Physico-chemical analysis of drinking water quality in vicinity of Narsampet Mandal, WARANGAL DISTRICT, Telangana State , India

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Abstract: The suitability of water quality for drinking purpose in the Narsamapet Mandal area was assessed by measuring physicochemical parameters, including major cation and anion compositions, pH, total dissolved solid, electrical conductivity, and total hardness.
The nitrate concentration ranged between 20 to145 mg/liter. The chloride concentration range of 48-241mg/liter, where the fluoride concentration ranges from 0.52 to 0.60 mg/liter . The Values obtained for different parameters, are compared with the standard values given by WHO/TSE and suitable suggestion were made in the Narsamapet Mandal area. The water investigation was carried out to identify groundwater quality and its suitability for drinking purpose.

Keywords: Geochemistry, physico-chemical analysis, anions, cations, drinking water quality,

1. Introduction.

Groundwater is a vital natural resource. Depending on its usage and consumption it can be a renewable or a non renewable resource. It is estimated that approximately one third of the world's population use groundwater for drinking . Groundwater is the major source of water supply for domestic purposes in urban as well as rural parts of India. The WHO has clearly stated that the quality of drinking water is a powerful environmental determinant of health. Drinking-water quality management has been a key pillar in the prevention and control of waterborne diseases. Water is essential for life, but it can and does transmit disease in all countries of the world from the poorest to the wealthiest. Safe drinking water therefore is a basic need and hence, an internationally accepted human right, and reducing the number of people without access to sustainable safe drinking water supply has been enlisted as one of the ten targets of the millennium development goals. The importance of water quality in human health has also recently attracted a great deal of interest . The evaluation and management of groundwater resources require an understanding of hydro chemical investigation and the same was carried out to identify groundwater geochemistry and its suitability for drinking purpose.

Warangal district with a total geographical area of 12,846 sq km is one of the ten district of Telangana State The district is mainly agrarian and agriculture is themain stay of the population. Population density 274 person per sq km as per 2001 census.The district falls in the drainage basins of both Godavari and Krishna rivers. Theriver Godavari, the largest river in the peninsular India flows along the eastern boundary ofthe district in south easterly direction Pedavaguand, Lakhnavaram are the two maintributaries of the Godavari. In the southern and south western part of the district the streamsflow towards south and south easternly direction and finally fall into the Krishna river. Theimportant tributaries of river Krishna are Akeru, Paleru and Muneru. The entire district isdivided into 58 minor basins. In this present work we took thr vicinity of Narsampet.It is located at 17° 55'0N 79° 54' 0E.It has average altitude of 221 meters. Narsampet is a historical place. Before Independence the administrative unit of Narsampet was officially known as Pakhal Taluka because of its proximity to the area's lifeline - the Pakhal lake, largest lake in the region built by the Kakatiya rulers. The Pakhals and Sullavais the oldest sedimentary rocks occupy an area of 1500 an700 sq.km respectively in north eastern part of the district. They comprise mainly sandstones, quartzite, limestone's, shale's and phyllites. They are hard, compact and possess limited primary porosity.

However, subsequent fracturing and fissuring followed by weathering enabled them to form aquifers locally. The thickness of weathered zone varies from 8 to 20m.The depth ranges of the dug wells vary from 6 to 10 m bgl. The pre monsoon water levelsvary from 5 to 20 m bgl and the post monsoon water levels vary from <2 to 10 m bgl. Ground water occurs in all the geological formations in the district. The major rocktypes occurring in the district are granites, gneisses, sandstone, limestone, shale, quartzite'setc. The occurrence and movement of the ground water is a consequence of a finitecombination of topographical, climatologically, hydrological, geological, structural and pedagogical factors, which together form integrated dynamic system. All these factors are interrelated and inter dependent, each providing a insight into the total functioning of this dynamic system.

