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Analysis Of Hydrochemical Characteristics And Assessment Of Groundwater Quality In Areas Surrounding Municipal Solid Dumping Yards In Southern Parts Of Bengaluru Karnataka

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Abstract: The current research attempts to analyze the chemical characteristics of the groundwater that will contribute to groundwater quality evaluation. The groundwater chemistry depends on precipitation, general geological conditions, weathering degree of different rock types, quality of recharge water, and inputs from sources other than water-rock interaction. Analyzing the hydrochemical characteristics reveals the regional groundwater interaction mechanism between the groundwater and the environment, and the scientific basis for managing groundwater resources can be provided. The suitability of groundwater quality of 32 locations in the southern parts of Bengaluru, which is situated near the municipal solid waste management plant, was assessed for drinking purposes based on the various water quality parameters. The methods of physico chemical analysis of groundwater are employed. The laboratory results were plotted on piper trilinear and Gibbs diagrams through aquachem 5.1 software, and it is revealed that 34.3% of the total samples fell in Na-Cl hydrochemical facies, 46.8% occurred in Ca-Mg-Hco3 facies and remaining 18.75% occurred in Ca-Mg-SO4. It was also revealed that the controlling factors for the formation of analyzed ions were evaporation and rock weathering are 71.8% and 28.2%, respectively-. Most of the samples analyzed were according to BIS and WHO standards. According to the analysis, few samples show the sign of penetration of leachate from the landfill, which has contaminated groundwater in the vicinity.

Keywords: Groundwater, Hydrochemical characters, Gibbs plot

Introduction: Groundwater is a valuable natural resource for economic development and secure provision of potable water supply in both urban and rural environments (Foster *et al.,* 2002; Ghezelsofloo and Ardalan, 2012; Wakode *et al.,* 2014). Nowadays, groundwater pollution has become one of the most serious problems throughout the world. Urbanization, industrialization, and agricultural activity affect groundwater quantity and quality (Jat *et al.,* 2009; Tiwari *et al.,* 2015; Rubia and Jhariya, 2015; Khan and Jhariya, 2016). Water pollution threats human health, economic development, and social success (Milovanovic 2007; Wakode *et al.* 2014; Tiwari *et al.* 2015). In recent years it has been recognized that the quality of groundwater is of nearly equal importance as the quantity (Todd 1976; Jhariya *et al.* 2012). Groundwater quality is an essential factor in the suitability of water for various Purposes quality of groundwater is a function of physical-chemical and biological parameters (Joshi and Seth 2010). Due to the increase in the solid waste due to changes in the living style, many municipal solid wastes (MSW) landfills are needed, and the many hazardous materials have been disposed to these MSW dumping yards, and these wastes pose a serious threat to both surrounding environment and human populations. Once the waste is disposed of at the landfill, pollution can arise from the leachate percolation and runoff from these yards to the porous ground surface. Contamination of groundwater by such leachate and runoff renders it and the associated aquifer unreliable for domestic water supply and other uses. This study deals with landfills in the southwestern part of Bengaluru. The main objective of the present study is to assess the groundwater quality for drinking purposes by studying the physico chemical characteristics study and hydrochemical and characters and with the aid of the Geographic Information System (GIS).

Study Area: Bangalore, officially known as Bengaluru, is the capital and the largest city of the Indian state of Karnataka. Bangalore is a district headquarters located 260 km from the state capital of Bangalore, Karnataka, India, at 13°.5' and 14°50'N and 75°30' and 76°30'E geographically. The Bangalore district receives an average annual rainfall of 644 mm (25.4 inches). The district enjoys a semi-arid climate with dryness in most of the year and hot summer. In general, the southwest monsoon contributes 58% of total rainfall, and the northeast monsoon contributes 22% of total rainfall. The remaining 20% of rainfall is received as sporadic rains in the summer months. It receives low to moderate rainfall. The groundwater quality degrades in Bangalore due to increased human habitation and commercial practice.

Materials and Methodology:

Description of the study area

kannahalli CMSWMF is located at Survey No. 85, Kannahalli Village, Yeshwanthpura Hobli, Seegehalli Cross, Magadi Road, Bangalore – 560 091. The site is located towards the West of Bangalore city, next to the Seegehalli bus depot. The site has an average elevation of 16 meters. Chikanagamangala CMSWMF is constructed on an area of 15.3 acres with a design capacity to handle 500 TPD of municipal waste. The yard is located at village Chikanagamangala, Sarjapur Hobli, Anekal Taluk in the Bangalore Urban district of the State of Karnataka at an average elevation of 916 m. The Lingadeeranahalli CMSWMF municipal dumping yard is situated in Lingadeeranahalli village Kengeri Hobli, Bangalore South Taluk in the Bangalore Urban district of the State of Karnataka. The CMSWMF municipal dumping yard at Subarayanapalya village is located at an elevation of 775 meters and is sloping from West to East towards the natural nallah adjacent to the site. This CMSWMF is situated at Survey. No. 143, Kumbalgood village, Kengeri Hobli, Bangalore South Taluk, Bengaluru. It has an area of 3.8 hectares and handles about 200 TPD of municipal waste, which is collected from areas within the RR Nagar and Bangalore South Zone. The geographical coordinates of these municipal common treatment facilities are given in table 1. The Gps coordinates of the common municipal solid waste management facility are given below in Table 2.

Data collection and analysis

Groundwater samples were collected from the surroundings of four solid waste dumping yards, namely Kannahalli, Lingadeeranahalli, Chikanagamangala, and Subarayanapalya, which were selected and located in the southern parts of Bangalore city. Eight groundwater samples from each dumping yard were collected during the post-monsoon (Oct - Nov 2017) Total of 32 groundwater samples were collected. The collected water samples were transferred into pre-cleaned plastic water bottles for analysis of chemical characteristics. Samples collected in black-colored bottles of 3-liter capacity at the study sites were properly labeled and recorded. The various physicochemical parameters were analyzed and are reported (Tables 3 and 4). The total alkalinities of the water samples were determined by titrating with N/50 H_2SO4 using phenolphthalein and methyl orange as indicators. The chloride ions were generally determined by titrating the water samples against a standard solution of AgNO3 using potassium chromate as an indicator. The conductivity of the water samples was measured using the conductometric method. The total hardness of the water samples was determined by complex metric titration with EDTA using Erichrome black-T as an indicator. The sulphate and fluoride content of the water samples were estimated by a UV-visible spectrophotometer. The TDS of a water sample was measured using the gravimetric method. The geographical locations of all the sampled points were recorded using a portable GPS (Etrex 20 X). The selection of the ions assumed made by the inventor of the piper trilinear diagram (Athur m .piper), which is stated that most water contains cations and anions in chemical equilibrium with Ca, Mg, Na, and K as the most abundant cations while Cl HCO3 and so as the most common anions. On the other hand, TDS was analyzed on the fact that it is required for preparing for the Gibbs diagram.

