Original Article

Hydro-chemical Investigation of Ground Water in Eastern Rural area, Aligarh District (U.P.)

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DOI: 10.47750/pnr.2022.13.S09.224

Abstract

Various water quality parameters are analyzed in three blocks (Bijauli, Gangeri and Jawan) of the eastern part of Aligarh district (U.P.). From each block ten water samples have been collected to characterize the groundwater status for potability and other purposes. In this analysis, various hydro-chemical parameters are examined including pH, turbidity, electrical conductivity (EC), Total Dissolved Solids, total hardness, sulphate (SO42-), phosphate (PO42-), Total alkalinity and Nitrate (NO32-) concentrations present in water samples. The findings were compared to BIS standards. This work is focused on the evaluation of the water quality index (WQI) of three blocks ground water. To calculate WQI, the above parameters are considered. The water quality index for these 30 samples ranges from 30.68 to 71.83. High value of water quality index in Bijouli block is found that the WQI mainly comes from higher limits of Fe, NO32-, total dissolved solids, hardness, and F- in underground water. Gangeri and Jawan blocks WQI show that the water of these blocks is good and useful for every purpose. The results of evaluations can be used for design models to predict water quality. The analysis shows that the water in the study area is currently appropriate for normal purposes and irrigation, but the some parameters are approaching a higher limit and need a certain degree of treatment before consumption and must be protected from the risk of contamination and must be regularly checked to maintain quality in the future as well.

Keywords: Water Quality Index, Hydro-chemical analysis, Total Hardness, Total dissolved solids.

INTRODUCTION

Water plays a critical function in human existence. notwithstanding the information of the WHO reviews, approximately 36 percent of the city populace and 65% of the rural Indians did not have get right of entry to to secure consuming water [1]. Groundwater is the maximum practical new water asset for human use in metropolises. The importance of groundwater for the presence of human tradition cannot be overemphasized. There are so many states in India where greater than ninety% humans depend upon groundwater for ingesting and other beneficial functions (Tank et al., 2010 and Ramesh et al., 2012). The problem of groundwater pleasant is significantly greater extreme in areas which might be densely populated, densely industrialized and shallow water tables. Groundwater is taken into consideration enormously perfect and free of infection than surface water (Patil et al., 2010). However, delayed discharge of modern industrial wastewater, domestic sewage, and heavy landfills cause groundwater contamination and cause health problems. Groundwater contamination has become a major public concern worldwide.

It is even extra vital component for humans as they survive on it for food production, commercial processing, and daily requirements [2]. The use of groundwater depends on the quality of the surrounding water. Human modification of the landscape has an absolute effect on watershed [3]. Groundwater is taken into consideration as essential source in rural areas in particular in the ones regions in which other water assets including dams, rivers and canals are scarce. The effects of urban and industrial growth lead to water depletion for agricultural purposes. Over the past decade, it has been noted that groundwater is highly polluted as a result of increased human activity. As a end result, a number of waterborne diseases have been diagnosed because the motive of fitness dangers. Know-how water chemistry is the premise of information of the multi-faceted nature of aquatic chemistry which includes supply, composition, response and transport of water.

Water quality is very important to humanity as it is directly related to human well-being [4]. Consequently, it is necessary to evaluate the great of surface and underground waters. Water satisfactory tracking using the Water first-class Index (WQI) developed through Horten (1965) helps in the overall evaluation and management of groundwater (Shahu et al., 1991 and Chauhan et al., 2010) and a powerful manner to talk water best statistics to policy makers and concerned citizens, environmental indices, hobby in such indices has grown drastically international. The water first-class index is a numerical expression of the degree of pollutants and will increase with pollution. WQI is described as an assessment approach that provides the composite impact of man or woman water exceptional parameters on ordinary exceptional of water for human consumption (Deiniger et al., 1971 and Rankrishnaih et al., 2009). The WQI presents a comprehensive image of exceptional of surface or groundwater for maximum domestic makes use of and effortlessly apprehend by means of exceptional decision makers a possible use of any water frame.

