Study of physiochemical contents in different types of surface Water from different area of Ghaziabad

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RESEARCH ARTICLE

Mohit Sharma*, R Sivaperumal

Department of Microbiology, Sri Satya Sai University of Technology & Medical Sciences, Sehore-466001, India.

**Corresponding Author's E-mail: om11agra85@gmail.com*

ABSTRACT

The surface water forms the lifeline of almost all the human activities. The water pollution, inflow of solid waste, dumping of garbage in the drains and eroded soil, silt deposited in the natural drainage are major threat to surface water. The studies focusing on the assessment of changes in the river hydrology, morphology and water quality. The methodology used in the study involved assessment of Ghaziabad district water quality from six different locations for a period of one year 2016-17 in monsoon, winter and summer seasons. The parameters observed are Temperature, pH, Turbidity, Total Hardness (T-H), Calcium Hardness.

Keywords: Assessment, Parameters, Evaluating, Quality.

1. Introduction

Water is one of the abundant and available substances in nature. Man has exploited more than any other resources for the sustenance of life. Water of good quality is necessary and required for living organisms. Due to the rapid development in industrial growth, urbanization and consequence of pollution made the fresh water systems as challenges for the fragile fresh water ecosystems (1). The ability of water bodies to clean themselves has been affected by the sheer quantity of waste generated by ever increasing population (2-5). The anthropogenic activities such as disposal of sewage and industrial effluent, recreational activities, excess fertilization of land and the use of pesticides have threatened environmental health of surface water. Deterioration of water quality and the fast depletion of water resources is the main challenge which needs an immediate solution (6-8).

India is endowed with a vast expanse of open inland water resources. There are about 7.6 million hectares of wetland, excluding paddy fields, rivers and canals, out of which 3.6 million hectares is inland and 4 million hectares coastal. There are 2,175 natural wetlands having 1.46 million hectares area and 65,254 man-made lakes having 2.85 million hectares area in India (7-10).

2. Materials and Methods

Samples of Hindon water were collected from six different sites of Ghaziabad. Ghaziabad is situated in the middle of Ganga-Yamuna doab about 1.5 km east of the Hindon river. Geographically, it is located at latitude 28◦40_ N and longitude 77◦25 E. The north part of Ghaziabad is bounded by the Meerut district, whereas on the southern part are Gautambudh Nagar and Bulandshahar. The climate of this region is tropical to temperate with extreme temperature conditions in summer (up to 43◦C) and winter (up to 3◦C). The mean annual rainfall in this region is 702 mm varying spatially in different subregions of the district. The river is characterised by sluggish flow throughout year, except during monsoon when rainfall causes a manifold increase in the runoff.

The brief description of sampling station (Figure 1) is as follows

1. S-2 (Bhojpur): It is a downstream site of river Hindon and a short stream, i.e. Hindon branch originates at this site.

2. S-3 (Hapur bypass): It is downstream site of Hindon with sever anthropogenic activities, night soil elimination etc.

3. S-4: It is downstream site and located near Murad Nagar.

4. S-5 (Hindon branch): Sample was taken from Hindon branch at a site near Ghazipur landfill. Hindon branch passes through the urban locality of eastern Delhi and ultimately opens into river Yamuna.