Both Gibbs diagram and piper trilinear were drawn based on laboratory results in aquachem 5.1 software. Arthur M. Piper proposed an effective graphic procedure to segregate relevant analytical data to understand the sources of the dissolved constituents in water.

Kannahalli			subbarayanapalya			Lingadeeranahalli			Chikkamangala		
Sample	X	Y	sample	X	Y	sample	Y	X	sample	X	Y
KG1	77.45529	12.99889907	SG1	77.46277	12.89384	LG1	12.85372	77.53359	CG1	77.7231	12.87701
KG2	77.38572	12.99798934	SG2	77.46595	12.91087	LG2	12.90355	77.49891	CG2	77.69665	12.88256
KG3	77.47324	12.94743798	SG3	77.42389	12.92905	LG3	12.86057	77.47902	CG3	77.67277	12.90132
KG4	77.51102	12.95154189	SG4	77.4018	12.91555	LG4	12.81389	77.47609	CG4	77.64802	12.88554
KG5	77.50293	12.98657431	SG5	77.3747	12.86449	LG5	12.82328	77.52548	CG5	77.61859	12.82987
KG6	77.42701	13.01991109	SG6	77.37722	12.89822	LG6	12.84176	77.564	CG6	77.64674	12.79724
KG7	77.3705	12.96398174	SG7	77.40451	12.87711	LG7	12.87382	77.55924	CG7	77.68897	12.80791
KG8	77.40433	12.96088526	SG8	77.43863	12.86319	LG8	12.887	77.55248	CG8	77.72075	12.83307

Table-2. Gps coordinates of the groundwater samples

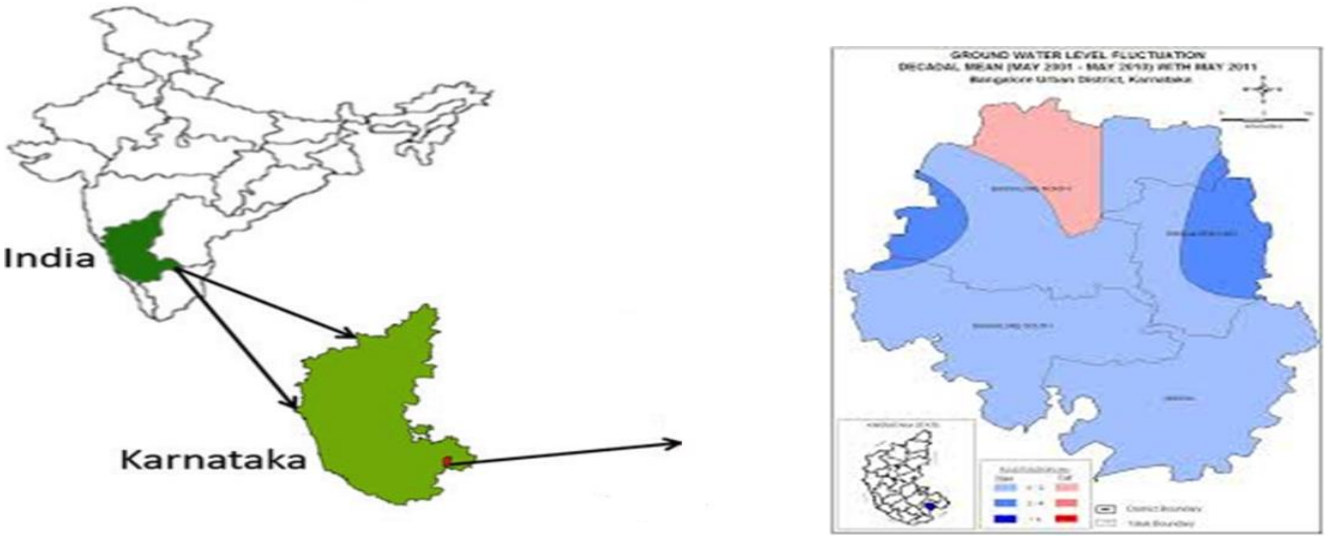


Fig 1. a Map of the study area

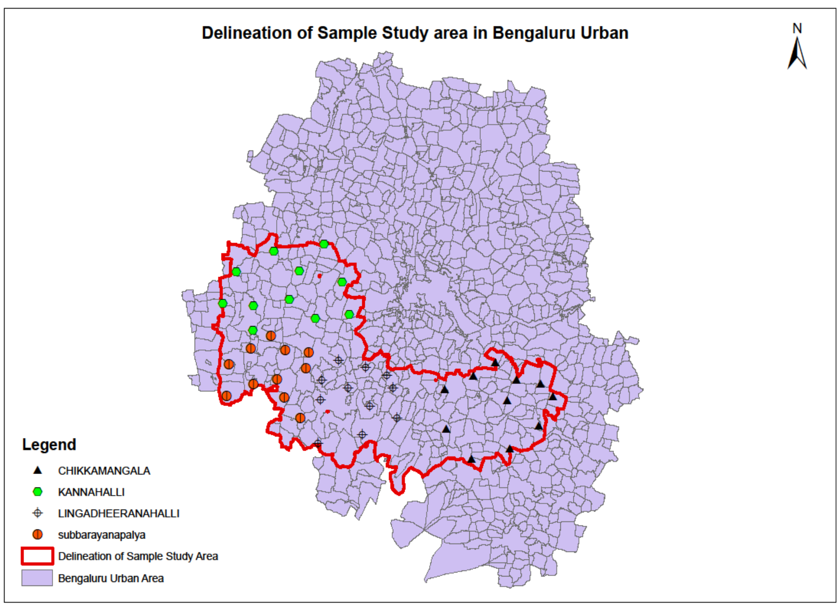


Fig 1. b. Delineation of the sample study area with sampling location

kannahalli CMSWMF	12°96’90.84"N, 77°44'72.31"E.
Chikkanagamanagala CMSWMF	12°51’40.36"N, 77°41'10.16"E .
Ligadeeranahalli CMSWMF	12°52'36.02"N, 77°30'22.76"E.
Subbarayanapalya CMSWMF	12°53'0.18"N 77°25'50.23"E.

