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# Geo-Informatics to Ground Water Quality Index

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***Abstract: In this research the data on the chemistry of groundwater from the study area has been presented. The format followed in standard hydro geological presentations has been used. A brief background on the general chemistry of individual elements is given for a better appreciation of their behavior in aqueous phase. Chemical composition of groundwater depends upon the factors like geology, soils, biological process, topography and climate (Davis and DeWiest 1966, Walton 1970, Todd 1980, Himill and Bell 1986).Various chemical constituents of water occur as dissociated particles or ions in the present area of investigation, the chemistry of groundwater with respect to the major elements, and chemically related properties have been determined. The major cations include sodium (Na), and anions such as chloride (cl), sulphate ($So_4$), fluoride (F) and nitrate ($No_3$). Similarly the chemically related properties such as hydrogen ion activity ($P^H$), total dissolved solids (TDS), total alkalinity (TA) and total hardness (TH) were also determined. The results of groundwater quality determinations are tabulated and bar charts presented in the form of an Annexure-I and IIat the end of the volume.***

***Keywords: Spatial Distribution Of pH, TDS, Alkalinity, Hardness, Sulphate..***

## I. INTRODUCTION

### *A. Spatial Distribution Of Ph(fig. 1.1)*

$P^H$ is one of the most important chemical parameter used in the groundwater quality assessment. It is generally believed that the naturally occurring groundwater will have a $P^H$ around 7.0 to 7.3 which may be regarded as neutral $P^H$ (Twort et al. 1974). It is very rare to have $P^H$ value below 5.5 for natural waters. However, high $P^H$ values above 8.5 are observed in lithologies of $NaCo_3$-$HCo_3$ areas. Bicarbonate ($HCo_3$) causes moderate to high $P^H$ values for surface waters as well as ground waters. When the geological environment containing free acid radicals low $P^H$ values of the order 4.0 are not uncommon. The mineralogical composition of the lithology through which these waters will be traversing will play a major role in determining the $P^H$ of the water similarly, other aspects like organic aspects etc., will also influence the pH of natural waters.

In the study area the value of pH is ranges in between 7.02 to 8.2 among samples areas in the study area. Relatively higher value of pH is reported in the area of Purana Pool while the lowest value of pH is reported in the Sulthan Bazar area. Further, almost all the areas reported within the limits when compared to the desirable limit (6.5 – 8.5) prescribed by WHO standards

### *B. SPATIAL Distribution Of Tds (fig. 1.2).*

This is one of the very important measures of groundwater quality in simple terms, it indicates the total quantity of dissolved solids in mg/l. It can be determined by two methods, in the first method the E.C. values of ground waters are multiplied with factor which is usually varies from 0.55 mg/l to 0.75 mg/l, depending upon the nature of ions present (Hem 1975) because, the electrical conductance and total dissolved solids are interdependent. It is generally agreed that, if the total dissolved solids are less than 3000 mg/l, the factor 0.64 can be used to multiply the E.C. values to obtain the total dissolved solid values. In the other method, the total dissolved values can be determined by evaporation technique in which the total solid material will be collected and determined gravimetrically.

The total dissolved solids value is a convenient parameter for the groundwater quality comparisons and groundwater classification. Very high rainfall and insoluble rocks of any area will be showing total dissolved solid values as low as 25 mg/l. In contrast, the ground waters saturated with sodium chloride such as brines etc., may contain more that 30,000 mg/l. The U.S. Geological survey (Swenson and Baldwin 1965. Wesselman and Saul Arnow 1971, Winslow and Kister 1956) has made the classification of waters based on total dissolved solids and presented below.

Classification of Waters based on TDS(After U.S. Geological survey Swenson and Baldwin1965, Wesselman and Saul Amow 1971, Winslow and Kister 1956).

| Description | Dissolved solid contents (mg /1) |
|---|---|
| Non saline | Less than 1000 |
| Slightly saline | 1000 to 3000 |
| Moderately saline | 3000 to 10000 |
| Very saline | 10000 to 35000 |
| Brine | More than 35,000 |

Carbonates, bicarbonates, sulphates, chlorides and the cations Ca, Mg Na and K will constitute the total dissolved solid contents of waters. Davidson (1973) correlated the total dissolved solid values with the geological composition of the aquifer material. According to him the maffic rocks will have total dissolved solids concentration ranging between 300 mg/l to 500 mg/l, whereas clayey silt aquifers will contain total dissolved solid concentrations ranging between 500 mg/l to 3000 mg/1.

The total dissolved solid values from the area of the investigation have been observed to be ranging from 155mg/l to 1235 mg/l and majority of the wells are showing the total dissolved solid values from 600 mg/l to 1235 mg/l the general variation of total dissolved solid values within the study area has been depicted in Fig.1.2.

Dissolved minerals, gases and organic constituents may produce aesthetically displeasing colour, taste and odour. The mam source of TDS in ground water is the seepage of industrial and domestic wastes. The permissible value recommended for TDS is 500 mg/1 as per Indian standard. The TDS concentration in the Present study area ranged from 155 - 1235 mg/1. 56% of water samples collected showed high concentrations of TDS in areas like Kishanbagh, Ramanjpura, Afzal Gunj, Hussaini Alam, Gulab Singh Bowli, Asad Baba Nagar, Amberpet, Kamalanagar, Bazarghat, Bathkammakunta, Chikkadpally, Imlibun, Ghansi Bazar, Nawab Saheb Kunta High TDS concentrations in Bazarghat Kamalanagar (DW) etc., may be due to seepage of domestic wastes and insufficient rainfall. Samples collected nearby Musi River and outlet of Hussain Sagar at Chikkadpally showed high TDS concentration. Source of high TDS may be add from residential areas and slums existing along the Musi river.

### *C. Spatial Distribution Of Alkalinity (a):(fig. 1.3)*

The property of total alkalinity in natural waters is a reliable measure of Co, and $HCo_3$ ions. The alkalinity of waters is not effected by Cl, $SO_4$, and $NO_3$ ions (Gairg 1982). Total alkalinity which is due to $Co_3$ and $HCo_3$ is expressed as the equivalent concentration of $CaCo_3$. Alkalinity of the waters from the study area has been determined and their variation is shown in fig. 1.3

Alkalinity is a measure of water to neutralize acids it is a measure of the quantity of ions that will react to neutralize H+ ions. It's mainly caused due to bicarbonate, carbonate and hydroxyl ions.

The permissible value of alkalinity as recommended by the Indian standards is 250 mg/1 as $CaCo_3$. The alkalinity concentrations of the water samples collected in the present study area ranged from 20-130 mg/1 as $CaCo_3$.

In the study area the alkalinity quality rating is ranges in between 20 to 150 among samples in the study area. The samples such as sample 61 in Kachiguda Railway Station, 75 in Nayapal, 79 in Gosha Mahal stadium, 82 in Nampalli Station, 87 sample in AV College and 91 in Nabathapur and 8 samples (8.79 per cent) in the study area as a whole are reported more than 10 rating figure. Similarly, about 10 samples (8.79 per cent) are reported relatively higher values more than 6 when compared to the figures of the rates and also WHO standards. Similarly, about 43 (47.25 per cent) samples are reported relatively higher values when compared to the figures of quality rating figures and WHO norms in the study area.

### *D. Spatial Distribution Of Hardness(fig. 1.4).*

To describe total hardness in simple terms, it is the property of groundwater which reacts with the soap causing a white precipitate on the surface. This prevents the formation of lather from the soap. Groundwater with this quality is said to be hard.