6. S-6: It is an upstream sampling site situated near Ataur village.

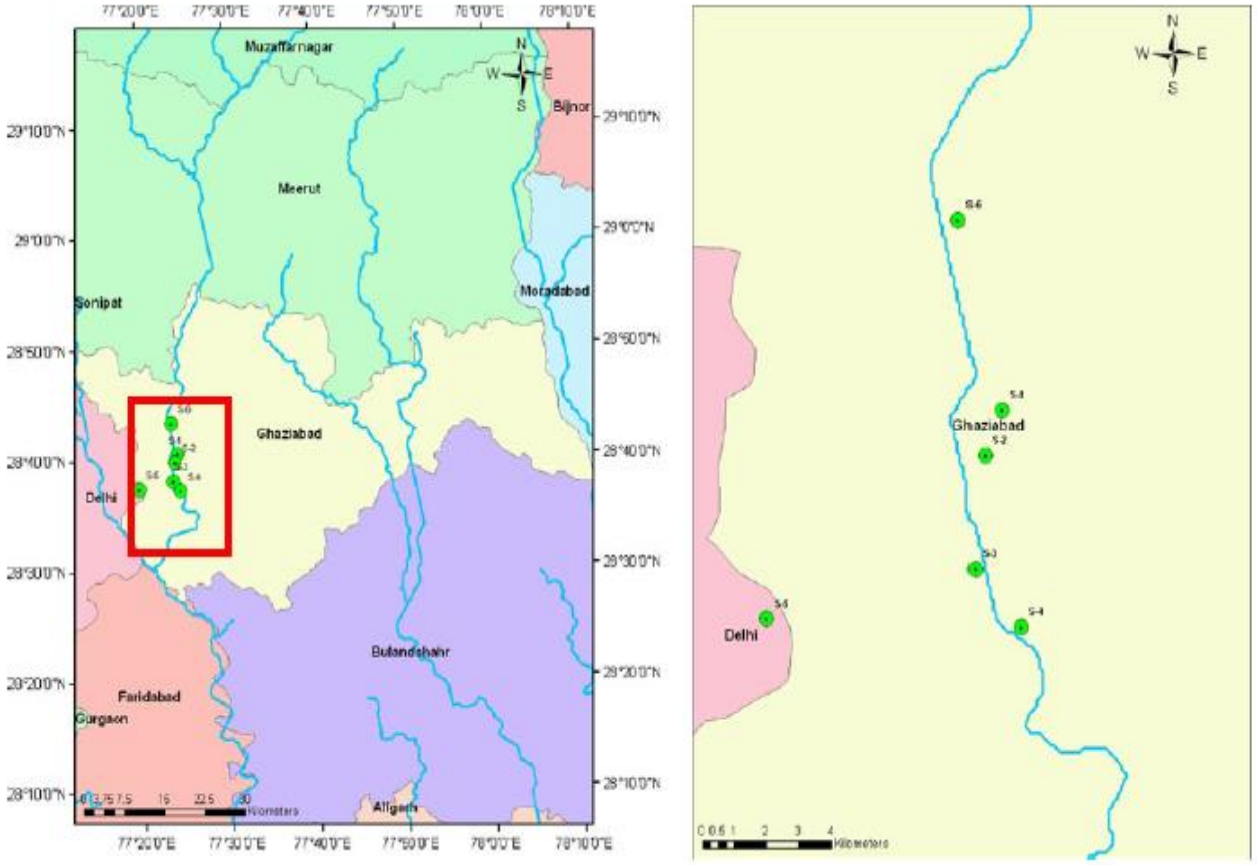

Figure 1. Location map of the sampling sites in Ghaziabad area

In the analysis of the physic-chemical properties of water, standard methods prescribes in hydrological literature were used. The water temperature, pH, dissolved oxygen, alkalinity, conductivity, hardness, chloride, nitrate, Turbidity, Sulphate, calcium and magnesium were observed in the study.

The various physic-chemical parameters were determined adopting methods given by APHA, and Trivedy and Goel.

Temperature

The hydrological characteristics of the water body depend upon solar radiations hence Temperature was recorded by a good thermometer with 0°C to 60°C range and having a least count of about 1°C. The Temperature of sample was measured at the time of sampling on the site.

pH

pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. It is a measure of Hydrogen Ion concentration or more precisely, the Hydrogen Ion activity. pH is defined as the "logarithm (base 10) of the reciprocal of the Hydrogen Ion concentration." It is an important factor in water chemistry. Since it enters into the calculation of Acidity and Alkalinity and processes such as coagulation, disinfection, softening and corrosion control. It is measured by a Systronix battery operated pH meter using a glass electrode which generates a potential varying linearly with the pH of solution in which it is measured. The pH meter was earlier calibrated standard buffer solution of 7.0 pH and 9.2 pH buffers.

Turbidity

Turbidity is an important parameter for characterizing water quality. It is an expression of optical property of a sample containing insoluble substance which causes light to be scattered rather than transmitted in straight lines. The amount and angular distributions of this scattered light is governed not only by the quantity of the insoluble substances but also by their size, shape and refractive index. In most of the waters, Turbidity is due to colloidal and extremely fine depressions, suspended matters such as clay slit, finely divided organic and inorganic matter, plankton and other microscopic organisms also contribute to Turbidity. The Turbidity of a sample is thus measured (Nephelo Turbidity Meter) from the amount of light scattered by the sample taking a reference with standard Turbidity suspension. Result is expressed in N.T.U.