Table: 1 Gps coordinates of the common municipal solid waste management facility

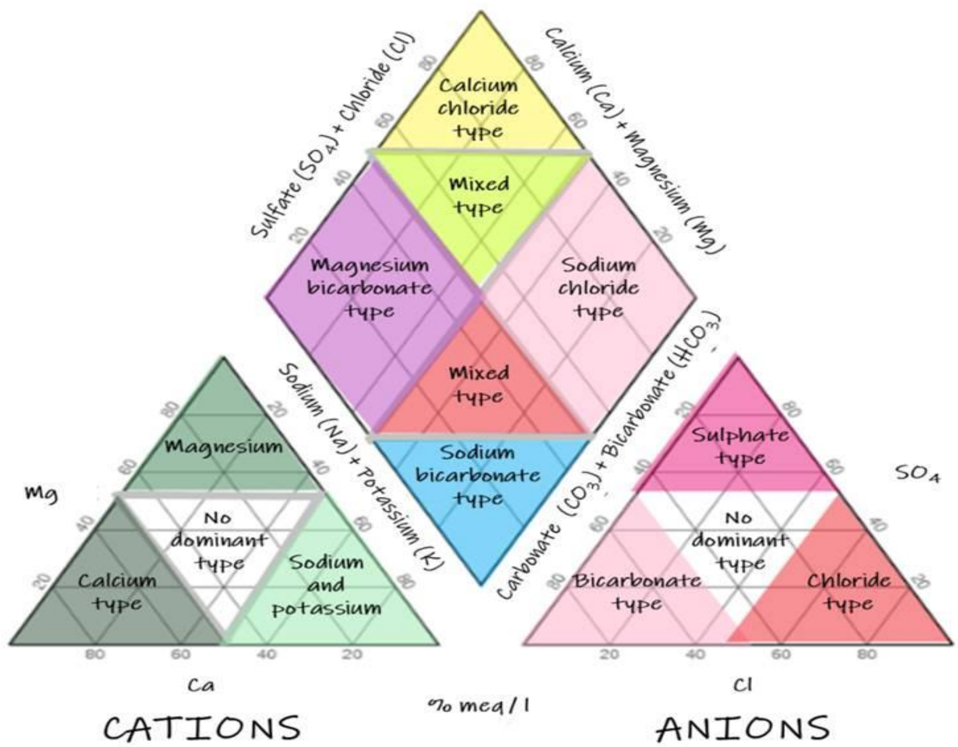


Fig:2 Hydrochemical facies in piper trilinear diagram

Results and discussion:

The laboratory results of the various parameter examined in all the sampling locations alongside the geographical coordinate of the groundwater points are shown in table .3. Piper trilinear diagram obtained from the results shown in table .3 is presented in fig .3, while the Gibbs diagram on TDS against cations and anions ratios is displayed in fig 4.

Parameters	pH	EC	TH	TDS	Ca^{2+}	Mg+	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^{-}	Cl^{-}	CO_3^{2-}	SO_4^{2-}	PO_4^{-}	NO_3^{-}	SiO_2^{-}
Unit		µs/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KG1	8.1	1103	462.7	807	50.1	62	13.8	2	50	244.1	75.4	0	0	0.49	0	10.31
KG2	8.3	1251	483.8	764	60.1	69	51	2.1	20	250	125.5	0	0.4	1.35	18.5	6.14
KG3	8.2	1409	458.9	968	48.1	54	70	2.1	30	145.2	174	50	4.4	1.4	0	22.14
KG4	8	1771	612.5	879	32.1	62	37	2.1	20	250	175	50	5	0.16	0	20.2
KG5	7.8	1832	432	772	32.1	28	74	3	30	300	114	50	1.6	0.29	36.8	39.96
KG6	8.3	1141	455	1158	56.1	94	42	4	20	200	121.4	50	4.8	0.04	27.6	3.42
KG7	8.3	1405	620.9	1179	32.1	54	64	3	20	400	148.9	60	4.2	0.1	0	7.56
KG8	8.4	1295	484.5	941	38.1	53	0	5	60	201	195.5	100	15.3	0.1	18.4	39.7
LG1	8.3	264	80	205	40.1	52	5.2	1.5	40	51	48.6	0	0	0.8	124.5	11.25
LG2	8.3	278	90	345	40.1	58	45.5	2.5	40	142.5	54.32	39	5.2	1.3	124.5	42.5
LG3	8.2	489	120	495	45.2	64	34.8	39.1	40	150.9	69.7	50	2.5	1.3	145.2	57.45
LG4	8.2	546	140	924	29.1	75	50	39.1	60	205.14	70.9	50	2.8	1.4	165.4	42.3
LG5	8.5	798	190	435	48.1	43	54.5	4.5	20	305	85.5	50	9.2	1.4	34.5	44.5
LG6	8.4	1204	210	479	48.2	72	57.5	6	40	280	105.4	60	3.4	1.5	136.5	65.5
LG7	7.9	618	180	645	40	41	23	6	20	187.9	117.5	30	1	1.5	195.4	13.5
LG8	8	718	160	924	50.1	61	24	48.5	40	125.5	110.4	50	0	0.8	174.8	12
CG1	7.5	345	105	250	48.1	58	22	38.1	20	240	46.8	0	0	0.39	0	15.93
CG2	7.8	355	140	245	50.1	42	15.8	2.2	20	244.1	77.1	0	0	0.23	0	9.95
CG3	8	659	170	420	60.1	61	45.5	2	60	145	135.8	50	4.4	1.35	0	10.15
CG4	8.2	680	140	450	60.1	81	58	2.1	40	260	147.5	50	0.2	0.42	15.8	7.45
CG5	8.3	848	170	510	60.1	64	65	3.1	40	250	174	50	5	0.22	29.6	20.54
CG6	8.7	746	190	598	48.1	16	50	4	20	300	117.8	60	1.6	0.64	35.4	67.68
CG7	8.4	842	280	438	40.1	48	37	3	40	250	131.4	100	4.8	1.4	0	50.54
CG8	8.5	1125	340	460	32.1	86	74	4	40	200	165.9	100	4.2	0.5	0	22.25
SG1	8.2	365	110	240	47.1	58	22	38.1	40	245	58.6	0	0	0.29	0	0
SG2	8.2	325	160	235	48.1	64	15.8	2	40	244.8	87.1	0	0	0.12	0	0
SG3	8	439	130	260	50.1	48	45.5	2	20	250	183.5	40	0	0.32	15.8	0.1
SG4	8.1	585	170	360	55.1	58	51	2.1	20	145.3	147	40	0.2	1.45	0	0.2
SG5	8.1	650	190	470	60.1	61	41	3	20	250	174	55	0.2	0.24	0	3.5
SG6	8.3	687	190	490	60.1	84	41	4	40	250	118.3	55	4.5	0.25	18.5	3.5
SG7	7.9	616	340	585	50.1	75	54	4	60	350	169.6	55	4.5	0.18	26.8	4.5
SG8	7.8	1002	170	438	50.1	84	60.5	7	60	300	138.5	50	5	0.05	45.2	4

