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PHYSICAL AND CHEMICAL PARAMETERS OF THE NARAYANPUR MANDAL WATER SAMPLES, NALGONDA DISTRICT, TELANGANA STATE

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Abstract:

Water is an important constituent of the ecosystem on the earth and essential component of life; therefore there exists a close linkage between the quality of water and the environment, which bears an utmost importance for the ecosystem. The quality of water resources is deteriorating due to the continuous pollution with undesirable additions of pollutants. Water quality is closely linked to the surrounding environment and land use; water is never pure and is affected by community uses such as Agriculture, Urban, Industrial and Recreation etc. The main sources of water pollution are urbanization, industrialization, agricultural activities other environmental and resultant global and regional climatic changes. If all the physical, chemical and biological pollutants are within the limits, then we may assume a normal or ideal condition of the water resources; otherwise one can say that the environment is polluted. The pH of ground water in the study area is varying between (5.27-6.57). It is observed that most of groundwater is alkaline in nature.Total dissolved solids (TDS) of groundwater in the study area vary from (452-2701).. Calcium & Magnesium concentrations are varying from (16-144) and (5-175) mg/l. Chloride concentrations are varying from (20-1080) mg/l. Nitrate concentrations vary from (0.35-100) mg/l. 45% of the samples are exceeding in desirable limit. TDS values the groundwater of the study area has been classified and observed that 100% of groundwater falls into the fresh category. The Fluoride concentration in the study area ranges from (0.95-8.17) mg/l. The sulphate concentration of the groundwater samples of the study area ranges from 21 to 300 mg/l. which below the permissible limit of 400 mg/l (BIS, 1991).

1.0. Introduction

Most of the earth's water sources get their water supplies from precipitation, which may fall in various forms, such as, rain, snow, hail, dew etc. Rains no doubt, form the principal and the major part of the resultant supplies. When rain starts falling, it is first of all intercepted by buildings and other objects. When the rainfall rate exceeds the interception rate, water starts reaching the ground and infiltration starts. This is the source of groundwater storage. Water is one of the five basic elements of life i.e. air, water, fire, land and sky on the Earth and is the most essential element of life. Even though $3/4^{th}$ of the Earth's surface is covered by water sufficient fresh water is not available both for drinking and irrigation in several parts of the world. India in general and Andhra Pradesh in particular are among them. With in Andhra Pradesh the severe drought is predominant in the most backward district i.e. Nalgonda district. Freshwater problem is not limited to the arid climatic regions, even in areas with good supply; the access to safe water is becoming a critical problem. Water on the Earth goes through a gigantic cycle of conversion to gaseous form by evaporation and coming down again to Earth as precipitation. The main source of water is the surface water that flows in streams, rivers and groundwater, which are highly influenced by the physical factors of watershed. Water has been identified as an integral part of the socio economic fabric. It is tagged to the destiny of man. It is reported that $2/3^{rd}$ of the world does not have safe drinking water and $1/5^{th}$ of the urban population and $3/4^{th}$ of the rural inhabitants do not have safe supplies of drinking water. In India rainwater is the most important factor in agricultural production. 75% of the total cropped area is under rain fed / unirrigated and accounts for about 42% of the total food grain production. More than 78% of cotton; 82% of oil seeds 96% of sorghum; 98% of the millets and as much as 62% of the rice and 38% of wheat in India are grown under rain fed conditions. Since water is the major limiting

factor for the production of rain fed crops and precipitation is the only source of water in most of rain fed regions, effective rainwater management is vital to increase and stabilize their yields.

