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A Comparative Study of Water Quality of Groundwater in Garautha Block, Jhansi District, Uttar Pradesh, India

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Abstract-.The present study objectively analyzes the physicochemical parameters and trace elements in Garautha Block of Jhansi District in Bundelkhand region. The analysis of physicochemical parameters of 20 groundwater samples during the month of June 2015 were examined, namely as pH, EC, Turbidity and TDS. The analysis of major cations is namely as Calcium, Potassium, Magnesium and Sodium in the groundwater and follows the abundance order of $Ca^{2+} > Na^{+} > Mg^{2+} > K^{+}$ in majority of the groundwater samples and the major anions are namely as Bicarbonate, Fluoride, Nitrate, Sulphate and Chloride in the groundwater and follows the abundance order of $HCO_3^{-} > Cl^{-} > NO_3^{-} > SO_4^{2-} > F^{-}$ in the majority of the groundwater samples. The results showed that among various locations, many of the estimated physico-chemical parameters are more or less within the acceptable limits given by WHO except at few locations.

Keywords- Groundwater quality, Physico-chemical analysis, Irrigation purposes, Drinking purposes

1. INTRODUCTION

Groundwater plays a very important role in human life and economic activity. In total, nearby about 140000 billion litres of water in the world, however huge amount of the water is not suitable for drinking purpose, therefore 97.5% of the water lies in the seawater, 2.5% is the fresh water, whereas a large amount of the water at the surface of earth and ice on land comprise 1.7%, rivers and lakes 0.007%, groundwater 0.8 and atmosphere 0.001% otherwise only 1% water is available for portative usage whereas more water goes for irrigation than to drinking sanitation and all other uses. The need of study of surface water quality is one of the major issues today due to increasing the load of pollution from industrial, commercial and residential with its effects on human health and aquatic ecosystems. In developing countries, about 1.8 million people, mostly children, die every year as a result of water related diseases [4]. Among the various sources of water, groundwater is said to be the safest water for drinking and domestic purposes [10]. Untreated discharge of pollutants into a river from domestic sewers, storm water discharges, industrial wastewaters, agricultural runoff and other sources can have short-term as well as long-term effects on the water quality of a river system [12]. As groundwater moves along flow lines from recharge to discharge areas, its chemistry is altered by the effect of a variety of geochemical processes [10]. Total 80% of the water in India has become polluted due to the discharge of untreated domestic sewage and partially-treated industrial effluents into the natural water source [3]. In natural waters, the dissolved solids mainly consist of bicarbonates, carbonates, sulphates, chlorides, nitrates and phosphates of calcium, magnesium, sodium, and potassium with traces of iron, manganese and other minerals [9]. Contaminated drinking water can cause various diseases such as typhoid fever, dysentery, cholera and other intestinal diseases [11].

Although, many components like the improper discharge of irrigation, drinking and industrialized waste waters casually land use practices, geological formation along with the patterns of rainfall and the rate of infiltration are declared to influence the ground water quality of the study area of Jhansi. Therefore, monitoring the quality of water is one of the essential issues of drinking water management [5]. Basic problem in the case of water quality monitoring is the complexity associated with analyzing the large number [9]. Groundwater quality is profoundly subject in the way of the groundwater aquifers and on the ambient weather situation. At some places of the Bundelkhand belt content high concentration iron, fluoride and nitrate demanded a broad study of the resources of groundwater for its good management

and utilization. It is considered that about 62 million human beings countrywide are trusted to suffer from many problems with fluorosis (skeletal or dental) such a solution of long-term showing in high-fluoride drinking water. It is observed that groundwater gets polluted significantly due to use of human activities. The chemical quality of ground water depends mostly on the composition of the host rock [8]. The quantity is also subjected to the degree of weathering, movement of ground water, individual ion-contents and ion-exchange, climate and to time variation in the process of recharge and discharge [8]. The quality of water reflects inputs from the atmosphere, soil, water rock weathering and pollutant sources [7]. It required for irrigation depends upon the dissolved salts like Na, Ca, Mg and HCO3 in water [7]. The polluted waters lead to different gastrointestinal problems such as tropical and terminal infection as cancer or liver infections. In this paper an attempt has been made to evaluate the quality indices of groundwater to understand the hydro geochemical relationships of the water quality parameters for the suitability of groundwater resources. The quality of groundwater is highly influenced with physical and chemical soluble parameters due to weathering from source rocks, anthropogenic activities, and local environmental and ecological conditions [6]. Rapid growth of population, expansion of irrigation and increasing trend of industrialization has contributed towards rising demand for groundwater [6].