Total Hardness

Temporary Hardness is due to the presence of Bicarbonate of Ca2+ and Mg2+ while Permanent Hardness is due to Sulphates, Chlorides of Mg+2 and Ca2+. Besides these, Sr2+, Fe2+ Mn2+, $HCO3^{-}$ S04 =, CI^{-} and SiO3 = are also responsible for the Hardness of Water. The Total Hardness is expressed in terms of Calcium Carbonate. The analysis was done by complexometric titration. During, titration, Calcium and Magnesium Ions react with EDTA to form soluble complexes and the completion of reaction is indicated by the colour change of a suitable indicator such as Erichrome Black T.

Ca2+ + $H2Y^{-}$ $Cay2^{-}$ + 2H+

(EDTA)

Mg2+ +$H2Y2^{-}$ $Mgy2^{-}$ + 2H+

MgD^{-} + $H2Y2^{-}$ $MgY2^{-}$ + $HD2^{-}$ + H+

(Wine red) (Blue)

In this titration, Calcium Ions do not react with the indicator dye. Magnesium Ions only will react and change the color of the dye. Therefore, a small amount of complex metrically neutral Magnesium Salt of EDTA is introduced to the titer through the addition of buffer (Wine red) to obtain end point (blue) by color change of the indicator.

Calcium

The presence of Calcium in water is mainly due to its passage through or over deposits of Lime Stone, Dolomite, Gypsum and other Gypsiferous Materials. Calcium and Magnesium are the two major scale-forming constituents in most raw water supplies. Calcium can be determined by EDTA titrimetric method. In this method, the pH of the sample is made sufficient high (12-13) to precipitate Magnesium as Hydroxide and Calcium only is allowed to react with EDTA in the presence of a Murexide Indicator.

Mg^{2+} + 2 NaOH Mg $(OH)^2$ + 2 Na+

Ca^{2+} + 2 EDTA Ca $(EDTA)^2$ + 2 Na+

Statistics Analysis

Laboratory characteristics of studied water bodies were expressed as mean ± standard deviation (SD). ANOVA is used to compare data of studies before and after treatment. P value less than 0.05 was considered to be significant correlation and regression analysis were performed for the assessment of improvement in the water quality after treatment.

3. Result and Discussion

The following variations were found in different environmental parameters recorded during the study period.

Table 1 Showing Temperature (^{o}C)

Water Temperature									
Water Bodies		Bhojpur		Hapur bypass		Murad Nagar		Hindon branch	
Seasons		Before Filtration	After Filtration	Before Filtration	After Filtration	Before Filtration	After Filtration	Before Filtration	After Filtration
Rainy	Mean± SD	25.8±3.05	25.4±2.94	27.4±0.86	26.8±1.16	28.2±0.25	28.05±0.23	28.5±0.53	28.05±0.69
	Range	21.8-29.5	21.4-28.1	26.2-28.2	25.2-27.9	26.2-28.3	25.5-28.8	28.1-29.5	25.7-29.0

Winter	Mean± SD	23.5±2.35	23.1±2.22	22.7±2.09	22.6±1.87	23.5±3.72	23.2±3.80	22.6±1.93	22.3±2.20
	Range	21.1-26.5	20.8-5-25.4	20.1-26.7	20.2-26.2	20.5-27.3	19.9-27.5	20.2-26.4	19.8-25.3
Summer	Mean± SD	29.3±0.83	28.9±0.80	26.4±4.17	25.8±4.07	26.1±3.20	25.0±2.78	25.3±2.69	24.8±2.83
	Range	28.4-30.1	28.2-30.0	21.1-29.8	20.5-29.1	21.4-29.5	21.1-27.1	22.1-28.7	21.3-27.3

Temperature of studied surface water bodies were expressed in terms of Mean ± SD (range). Water after taking from all the above four sampling stations. Temperature recorded before filtration and after filtration in rainy season during year 2017. The highest and lowest temperature recorded in Hindon branch i.e 28.5±0.53°C after filtration and Bhojpur i.e 25.4±2.94°C in also after filtration respectively. The highest and lowest temperature recorded during winter season was of Murad Nagar (III) i.e 23.5±3.72°C in before filtration and Hindon branch (IV) i.e 22.3±2.20°C in after filtration. The lowest and highest temperature recorded during summer season was of Murad Nagar (III) i.e 25.0±2.78°C in after filtration and Bhojpur (I) i.e 29.3±0.83°C in before filtration respectively.

