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Hydrogeo Chemistry of Musi River Basin

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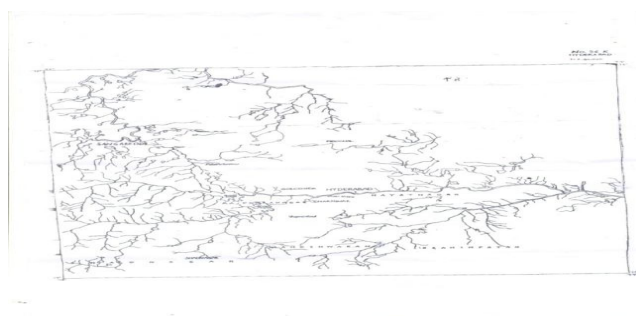
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Abstract: Musi river one of the major river system in Telangana state which is a source of water supply for different purpose ranges from drinking to industrial usage which flow through state capital city Hyderabad. In this present work study the quality of surface (River water) and ground water to check influence of musu river on quality of ground water from origin point to mouth. In the present work samples are collected at the regular interval of 16 km along the length wise both surface and ground water tested with standard parameters i.e. pH, EC, Hardness, Alkalinity and other captions. To find out the morphological, geological impact on surface and ground water quality.

Keywords: Geomorphology, water quality, surface relief.

I. INTRODUCTION

Along the river length Musi river originate at Ananthagiri hills, Vikarabad District, Telangana. Peaks at about 575 mts above mean sea level (MSL). The following of river water moving down to ocean. In interact with earth compounds such as atmosphere, various rock type (lithosphere), soils, plants. Animal ranges from micro level to macro level. (Bio-sphere) during its journey from atmosphere to final density. Its Leaches so many Gases, in organic and inorganic mineral components. The quality of surface and ground water depends on environmental, Geological conditions. The river Musi joins Krishna river at Vadapally, Nalgonda District, At a stretch of 240 Km Fig(1) surface and ground water samples are collected at regular intervals of 16 km based on geomorphology conditions which are analyzed with standard parameters to check the quality of water.



Fig(1) Drainage map of Musi River

B. Geology of Musi River

Musi river basin consisting of older metamorphics, peninsular Gneissic Complex (PGC), Dhawar Super group, Cuddapah Super group and Kurnool Group of Rocks. The hornblende schist's and amphibolites (older metamorphics). Which are the oldest Rocks occurs as Rafts enclaves and discontinuous linear bands with in the peninsular Gneissic complex (PGC). Main rock types are Granites, Granitiegneissic, Dolerites, gabbros, limestone's and quartzite.

C. Methods & Experimental Procedure

II. SAMPLE COLLECTION

The first step of the project is sampling. The sample collected should be small in volume, enough to accurately represent the whole water body. The water sample tends to modify itself in the new environment.

Basically we have 3 different types of samplings. They are:

Random sampling Inrandom sampling, the sample sites are selected randomly within the areas related to the more homogeneous components.

Systematic sampling This sampling method is considered most satisfactory as it gives more representative sample for water quality assessment. Sample sites are chosen to appropriate locations as to cover the whole water body.

Rapid sampling This sampling is carried out when there is constraint of time for detailed sampling. Rapid assessment of the water quality can be done by mixing equal volumes of water from the different locations of water body.

Out of the 3 types we chose random sampling so that it represents the whole area. We have collected samples from places about 100m distance from each other.

III. METHODOLOGY

A. pH

Alkalinity and acidity are the acid-base neutralization capacities of water and usually are expressed as mg/l of CaCO₃. pH can be measured in many methods such as electrometric method, pH-metry method using glass reference electrode. The method we used is electrometric method

B. Hardness Test

When total hardness is numerically greater than that of total alkalinity expressed as CaCO₃, the amount of hardness is equivalent to less than total alkalinity, is called Carbonate hardness. When the hardness is numerically equal to total alkalinity, all hardness is Carbonate hardness. The amount of hardness in excess of total alkalinity expressed as CaCO₃, is non-carbonate hardness, Non-Carbonate(Permanent) hardness is due to association of the hardness causing cations with sulphate, chloride or nitrate. It cannot be removed by boiling. Hardness in water is determined using complex metricitrimetry. The titrant used is EDTA as complexing agent for Ca, Mg ions and EBT is used as indicator. The volume of EDTA consumed for the wine red color to change to blue is noted and hardness is calculated.