Surface water exceptional is likewise affect ground water traits. Seasonal variations because of each anthropogenic and natural tactics including temperature and precipitation have an effect on river water satisfactory and result in specific traits for one of kind seasons (Barakat et al., 2016). Untreated effluents from factories are directly or circuitously discharged into rivers, causing surface water pollutants (Hasan et al., 2019). Both municipal strong waste and industrial effluents have adversely affected river water pleasant to a large extent in the previous few decades (Uddin and Jeong 2021). As reported by Ayodele and Abubakar et al., (1998), the concentrations of pollutants were correlated with the industrial activities. In this study area Harduaganj Power Plant, Bear Factory, Cement factory, slaughter houses and other factories are running so their drainage affected the water bodies. The best of groundwater inside the have a look at location is susceptible to deterioration in particular due to immoderate use and population strain. The current work is a try to quantify the water nice of the diverse water sources of the three blocks of Aligarh district (U.P.), India.

EXPERIMENTAL ZONE

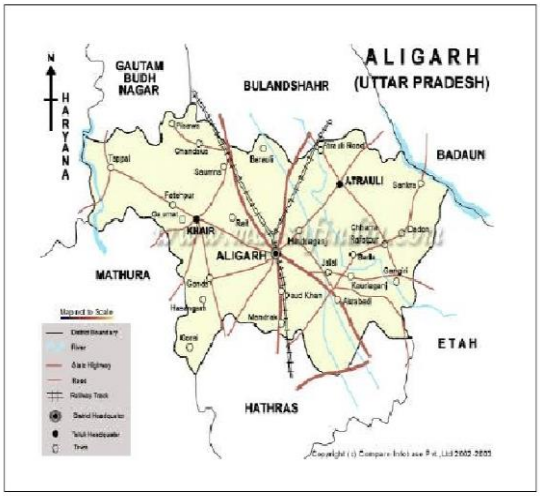
STUDY AREA

Aligarh District is a part of the central Ganga a state plain covering an area of 5498 square mile and is in the middle of the North latitudes 27°53′ and 28°53′ and East length 78°4′ and 78°36′. The region is bounded by the Ganga River to the west once on the river Yamuna to the east. Aligarh District is officially divided into 12 blocks namely (i) Atrauli (ii) Bijouli (iii) Jawan (iv) Khair (v) Lodha (vi) Dhanipur (vii) Akrabad (viii) Iglas (ix) Gonda (x) Tappal (xi) Chandaus and (xii) Gangeri. In our present research paper the water samples have been investigated in summer season in three blocks of eastern Aligarh District.

WATER SAMPLING

In the current study 30 water samples from three blocks (10 samples in each block) were collected. Water samples amassed in polythene bottles are purified with acidic water, accompanied via double rinsing with distilled water. Water samples were chemically examined [5]. Water evaluation is finished the usage of preferred methods APHA and BIS.

Figure1 - Area of Uttar Pradesh in India Figure 2- Region of Aligarh in U.P.



METHODOLOGY

The pH and EC was measured through the usage of Eutech-cybernetics pH meter and EC scan meter [6].Total hardness was evaluated through EDTA titration methods [7]. Total alkalinity was decided by volumetrically using silver nitrate titrametric strategies using potassium chromate as indicator [8]. Sulphate became decided by means of gravimetric method [9]. Fluoride content material in water was measured with the help of Colorimetric method. The Hydro-chemical examinations were performed in steps with requirements strategies of APHA and BIS [10, 11, and 12]. Turbidity calculated by Nephelometric method and TDS determined by using Gravimetric technique [13]. Iron turned into determined via spectrophotometer [14]. Nitrate turned into determined through Colorimetric method [15] [16].

Water Quality Index (WQI)

The Water Quality Index (WQI) is a vital method for analyzing groundwater quality and its suitability for consuming and other purposes. To calculate the Quality Index of water, the permissible values of various hydro-chemical parameters are used for ingesting water used on this have a look at is suggested with the aid of WHO, BIS and ICMR. The WQI value can be calculated using the subsequent equation

$$WQI = \frac{\sum QnWn}{\sum Wn}$$

Where Qn = the quality rating scale of the nth water quality parameter;

Wn = the unit weight of the nth water quality parameter.