2. MATERIALS AND METHOD

2.1. *Study Area*

Garautha block is situated in the Jhansi District of Uttar Pradesh, India. According to Census 2011, almost total area of Garautha is 1047 km² including 1037.99 km² rural area and 9.24 km² urban areas. Garautha has a population of 233688 peoples and 42747 houses in the 152 villages in this block. These tributaries are the part of the Ganga River. Being on a rocky plateau, Jhansi experiences extreme temperatures. Winter begins in October with the retreat of the Southwest Monsoon (Jhansi does not experience any rainfall from the Northeast Monsoon) and peaks in mid-December [15].

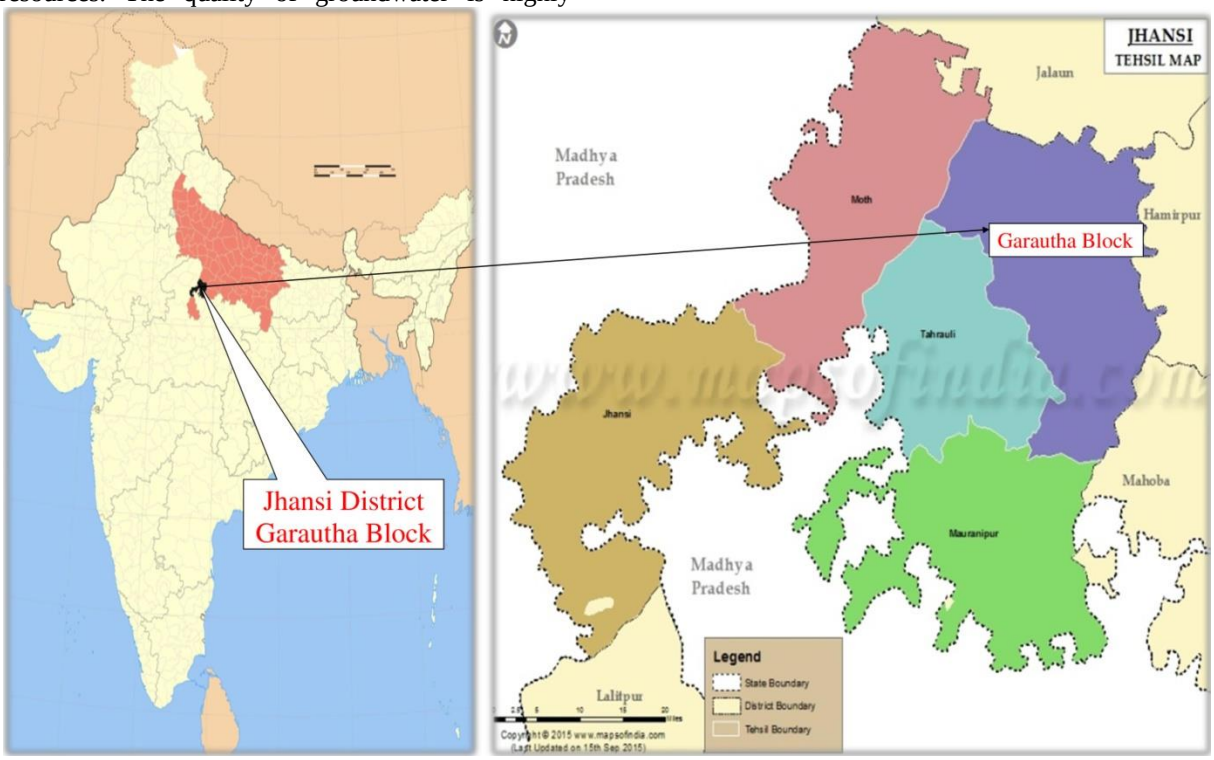

Fig.1. Map shows the locations of Garautha Block of Jhansi District (Source Map of India).