Table 3: Physico-chemical characteristics of groundwater

the pH of water samples varies in the range of 7.5 to 8.7 to 8.66 and 7.5. Most of the samples showed high pH that is greater than seven which might be due to the presence of carbonate and bicarbonate salts. The acceptable limit for the drinking water standard is 6.5 to 8.5. Since CG5, i.e., the water sample collected near the Chikanagamangala municipal dumping yard does not lie within the limit, it is not suitable for drinking% of the samples are out of the permissible limit.

TDS is generally considered not as a primary pollutant, but rather used as an indication of the aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants. The total hardness of 205 to 1179 was recorded. 46.88 % of samples were out of permissible limits in PRM and according to BIS standards. BIS (2012) permissible limit for TDS is 500. The samples which are out of permissible limits show the action of sewage and urban runoff in the study area.

The calcium *concentration* varies from 29.1 to 60.1 mg/L, and the magnesium concentration varies from 16 to 94 mg/L. The BIS limit for calcium is 200 mg/L, and the permissible limit in the absence of an alternate source is 200 mg/L. The desirable limit for

Magnesium is 100 mg/L. Calcium & Magnesium are within permissible limits in groundwater samples.

Total alkalinity values vary from 80 to 620.9 mg/L. The desirable limit for total alkalinity is 200 mg/L. The water sample's total alkalinity value is much higher than the standard. Carbonated and bicarbonates are responsible for causing alkalinity in waterbodies. Anthropogenic activity, which includes alkalinity (bicarbonates and carbonates), is from cleaning agents and food residues. All the samples near kannahalli show high alkalinity. The average alkalinity of groundwater near the kannahalli is 501.3 mg/lt. The groundwater collected near Subarayanapalya shows less alkalinity. The average value is 182.5 mg/lt. The other sample shows moderate concentration. In the present study, carbonates fell in the range of 20.0 to 60.00 mg/L, and the average was 36.2 mg/lt. Bi carbonates were in the range of 51 to 400 mg/L. Chlorides are not usually harmful to people. The desirable limit for chloride is 250 mg/L, and the permissible limit in the absence of an alternate source is 1000 mg/L. All the water samples fall within the limit. The chloride content observed ranged from 46.8 to 195.5 mg/L. The values of TDS range from 205 to 1179 mg/lt. The desirable limit for TDS is 500 mg/L, and the permissible limit in the absence of an alternate source is 2000 mg/L. The TDS levels of the water come within the limit. The water samples collected from the kannahalli region show a high TDS value with an average of 933.5 mg/Lt.

Nitrate is one of the most common groundwater contaminants. The excess levels can cause methemoglobinemia, or "blue baby" disease. Although nitrate levels that affect infants do not pose a direct threat to older children and adults, they do indicate the possible presence of other more serious residential or agricultural contaminants, such as bacteria or pesticides. Nitrate in groundwater originates primarily from fertilizers, septic systems, and manure storage or spreading operations. The permissible limit for nitrate is 45 mg/L. The water samples are in the range of 0 to 195.4 mg/L. 25% of samples are out of the permissible limit.

Phosphate ranges from 0.04 to 1.5 mg/Lt. Superphosphates applied to the fields as fertilizer and alkali phosphate used in households as detergents can be the sources of inorganic phosphate. SiO2 varied from 0 to 67.68 mg/L.

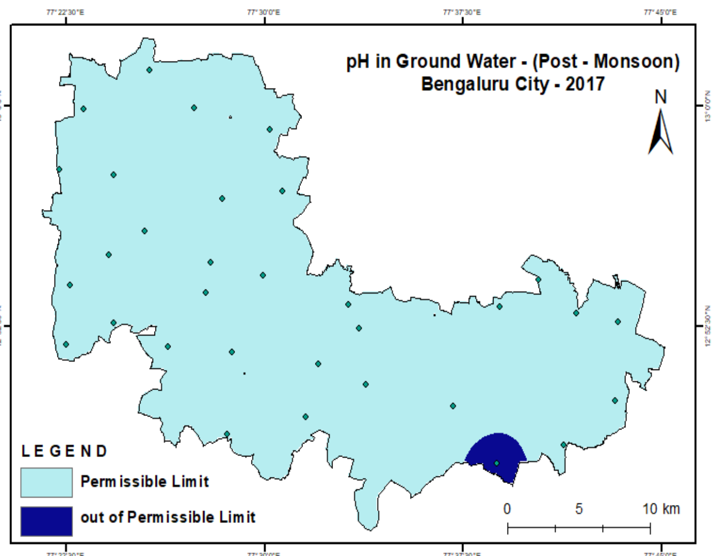
BIS permissible limit for fluoride is 1.5 mg/l; if present in low concentration, up to 1 mg/lt is generally considered beneficial in water. Such water consumption improves dental health and prevents the formation of dental caries. Excessive fluoride is greater than 1.5 mg/lt in drinking water may cause moulting of teeth or dental caries. All the samples are within the permissible limit.