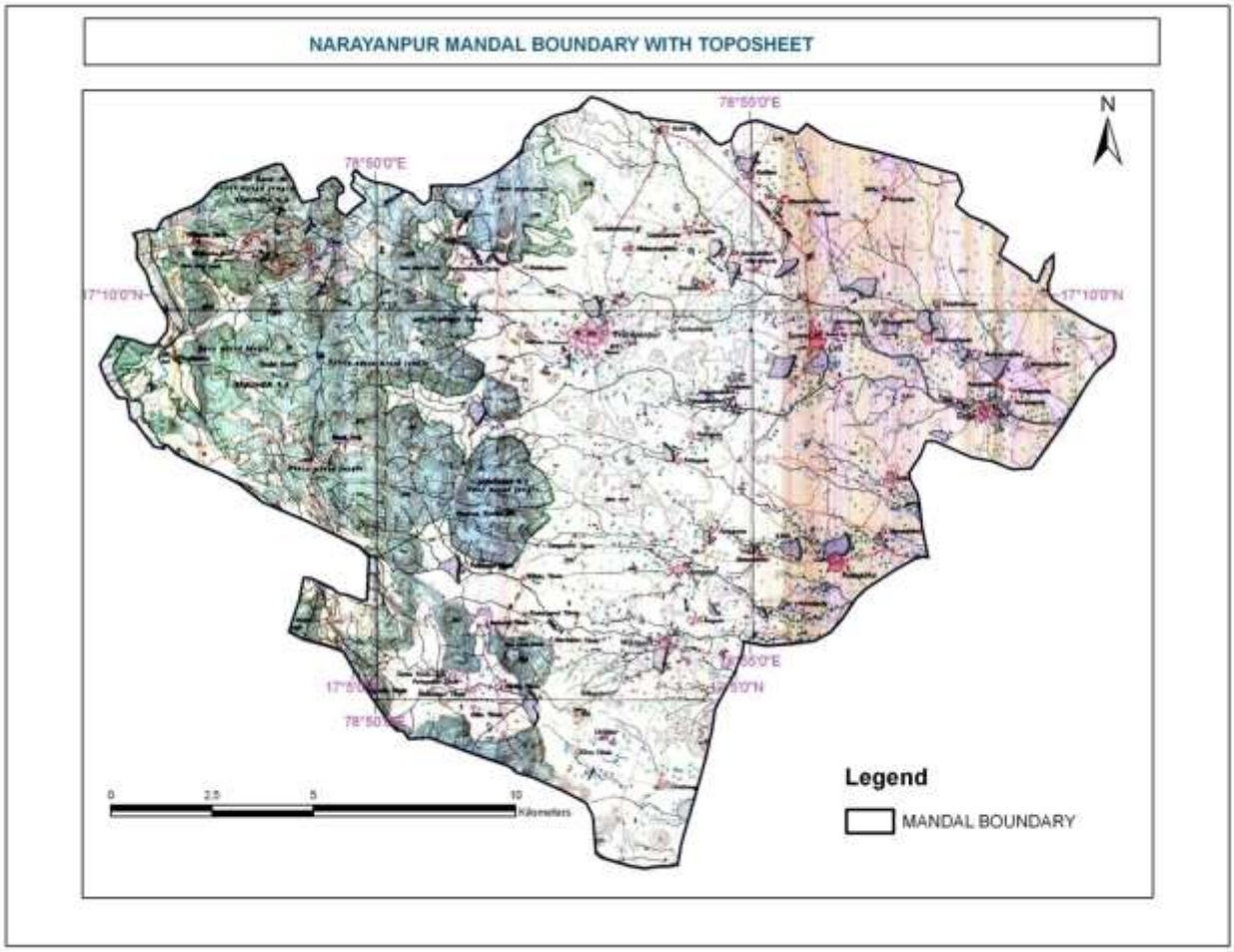
1.1. Study area

The study area occurs in the western part of Nalgonda district Narayanapur Mandal and lies between latitudes 17^0 02′ - 17^0 12′ N and longitudes 78^0 46′ - 78^0 59′ E covering Survey of India toposheet no 56 k/16. Major part of the investigated area falls in western part of the Nalgonda district. The study area covering of 252 Sq.km comprises 24 revenue villages.

1.2. Climate

The climate in this region is generally hot because it falls under semi arid climate. The average maximum temperature in the summer months generally varies between 350 C to 420 and the average minimum temperature between 100 C and 220 C. The average rainfall of the study area is about 725 mm. a major part of the district is declared as the drought prone area schemes such as Drought Prone Area Programme (DPAP) is intensively taken up in this region. Narayanpur is the biggest mandal in Nalgonda district. It is located in the neighbourhood of the capital of Telangana – that is Hyderabad. All the villages and tandas are located around 100 km away from BDL. These are connected with the highway. The locations mostly constitute the tribal population called Lambada. The broad issues are related to water, sanitation, livelihood and employment, and education. Following is the location-wise analysis of data for every site. Narayanpur has an average elevation of 349 metres (1148 ft).