It isgenerally agreed that the hardness of water is caused entirely by compounds or carbonates and bicarbonates of calcium and magnesium. However, other minor constituents such as iron, manganese, aluminium, barium, strontium and free acids also to some extent contribute hardness to water for some extent. The water which is very hard & also objectionable for industrial purposes, since it causes damage to the boilers, water heaters, radiators and pipes. The hardness of water varies considerably from place to place. In general the hardness of surface water is less than that of groundwater's The geological formations directly influence the hardness of groundwater, flowing through them According Twort et al.(1974) hardness should be measured in mg/l as CaCo,. Water classifications based on hardness is presented below.

Water Classification Based on Hardness (After Twort et al 1974)

| Hardness as mg/l of $CaCo_3$ | Quality of water |
|---|---|
| 0-75 mg/l | Soft |

| | |
|---|---|
| 75-150 mg/l | Moderately soft |
| 150-300 mg/l | Hard |
| Over 300 mg/l | Very hard |

According to Hem (1959) and Hammond (1969), the hardness of water becomes objectionable when it exceeds 120 mg/l.
Figure 1.4 demonstrates that the higher values of hardness (360 – 480 and 480 – 700 ppm) are reported in the central parts of north, west east and southern areas in the study area. Relatively lower values of hardness (100 – 220 ppm and 220 – 240 ppm) are reported in the corner regions of north, east, west and south in the study area. The areas such as Patel Nagar, Kachiguda, Golnaka Nagar, Nimballi Adda, Purana Pool, Begum Bazar, Nabutha Phar, Bazar Ghat, Zindal Nagar, Amberpeta STP, Gosha Mahal are reported relatively higher values of hardness in the ground water of the study area. Further, relatively higher extent of areas come under these categories.

*E. Spatial Distribution Of Sodium (na)(fig. 1.5).*

The sodium content of groundwater is due to the weathering of sodium bearing minerals, such as sodic plagioclase and other minerals. It is also due to the exchange of calcium ion and sodium ion on the surface of clay minerals (Davis and DeWeist 1966) According to Feth et al. (1964), the weathering reactions generally contribute sodium to the groundwater. Garrels (1967) suggested that the weathering of sodic plagioclase feldspars contribute major part of the sodium content to the groundwater. In summer months the sodium content of groundwater is a function of weathering, $P^H$, reaction time and drainage time.
Sodium content of water samples is measured by flame photometer, which is based on principle of emission spectroscopy. The Sodium concentrations was found to be in the range of 17 to 200 mg/1 in the present study indicating that it is within permissible limit, whereas the sample collected at Kamalanagar (DW)showed a Sodium concentration of 220 mg/1.
In the study area the sodium values of ground water is ranges in between 2.00 to 10.22 mg/l among samples in the study area. Relatively higher value of sodium is reported in the samples of sample 1 in Chikadpally, 4 in Narayana Guda, 8 in Himayat Nagar, 12 in Basheer Bagh, 14 in New MLA quarters, 17 and 18 in near Tilak Nagar, 38 and 39 in Bazaar Ghat, 42 in L B Stadium, 46 in Hyderguda, 56 in Osmania Medical College (Koti), 62 and 63 in Nimbodh Adda, 64 in sewage treatment plant (Amberpet), 66 in MG Bus station, 76 and 77 in Begum Bazaar, 79 in Gosha Mahal stadium, 80 in Mozani Jahi market, 84 and 85 in YMCA, among samples in the study area (more than 4). Further, the values of sodium are relatively higher when compared to the quality rates (more than 5). Further, about 32 samples (35.16 per cent) are reported relatively higher values of sodium (more than 4).

*F. Spatial Distribution Of Chloride (cl)(fig. 1.6).*

Chloride is a most common anion in the groundwater. Chloride concentrations vary widely in natural waters and it is directly related to mineral content of the water. It is known that, the sea water contains very high amounts of chloride and the coastal aquifers which suffer the sea water intrusion will be showing abnormal concentrations of chloride Besides this, chloride enters into natural waters in many ways. The solvent power of water dissolves chlorides from the soil as well as from geological formations and spray from the ocean in the form of salt dust which will be carried inland and will be infiltrated into the groundwaters through precipitation. The pollution from the industrial effluents will also be a source of chloride concentration in the industrial areas.
From the international standards given by WHO, the desirable level of chloride is 200 mg/l and maximum permissible level is 600 mg/l. However, at many places waterscontain as much as 1000 mg/l chlorides due to different reasons waters with chloride content more than 250 mg/l is not suitable for industrial purposes. Water with chloride content more than 500 mg/l frequently has disagreeable taste.
Chloride is estimated by Argentometric method (Titrimetry) using silver nitrate as titrant and dichromate as indicator. Sodium chloride is the main substances responsible for chloride concentration in water. 250 mg/1 being the desirable limit for chlorides, concentration greater impart a salty taste to water and is therefore objectionable. (Fig.1.6)
In the study area chloride value of ground water is ranges in between 2.51 to 21.26 mg/l among samples in the study area as a whole, the sample 29 in Kamala Nagar, 52 and 53 in Ramakoti, 90 and 91 in Nabathapur and 5 samples (5.49 per cent) in the study area as a whole are recorded more than 10 mg/l value for chloride in the study area. Further, almost all the values of chloride in almost all the areas reported relatively higher values when compared to the quality rating figures in the study area.

*G. Spatial Distribution Of Sulphate ($S0_4$)(Fig.1.7)*

The concentration of sulphate is also an important parameter of groundwater quality It is important, especially when dealing with drinking water, because its excessive amounts will have different effects on the health of human beings. According to the U S public

health services (1962), the sulphate concentration should not be more than 250 mg/l in drinking waters. However, the sulphates are less toxic to the crops than chlorides. In industries also the sulphate concentration causes problems by forming hard crust on boilers and heat exchangers. Clays contribute sulphate ion in the form of calcium sulphate which will be dissolved from that clay and enters into the groundwater. In industrial areas sulphate will be contributed through atmospheric pollution.

Sulphate is a naturally occurring cation ($S0_4$) found in all kinds of natural waters discharge of industrial waste and domestic sewage in water tends to increase sulfate concentration most of them originate from the oxidation of sulphate ores, the presence of shales etc. Sulphate can be readily leached from zone of weathering by infiltrating waters and surface runoff. The desirable limit of sulphate concentration is 250 mg/1 in waters intended for human consumption. Sulfates are determined spectro photo metrically at wavelength of 420 mm. The sulfate concentrations in the ground water samples of study area range from 8.5 - 120 mgl indicating that the concentrations are well within the permissible limits as given by Indian Standards.

In the study area the values of sulphate in ground water samples are ranges in between 2.51 to 4.15mg/l among samples in the study area. Relatively higher rating of sulphate is reported in sample 2 and 3 in Chikadpally, 7 and 9 in Himayat Nagar, 67 in MG Bus station, 75 in Mayapal, 82 in Nampally station and 7 samples (7.69 per cent) in the study area as a whole are reported relatively higher rating values when compared to the rating figures (more than 4). Further, about 61 samples (67.03 per cent) are reported more than 3.00 mg/l among samples in the study area.