For computing WQI, we first calculate the Q value by using the following formula-

$$Qn = 100\ \frac{Vn - Vi}{Sn - Vi}$$

Where Vn =amount of nth parameter present, Vi = ideal value of the parameter i.e. Vi=0,

Sn= recommended standard value for nth parameter calculated by the following equation-

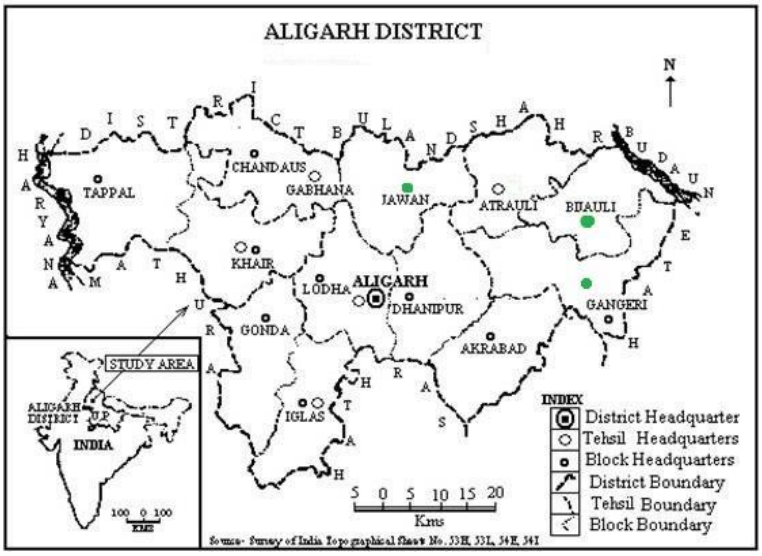
$$Wn = \frac{K}{Sn}$$

Where K=proportionality constant and it is calculated by the following equation-

$$K = \left[\frac{1}{\sum \frac{1}{Sn}}\right]$$

The water quality based on the quality index (WQI) value and their possible uses

Figure 3- Location of Three Blocks (Bijouli, Gangeri, Jawan) in Aligarh district (U.P.)



RESULTS AND DISCUSSION

Water from the observed region is colorless, odorless, Taste of water sample water in many places was found good. The consequences of the water evaluation inside the present locations are described in table in Table 1, 2, 3. These are compared with the BIS standards. The statistical parameters are shown in Table 4. The pH limits of the water are observed between 7.12-7.86 and represent that they are within the permissible limit of water quality parameters. The Electric Conductivity of water samples shows wide range variation 786 µS/cm - 1865 µS/cm across all three blocks. Total Alkalinity was found 234-592 mg/L that shows that some areas were near to higher limit. The fluoride rage is 0.24-0.98 mg/L in the present study location. The turbidity is examined within limit in all blocks. Hardness values were found 243-576 mg/L and according to BIS limits this result shows that water of Jawan Block is soft and appropriate for drinking and other purposes and Gangeri Block water is moderately hard so it can be used for drinking and Bijauli Block water is hard and unsuitable for drinking but can be used for agricultural purposes. Phosphate and sulphate data were low on all blocks. The determination on the basis of absolute strength indicates that the most water samples in all blocks contain the highest ranges of Hardness. Total Dissolved Solids are within limit in all studied blocks according to standard limits but some sites show near to higher desirable limit. NO3- was also found higher in Bijouli block area water. Due to higher limit of NO3- it can be cause of Methemoglobinemia or blue baby disease in infants. There is a need to be continuously monitoring to make water healthy and drinkable.

TABLE 1- HYDRO-CHEMICAL EXAMINATION OF GROUND WATER OF BIJOULI BLOCK

Sr. No.	pH	Turbidity	EC	Total Hardness	TotalAlkalinity	Total Dissolved Solid	Fluorides	TSS	PO_4^{2-}	$SO4^{2-}$	$NO3^-$	Fe
1	7.43	1.2	985	254	354	1287	0.56	1.7	0.87	104.7	57.3	0.70
2	7.54	1.6	1008	368	458	1267	0.35	0.5	0.67	176.1	45.6	0.80
3	7.13	1.3	789	287	278	1089	0.26	0.2	0.94	184.3	36.6	0.34
4	7.65	1.9	994	576	487	1254	0.47	1.2	0.64	108.5	37.65	0.40
5	7.51	2.18	1865	472	592	1202	0.32	1.8	0.98	106.4	36.1	0.45
6	7.12	1.2	1265	376	276	1289	0.56	0.4	0.78	104.8	45.8	0.72
7	7.67	1.6	884	312	265	1190	0.74	0.9	0.85	108.4	43.8	0.28
8	7.35	1.4	983	432	376	1098	0.86	1.7	0.94	135.7	35.76	0.58
9	7.13	1.78	1398	287	356	1176	0.24	0.5	0.68	195.8	35.7	0.31
10	7.87	2.3	897	476	486	1269	0.63	1.4	0.57	165.6	38.7	0.33