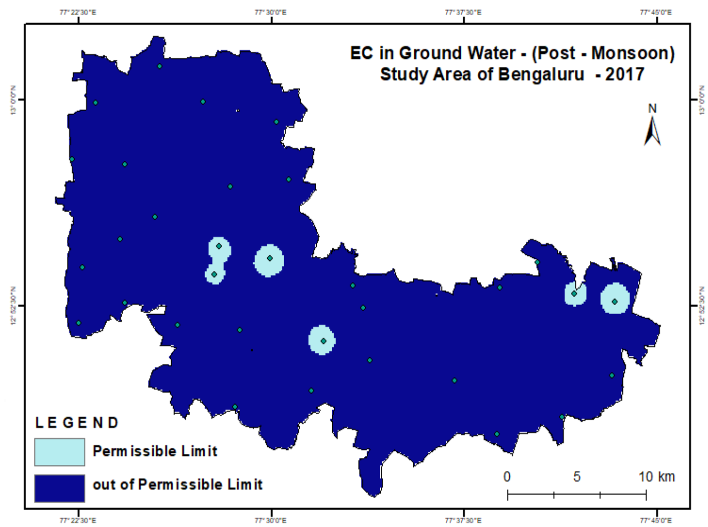
Sulfate is found in almost all-natural water. The origin of most sulfate compounds is the oxidation of sulfite ores, the presence of shales, or industrial wastes. Sulfate is one of the major dissolved components of rain. when High sulfate concentrations water is used for drinking can have a laxative effect when combined with calcium and Magnesium, the two most common hardness constituents. The sample contains the sulphate concentration range of 0 to 15.3 mg/L. The desirable limit for sulphate is 200 mg/L, and the permissible limit in the absence of an alternate source is 400 mg/L. all the samples are within the desirable limit.

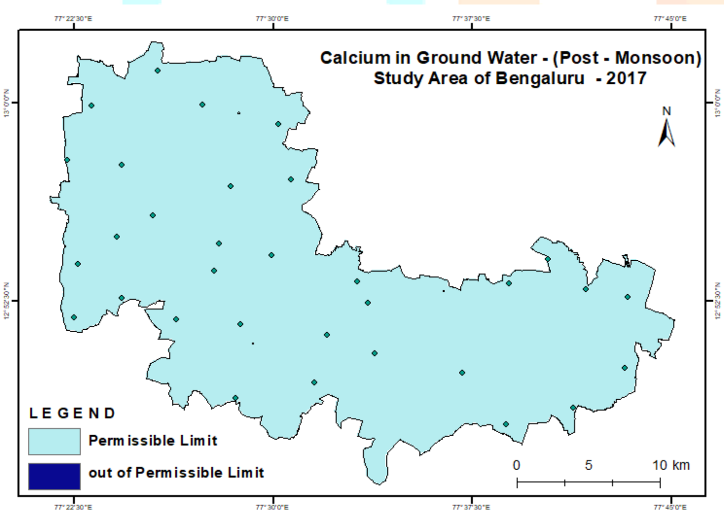
Sodium salts (exact limits have not been prescribed concerning the sodium in drinking water and the occurrence of hypertension). The threshold limit for sodium has not been assigned by BIS. However, a concentration of more than 200mg/l may give rise to unacceptable taste. The present study reveals the ranges of sodium from 0 to 74 mg/L. All samples showed acceptable conditions concerning sodium content. Sodium is an essential nutrient. The Food and Nutrition Board of the National Research Council recommends that most healthy adults need to consume at least 500 mg/day and that sodium intake be limited to no more than 2400 mg/day.

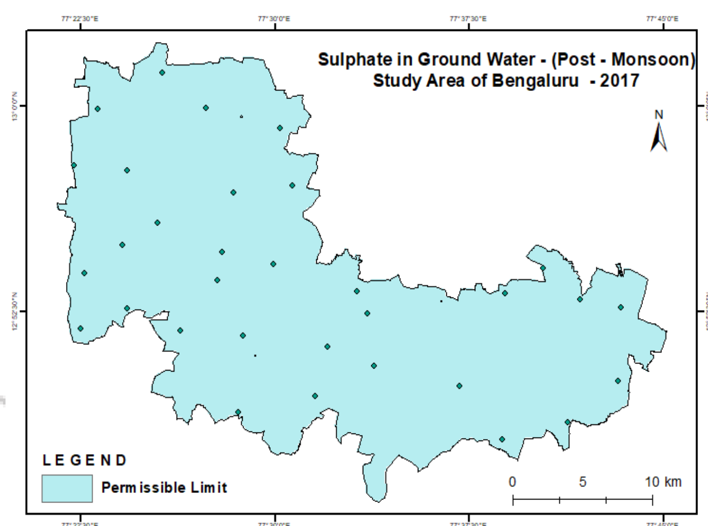
Potassium occurs widely in the environment, including in all-natural water sources. Potassium ranges observed were 1.5 to 48.5 mg/L. The presence of potassium in-ground waste supports the daily requirement of humans. Dissolved oxygen is a fundamental requirement for the maintenance of life of all living organisms in the water. BIS has indicated the value of DO drinking water as 6mg/L. DO ranges from 4.9 to 8.0 mg/lt in the this shows the presence of high organic pollutants in the groundwater. At the end of the monsoon season, the addition of new water to the aquifer has reduced. 21.88% of samples have less Dissolved Oxygen than the permissible limit. Biological oxygen demand: BOD can be defined as a measure of the organic pollution matter present in each sample of water. BOD is defined as the amount of oxygen used during the oxidation of oxygen-demanding waste when a sample of water is incubated for 5 days at 20°C with DO measured before and after. In the present study, BOD varied from 2.0 to 3.0 mg/lt. BIS put a permissible limit of BOD for drinking purposes as 2 mg./L, and all the samples had high BOD 43.75% of samples were out of permissible limits. Chemical oxygen demand is a measure of oxygen equivalent to the organic matter of the water, which is susceptible to oxidation by a strong chemical. COD ranges from 12.1 to 20.2 mg/lt. COD values indicated the intrusion of chemicals into groundwater through percolation and the origination of chemicals on the land surface with anthropogenic activities.