### *H. Spatial Distribution Of Fluoride (F)(Fig.1.8)*

Fluoride is also an important chemical constituent of the water. It belongs to halogen group and its chemical behavior is different from that of the other halogens It has maximum electro negativity and partially soluble in most natural waters. It is generally present only in small quantities. Its occurrence in higher amount in some parts causes serious health hazards. However, some concentration of fluorine in the order of 1 mg/l is safe and effective in reducing the dental decay Twort et al., (1974) A report by California state water pollution control board on water quality standards stated that, water containing less than 0.9 mg/l to 1.0 mg./l will be helpful for healthy growth of teeth in children For adults the concentration may be tolerable 2 to 3 mg/l.

The weathering and decomposition of fluorine bearing minerals from rocks generally contribute the major part of fluorine content in groundwater. The concentration varies from place to place depending upon the type of rocks and soils from which they originate Bond (1945), White et al. (1963). According to Srinivasan (1959), ground waters from several places of India, are characterized by high fluoride contents. The manual published by ministry of health, Government of India, listed several places in this country where people are suffering from fluorosis by consuming waters containing high amounts of fluoride ions. It is well known that, the districts Nalgonda and Prakasam of Andhra Pradesh state are marked by high concentrate on of fluoride ions in the groundwater. Pathak and Prasad (1973) reported the presence of higher amounts of fluoride ions in ground waters from several parts of Tamil Nadu, Mysore and Andhra Pradesh and Telangana State.

Fluoride of water is important in determining the suitability of water for drinking purpose use. Water in contact with natural deposits of fluoride such as fluorspar, calcium fluoride, cryolite and water contaminated with industrial effluents are found to contain excess fluorides. Fluorides can be categorized as:

| | | | | | |
|---|---|---|---|---|---|
| < 1 | - | Good | 1.5-2 | - | Tolerable |
| 1-1.5 | - | Very Good | >2 | - | Polluted |

Fluorides are determined using ion selective electrode method.

The fluoride concentration in the present study areas ranges from-0.45 mg/1 - 5.83 mg/1 in areas like Miralam Tank, Fathedarwaja, Bahadurpura, Kachiguda, Patelnagar and with a maximum value of 5.83 mg/1 in dense residential area Golnaka. However for the studies a required to establish the linkages.

Fluoride distribution in the study area is ranges in between 0.45 to 5.83 mg/l among samples in the study area. The maximum value of Fluoride is reported in the area of Golnaka (5.83 mg/l), followed by near Zinda Tismath factory and A.V. College (4.83 mg/l each), Tilak Nagar (449 mg/l) Gosha Mahal stadium (3.82 mg/l), Kamala Nagar (3.33 mg/l) and Chikadpally (3.01 mg/l)- among areas in the study area. Further, about 18 areas (17.59 per cent) such as Chikadpally, Himayat Nagar, near Tilak Nagar, Tilak Nagar (near hospital), near Bathukamma Kunta, Police academy, Zinath Nagar, Kamala Nagar, Golnaka, near Zinda Tismath Nagar, Hyderguda (HS), Osmania Medical College (Koti), M.G. Bus Station, Gosha Mahal stadium, Mozamjahi Market, A.V. College and near Namballi Pahar are reported relatively higher values of Fluoride when compared to the figures of permissible of WHO norms (1.50 mg/l).

The fluoride values in almost all the samples in almost all the areas are reported relatively lower values when compared to the figures of the desirable limits.

*I. Spatial Distribution Of Nitrate (N):(Fig.1.9)*

Nitrate occurrence in groundwaters is also very common. It is mainly due to aerobic decomposition of nitrogen from organic matter. Nitrate from other sources like fertilisers, industrial effluents and septic tanks contribute in the form of pollutants as mentioned earlier, nitrate from natural sources can be attributed to the oxidation of nitrogen in the air by bacteria and it will decompose the organic material in the soil. Generally, nitrate concentration in groundwater ranges from 10 mg/l to several hundreds of mg/l. However, in unpolluted natural waters the nitrate content will be generally 10 mg/l.

Nitrate determinations are important to assess the self-purification properties of the water bodies and nutrient balance in surface waters and soil and state of decomposition of organic matter present in wastewater. Nitrates by sewage and other wastes rich in nitrates may contaminate surface water, nitrates were analyzed by UV method spectrophoto metrically at 220nm.

In the study area the value of Nitrate (NO3) is ranges in between 10 to 140 mg/l among areas in the study area. About 5 areas (12.19 per cent) such as near Bathukamma Kunta, Kamla Nagar, Kamala Nagar, Golnaka Nagar, Mosaram Bagh, M.G. Bus Station are reported relatively higher values of Sulphate when compared to WHO permissible limits (100 mg/l). Further, about 4 areas (9.75 per cent) reported relatively higher values when compares the figures of desirable limit of WHO norms (100 mg/l). Moreover, about 10 areas (24.39 per cent) are reported relatively lower values of less than 50 mg/l when compared to the norms of WHO permissible limit (100mg/l).