TABLE -2 HYDRO-CHEMICALS EXAMINATION OF GROUND WATER OF GANGERI BLOCK

Sr. No.	pH	Turbidity	EC	Total Hardness	Total Alkalinity	Total Dissolved Solids	Fluorides	TSS	PO_4^{2-}	$SO4^2$	$No3^-$	Fe
1	7.45	1.6	885	365	356	608	0.67	1.9	0.89	56.6	14.6	0.54
2	7.56	1.9	998	249	435	654	0.48	0.7	0,57	59.3	13.2	0.26
3	7.86	1.23	1080	523	376	589	0.56	0.2	0.78	45.7	17.4	0.36
4	7.34	1.54	1289	350	276	578	0.93	1.3	0.73	38.9	14.2	0.20
5	7.56	1.9	1081	416	444	708	0.92	0.8	0.61	43.8	12.5	0.71
6	7.89	1.3	786	298	534	634	0.46	0.5	0.89	54.8	14.2	0.21
7	7.54	1.98	956	485	376	765	0.56	0.2	0.95	56.9	13.8	0.32
8	7.52	1.45	1028	523	387	746	0.64	1.2	0.58	43.7	12.4	0.13
9	7.24	1.2	1298	243	276	735	0.69	0.8	0.86	49.6	12.9	0.40
10	7.56	1.67	978	264	250	598	0.93	1.5	0.64	54.3	13.6	0.23

TABLE – 3 HYDRO-CHEMICALS EXAMINATION OF GROUND WATER OF JAWAN BLOCK

Sr. No.	pH	Turbidity	EC	Total Hardness	Total Alkalinity	Total Dissolved Solids	Fluorides	TSS	PO_4^{2-}	$SO4^{2-}$	$NO3^-$	Fe
1	7.86	1.9	987	243	398	487	0.87	0.5	0.56	58.3	2.5	0.48
2	7.34	1.45	789	267	346	498	0.98	0.9	0.94	43.7	3.7	0.74
3	7.25	1.35	865	287	235	387	0.45	1.2	0.87	45.8	4.2	0.25
4	7.67	1.2	1020	256	276	395	0.34	0.3	0.56	53.6	2.4	0.53
5	7.86	1.20	885	224	304	416	0.67	0.4	0.76	44.6	3.4	0.59
6	7.86	1.98	988	354	256	412	0.45	1.8	0.98	43.7	3.78	0.31
7	7.32	1.56	845	465	238	500	0.76	1.2	0.57	39.6	3.5	0.62
8	7.56	1.2	1234	398	364	412	0.98	0.6	0.63	43.2	4.5	0.59

9	7.26	1.4	982	287	342	398	0.42	1.0	0.75	38.5	4.8	0.52
10	7.67	1.34	1067	280	234	423	0.51	0.7	0.89	43.4	3.6	0.50

Fig: collection of water samples from various sites of three blocks in Aligarh district

Table 4- Comparison of ground water parameters with drinking water standards (BIS)

Parameters	**Minimum range**	**Maximum range**	**Mean values**	**BIS (Desirable ranges)**
pH	7.12	7.89	7.5	6.5-8.5
EC	786	1865	1325.5	-
TDS	395	1289	842	500-2000
TH	243	576	409.5	200-600
TA	234	592	413	200-600
TSS	0.2	1.9	1.05	-

Turbidity	1.2	1.98	1.59	1-5NTU
Fe	0.08	0.83	0.45	0.1
No3	2.5	57.3	29.9	45
F^-	0.24	0.98	0.61	1.0-1.5
Po_4^{2-}	0.56	0.98	0.77	-
So4	38.9	195.8	117.35	200-400

Table 5- Classification of the groundwater samples on the basis of TDS

Sr. No.	Total Dissolved solid (mg/l)	Classification of Ground water	No. of Samples
1	<1000	**Non-salty water**	20
2	1000-3000	**Slightly salty water**	10
3	3000-10,000	**Moderately salty water**	0
4	>10000	**Very salty water**	0