C. Alkalinity

The alkalinity of water is a measure of its capacity to neutralize acids. The alkalinity of natural waters is due to the salts of carbonates, bicarbonates, borates, silicates and phosphates along with the hydroxyl ions in Free State. Alkalinity of sample can be estimated by titrating with standard sulphuric acid. Titration to pH 8-3 or decolorization of phenolphthalein indicator will indicate complete neutralization of pH and ½ of CO₃ while pH or sharp change from yellow to pink of methyl orange indicator will indicate total alkalinity (complete neutralization of OH⁻, CO₃, HCO₃).

D. Electrical Conductivity

It is measured by using Elico Conduct meter

E. Na & K

K ions are estimated using Flame Photometer and Na ions are measured with Sodium Adsorption Ratio

IV. RESULTS&DISCUSSIONS

A. Sample-1

Place: Toopran Date: 03-04-15 Tested on: 04-04-15, Elevation: 536m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|----------------------------------|--------------|--------------|
| 1 | pH | 5.63 | 6.29 |
| 2 | Electrical Conductivity-/cm | 2.532ms@28.3 | 879.6ms@2803 |
| 3 | Total Dissolved Solids-mg/l | 1.441 | 502.4 |
| 4 | Total Hardness as caco3-mg/l | 770ppm | 140ppm |
| 5 | Calcium Hardness as caco3-mg/l | 555 | 15 |
| 6 | Magnesium Hardness as caco3-mg/l | 215 | 125 |
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co3-) | 0 | 0 |

| | | | |
|----|--|------|------|
| 9 | Alkalinity(hco ₃ ⁻) | 460 | 120 |
| 10 | Na ⁺ | 12.8 | 11 |
| 11 | K ⁺ | 21.3 | 10 |
| 12 | Sodium Absorption Ratio | 1.17 | 1.33 |

Sample-2

Place: Jogipet Date: 03-04-15, Tested on: 04-04-15, Elevation: 574m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|--|---------------|--------------|
| 1 | pH | 5.75 | 7.45 |
| 2 | Electrical Conductivity | 1.529ms@28.3c | 19.0us@28.3c |
| 3 | Total Dissolved Solids | 856.3ppm | 472.5ppm |
| 4 | Total Hardness as caco ₃ | 480ppm | 160ppm |
| 5 | Calcium Hardness as caco ₃ | 255 | 50 |
| 6 | Magnesium Hardness as caco ₃ | 225 | 110 |
| 7 | Alkalinity (oh ⁻) | 0 | 0 |
| 8 | Alkalinity(co ₃ ⁻) | 0 | 20 |
| 9 | Alkalinity(hco ₃ ⁻) | 495 | 215 |
| 10 | Na ⁺ | 10 | 7.1 |
| 11 | K ⁺ | 25.3 | 21.3 |
| 12 | Sodium Absorption Ratio | 0.89 | 0.87 |

B. Sample-3

Place: Andhol, Date: 03-04-15, Tested on: 04-04-15, Elevation: 490m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|--|-------------|---------------|
| 1 | pH | 5.91 | 6.78 |
| 2 | Electrical Conductivity | 3.892ms@29c | 915.1us@29.4c |
| 3 | Total Dissolved Solids | 2.097ppm | 513.7ppm |
| 4 | Total Hardness as caco ₃ | 980 | 155 |
| 5 | Calcium Hardness as caco ₃ | 415 | 15 |
| 6 | Magnesium Hardness as caco ₃ | 565 | 140 |
| 7 | Alkalinity (oh ⁻) | 0 | 0 |
| 8 | Alkalinity(co ₃ ⁻) | 0 | 20 |
| 9 | Alkalinity(hco ₃ ⁻) | 560 | 225 |
| 10 | Na ⁺ | 19.6 | 5.9 |
| 11 | K ⁺ | 6.9 | 19.3 |

| | | | |
|----|-------------------------|-------|------|
| 12 | Sodium Absorption Ratio | 1.159 | 0.66 |
|----|-------------------------|-------|------|

