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Study of Water Quality Index of Groundwater in Gorakhpur City

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ABSTRACT: There has been a tremendous increase in the demand for fresh water in the last few decades, due to rapid growth of population, unplanned urbanization, industrialization and too much use of fertilizers. With the growth of industry the ground water is made susceptible for contamination due to addition of waste materials. These waste materials from the factories percolate with rain water and reach aquifer resulting in erosion of ground water quality. Considering the above, study has been taken up in industrial areas of Gorakhpur city, which is located in the Terai belt of eastern Uttar Pradesh. The ground water samples have been collected in 14 locations and were subjected to the analysis of physico-chemical parameters including BOD, COD and Trace metals. The study shows that pH of ground water in the study area ranges from 7.02 to 7.93, EC ranges between 367 to as much as 3833 micro mhos/cm at 250C .Fluoride in water samples are well within the permissible limit of BIS standard. The other chemical parameters are within the normal range. BOD and COD of water samples ranges from ND (not detected) to 1.35 mg/l and ND to 12.3 mg/l respectively which indicates no major ground water pollution due to organic matter in the study area at present, but few areas are vulnerable where COD is more than 10 mg/l at GIDA, Gorakhpur. The heavy metal analysis of water samples are in general within the normal ranges (Copper Cu: ND to 0.008mg/l, Iron Fe:0.08 to 1.23 mg/l, Manganese Mn: 0.01 to 0.482 mg/l, Zinc Zn: 0.015 to 0.221 mg/l and Nickel: ND to 0.014mg/l) except iron and Manganese in few places.

KEYWORDS- Gorakhpur, ground water, water quality index, COD, BOD, fluoride

I. INTRODUCTION

Water could be a priceless gift from nature to all or any living organisms in need of sustenance. The subsurface and surface water are mostly accountable for the reasonableness of water for agricultural, industrial, and domestic needs. With the exception of glacial masses and polar icecaps, groundwater is that the world's largest source of H2O. Of some states in India, 90 percent of individuals depend upon groundwater for home, drinking, rural, and industrial needs. the character of groundwater is influenced by variety of things like discharge of rural, industrial, and domestic fluids, land use plans, topographical development, precipitation example, and infiltration rate. After reviewing the numerous research papers on this area, I found that assessment of seasonal variation of groundwater for drinking purposes. Thus, during this research paper i've got analyzed the monthly variation of groundwater for drinking purposes at Gorakhpur city. because of unanticipated population expansion, urbanization, technological improvement, and better standards of life, developed countries have experienced increased water demand in both the agricultural and industrial sectors. Only 0.16 percent of the water on Earth is acceptable for individual use, while the remaining 95 percent is contaminated for a range of ecological reasons (JHARIYA et al., 2018). The provision of an appropriate supply of drinking water while maintaining a standard water quality has become a serious concern as a result of the increasing demand for water around the world (Mekonnen & Hoekstra, 2016). One-third of the world's population relies on groundwater (also known as "groundwater") as one of the purest sources of water since it is the most dependable and vast repository of freshwater on Earth (Foster & Chilton, 2003).[1,2,3] Despite the importance of groundwater, it is not properly maintained in terms of quality. The most important elements that directly and indirectly influence the quality and quantity of Groundwater are a variety of pollution sources, climate changes, groundwater recharge, subsurface geochemical reactions, surface water characteristics, geographic locations, atmospheric precipitation, and human activities (Kumar et al., 2014). Furthermore, one of the main factors contributing to the decline in groundwater quality is the infiltration of saline water into the coastal region (Kim et al., 2006). Horton initially proposed and developed the estimation of WQI as one of the most useful methods for assessing water quality. WQI is often calculated to evaluate the water quality primarily based on its appropriateness for drinking. As a result, it has developed into a useful instrument for managing groundwater quality and ensuring the use of pure drinking water (Tiwari et al., 2014) . Since this technology is so effective at reducing large amounts of complex data to a single number, this process aids in the stable expression of water quality. [4,5,6]As a result, for management and decision-making reasons, the values

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generated from WQI can be considered to be much more accessible and simply understandable for researchers, public audiences, concerned citizens, as well as national water regulators. Although there are various methods for calculating WQI, each one takes into account the same physical and chemical characteristics of water; the only differences between the methods are in the data integration and result interpretation processes (Saeedi et al., 2009) . Salinity in groundwater has emerged as a major issue in India's North-East coastline region, particularly in Gorakhpur City, which is situated on the RAPTI river.