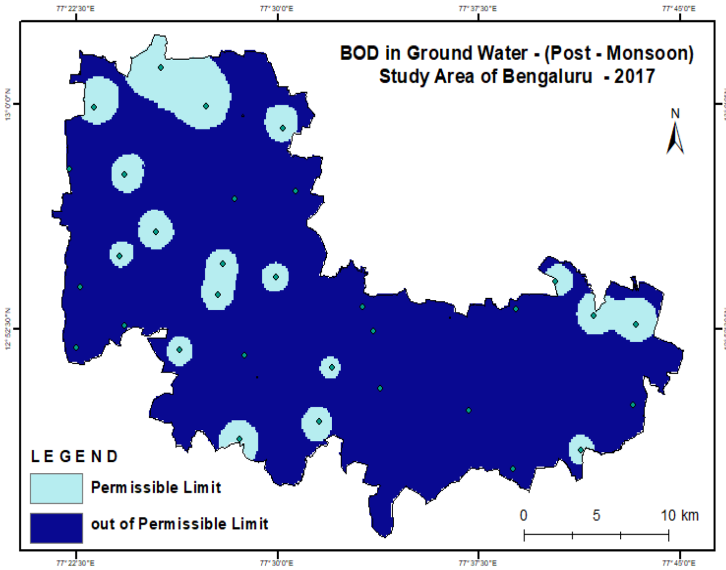
Thematic maps showing groundwater characteristics

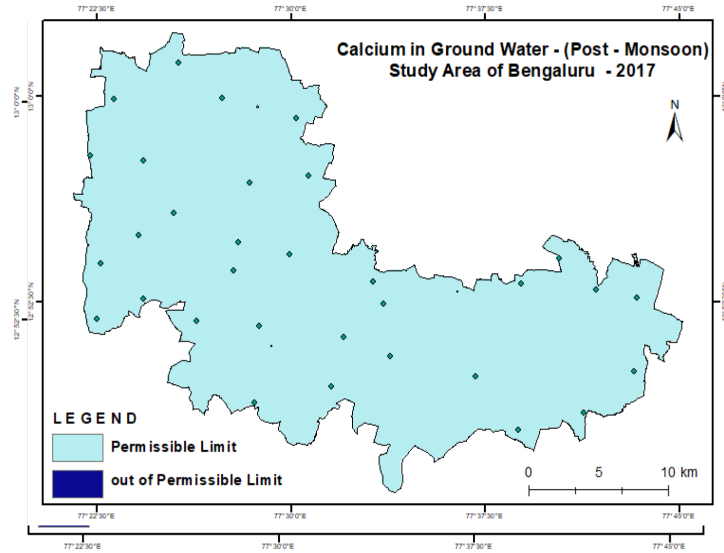









BOD in Ground Water - (Post - Monsoon)
Study Area of Bengaluru - 2017
N
LEGEND
Permissible Limit
out of Permissible Limit
0 5 10 km


Calcium in Ground Water - (Post - Monsoon)
Study Area of Bengaluru - 2017
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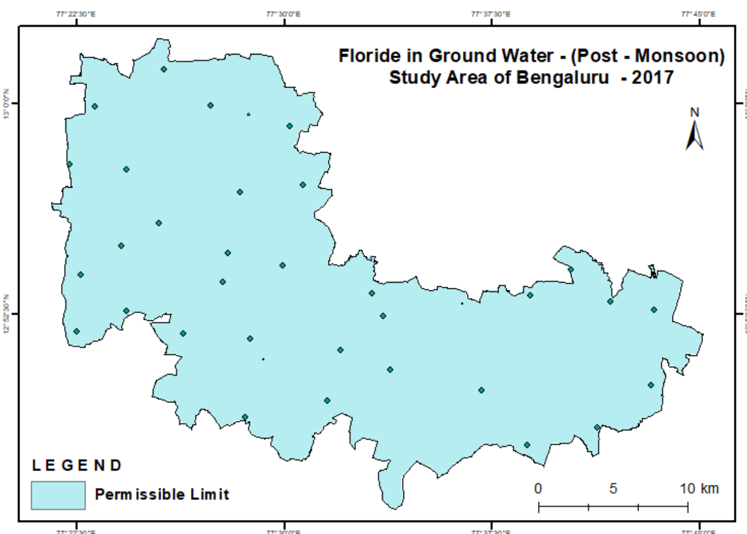
Permissible Limit
out of Permissible Limit
0 5 10 km


Floride in Ground Water - (Post - Monsoon)
Study Area of Bengaluru - 2017
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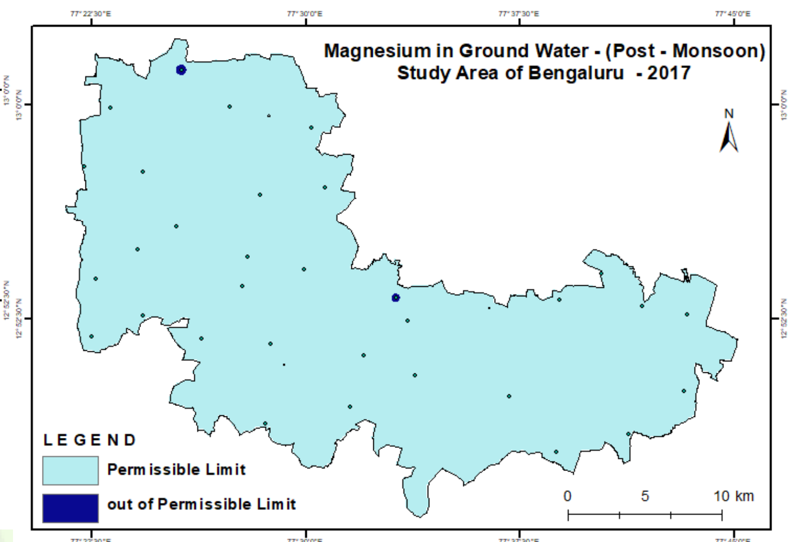
Permissible Limit
0 5 10 km


