human activities, but contaminated water is the biggest issue of the world. Physico-chemical characteristics of surface water vary according to season. It is alarming that the pollution in the Ganga, Sai and Bakulahi rivers is escalating over the years due to discharge of industrial effluents. Continuous immersion of idols of God, Goddess and Tazias are among other remarkable factors. The pollution level of the rivers is on the rise and can cause serious problems in near future. Pollution is increasing with increasing population. The water resources are polluted by population growth, industrialization, chemicals used in agriculture and illegal mining of sand and soil. All living beings consume natural water resources continuously. Conservation of water resource is impossible by some people or plans but has to be practiced by all. If our rivers are polluted, then rivers will be extinct from earth. As a large number of hospitals, lather industries, textiles mills are situated on the bank of rivers, increasing the pollution level efforts will have to be made to make the population aware and make policies so as to undo the effect. After the physico-chemical parameter analysis it was found that the rivers water are alkaline, quantity of fluoride and lead level are high. River water cannot be used for drinking and bathing. Awareness to the masses is the key to conservation of water for our future generations.

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