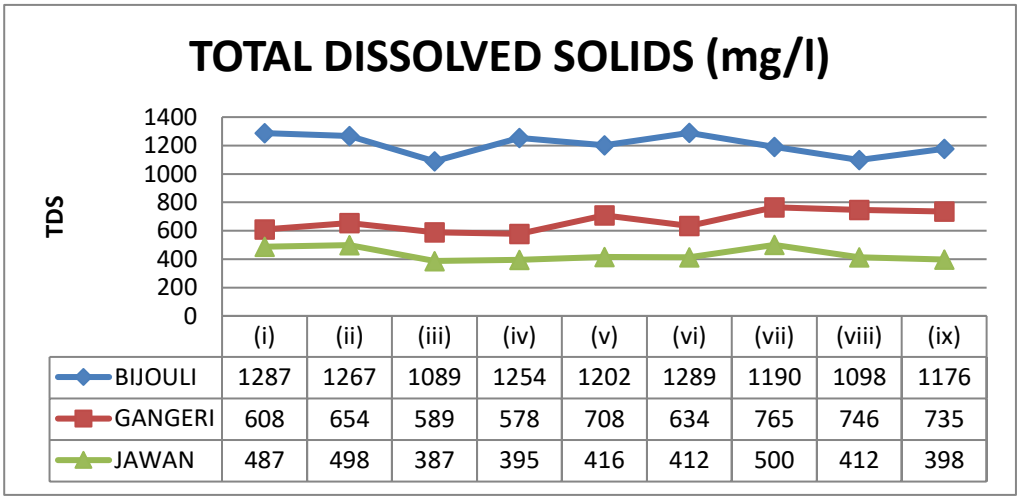


Table 6 -Classification of the groundwater samples based on Total Hardness

Sr. No.	Hardness(Mg/l)	Description	No. of Samples
1	0-60	**Soft water**	NIL
2	61-120	**Moderately hard water**	NIL
3	121-180	**Hard water**	NIL
4	>180	**Very hard water**	30

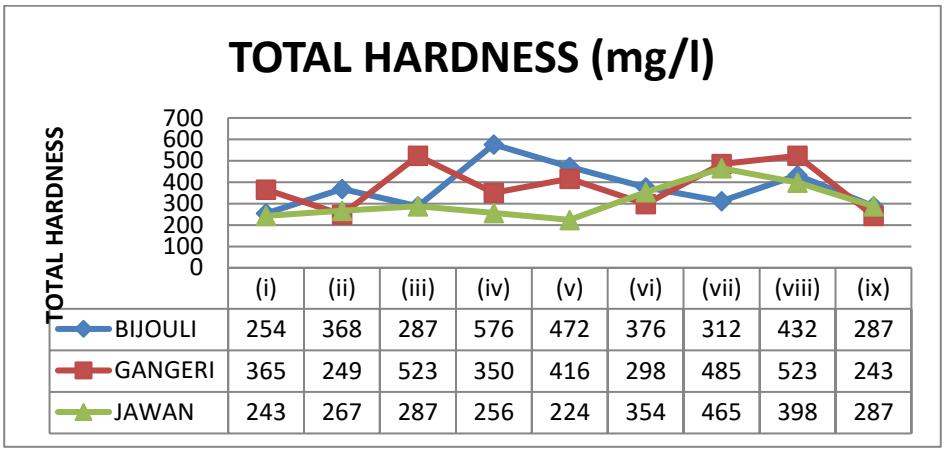
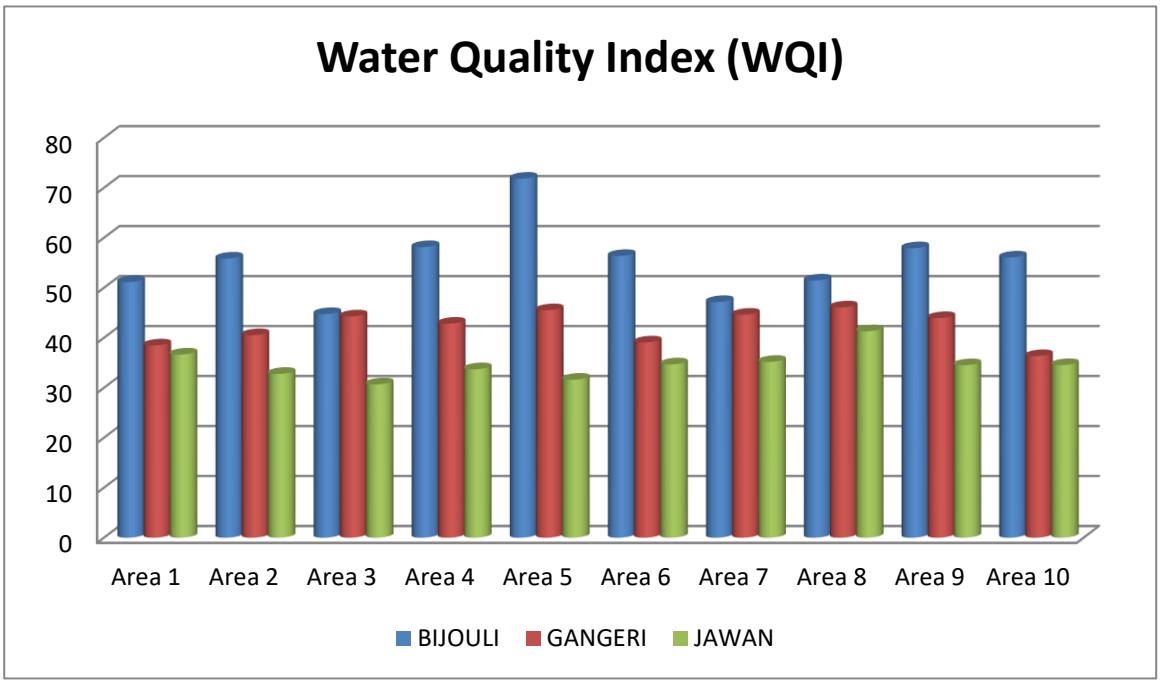