The water bodies were mostly filled up during the rainy season and which in turn charged the groundwater. Thus, the most farmers are mainly dependent on the monsoon rains to recharge these wells in Bundelkhand region. The sources of groundwater recharge through accumulating the

rainwater in usual ponds is not an acceptance place caused by degradation of such ponds, encroachment of woodlands, forests cutting and blocking off the catchment areas of the watershed zone. In the study area of Jhansi, mainly the rocks are found to be Bundelkhand Gneissic Complex of the age of 2500-2600 Ma and alluvium are found to be recent time. Generally, Bundelkhand Gneissic Complex (BGC) is found to be non-foliated granite-gneisses rocks, ultramafic rocks, Calc-silicates and banded magnetite formation. Winter begins in October with the retreat of the Southwest Monsoon (Jhansi does not experience any rainfall from the Northeast Monsoon) and peaks in mid-December and the mercury generally reads about 4^{o}C minimum and 21^{o}C maximum [13]. Spring arrives by the end of February and is a short-lived phase of transition. Summer begins by April and summer temperatures can peak at 47^{o}C in May [13]. The yielding capacity of the aquifer in Garautha Block of the groundwater is an intermediate amount of tube wells and dug wells. The yielding capacity of tube wells is found to be very low in the hard terrain areas of Garautha Block range from 200 l pm to 600 l pm.

2.2. *Water Sampling*

The groundwater samples of the areas were collected during the month of June-2015. Total 20 groundwater sampling locations were selected, ensuring maximum representation of diverse environments of the area. Groundwater samples of the areas of Garautha Block were collected from the hand pumps and tube wells where maximum peoples using them for drinking water and agriculture purposes. The collection of groundwater samples in polyethylene bottles of 500ml, and 250ml from each site which was thoroughly washed thrice with the water to be analyzed. APHA (the standard method for the Examination of Water and Wastewater) is the standard method for the investigation of physico-chemical parameters and trace elements treatment [1].

3. RESULTS AND DISCUSSION

The groundwater samples mainly varied between from 6.5-8.5 by BIS (2012). The groundwater samples measured the pH value varied between from 6.72 to 7.87 and 7.30 is an average value and according to [2], the value of pH within the acceptable limits. The concentration of electrical conductivity of the groundwater samples of study area ranging between from 562 to 4062 µS cm^{-1} and 1423.32 µS cm^{-1} is an average value. The acceptable limit of EC has prescribed <250 µmhos cm^{-1} and 5000 mg/l is the permissible limit by [14]. The acceptable limit of TDS has prescribed 500 mg/l and 2000 mg/l is the permissible limit by using [14]. The groundwater samples measured the TDS value varied between from 401 to 2594 mg/l and 9536.1 mg/l is an average value.

The acceptable limit of chloride has prescribed 250 mg/l and 1000 mg/l is the permissible limit by using [2]. The groundwater samples measured the chloride value varied between from 4.8 to 1143.5 mg/l and 182.9 mg/l is an average value. The acceptable limit of fluoride has prescribed 1 mg/l and 1.5 mg/l is the permissible limit by using [2]. The groundwater samples measured the fluoride value varied between from 0.58 to 8.81 mg/l and 2.78 mg/l is an average value. The permissible limit of bicarbonate has prescribed 600 mg/l by using [2]. The groundwater samples measured the bicarbonate value varied between from 196 to 522.5 mg/l and 356 mg/l is an average value. The acceptable limit of nitrate has prescribed 45 mg/l by using [2]. The groundwater samples measured the nitrate value varied between from 4.64 to 408.67 mg/l and 87.67 mg/l is an average value. The acceptable limit of sulphate has prescribed 200 mg/l and 400 mg/l is the permissible limit by using [2]. The groundwater samples measured the sulphate value varied between from 0.6 to 202.3 mg/l and 50.375 mg/l is an average value.