Table 1 Parameters of water with their permissible limits of drinking water, recommended agency and unit weights.

S. No.	Parameters	Standard Values	Recommended Agency	Unit Weight
1.	pH	6.5-8.5	BIS:10500 :2012	0.001135
2	Turbidity	5 NTU	BIS:10500 :2012	0.001929
3	Iron	0.3 mg/l	BIS:10500 :2012	0.032
4	Sulphate	200mg/l	BIS:10500 :2012	0.00004822
5	TDS	500mg/l	BIS:10500 :2012	0.00001929
6	TH	200mg/l	BIS:10500 :2012	0.00004822
7	Alkalinity	200mg/l	BIS:10500 :2012	0.00004822
8	Chloride	250mg/l	BIS:10500 :2012	0.00003858
9	Nitrate	45mg/l	BIS:10500 :2012	0.0002143
10	Arsenic	0.01mg/l	BIS:10500 :2012	0.964

A. Laboratory Evaluation

In order to evaluate the water quality, 50 samples from shallow deep hand pumps were collected from ten locations in t he Gorakhpur city. These samples are bring to ecomen Laboratories Pvt. ltd. Lucknow and were tested for pH, Alkalinit y, Total hardness, TDS, Turbidity, Iron, Chloride, Sulphate, Nitrate, and Arsenic. The analysis of the samples was carri ed out in accordance with the standard procedure

Table 2 Monthly variation of the physicochemical parameters of the waterbody.

S. No.	Parameters	January	February	March	April	May
1	Ph	7.035	6.9	7.13	7.9	7.1
2	Turbidity (NTU)	39.02	35.46	35.37	55.45	50.57
3	Iron (mg/l)	1.474	1.47	1.66	1.94	1.77
4	Sulphate (mg/l)	46.97	49.91	41.8	43.49	41.57
5	TDS (mg/l)	215.5	193.5	196.05	203.9	195.7
6	TH (mg/l)	278	267.54	268.36	276.8	270.63

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7	Alkalinity (mg/l)	101.7	98.18	99	103.5	102.4
8	Chloride (mg/l)	81.66	76.4	76.25	84.18	86.66
9	Nitrate (mg/l)	9.377	8.11	8.17	9.04	8.12
10	Arsenic (mg/l)	0	0	0	0	0

II. DISCUSSION

The testing of groundwater in the Gorakhpur City are tested in this research work. The sample for testing the ground water are taken from 25 India Mark II and 25 samples from shallow deep Handpump between the month of January to May. After the measuring the all samples the water is suitable for drinking according to limitation and the methods which are used that is IS:3025 for testing the pH, turbidity, TDS, Total Hardness, chloride, Nitrate, Iron, Sulphate, Arsenic and Alkalinity. After the testing of the result it was the water is suitable for drinking. The results of all testing parameters are shown below 1) [7,8,9]The limitation of pH between 6.5 to 8.5 according to the BIS:10500:2012 is good for drinking water. The results were found after testing are the permissible limit for drinking purposes. 2) The standard value of Turbidity is 5NTU is good for drinking water. The results were found in the month of January, February, March, April and May is 1.94, 1.87, 1.68, 2.125 and 1.69 respectively which are under the permissible limit. 3) The standard value of TDS is 500mg/l is good for drinking water. The results were found in the month of January, February, March, April and May is 215.5,193.5, 196.05, 203.9 and 195.7 respectively which are under this standard value. 4) The permissible limits of Total Hardness (200-600 mg/l) good for drinking water. The results were found in the months of January, February, March, April and May is 278,267.54, 268.36,276.8 and 270.63 respectively which are under the permissible limit. 5) The standard value of Chloride is 250 mg/l is good for drinking water. The results were found in the months of January, February, March April and May is 81.66, 76.4, 76.25, 84.18 and 86.66 respectively which are under the permissible limit. 6) The standard value of Nitrate is 45 mg/l is good for the drinking water. The results were found in the months of January, February, March, April and May is 9.37, 8.11, 8.17, 9.04 and 8.12 respectively which are under the limit. 7) The standard value of the sulphate is 200 mg/l is good for the drinking water. The results were found in the months of January, February, March, April and May is 46.97, 49.91, 41.8, 43.49 and 41.57 respectively which are under the permissible limit.[10,11,12] 8) The permissible limit of the Alkalinity is 200-600 mg/l is good for the drinking water. The results were found in the month of January, February, March, April and May is 101.7, 98.18, 99, 103.5 and 102.4 respectively which are under the permissible limit.