Magnesium in Ground Water - (Post - Monsoon)
Study Area of Bengaluru - 2017
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LEGEND
Permissible Limit
out of Permissible Limit
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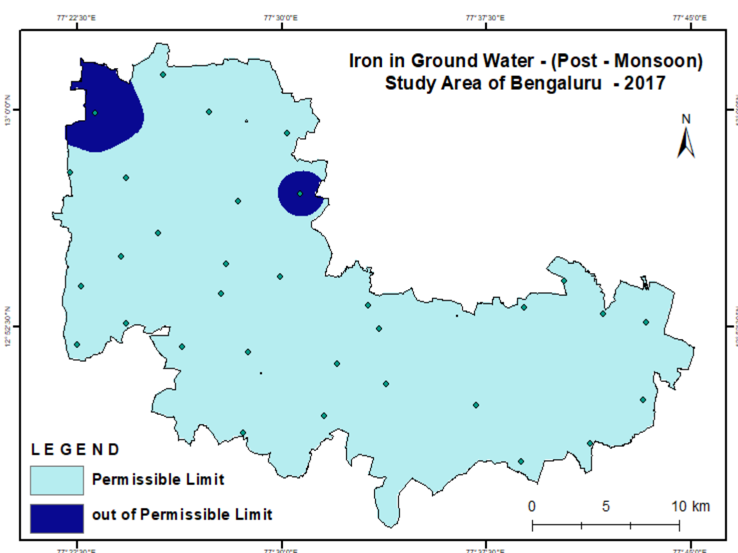
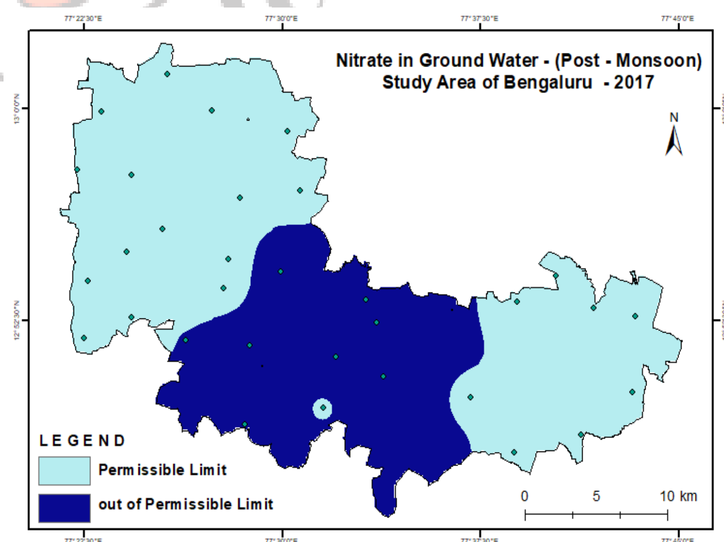

Iron in Ground Water - (Post - Monsoon)
Study Area of Bengaluru - 2017
N
LEGEND
Permissible Limit
out of Permissible Limit
0 5 10 km


Nitrate in Ground Water - (Post - Monsoon)
Study Area of Bengaluru - 2017
N
LEGEND
Permissible Limit
out of Permissible Limit
0 5 10 km

Parameters	WHO	BIS (Acceptable limit)	(% of samples out of permissible limits)
pH	6.5-8.5	6.5-8.5	3.1
EC (µs/cm)	400	NS	59.38
TH (mg/L)	300	300	31.25
TDS (mg/L)	500	500	46.88
Ca^{2+}(mg/L)	100	200	Nil
Mg^{2+} (mg/L)	150	100	Nil
Na^{+}(mg/L)	200	NS	Nil
K^{+}(mg/L)	NS	NS	-
CO_3^{2-}(mg/L)	NS	NS	-
HCO_3(mg/L)	NS	NS	-
SO_4^{2-}(mg/L)	200	400	Nil
Cl^{-}(mg/L)	250	250	Nil
NO_3^{-}(mg/L)	50	45	25
PO_4^{-}(mg/L)	NS	NS	-
SiO_2^{-}(mg/L)	NS	NS	-
F (mg/L)	1.5	1.5	Nil
DO	NS	06	21.88
BOD	NS	02	43.75
COD	NS	NS	-

Table:4 WHO (2012) and BIS(2009) permissible standards for water with calculated compliance compared with BIS of water samples.

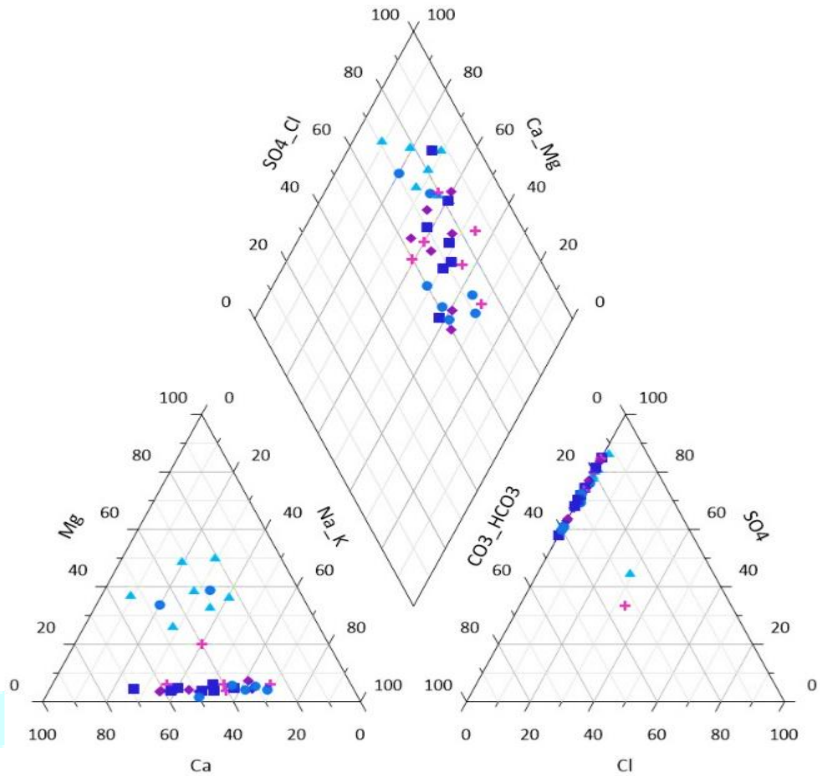


Fig:3 Trilinear diagram showing the chemical character of the groundwater

Hydrochemical facies of groundwater can be evaluated by plotting the major cations and anions as Ca2+, Mg2+, and K+.Co32-,HCO3-,So4@- and Cl- (in me/l) on piper diagram. piper linear diagram obtained from the result is presented in fig:3 while the diagrams on TDS against cations and anions ratio are displayed in fig 4a and 4b, respectively. By comparing the central diamond plots in the fig No.3, it is glaring that the groundwater of the study area shows little dominance of alkaline earth exceeding alkalies (Ca2+, Mg2+) (n=20) over the alkalies exceeding alkaline earths (n=12) and total dominance of strong acids exceeds weak acid (n=32). The n=12 fall in the category of sodium chloride type. The 14 groundwater samples N=14 fall in the category of mixed type, and six (n=6) groundwater samples fall in calcium chloride type.