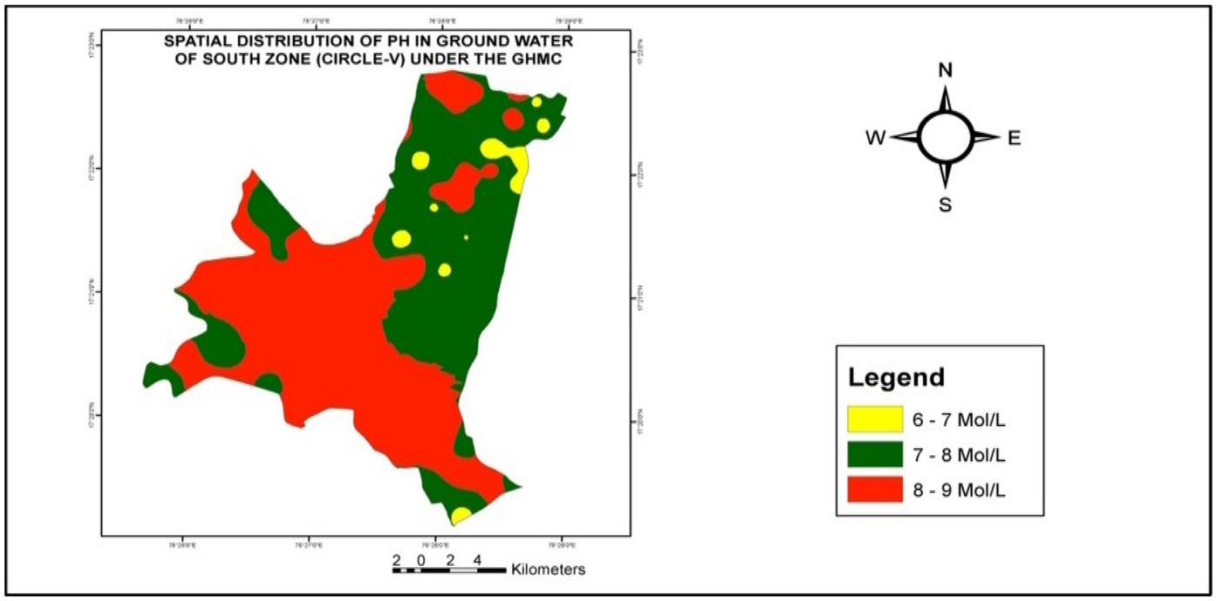


Fig.1.1: Spatial Distribution of pH in Ground Water of the Study Area

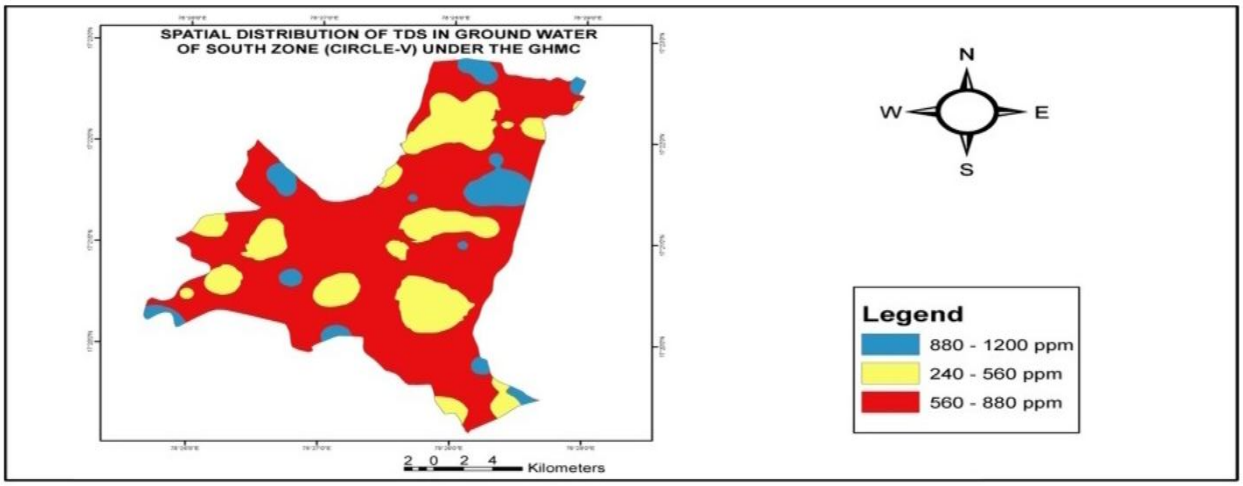


Fig.1.2: Spatial distribution of TDS in ground water of the study area

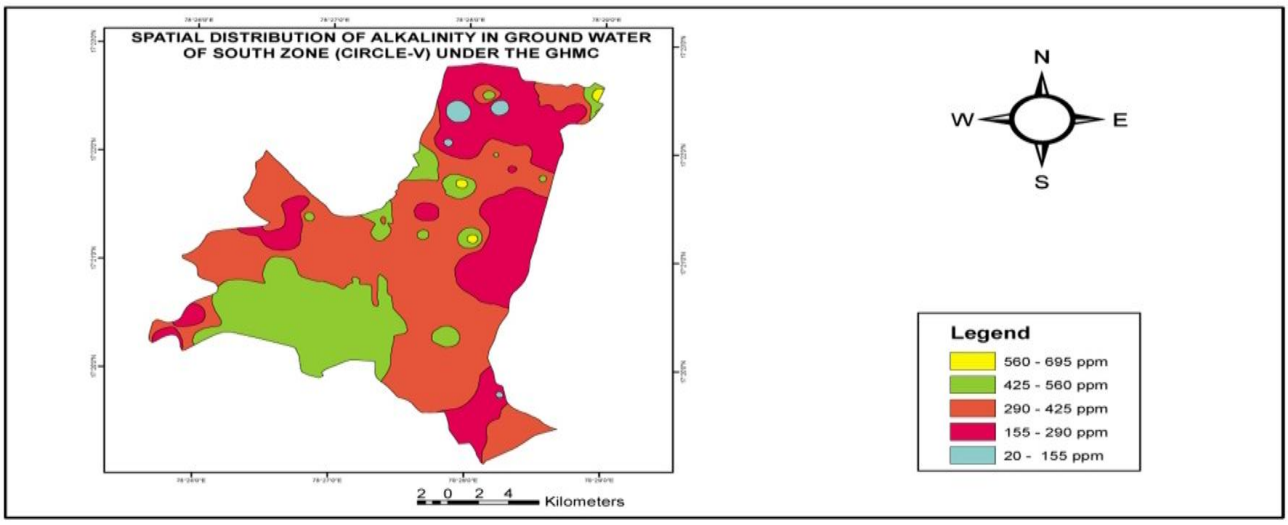


Fig.1.3: Spatial distribution of ALKALINITY in ground water of the study area

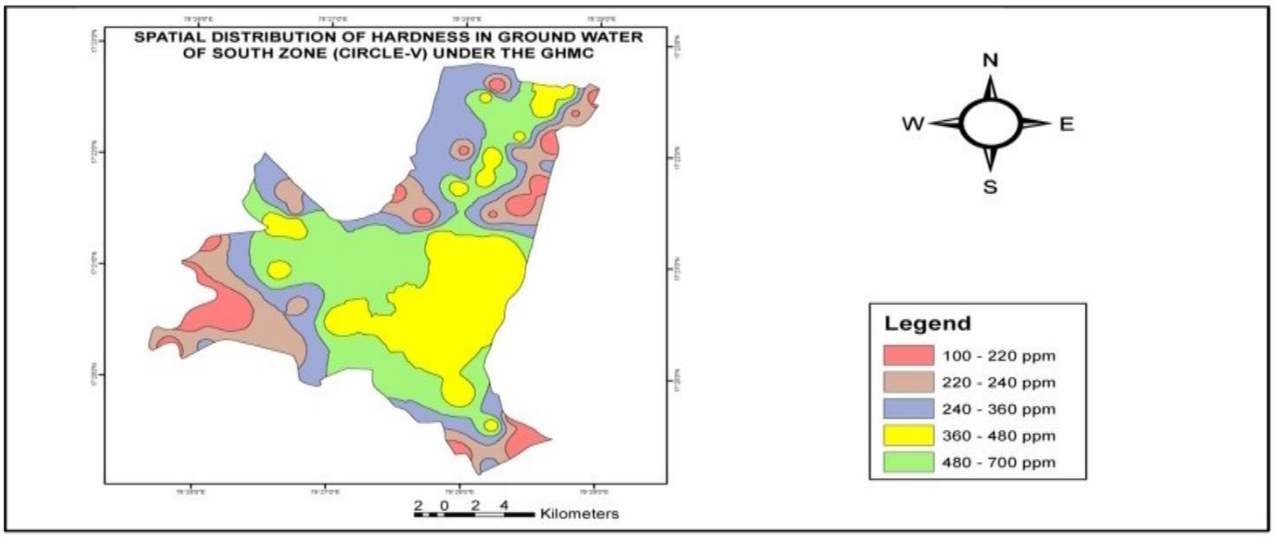