The acceptable limit of calcium has prescribed 75 mg/l and 200 mg/l is the permissible limit by using [2]. The groundwater samples measured the calcium value varied between from 19.67 to 389.91 mg/l and 118.90 mg/l is an average value. The acceptable limit of potassium has prescribed 200 mg/l and 300 mg/l is the permissible limit by using [2]. The groundwater samples measured the potassium value varied between from .68 to 27.09 mg/l and 6.55 mg/l is an average value. The acceptable limit of magnesium has prescribed 30 mg/l and 100 mg/l is the permissible limit by using [2]. The groundwater samples measured the magnesium value varied between from 21.35 to 195.44 mg/l and 54.52 mg/l is an average value. The acceptable limit of sodium has prescribed 200 mg/l and 300 mg/l is the permissible limit by using [2]. The groundwater samples measured the sodium value varied between from 39.75 to 271.77 mg/l and 93.34 mg/l is an average value.

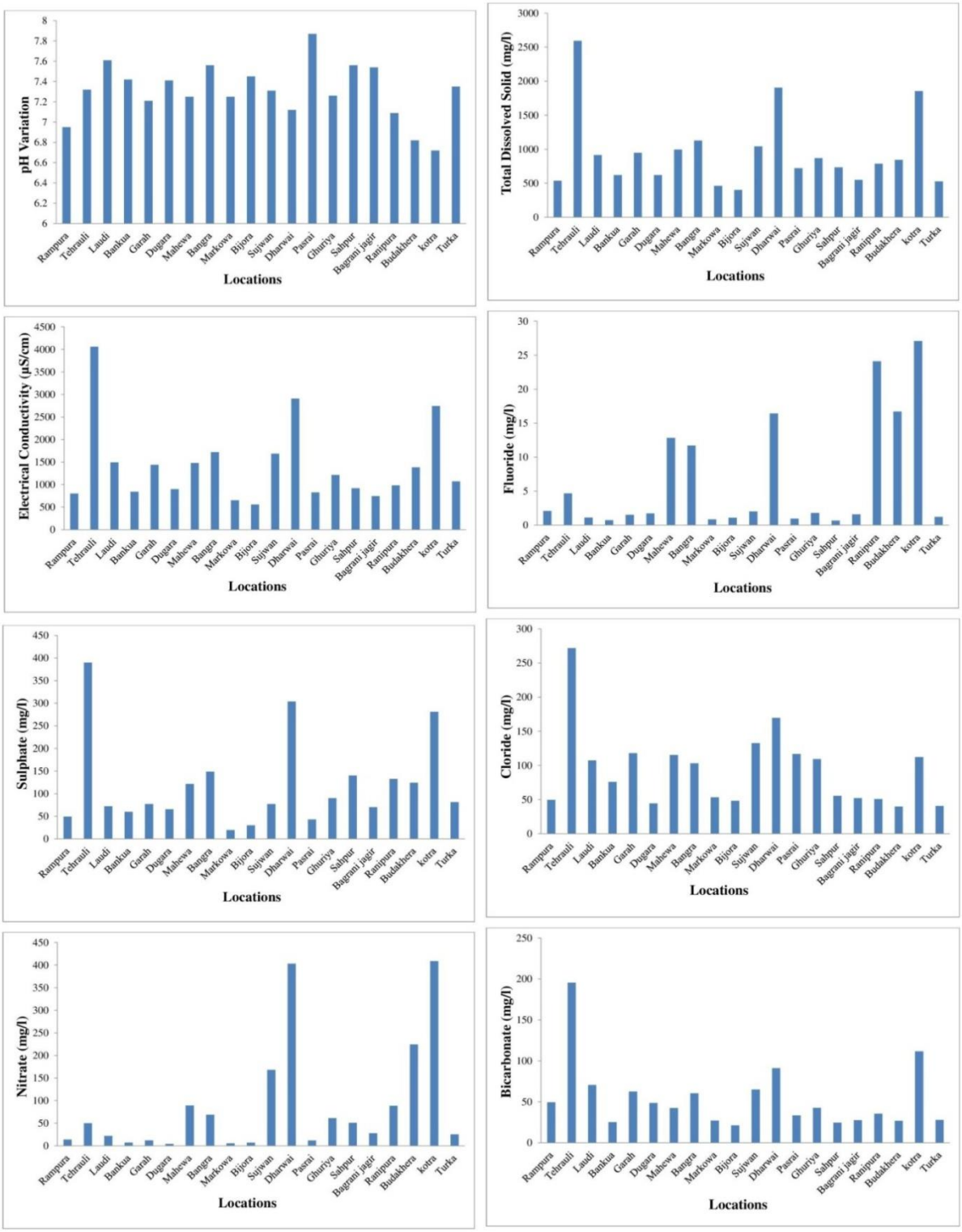

Fig. 1 Spatial Varaition of pH, TDS, EC and an ions of grondwater samples shows HCO_3^-, Cl^-, SO_4^{2-}, NO_3^- and F^-.

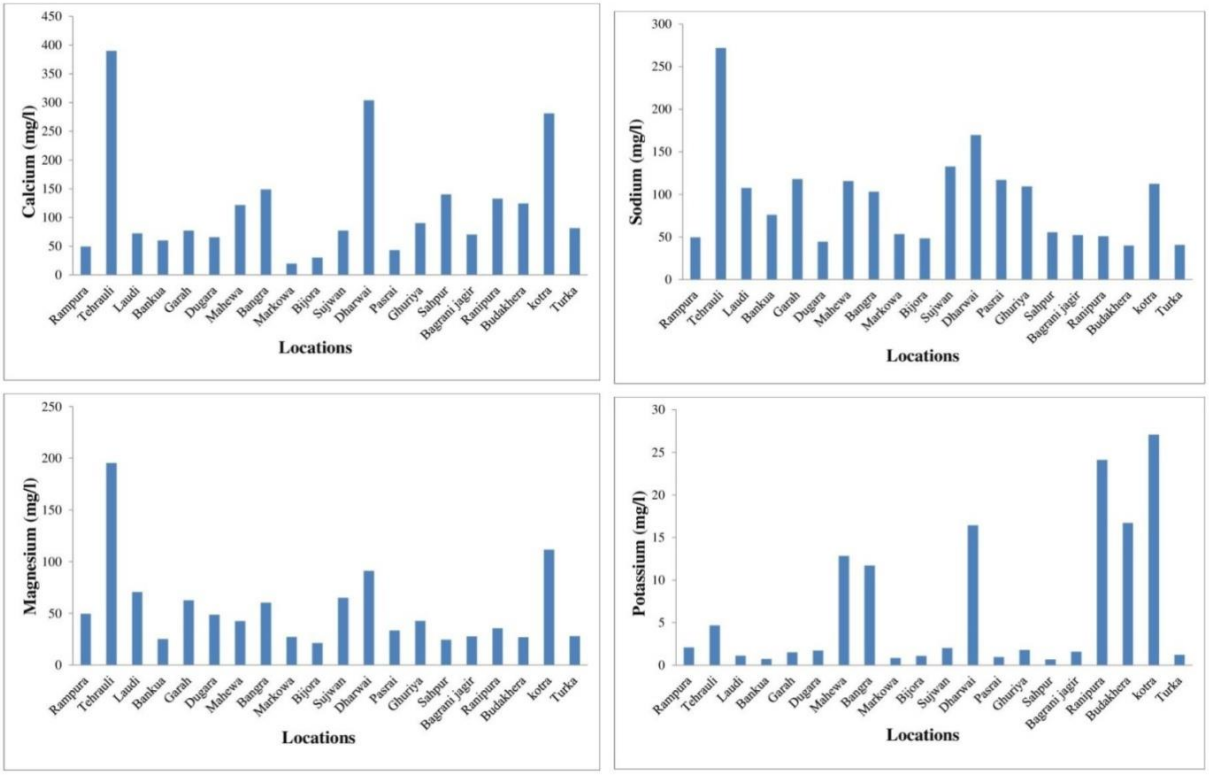

Fig. 2 Spatial Varaition of cat ions of grondwater samples shows Ca^{2+}, Mg^{2+}, Na^{+} and K^{+}.