The groundwater of the study area in terms of me/l is characterized by Na+>Ca2+>mg+>k+ and SO42->Cl->HCO3-. The average contribution of cations to the total cations is 34.37% of Na+, 18.75% of Ca+, and 6.2% of Magnesium.

Plots of Gibbs ratios of groundwater samples provide information on the relative importance of three natural mechanisms controlling water chemistry 1, atmospheric precipitation, mineral weathering and evaporation, and fractional crystallization. Fig 4. a and 4. b revealed that the factors controlling the analyzed ions are precipitation and rock dominance in the bivariate TDS versus Gibbs ratio weight ratio of (Na +K)/(Na+K=Ca2+)

diagram groundwater samples (n=32) plot either in rock dominance (n=30) suggesting weathering of minerals such as carbonates and silicates. Hence it is obvious that mineral dissolution is the major process that regulates water chemistry in the study area or very close to the boundary line between rock dominance and evaporation dominance field. In the evaporation dominance, two samples are plotted. It shows that the evaporation sedimentation is the main factor in the chemical composition of the groundwater. In the rock dominance, the samples fall to the lower right side of the Gibbs diagram, the TDS value is lower, and the values of Na/(Na+Ca) and Cl/(Cl+HCO3) are higher. All the samples fall in the rock weathering field, suggesting weathering of minerals such as carbonates and silicates. Two samples lie in the evaporation zone. The climate of the study area is not arid; hence groundwater evaporation is not a common phenomenon. Hence the infiltration of the leachate may be the reason for this.

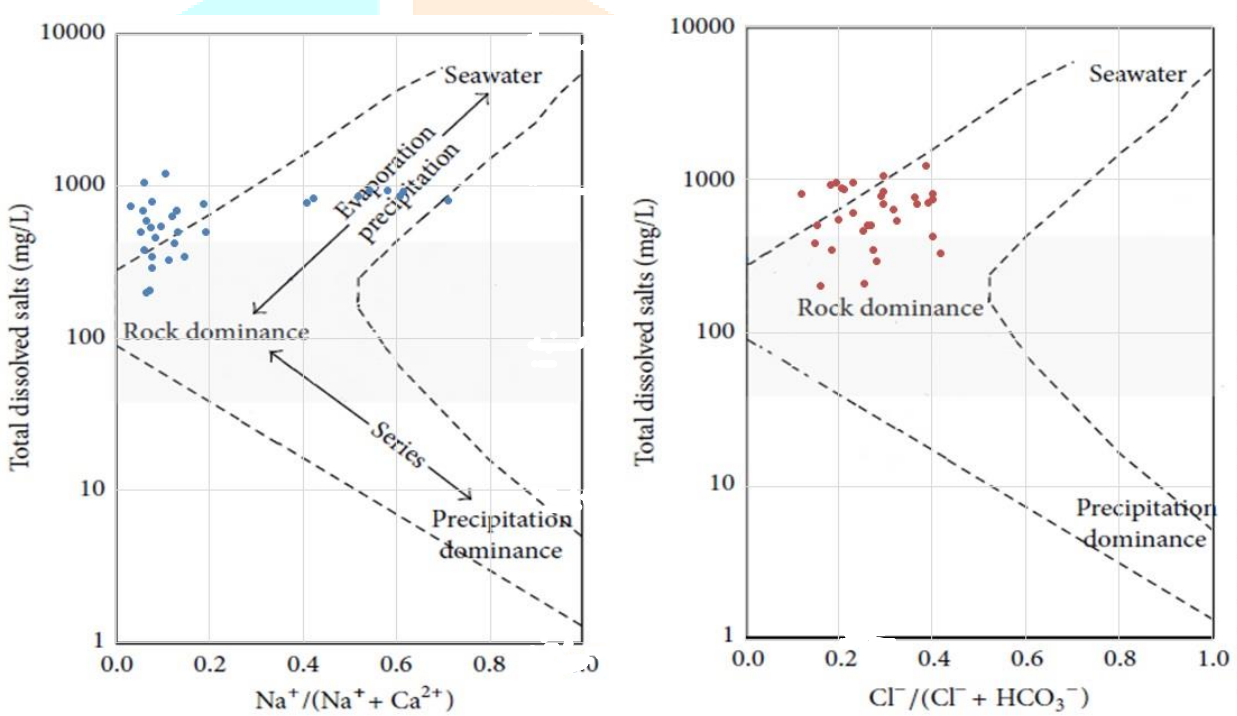


Fig:4 Gibb's plot of the groundwater samples

Conclusion: In the study area of the Bangalore urban district of Karnataka, there is no proper public water supply system, and the population of these areas is dependent upon groundwater for their needs. In the study area, groundwater taken from the 32 samples was analyzed for their chemical contents. The analytical results of the physical and chemical parameters of groundwater were compared with the WHO, and BIS standard values recommended for drinking purposes. The results show that 31.25% and 46.88% of the samples have a high concentration of total hardness and total dissolved solids, respectively, and are out of the permissible limit prescribed by the BIS standards. The analytical results also show that 43.75% of the samples show a high level of BOD concentration. The reason might be the infiltration of leachate from the nearby municipal solid waste treatment plant can be the cause for the increase in the concentration of BOD levels. The Hydrochemicalcharacteristics of groundwater shows a higher concentration of total dissolved solids. Moderate concertation of calcium and Magnesium and lower concentration of nitrite the further hydrochemical analysis reveals that the groundwater of the study area shows little dominance of alkaline earths exceeding alkalies over the alkalies exceed alkaline earths and total dominance of strong acids exceeds weak acid. The 12 samples fall in the category of sodium chloride type. The 14 samples of groundwater samples fall in the category of mixed type, and six groundwater samples fall in the calcium chloride type. The groundwater is laden with a high concentration of objectionable mineralization, chemical weathering of rock, leachate infiltration, and sewage contamination. The analysis reveals that the chemical weathering of rocks and infiltration of leachate and sewage contributed greatly to the major elements of the groundwater. This study stresses continuous monitoring of the quality of the groundwater and improving the leachate and sewage management better in the area to avoid further deterioration of groundwater quality.

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