C. Sample-4:

Place: Narsapur, Date: 03-04-15, Tested on: 04-04-15, Elevation: 560m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|-----------------------------|---------------|---------------|
| 1 | pH | 6.2 | 6.87 |
| 2 | Electrical Conductivity | 1.048ms@30.2c | 450.0us@30.1c |
| 3 | Total Dissolved Solids | 579.9ppm | 238.5ppm |
| 4 | Total Hardness as caco3 | 295 | 95 |
| 5 | Calcium Hardness as caco3 | 40 | 20 |
| 6 | Magnesium Hardness as caco3 | 255 | 75 |
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co3-) | 0 | 50 |
| 9 | Alkalinity(hco3-) | 380 | 155 |
| 10 | Na+ | 3.1 | 11.8 |
| 11 | K+ | 24.3 | 21.8 |
| 12 | Sodium Absorption Ratio | 0.26 | 1.7 |

D. Sample-5

Place: Sangareddy, Date: 03-04-15, Tested on: 04-04-15, Elevation: 496m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|-----------------------------|---------------|---------------|
| 1 | pH | 6.37 | 7.3 |
| 2 | Electrical Conductivity | 0.990ms@29.9c | 504.2us@29.9c |
| 3 | Total Dissolved Solids | 545.7ppm | 270.2ppm |
| 4 | Total Hardness as caco3 | 200 | 145 |
| 5 | Calcium Hardness as caco3 | 55 | 0 |
| 6 | Magnesium Hardness as caco3 | 145 | 145 |
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co3-) | 0 | 40 |
| 9 | Alkalinity(hco3-) | 460 | 190 |
| 10 | Na+ | 6.4 | 11.7 |
| 11 | K+ | 25.6 | 21.4 |
| 12 | Sodium Absorption Ratio | 0.69 | 1.28 |

E. Sample-6:

Place: Nakkawagu, Date: 09-04-15, Tested on: 10-04-15, Elevation: 486m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|-----------------------------|---------------|-------------------------------|
| 1 | pH | 6.74 | 6.52 |
| 2 | Electrical Conductivity | 1.103ms@30.7c | 1.508ms@30.5c |
| 3 | Total Dissolved Solids | 609.1ppm | 841.1ppm |
| 4 | Total Hardness as caco3 | 310 | 340 |
| 5 | Calcium Hardness as caco3 | 50 | 125 |
| 6 | Magnesium Hardness as caco3 | 260 | 215 |
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co3-) | 0 | 0 |

| | | | |
|----|-------------------------|------|------|
| 9 | Alkalinity(hco3-) | 400 | 570 |
| 10 | Na+ | 6.8 | 13.6 |
| 11 | K+ | 23 | 10.3 |
| 12 | Sodium Absorption Ratio | 0.57 | 1.28 |

F. Sample-7

Place: Shankarpalli, Date: 09-04-15, Tested on: 10-04-15, Elevation: 560m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|-----------------------------|---------------|---------------|
| 1 | pH | 6.21 | 4.31 |
| 2 | Electrical Conductivity | 1.409ms@30.4c | 129.1us@30.4c |
| 3 | Total Dissolved Solids | 785ppm | 105.4ppm |
| 4 | Total Hardness as caco3 | 545 | 50 |
| 5 | Calcium Hardness as caco3 | 215 | 0 |
| 6 | Magnesium Hardness as caco3 | 330 | 50 |
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co3-) | 0 | 0 |
| 9 | Alkalinity(hco3-) | 480 | 75 |
| 10 | Na+ | 4.8 | 22.5 |
| 11 | K+ | 23.7 | 26.5 |
| 12 | Sodium Absorption Ratio | 0.36 | 3.63 |