Table Physico-chemical analysis of groundwater samples of Garautha Block

S. No.	Village	PH	EC	TDS	F^-	Cl^-	HCO_3^-	SO_4^{2-}	NO_3^-	Ca^{2+}	Mg^{2+}	Na^+	K^+
1	Rampura	6.95	805	538	3.00	92.4	196.0	81.7	14.00	49.44	49.54	49.52	2.09
2	Tehrauli	7.32	4062	2594	8.81	1143.5	362.3	167.4	50.00	389.91	195.44	271.77	4.68
3	Laudi	7.61	1494	915	2.00	150.2	472.4	16.9	22.07	72.19	70.59	107.41	1.12
4	Bankua	7.42	844	621	1.57	27.0	420.4	2.3	7.40	60.00	25.28	76.00	0.73
5	Garah	7.21	1442	947	1.92	137.8	522.5	13.4	12.27	77.06	62.60	117.93	1.52
6	Dugara	7.41	902	620	2.30	54.1	374.5	23.8	4.64	65.59	48.61	44.44	1.72
7	Mahewa	7.25	1482	996	3.15	150.4	415.4	45.9	89.45	121.44	42.45	115.43	12.84
8	Bangra	7.56	1722	1128	2.12	249.5	407.2	76.0	69.18	148.89	60.43	103.21	11.71
9	Markowa	7.25	654	462	0.58	4.8	349.2	0.6	5.70	19.67	27.15	53.43	0.85
10	Bijora	7.45	562	401	2.14	9.0	278.8	3.5	7.10	29.99	21.35	48.23	1.11
11	Sujwan	7.31	1688	1043	5.23	205.8	338.8	48.4	168.16	77.22	65.09	132.66	2.03
12	Dharwai	7.12	2910	1906	1.77	446.3	349.6	124.1	403.21	303.81	91.19	169.58	16.42
13	Pasrai	7.87	829	723	2.19	22.7	475.4	16.8	11.95	42.96	33.45	116.81	0.97
14	Ghuriya	7.26	1215	869	2.73	99.2	442.0	19.5	61.43	90.09	42.79	109.38	1.80
15	Sahpur	7.56	922	734	1.90	136.5	288.0	35.1	51.04	140.28	24.59	55.42	0.68
16	Bagrani jagir	7.54	745	550	3.41	8.6	355.6	2.2	28.26	70.20	27.71	52.19	1.59
17	Ranipura	7.09	985	787	1.54	70.8	316.0	66.2	88.78	132.68	35.50	50.85	24.10
18	Budakhera	6.82	1385	844	1.52	141.8	220.4	47.9	224.57	124.27	26.95	39.75	16.72
19	kotra	6.72	2745	1857	5.45	420.0	288.0	202.3	408.67	281.20	111.72	112.35	27.09
20	Turka	7.35	1074	527	2.27	88.0	247.2	13.5	25.52	81.25	28.00	40.58	1.23

4. CONCLUSION

The groundwater samples of pH analysis the value between from 6.72-7.87 and the average value of pH is 7.30 showed that intermediate acidic to the alkaline quality of groundwater. Out of 20 groundwater samples showed within the acceptable value of EC and out of 19 groundwater samples showed within the acceptable limit of TDS value and very high TDS in Tehrauli. In general groundwater of the Garautha block is better to permissible quality, which can be used for domestic purposes. The most of the groundwater samples measured parameters are better within the acceptable limits and water is suitable for drinking purposes and irrigation. But, some of the parameters exceeds the acceptable limits at some location and must be treated previously domestic use.

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