Understanding groundwater quality is essential because it is the primary factor determining whether it is suitable for intended best use. In the vicinity of the sewage treatment plant, the physicochemical properties of groundwater samples from randomly chosen diverse water sources (India mark II, shallow deep hand pump) were examined to assess the potential quality of the groundwater. For the residents in the study area, boreholes and hand pumps are the main sources of water (for drinking and domestic needs). The bulk of the chosen characteristics, with the exception of turbidity, are within the range that is acceptable for drinking water. The research demonstrates that groundwater is safe for human consumption and public health.

III. RESULTS

Water Quality Index (WQI) $=\sum W_nQ_n / \sum W_n$Where, WQI = Water Quality Index W_n = Unit Weight of the nth parameter.Q_n = Quality Rating of the nth parameter. [13,14,15]

WQI is established through the measure-ment of various important physicochemical pa-rameters of the surface water. The physico-chemical parameters of nine different stations (Ramgarh Tal (West), Nausar, Ramgarh Tal(East), Shivpur Sahbazganj, Chargawan,Shaktinagar, Rajendranagar, Purdilpur,Humayunpur North) are summarized.Some remarkable variations of physico-chemical data are observed at all the nine sites. The water quality index val-ues is more than 100 or above it is unsuitablefor drinking purpose and value below 50 in-cessantly change into good water as recom-mended by WHO. The water quality index is classified into excellent, good, poor, and verypoor/severe based on values ranging from42.86 to 81.80 in 2015 and 56.27 to 78.24 in2017. It is also observed that there are spatial variations within the region. River is a dynamic system and pH is vital for river ecosystem. pHgreater than 8.5 causes bitter test or soda like test. Eye irritation and exacerbation of skin dis-order is also caused when pH is greater than11. It

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is observed that pH value is ranging be-tween 6.3 (Shivpur Sahbazganj) to 7.9 (Rapti river) in 2015 and 6.0 (Rapti river) to 8.0[16,17,18]

IV. CONCLUSIONS

Inverse Distance-Weighted (IDW) application was also used to prepare the spatial distribution maps of each groundwater quality parameter. It is observed that Total Dissolved Solid (TDS) in 41.6% of samples and Total Hardness (TH) concentrations in 75% (BIS)/100% (WHO) of samples were much higher than the permissible limit. GWQI values reveal that none of the samples has an excellent quality of water and 16.7% samples having good water quality. Similarly, 33.3%, 41.7% and 8.3% of samples has a fair, poor and very poor water quality respectively.[19] Results from the Piper plot showed that Ca–HCO_3 is the dominant hydrochemical facies. All samples were found in the rock dominance zone in Gibbs plots. Based on residual sodium carbonate (RSC) and soluble sodium percentage (SSP), 8.33% and 33.33% of the samples were found to be in the poor category and according to Kelly's ratio (KR) 8.33% of the samples were found in unsuitable category. Permeability Index (PI) indicates that 50% of the groundwater samples were found in Class I (suitable) and 50% in Class II (marginally suitable) category for irrigation purpose.[20]