Table 7 Water Quality Index of various sites of Bijouli Block, Gangeri Block and Jawan Block

Sites	Bijouli WQI	Gangeri WQI	Jawan WQI
1	51.15	38.47	36.65
2	55.85	40.52	32.78
3	44.74	44.27	30.68
4	58.13	42.82	33.71
5	71.83	45.51	31.62
6	56.37	39.07	34.68
7	47.15	44.61	35.18
8	51.46	46.08	41.31
9	57.91	43.94	34.51
10	56.06	36.33	34.53



Water quality index and its status with uses

According to Brown et al 1972, the range of water quality index follows these conditions

- If the range of WQI is less than 25 than water quality is excellent and water is appropriate for drinking, agricultural uses, and commercial uses

- If the range of WQI is 26 to 50 than water quality is good and water is appropriate for drinking, agricultural uses, and commercial uses

- If the range of WQI is 51 to 75 than water quality status is poor and water is inappropriate for drinking, agricultural uses, and commercial uses

- If the range of WQI is 76 to 100 than water quality is very poor and it shows that the water is useful for only agricultural uses

- If the range of WQI is beyond 100 than water quality is bad and proper treatment is essential before any kind of use

Table 8 Overall WQI of the blocks

Blocks	WQI
BIJOULI	55.06
GANGERI	42.16
JAWAN	34.56

CONCLUSION

The hydro-chemical examination of ground water shows significant variability in the observed area. The study shows that most water samples comply with BIS standards for irrigation purposes, daily uses and drinking but some of them were good only for irrigation and other industrial uses. The assessment highlights the urgent need for regular monitoring of groundwater quality in order to assess pollution activity from time to time and take appropriate and timely measures to reduce the severity of pollution activity. A very important measure is to enrich groundwater resources by using rainwater to replenish aquifers and thereby reduce high concentrations of chemical parameters. A public awareness program should be initiated to increase public awareness of water conservation. Water is essential for human existence and human development. The water quality index (WQI) for the 30 groundwater samples ranged from 30.68 to 71.83. The upper limit of the TQI at these sampling points was primarily determined by the higher alkalinity range of the groundwater sample, the total dissolved solids. Water samples from Bijuli are of poor quality, while water from Gangeri and Javan blocks is drinkable. The results of this study also show that the water quality of the groundwater in the area must be properly and regularly treated before consumption and protected from contamination by industrial waste and sewage. Regular groundwater quality monitoring is also important to prevent groundwater contamination. The water quality index of these blocks shows that the water in the Bijouli block is suitable for irrigation and industrial water use, the water quality in the Gangeri block is good and suitable for all uses, and the water quality of the Javan block is also shown good.

Acknowledgement

The author is grateful to Chemistry research lab S.V. College, Aligarh (U.P.) and U.P. Jal Nigam Aligarh for analytical study and grateful guidance.

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