Fig.1.4: Spatial distribution of HARDNESS in ground water of the study area

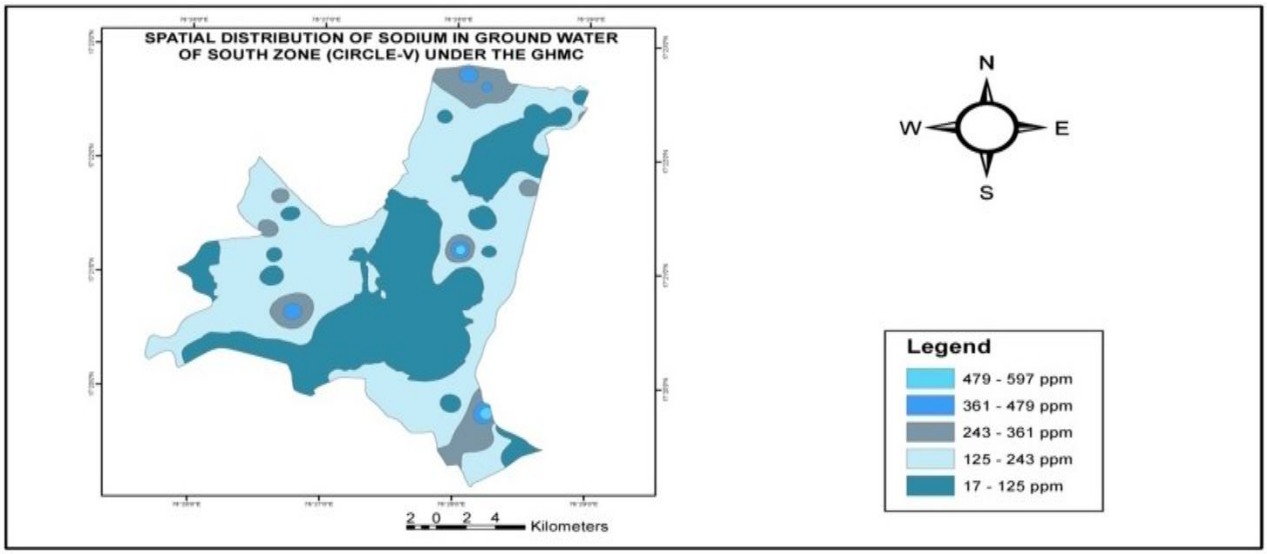


Fig.1.5: Spatial distribution of SODIUM in ground water of the study area

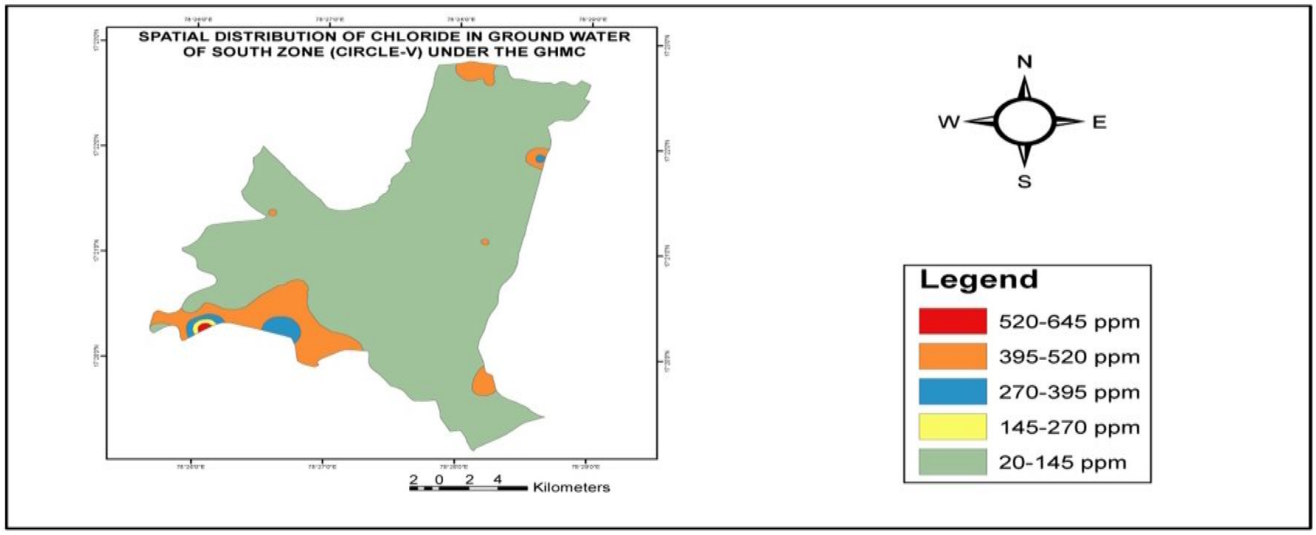


Fig.1.6: Spatial distribution of CHLORIDE in ground water of the study area

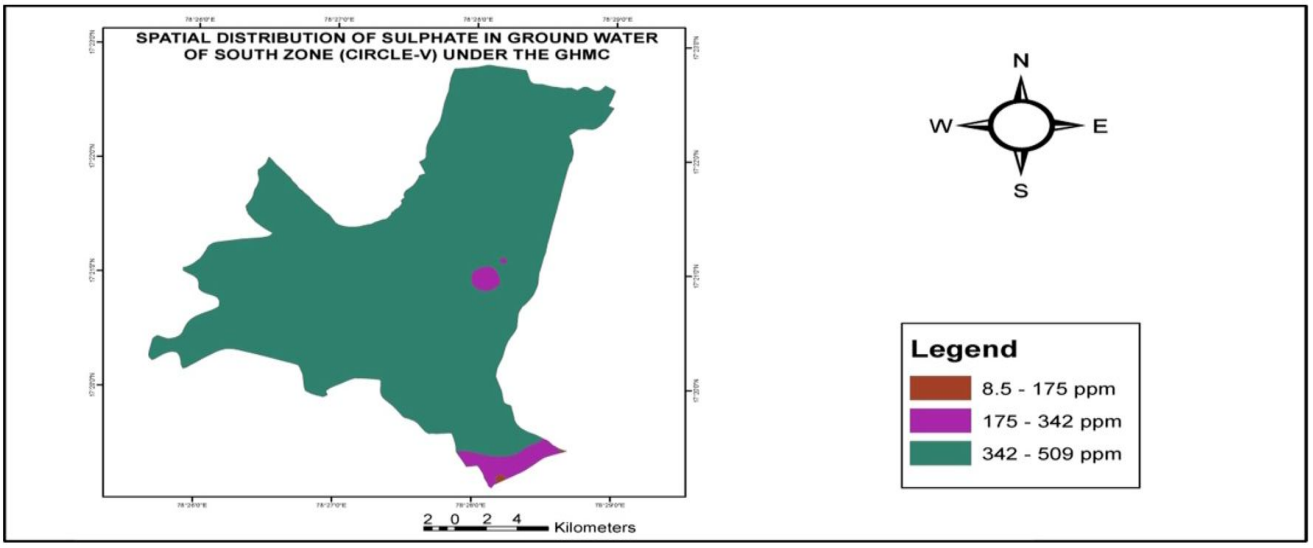