G. Sample-8

Place: Gandipet, Date: 09-04-15, Tested on: 10-04-15, Elevation: 540m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|-----------------------------|---------------|---------------|
| 1 | pH | 6.13 | 6.77 |
| 2 | Electrical Conductivity | 1.547ms@30.3c | 518.3us@30.8c |
| 3 | Total Dissolved Solids | 856.7ppm | 287.9ppm |
| 4 | Total Hardness as caco3 | 545 | 155 |
| 5 | Calcium Hardness as caco3 | 210 | 0 |
| 6 | Magnesium Hardness as caco3 | 335 | 155 |
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co3-) | 0 | 0 |
| 9 | Alkalinity(hco3-) | 540 | 185 |
| 10 | Na+ | 7.2 | 11.8 |
| 11 | K+ | 21.6 | 19.9 |
| 12 | Sodium Absorption Ratio | 0.54 | 1.26 |

H. Sample-9

Place: OsmanSagar, Date: 09-04-15, Tested on: 10-04-15, Elevation: 556m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|-----------------------------|--------------|---------------|
| 1 | pH | 5.85 | 7.04 |
| 2 | Electrical Conductivity | 777.7us@30.6 | 416.3us@30.5c |
| 3 | Total Dissolved Solids | 426.1ppm | 227.5ppm |
| 4 | Total Hardness as caco3 | 350 | 125 |
| 5 | Calcium Hardness as caco3 | 150 | 35 |
| 6 | Magnesium Hardness as caco3 | 200 | 90 |
| 7 | Alkalinity (oh-) | 0 | 0 |

| | | | |
|----|--------------------------------|-------|------|
| 8 | Alkalinity(co ₃ -) | 0 | 10 |
| 9 | Alkalinity(hco ₃ -) | 380 | 185 |
| 10 | Na ⁺ | 11.3 | 10.7 |
| 11 | K ⁺ | 25 | 21.6 |
| 12 | Sodium Absorption Ratio | 1.065 | 1.43 |

I. Sample-10

Place: Peddatupra, Date: 09-04-15, Tested on: 10-04-15, Elevation: 581m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|---|---------------|---------------|
| 1 | pH | 6.41 | 7.15 |
| 2 | Electrical Conductivity | 1.396ms@33.5c | 850.3us@33.2c |
| 3 | Total Dissolved Solids | 817ppm | 496.9ppm |
| 4 | Total Hardness as caco ₃ | 475 | 190 |
| 5 | Calcium Hardness as caco ₃ | 300 | 80 |
| 6 | Magnesium Hardness as caco ₃ | 175 | 110 |
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co ₃ -) | 0 | 0 |
| 9 | Alkalinity(hco ₃ -) | 525 | 310 |
| 10 | Na ⁺ | 2.7 | 7.5 |
| 11 | K ⁺ | 23.6 | 15.7 |
| 12 | Sodium Absorption Ratio | 0.27 | 0.95 |

J. Sample-11

Place: Ibrahimpatnam, Date: 16-04-15, Tested on: 17-04-15, Elevation: 523m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|---|-------------|---------------|
| 1 | pH | 5.9 | 7.33 |
| 2 | Electrical Conductivity | 1.451ms@26c | 521.7us@28.7c |
| 3 | Total Dissolved Solids | 743.8ppm | 28.49ppm |
| 4 | Total Hardness as caco ₃ | 460 | 145 |
| 5 | Calcium Hardness as caco ₃ | 340 | 15 |
| 6 | Magnesium Hardness as caco ₃ | 120 | 130 |
| 7 | Alkalinity (oh-) | 0 | 10 |
| 8 | Alkalinity(co ₃ -) | 0 | 0 |
| 9 | Alkalinity(hco ₃ -) | 264 | 0 |
| 10 | Na ⁺ | 10.1 | 2.1 |
| 11 | K ⁺ | 40.1 | 13.1 |
| 12 | Sodium Absorption Ratio | 1.13 | 0.25 |