Table 2 Showing pH of Studied Surface Water Bodies

pH									
Water Bodies		**Bhojpur**		**Hapur bypass**		**Murad Nagar**		**Hindon branch**	
Seasons		Before Filtration	After Filtration	Before Filtration	After Filtration	Before Filtration	After Filtration	Before Filtration	After Filtration
Rainy	Mean± SD	8.075±0.29	8.17±0.30	8.17±0.28	8.3±0.25	7.85±0.12	8.15±0.26	8.15±0.34	8.4±0.42
	Range	7.7-8.4	7.2-8.5	8.0-8.6	8.0-8.4	7.7-8.0	7.5-8.5	7.8-8.6	7.9-8.8
Winter	Mean± SD	8.1±0.14	8.2±0.21	8.225±0.32	8.25±0.36	8.075±0.09	8.3±0.27	7.5±0.14	8.175±0.05
	Range	8-8.5	7.5-8.0	8.0-8.7	8.0-8.8	7.5-8.5	8.1-8.9	7.3-8.9	8.1-8.8
Summer	Mean± SD	8.42±0.22	8.725±0.12	8.35±0.17	8.55±0.17	8.07±0.09	8.47±0.28	8.02±0.12	8.6±0.29
	Range	8.0-8.8	7.9-8.9	8.2-8.6	7.8-8.8	8.0-8.5	8.4-8.9	7.9-8.5	8.5-9.0

pH of studied surface water bodies were expressed in terms of Mean ± SD (range) of Ghaziabad, supplies filtered water after taking from all the above four sampling stations. pH recorded before filtration and after filtration in rainy season, the highest and lowest pH recorded during rainy season was of Hindon branch (IV) i.e 8.4±0.425 in after filtration and Murad Nagar (III) i.e 7.85±0.12 in before filtration respectively. Recorded pH before treatment and after treatment in winter season, the highest and lowest pH recorded was of Murad Nagar (III) i.e. 8.3±0.27 in after filtration and Hindon branch (IV) i.e. 7.5±0.14 in before filtration respectively. The lowest and highest pH recorded during summer season was of Hindon branch (IV) i.e. 8.07±0.09 in before filtration and Bhojpur (I) i.e. 8.725±0.12 in after filtration respectively.

Table 3 Showing Turbidity (NTU) of Studied Surface Water Bodies

Turbidity (NTU)								
Water Bodies	Bhojpur		Hapur bypass		Murad Nagar		Hindon branch	
Seasons	Before Filtration	After Filtration	Before Filtration	After Filtration	Before Filtration	After Filtration	Before Filtration	After Filtration

Rainy	Mean± SD	39.5±2.08 1	34.5±3.10	39.5±3.10	36.5±1.73	34.5±2.64	31.25±2.5	38±3.55	32.25±2.62
	Range	37.5-42.4	30.7-37.4	35.5-42.5	35.8-38.4	32.4-38.5	30.5-35.5	35.7-42.5	30.5-35.4
Winter	Mean± SD	10.425±3. 61	8.375±1.2 5	9.9±1.19	9±1.08	12.675±2.32	9.625±0.85	11.175±1. 81	9.625±0.85
	Range	7.5-15.5	7.0-10.5	8.5-11.2	8.3-10.5	10.2-15.5	8.5-10.5	9.2-13.5	8.5-10.5
Summer	Mean± SD	5.625±0.8 5	4.875±0.6 2	4.375±0.8 5	3.625±0.9 4	5.625±1.13	4.875±0.85		4.8±1.27
	Range	4.5-6.8	4.0-5.8	3.5-5.5	3.2-5.0	4.5-7.5	4.2-6.0	4.5-7.2	3.0-6.0

Turbidity of studied surface water bodies were expressed in terms of Mean ± SD (range). Supplies filtered water after taking from all the above four sampling stations. The highest and lowest turbidity recorded during rainy season was of Bhojpur (I) i.e 39.5±2.081 in before filtration and Murad Nagar (III) i.e 31.25±2.5 in after filtration respectively. Recorded turbidity before treatment and after treatment in winter season, the highest and lowest recorded in Hapur bypass (II) i.e 12.675±2.32 in before filtration and Bhojpur (I) i.e 8.375±1.25 in after filtration respectively. The lowest and highest turbidity recorded during summer season was of Hapur bypass (II) i.e 3.625±0.94 in after filtration and Hindon branch (IV) i.e 5.875±1.10 in before filtration respectively.