Fig (1)WARANGAL DISTRICT
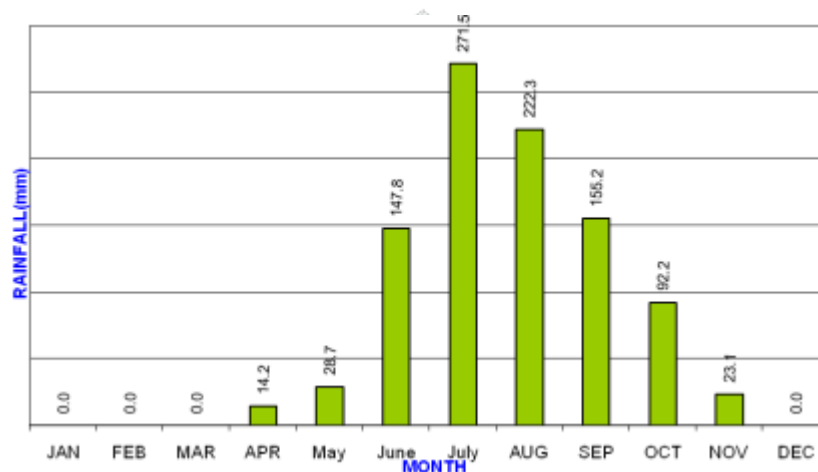
.   fig(2) Average rain fall in the year

Methods & Experimental Procedure:

2. 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:

1. **Random sampling** In random sampling, the sample sites are selected randomly within the areas related to the more homogeneous components.

2. **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.

3. **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.

3. METHODOLOGY

S.NO	PARAMETER	METHODS USED
1	pH	electrometric method
2	Electrical Conductivity	conductometry
3	Total Dissolved Solids	Titration
4	Total Hardness as $CaCO_3$	Titration
5	Calcium Hardness as $CaCO_3$ -mg/l	EDTA Method
6	Magnesium Hardness as $CaCO_3$ 3-mg/l	EDTA Method
7	Nitrate	Spectrophotometric method
8	Na+	Flame Photometry
9	K+	Flame Photometry
10	Fluoride	Ion selective electrode

11	sulphate	ultraviolet absorption
12	Chloridre	Argentometrictitration

4. RESULTS & Discussions:

SAMPLE-1

Place: Laknepalle **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 $CaCO_3$ -mg/l	770ppm	140ppm
5	Calcium Hardness as $CaCO_3$ -mg/l	555	15
6	Magnesium Hardness as $CaCO_3$ -mg/l	215	125
7	Alkalinity (OH)	0	0
8	Alkalinity	0	0
9	Alkalinity	460	120
10	Na+	12.8	11
11	K+	21.3	10
12	Sodium Absorption Ratio	1.17	1.33

SAMPLE-2:

Place: Kammepalle **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 CaCO3	480ppm	160ppm
5	Calcium Hardness as CaCO3	255	50
6	Magnesium Hardness as CaCO3	225	110
7	Alkalinity (OH)	0	0
8	Alkalinity(co3-)	0	20
9	Alkalinity(hco3-)	495	215
10	Na+	10	7.1
11	K+	25.3	21.3
12	Sodium Absorption Ratio	0.89	0.87

SAMPLE-3:

Place: Madannapet**, 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 CaCO3	980	155
5	Calcium Hardness as CaCO3	415	15
6	Magnesium Hardness as CaCO3	565	140
7	Alkalinity (OH)	0	0
8	Alkalinity(co3-)	0	20
9	Alkalinity(hco3-)	560	225
10	Na+	19.6	5.9
11	K+	6.9	19.3
12	Sodium Absorption Ratio	1.159	0.66

SAMPLE-4:

Place: Paspunur**, 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	0	50
9	Alkalinity	380	155
10	Na+	3.1	11.8
11	K+	24.3	21.8
12	Sodium Absorption Ratio	0.26	1.7

SAMPLE-5:

Place: Ramavaram **, 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	0	40
9	Alkalinity	460	190
10	Na+	6.4	11.7
11	K+	25.6	21.4
12	Sodium Absorption Ratio	0.69	1.28

CaCO3

SAMPLE-6:

Place: Sarwapur**, 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	0	0
9	Alkalinity	400	570
10	Na+	6.8	13.6
11	K+	23	10.3
12	Sodium Absorption Ratio	0.57	1.28

SAMPLE-7:

Place: Rajupet **, 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	0	0
9	Alkalinity	480	75
10	Na+	4.8	22.5
11	K+	23.7	26.5
12	Sodium Absorption Ratio	0.36	3.63

SAMPLE-8:

Place: Maheshwaram **, 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	0	0
9	Alkalinity	540	185
10	Na+	7.2	11.8
11	K+	21.6	19.9
12	Sodium Absorption Ratio	0.54	1.26

SAMPLE-9:

Place: , 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	0	10
9	Alkalinity	380	185
10	Na+	11.3	10.7
11	K+	25	21.6
12	Sodium Absorption Ratio	1.065	1.43

SAMPLE-10:

Place: , 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 CaCO3	475	190
5	Calcium Hardness as CaCO3	300	80
6	Magnesium Hardness as CaCO3	175	110
7	Alkalinity (OH)	0	0
8	Alkalinity	0	0
9	Alkalinity	525	310
10	Na+	2.7	7.5
11	K+	23.6	15.7
12	Sodium Absorption Ratio	0.27	0.95
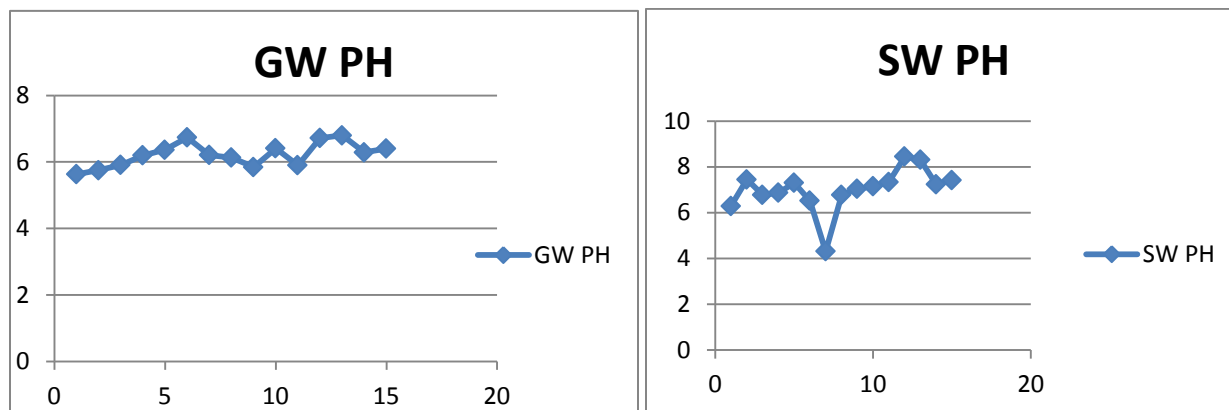
5. Discussions:

5.1 HARDNESS

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

$$CaCO3 \text{ (s)} + CO_2 \text{ (aq)} + H_2O \text{ (l)} \leftrightharpoons Ca^{2+} \text{ (aq)} + 2HCO_3^- \text{ (aq)}$$
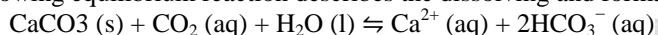
The reaction can go in either direction. Rain containing dissolved carbon dioxide can react with calcium carbonate and carry calcium ions away with it. The calcium carbonate may be re-deposited as calcite as the carbon dioxide is lost to atmosphere, sometimes forming stalactites and stalagmites. Calcium and magnesium ions can sometimes be removed by water softeners.

5.2 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.

5.3 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. Higher values of pH hasten the scale formation in water heating apparatus and also reduce the germicidal potential of chlorine.
3. High pH induces the formation of trihalomethanes which are causing cancer in human beings.

6. Conclusions:

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

6.1 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.

6.2 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.

6.3 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.

6.4 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.

6.5 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.

6.6 Sodium Adsorption Ratio

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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