K. Sample-12

Place: Batasingaram, Date: 16-04-15, Tested on: 17-04-15, Elevation: 505m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|---|-------------|--------------|
| 1 | pH | 6.72 | 8.45 |
| 2 | Electrical Conductivity | 1.81ms@27 | 1.863ms@28c |
| 3 | Total Dissolved Solids | 922.4ppm | 1.042ppt |
| 4 | Total Hardness as caco ₃ | 285 | 260 |
| 5 | Calcium Hardness as caco ₃ | 90 | 20 |
| 6 | Magnesium Hardness as caco ₃ | 195 | 240 |

| | | | |
|----|-------------------------|------|-------|
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co3-) | 0 | 120 |
| 9 | Alkalinity(hco3-) | 480 | 445 |
| 10 | Na+ | 18.6 | 1.8 |
| 11 | K+ | 10.7 | 4.1 |
| 12 | Sodium Absorption Ratio | 1.98 | 0.163 |

L. Sample:13

Place: Bibinagar, Date: 16-04-15, Tested on: 17-04-15, Elevation: 429m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|-----------------------------|--------------|---------------|
| 1 | pH | 6.8 | 8.31 |
| 2 | Electrical Conductivity | 2.792ms@29.6 | 1.574ms@29.4c |
| 3 | Total Dissolved Solids | 1.522ppt | 865.3ppt |
| 4 | Total Hardness as caco3 | 540 | 370 |
| 5 | Calcium Hardness as caco3 | 235 | 140 |
| 6 | Magnesium Hardness as caco3 | 305 | 230 |
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co3-) | 0 | 140 |
| 9 | Alkalinity(hco3-) | 550 | 380 |
| 10 | Na+ | 12 | 23.4 |
| 11 | K+ | 38.9 | 12.8 |
| 12 | Sodium Absorption Ratio | 0.91 | 2.12 |

M. Sample-14

Place: Brahmanapalli, Date: 16-04-15, Tested on: 17-04-15, Elevation: 317m

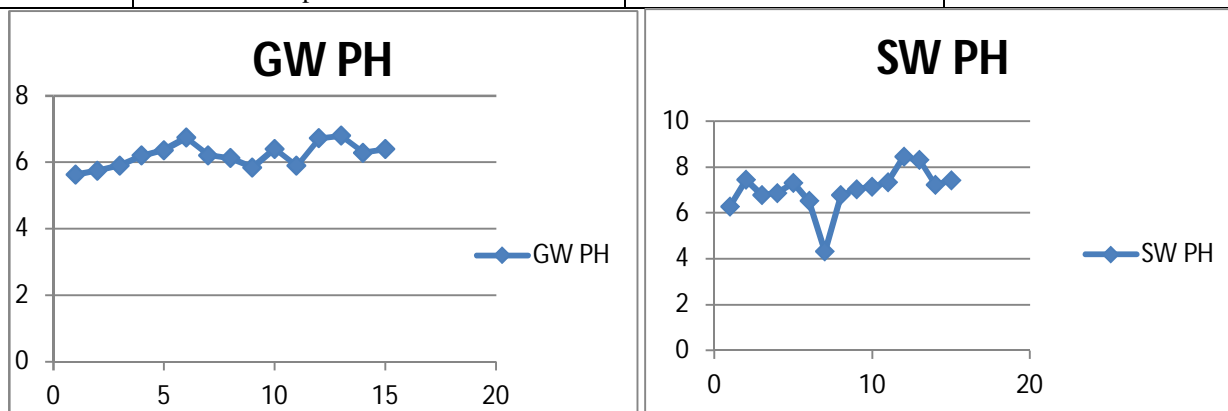
| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|----------------------------------|-------------|--------------|
| 1 | pH | 6.29 | 7.24 |
| 2 | Electrical Conductivity-/cm | 3.951ms@29 | 1.907ms@28 |
| 3 | Total Dissolved Solids-mg/l | 1.871ppm | 885.3ppm |
| 4 | Total Hardness as caco3-mg/l | 980 | 320 |
| 5 | Calcium Hardness as caco3-mg/l | 270 | 100 |
| 6 | Magnesium Hardness as caco3-mg/l | 710 | 220 |
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co3-) | 80 | 0 |
| 9 | Alkalinity(hco3-) | 345 | 335 |
| 10 | Na+ | 26.9 | 20.4 |
| 11 | K+ | 37.4 | 14.9 |
| 12 | Sodium Absorption Ratio | 1.39 | 1.88 |