Table 4 Showing Total Hardness (mg/l) of Studied Surface Water

Total Hardness									
Water Bodies		Bhojpur		Hapur bypass		Murad Nagar		Hindon branch	
Seasons		Before Filtration	After Filtration	Before Filtration	After Filtration	Before Filtration	After Filtration	Before Filtration	After Filtration
Rainy	Mean± SD	297.5±51.23	98.5±32.95	277.5±73.65	84.5±17.07	185±30.00	85±18.58	157.5±49.91	81.5±7.72
	Range	240-350	72-140	190-370	74-110	170-210	66-110	120-230	74-92
Winter	Mean± SD	319±15.26	114±6.16	210±25.49	111.5±6.98	285±54.08	120.5±7.39	173±45.39	116±4.89
	Range	300-340	108-124	180-250	100-118	210-360	110-130	120-230	108-116
Summer	Mean± SD	266.5±26.50	113±8.08	283.5±45.23	107.5±15.77	110±22.03	116±8.16	263±103.92	115±3.82
	Range	236-300	102-120	250-350	96-122	360-400	104-122	138-390	112-120

Hardness (mg/l) of studied surface water bodies were expressed in terms of Mean ± SD (range), supplies filtered water after taking from all the above four sampling stations. The highest and lowest hardness recorded during rainy season was of Bhojpur i.e 297.5±51.23 and Hindon branch i.e 81.5±7.72 mg/l respectively. The highest and lowest hardness recorded during winter season was of Bhojpur i.e 319±15.26 and Hapur bypass i.e 111.5±6.98 respectively. The lowest and highest temperature recorded during summer season was of Bhojpur i.e 266.5±26.50 mg/l and Hapur bypass i.e 107.5±15.77 mg/l respectively.

Table 5 Showing Calcium (mg/l) of Studied Surface Water Bodies

Calcium (mg/l)									
Water Bodies		Bhojpur		Hapur bypass		Murad Nagar		Hindon branch	
Seasons		Before Filtration	After Filtration	Before Filtration	After Filtration	Before Filtration	After Filtration	Before Filtration	After Filtration

Rainy	Mean± SD	28.05± 9.82	25.84±2. 30	51.615± 12.05	23.845± 2.10	43.5875 ±10.40	21.23±1. 90	32.065± 5.67	22.2375 ±2.30
	Range	20.04- 40.09	22.44- 27.25	40.08- 68.13	21.64- 25.65	28.05- 48.09	18.43- 22.44	28.05- 40.08	19.23- 24.04
Winter	Mean± SD	31.35± 5.13	28.45±3. 03	20.23±1 3.34	30.45±3. 87	51.73±1 6.48	28.75±4. 37	36.60±4. 88	30.65±3. 02
	Range	27.05- 38.07	26.45- 32.86	12.02- 40.08	24.84- 33.66	27.05- 61.17	26.05- 35.27	30.21- 42.02	28.05- 33.66
Summer	Mean± SD	30.60± 9.09	30.05±7. 47	36.06±1 6.36	28.65±7. 47	54.9±36. 004	30.255± 4.36	50.89±1 2.28	30.80±4. 73
	Range	24.64- 44.08	21.64- 38.47	24.04- 60.12	17.63- 33.66	21.1- 80.16	24.04- 38.66	32.66- 62.51	24.04- 34.46

Calcium (mg/l) of studied surface water bodies were expressed in terms of Mean ± SD (range). Supplies filtered water after taking from all the above four sampling stations. Recorded Calcium (mg/l) before treatment and after treatment in rainy season. The highest and lowest temperature recorded during rainy season was of Hapur bypass (II) i.e 51.615±12.05 mg/l and Murad Nagar (III) i.e 21.23±1.90 mg/l respectively. Recorded Calcium before treatment and after treatment in winter season, the highest and lowest Calcium recorded in Bhojpur (I) i.e 31.35±5.13 mg/l and Hapur bypass (II) i.e 20.2375±13.34 mg/l respectively. The lowest and highest Calcium recorded during summer season was of Hapur bypass (II) i.e 28.65±7.47 mg/l and Hindon branch (IV) i.e 30.80±4.73 mg/l respectively.

4. Discussion

Temperature

Temperature is one of the most important ecological factors, which has profound influence on the abiotic and biotic component of the environment. It never remains constant in rivers due to changing environmental conditions. The variations are to large extent, because of seasonal changes, rainfall and the depth of river. In shallow waters with lesser depth profile both surface and bottom water temperature remained more or less the same. Water has several unique thermal properties(i.e. Specific heat, heat of vaporization, heat of fusion, specific gravity and heat conduction), which combine to minimize temperature is smaller and changes occur more slowly in water than in air. The temperature is basically important for its effect on certain chemical and biological reaction taking place in the organisms inhabiting aquatic media.