Fig.1.7: Spatial distribution of SULPHATE in ground water of the study area

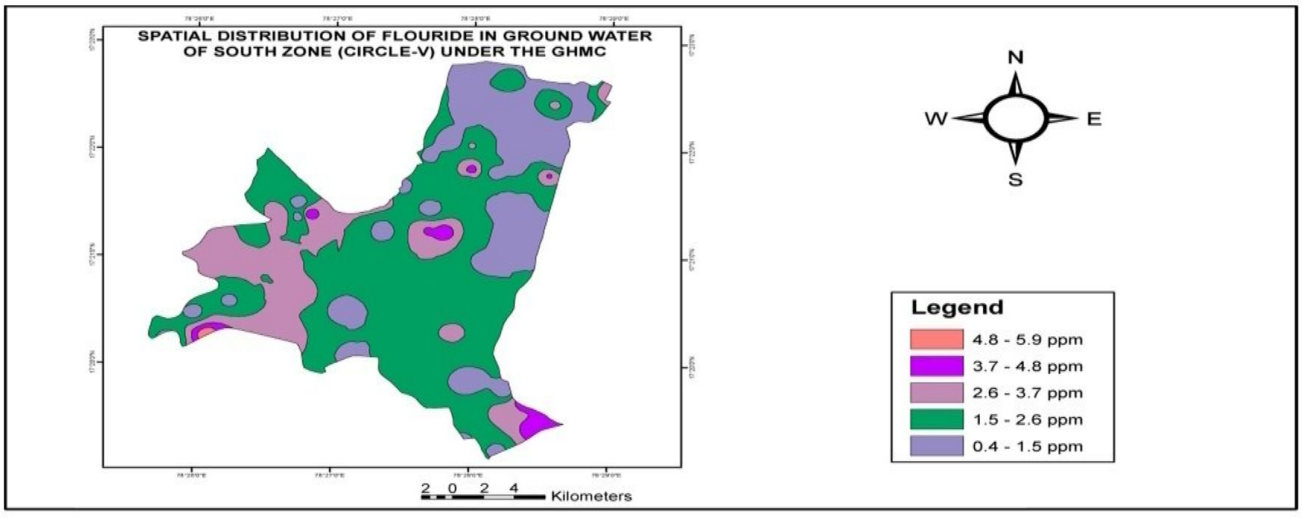


Fig.1.8: Spatial distribution of FLUORIDE in ground water of the study area

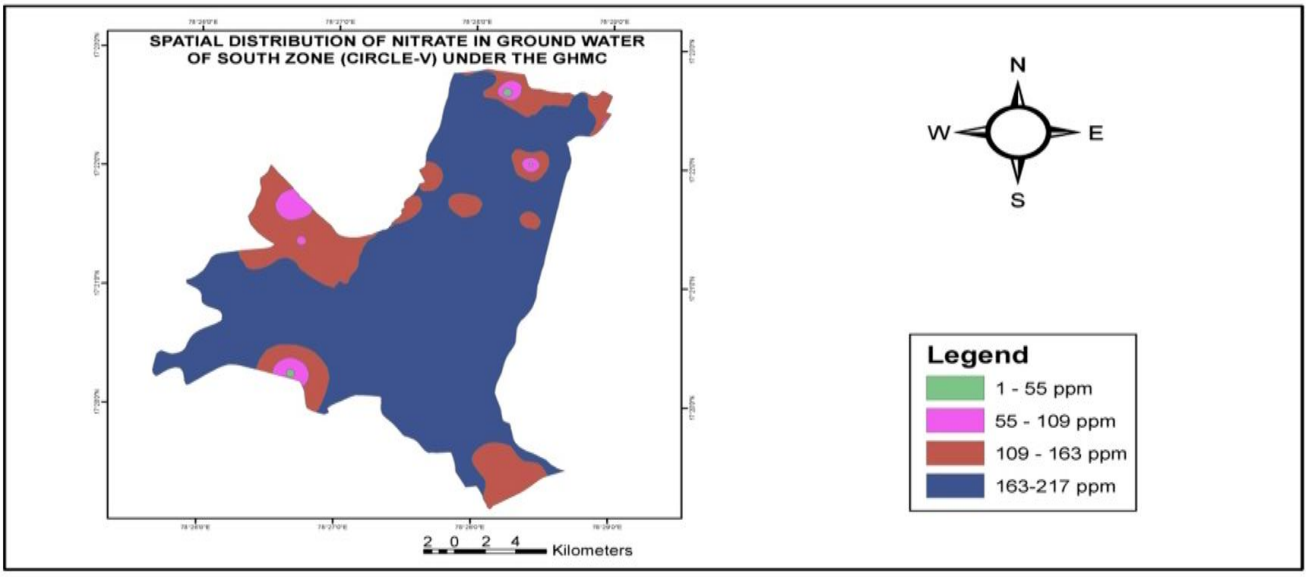


Fig.1.9: Spatial distribution of NITRATE in ground water of the study area

Table 1.1 Location wise Physico-Chemical analysis of water samples of study area surroundings