N. Sample-15

Place: Sangem, Date: 16-04-15, Tested on: 17-04-15, Elevation: 317m

| Sl.no | Characteristics | groundwater | Surfacewater |
|-------|------------------------------|-------------|--------------|
| 1 | pH | 6.4 | 7.42 |
| 2 | Electrical Conductivity-/cm | 2.477ms@28 | 2.311ms@28 |
| 3 | Total Dissolved Solids-mg/l | 1.275ppt | 1.167ppt |
| 4 | Total Hardness as caco3-mg/l | 735 | 405 |

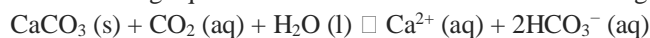
| | | | |
|----|----------------------------------|------|------|
| 5 | Calcium Hardness as caco3-mg/l | 350 | |
| 6 | Magnesium Hardness as caco3-mg/l | 385 | |
| 7 | Alkalinity (oh-) | 0 | 0 |
| 8 | Alkalinity(co3-) | 0 | 140 |
| 9 | Alkalinity(hco3-) | 355 | 360 |
| 10 | Na+ | 14.1 | 20.1 |
| 11 | K+ | 35.6 | 20.4 |
| 12 | Sodium Absorption Ratio | 0.97 | |



V. DISCUSSIONS

A. Hardness

The following equilibrium reaction describes the dissolving and formation of calcium carbonate.



The reaction can go in either direction. Rain containing dissolved carbon dioxide can react with calcium carbonate and carry calcium ions away with it. The calcium carbonate may be re-deposited as calcite as the carbon dioxide is lost to atmosphere, sometimes forming stalactites and stalagmites. Calcium and magnesium ions can sometimes be removed by water softeners.

B. Alkalinity

- 1) Highly alkaline waters are usually unpalatable and consumers tend to seek other supplies.
- 2) Chemically treated waters sometimes have rather high pH values which have met with some objection on part of consumers.
- 3) Large amount of alkalinity imparts a bitter taste to water.

C. pH

- 1) pH (6.5 to 8.5) has no direct adverse effect on health, however a lower value below 4 will produce sour taste and higher value above 8.5 a bitter taste
- 2) 3. High pH induces the formation of trihalomethanes which are causing cancer in human beings.

VI. CONCLUSIONS

In the present study 30 samples were collected from surface sources and bore wells located in the study area.

A. pH

The pH of the analyzed samples in the study area varies in the range of 5.63 to 6.8 for ground water and from 4.31 to 8.45 for surface water samples analogous to the permissible limits of 6.5 to 8.5. Few groundwater samples are acidic.

B. Electrical conductivity

The electrical conductivity gives quantitative picture of water. The values of electrical conductivity range from 777.7us to 3.951ms for ground water samples and from 19us to 2.311ms for surface water samples. Such anonymous values arise from various anthropogenic activities and geochemical processes prevailing in the region. All the values are within the limits.



C. Total dissolved solids

The weight of the residue consisting of pollutants left behind after the water sample is evaporated is a measure of TDS and gives the general nature of ground water quality and extent of contamination. The permissible limit is 500-1000ppm. The TDS value varies from 1.275ppt to 922.4ppm for ground water and from 1.042ppt to 885.3ppm for surface water samples. The high concentration may be due to leaching of solid waste from ground surface.

D. Alkalinity

In the area the value of alkalinity varies from 264 to 560mg/l for ground water and from 0 to 570mg/l for surface water samples. The source of alkalinity in water is from sewage and various human activities. The alkalinity is in the permissible limit i.e. 200-600 mg/l.

E. Total Hardness

The total hardness is an important property indicating the quality of groundwater. The desirable limit for TH is up to 300mg/l and up to 600mg/l is acceptable, actual values in the study area are found to vary from 200mg/l to 980mg/l for ground water and from 50 to 405mg/l for surface water samples which is above permissible limits.

F. Sodium adsorption ratio (SAR)

Is a measure of the suitability of water for use in agricultural irrigation, as determined by the concentrations of solids dissolved in the water. The values are from 0.26 to 1.98 for ground water and from 0.25 to 3.63 for surface water samples. As the values are more the suitability for irrigation is less.

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