The wide range of temperature tolerance of aquatic biotic biota in nonpolluted environment, but in the polluted water rapid temperature change may cause over shoots in the metabolism of the aquatic organism and it may have a profound effect on dissolved oxygen which subsequently affects the aquatic biota. With increasing water temperature solubility of oxygen is reduced causing deoxygenation. In the present study surface water samples I to IV showed the average range of temperature from 16.12 -29.50 °C.

pH

pH is one of the most important factor in measuring water quality. pH indicate the concentration of hydrogen ions. The pH of surface water sample I to IV was ranged between 7.17 to 8.70. The maximum PH of 8.70 was noted in summer season. . Natural water generally has been found to range from pH 5.5 to 8.6 because of the presence of bicarbonates and carbonates of alkaline earth metals. Desirable pH range of drinking water was 6.5 to 8.3. Practically every aspect of water like acid and base neutralization, water softening, precipitation, coagulation and acidification is pH dependent. The pH of water is accompanied by change in other physico-chemical aspect of the medium. Gautam et al., (2000) observed that pH of water have direct relationship with CO3 —and an inverse with free CO2. They have recorded lower pH during night hours in the Ganga water and attributed this low pH to CO2 free content of water. The water in river Narmada was always alkaline during the period of study by Mitra (1982).

Turbidity

Turbidity of water is mainly due to suspended solids in the water, including silts, clays, industrial wastes, sewage and plankton. Such particles absorb heat in the sunlight, thus raising water temperature, which in turn lowers dissolved oxygen levels. They also prevent sunlight from reaching plants below the surface. This decreases the rate of photosynthesis, so less oxygen is produced by plants. According to IS: 10500, the desirable limit of turbidity is 1-10 NTU. In present investigation the turbidity of surface water recorded in range from 2.2 to 48.00 NTU. The maximum value of turbidity 48.00 NTU was noted rainy season while minimum of 2.2 NTU at in winter season. All the sampling stations turbidity recorded higher than permissible limit especially in rainy season due to heavy runoff from all the nearby area of a water body**.**

Total Hardness

Hardness is an important parameter in the detection of surface and ground water pollution. Hardness of water mainly attributes to the sum of calcium and magnesium, is an important determinant of the distribution and abundance of riverine organism. Water hardness has been found to range from less than 10 ppm to 1800 ppm. A preferable hardness must be in the range 90- 100 ppm. Above 500 ppm the water may be regarded objectionable for domestic use. Water with hardness less than 30 ppm has been quite soft and usually not corrosive. In the present studies the surface water sample I to IV showed the range of total hardness from 81.50 to 297.00 mg/l. The maximum hardness of 397 mg/l was noted in summer season in station (III)**,** in untreated sample while the minimum of 81.50 mg/l in rainy season in station (1) Nandan and Aher (2002) have noticed hardness in river Mousam between 72 and 284 mg/l. Water possesses hardness between 50-300 mg/ l is moderately hard quality. In present analysis range of hardness may be classified from medium to very low at all the sampling stations in different seasons.

Calcium Hardness

Calcium is also responsible for hardness of water. Calcium ions are one of the important components of the plants tissues and participate in various cellular functions. It also required as a nutrient for various metabolic processes. In present study the surface water sample I to IV, the highest concentration of calcium hardness recorded was in summer season while the lowest in rainy season. Range of from 20.23 mg/l to 67.40 mg/l also observed in summer season at station (III).

5. Conclusion

The present study investigated the status of groundwater quality of Ghaziabad district of Uttar Pradesh based on the land use types. The higher concentrations of the major physicochemical and heavy metals such as TDS, TH, Cl-, F- , major cations (Na+ and K+); Fe, Cd and Ni are degrading the quality of groundwater through the major influence of emerging urbanization and industrialization. The elevated levels of various constituents direct the dominance of anthropogenic activities within the region. The quality of groundwater was examined for the drinking purposes in compliance with BIS 2012 standards by integrating the GWQI, which offers the inclusive property of drinking water quality. Results revealed that about 69% of the samples were in the category of unfit for drinking. An immediate attention should be given in order to reduce the contamination through land use activities and heavy metals pollution loading need to be checked especially for Fe, Cd and Ni for the shallow and deep aquifer levels.

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Conflicts of Interest

The author declares that there are no conflicts of interest.

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