| Sample No. | SAMPLE LOCATION | Sample Type | pH. mg/l | TDS mg/l | Cl mg/l | SO4 mg/l | F mg/l | NO3 mg/l | PO4 mg/l | Na mg/1 | K mg/l |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CHIKKADPALLY | BW | 6.95 | 920 | 126 | 86 | 3 | 69 | NF | 95 | 3.5 |
| 2 | NARAYANGUDA | BW | 6.89 | 865 | 119 | 44 | 0.9 | 58 | 0.12 | 59 | 4 |
| 3 | HIMAYATNAGAR | BW | 7.43 | 793 | 98 | 17.5 | 2.8 | 26 | NF | 77 | 5 |
| 4 | BASHEERBAGH | BW | 7.69 | 315 | 70 | 8.5 | 0.6 | 15 | 1.67 | 19 | 3 |
| 5 | NEW MLA QTRS | BW | 7.76 | 295 | 35 | 9.5 | 0.5 | 12 | 0.1 | 50 | 4 |
| 6 | NEAR T1LAKNAGAR | BW | 7.09 | 635 | 49 | 35.5 | 4.5 | 22 | 0.09 | 56 | 3 |
| 7 | TILAKNAGAR | BW | 7.14 | 545 | 56 | 21 | 4.2 | 21 | 0.006 | 186 | 2 |
| 8 | BATHKAMMAKUNT A | BW | 6.79 | 1156 | 287 | 52.5 | 4.6 | ## | 0.06 | 148 | 25 |
| 9 | AMBERPET | BW | 6.86 | 680 | 35 | 15 | 1.4 | 46 | 0.09 | 122 | 3 |
| 10 | POLICE ACADEMY | BW | 6.87 | 680 | 21 | 26.5 | 1.6 | 87 | 1.57 | 103 | 25 |
| 11 | PATEL NAGAR | BW | 7.41 | 285 | 21 | 24.5 | 0.5 | 14 | NF | 31 | 3 |
| 12 | Z1NDATH NAGAR | BW | 6.83 | 564 | 91 | 120 | 2.4 | 10 | 0.31 | 117 | 34 |
| 13 | KAMALNAGAR | DG | 6.77 | 1175 | 35 | 104 | 3.3 | ## | 0.03 | 220 | 76 |
| 14 | GOLNAKA | BW | 6.94 | 1020 | 154 | 32.5 | 5.8 | 15 | 0.016 | 24 | 20 |
| 15 | TILASMATH FACTORY | BW | 7.08 | 1085 | 196 | 43.5 | 4.8 | 80 | 0.017 | 174 | 40 |
| 16 | GOLNAKA V. NAGAR | BW | 7.12 | 942 | 67 | 49 | 2.9 | ## | NF | 186 | 39 |
| 17 | MOOSARAMBAGH | BW | 7.05 | 942 | 234 | 63 | 1.2 | ## | NF | 101 | 4 |
| 18 | BAZARGHAT | BW | 7.26 | 1005 | 182 | 35 | 1.3 | 68 | 0.1 | 101 | 14 |
| 19 | NEAR MUSEUM | BW | 7.86 | 478 | 119 | 11 | 0.5 | 26 | 0.008 | 58 | 21 |
| 20 | L.B. STADIUM | BW | 7.68 | 890 | 245 | 16.5 | 1.1 | 30 | 0.115 | 19 | 2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | ABIDS | BW | 8.28 | 405 | 91 | 8.5 | 0.5 | 91 | 0.16 | 43 | 4 |
| 22 | HYDERGUDA HS | BW | 7.19 | 745 | 147 | 61.5 | 2.9 | 50 | 0.14 | 20 | 4 |
| 23 | OLD MLA QUARTERS | BW | 8.01 | 417 | 112 | 9 | 0.5 | 72 | 0.017 | 57 | 4 |
| 24 | KING KOTI | BW | 8.02 | 315 | 91 | 9.5 | 0.5 | 12 | 0.11 | 19 | 4 |
| 25 | RAM KOTI | BW | 8.01 | 472 | 140 | 9 | 0.5 | 5 | 0.1 | 19 | 4 |
| 26 | SULTAN BAZAR | BW | 8.08 | 310 | 84 | 11.5 | 0.6 | 9 | 0.009 | 17 | 4 |
| 27 | KOTI | BW | 7.69 | 310 | 98 | 27.5 | 2.7 | 50 | 0.11 | 20 | 17 |
| 28 | KACHIGUDA | BW | 7.24 | 350 | 245 | 32 | 1 | 14 | 0.009 | 110 | 4 |
| 29 | KACHIGUDA RS | BW | 8 | 460 | 84 | 10.5 | 0.6 | 62 | 0.12 | 76 | 4 |
| 30 | NIMBOLIADDA | BW | 7.47 | 612 | 91 | 46.5 | 1.3 | 68 | 0.009 | 23 | 4 |
| 31 | AMBERPET | BW | 7.21 | 1140 | 217 | 19.5 | 1.1 | 48 | 2.5 | 93 | 59 |
| 32 | M.G. BUS STATION | BW | 7.96 | 1180 | 245 | 46 | 2.2 | ## | 0.017 | 160 | 4 |
| 33 | IMLIBUN | BW | 7.76 | 1146 | 245 | 14.5 | 1.3 | 7 | 0.87 | 170 | 10 |
| 34 | AFZALGUNG | BW | 7.44 | 747 | 154 | 20 | 0.5 | 53 | 0.007 | 41 | 21 |
| 35 | PURANAPUL | BW | 7.65 | 505 | 105 | 14.6 | 1.5 | 27 | 0.24 | 51 | 30 |
| 36 | NAYAPUL | BW | 7.87 | 350 | 56 | 14.5 | 0.9 | 11 | 0.11 | 27 | 4 |
| 37 | BEGUM BAZAR | BW | 8.12 | 348 | 56 | 18.5 | 0.7 | 13 | 0.009 | 17 | 4 |
| 38 | GOSHAMAHAL STADIUM | BW | 7.81 | 1070 | 198 | 64.5 | 3.8 | 90 | 0.006 | 130 | 4 |
| 39 | MOZAMJAHI MARKET | BW | 7.81 | 410 | 89 | 18.5 | 2.6 | 10 | 0.17 | 17 | 3 |
| 40 | NAMPALLY STATION | BW | 7.7 | 325 | 49 | 15 | 0.5 | 9 | 0.004 | 19 | 3 |
| 41 | YMCA | BW | 7.89 | 335 | 56 | 18 | 0.7 | 13 | 0.006 | 20 | 3 |
| 42 | AV COLLEGE | BW | 7.12 | 820 | 166 | 42.5 | 4.8 | 50 | 0.05 | 117 | 4 |
| 43 | NAUBATHPAHAR | BW | 7.08 | 347 | 56 | 8.5 | 2.6 | 15 | 0.05 | 18 | 4 |

Table 1.2 Ground Water Quality of Study Area in the Year 2012
PRE-MONSOON

| Year | TDS mg/l | T.H. mg/l | HCO3 mg/l | Cl mg/l | Na mg/l | K mg/l | F mg/l | No3 mg/l | pH mg/l |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 1850 | 700 | 410 | 650 | 280 | 16 | 0.65 | 6 | 7.5 |
| 2008 | 934 | 200 | 335 | 556 | 140 | 9 | 0.9 | 3 | 7.8 |
| 2009 | 46 | 420 | 230 | 370 | 91 | 3 | 0.8 | 10 | 7.58 |
| 2010 | 1076 | 640 | 340 | 370 | 133 | 10 | 1.25 | 10 | 7.8 |
| 2011 | 1152 | 403 | 460 | 320 | 21.6 | 10 | 1.94 | 17.6 | 8.2 |
| 2012 | 979 | 420 | 400 | 240 | 146 | 31 | 0.31 | 0 | 8 |

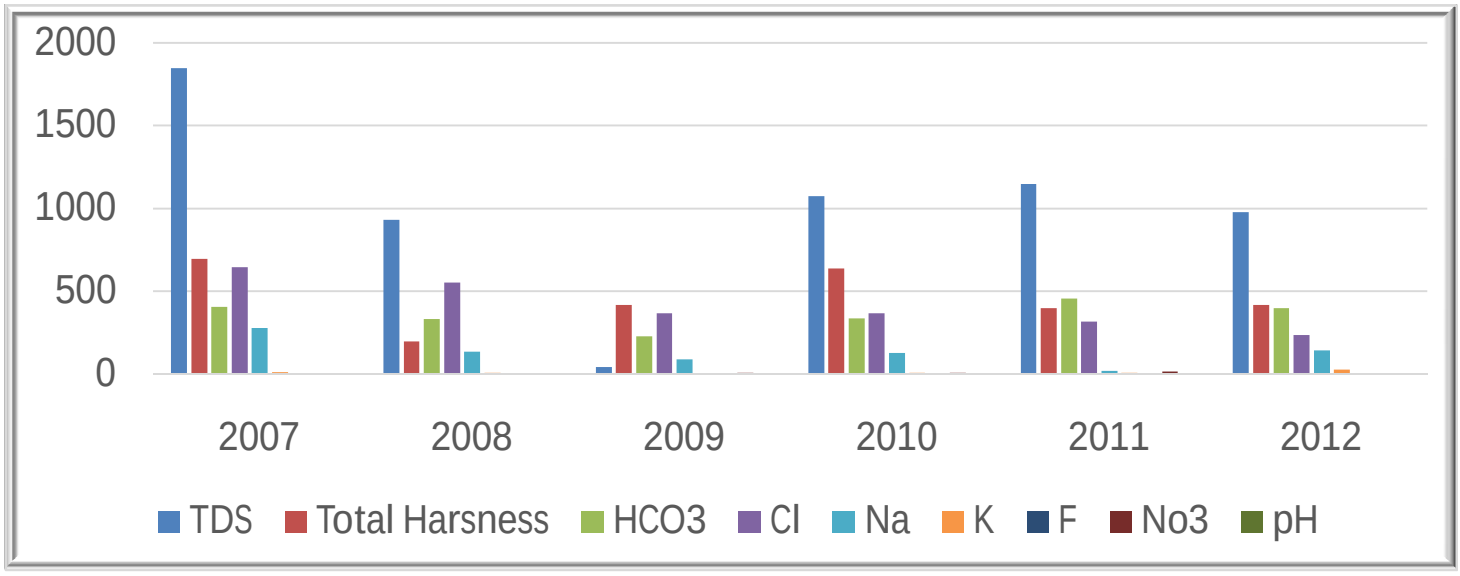


Fig. 1.10 Ground Water Quality of Study Area in the Year 2012 PRE-MONSOON

Table 1.3 Ground Water Quality of Study Area in the Year 2012
POST-MONSOON

| Year | TDS mg/l | T.H. mg/l | HCO3 mg/l | Cl mg/l | Na mg/l | K mg/l | F mg/l | No3 mg/l | pH mg/l |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 1760 | 750 | 460 | 565 | 315 | 25 | 1.2 | 14 | 7.5 |
| 2008 | 1520 | 1000 | 520 | 700 | 280 | 21 | 0.5 | 10 | 7.7 |
| 2009 | 944 | 310 | 315 | 245 | 255 | 20 | 0.9 | 15 | 7.9 |
| 2010 | 1076 | 640 | 340 | 370 | 133 | 35 | 1.05 | 9 | 8.1 |
| 2011 | 1152 | 403 | 460 | 320 | 21.6 | 17 | 0.75 | 11 | 8 |
| 2012 | 497 | 220 | 395 | 60 | 90 | 14 | 0.9 | 59 | 8.02 |