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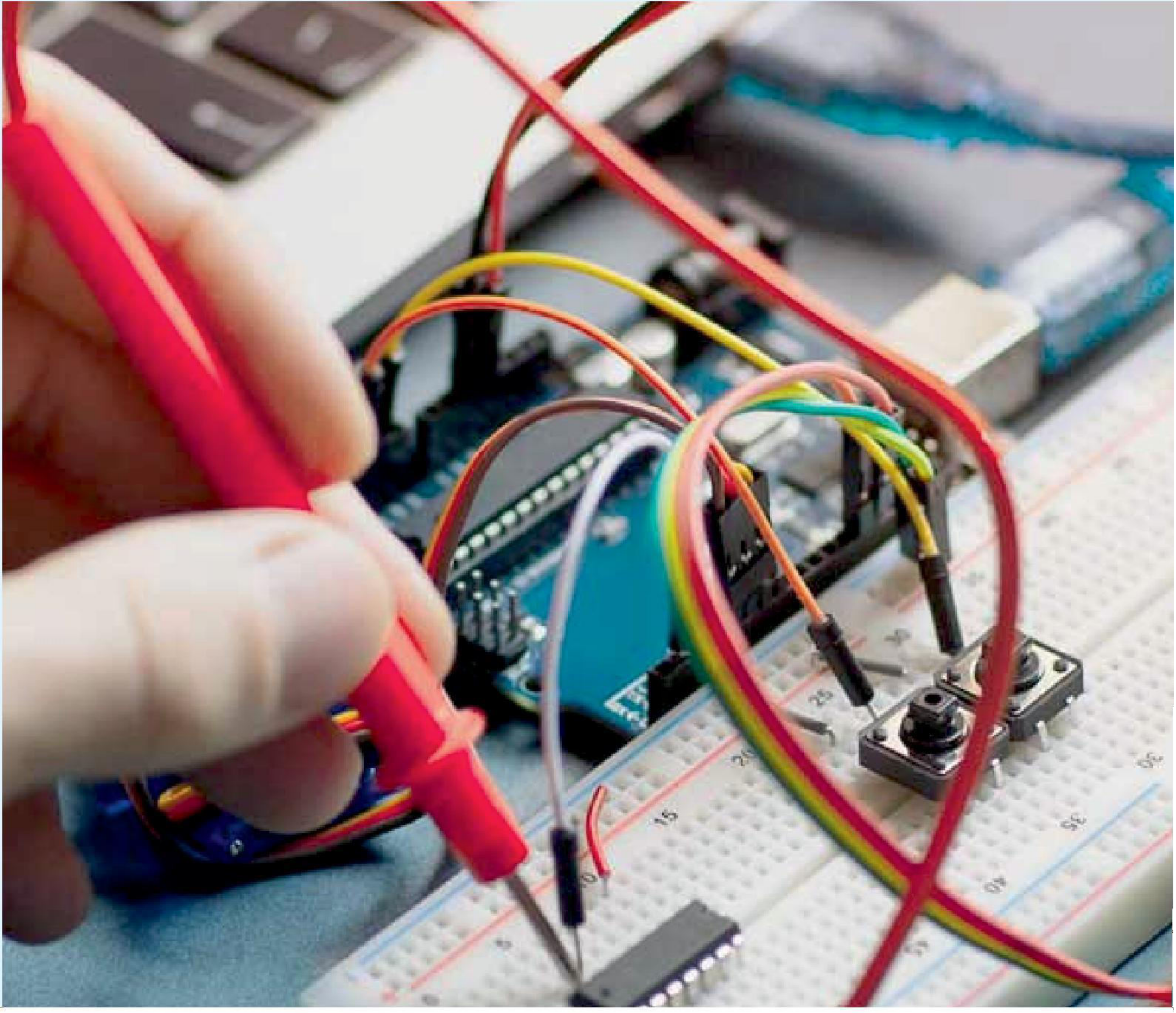

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