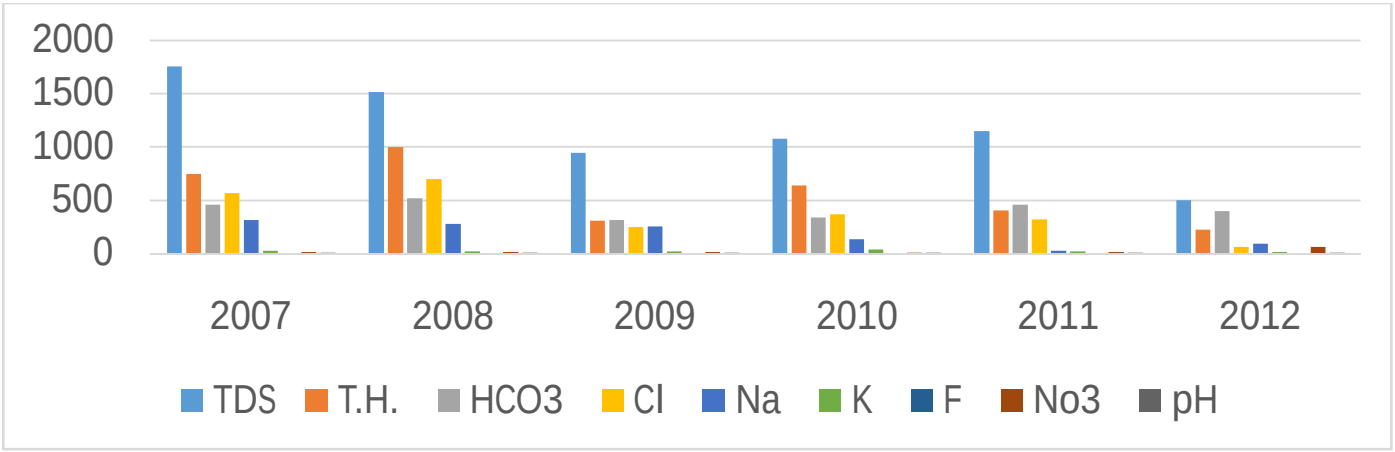


Fig. 1.11 Ground Water Quality of Study Area in the Year 2012
POST-MONSOON

## IV. CONCLUSIONS

Based on the water quality data obtained from physico-chemical analysis and WQI, the areas where ground water showed high concentrations of water quality parameters are identified. The results indicated that certain parameters such as fluoride, TDS, Hardness and Nitrates exceeded the permissible limits as given by ICMR/BIS Standards. Concentration of Sodium, Chloride and Alkalinity were observed to be within the permissible limits. The Recommendations are suggested based on source of pollutant and drinking water standards of the parameters and the associated Land use.

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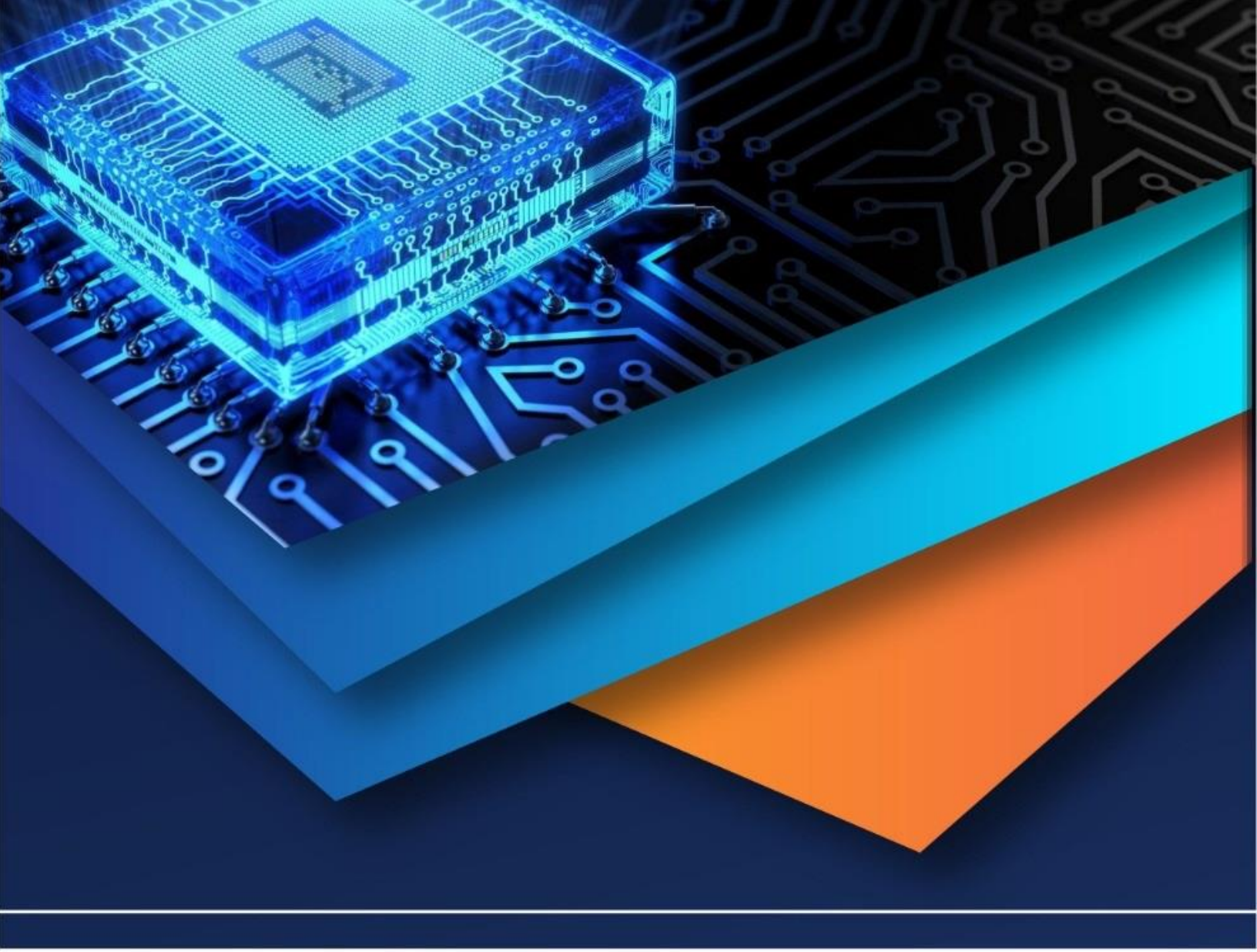

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