- The villages in Narayanapur mandal include: Guddi Malkapur, Katlapur, Allamdevi Cheruvu, Nagvaniguda, Erranbhavi, Serigudem, Chimirala, Yerragunta, Rajannabavi.



2.0. Regional Geology

The basement granitic/granitic gneisses of late Archaean are exposed in most part of this area. They are generally medium to coarse grained. These rocks are traversed by numerous dolerite dykes and quartz veins. The Srisailam formation, the youngest member of the Cuddapah super group, directly overly this basement granite with a distinct unconformity. This Srisailam formation is exposed in the southern part of the ditrict. The Meta sediments of Srisailam formation include pebbly gritty quartzite, shale, and dolomitic limestone, intercalated sequence of shale-quartzite and massive quartzites. The litho units of this formation are dipping at an angle ranging from $3^0$to 5^0towards SE.

3.0. Materials and methods:

In order to study the major ion geochemistry of ground water and to assess its quality, 24 groundwater samples were collected from the study area and analyzed for various parameters, a random sampling was used to select sampling points. The pollutants like fertilizers, pesticides, insecticides used in agriculture are the main source of water pollution. The quality of ground water is assessed depending on different constituents occurring in the water as dissolved minerals. The dissolved minerals determine the chemical quality of ground water and determine the usefulness of water for different purposes. Beyond certain limits dissolved constituents, may make this unsuitable for drinking, industrial, and agriculture purposes. In the hard rock areas the aquifers have a very limited thickness (generally less than 100 meters) as they are formed by the insitu weathering of the country rock. (Marechal et al., 2004).

4.0 Results

S. No	Village	pH	Ec	TDS	CO_3	HCO_3	Cl	TH	Ca	Mg	F^-	NO_3	SO_4	Na	K
1	Guddimalkpur	6.57	2310	1478	0	556	280	740	112	112	4.46	26.80	93	179	30
2	Katlapur	6.47	945	605	0	388	40	120	40	5	6.31	0.35	21	147	30
3	Allamdevicheruvu	6.19	1850	1184	0	505	220	360	48	58	3.65	12.75	53	247	30
4	Nagvaniguda	5.37	2220	1421	0	453	350	400	72	53	3.74	14.67	96	314	30
5	Erranabhavi	6.13	936	599	0	342	40	160	48	10	3.90	7.88	35	126	30
6	Serigudem	5.27	1296	829	0	255	160	360	104	24	2.15	25.00	69	118	29
7	Near muthyalama temple	5.50	2620	1677	0	230	530	560	88	83	1.69	50.00	135	334	30
8	Chimirala	6.17	1008	645	0	312	50	300	64	34	2.32	22.30	35	84	20
9	Yarragunta	5.90	3130	2003	0	481	430	680	72	122	2.50	74.95	187	239	299
10	Rajannabawi	5.39	3740	2394	0	522	620	400	144	10	3.00	40.00	300	668	29
11	Mallareddyguda dem	6.06	4220	2701	0	484	1080	78	64	78	1.90	1.01	75	693	113
12	Bodamarlagudem	5.76	1517	971	0	410	140	10	72	10	3.70	12.17	96	249	4
13	Harijandudain	6.45	1921	1229	0	725	40	117	24	117	8.17	15.00	111	186	20
14	Kotlaram	6.20	1130	723	0	390	60	10	16	10	4.09	9.80	48	225	2
15	Gujja (opposite kakatiya school)	6.07	1598	1023	0	452	150	19	48	19	3.88	7.84	96	277	3
16	Gujja	5.45	1503	962	0	273	250	63	112	63	0.98	12.30	72	97	6

17	Servali	5.27	707	452	0	260	20	34	80	34	0.95	10.99	22	7	2
18	Kankanalagudem	5.6	1150	736	0	293	130	29	96	29	1.60	11.31	50	101	1
19	Narayanpur	5.35	898	575	0	295	80	29	40	29	5.37	0.37	34	105	5
20	Aregudem	5.55	3440	2202	0	572	500	175	72	175	4.21	80.90	131	384	2
21	Wailpalli	6.28	3670	2349	0	621	500	980	112	170	2.20	100	128	372	50
22	Jangaon	5.75	1576	1009	0	426	130	380	64	53	2.60	30	61	174	30
23	Purlakunta	6.17	1542	987	0	524	100	400	80	49	2.80	10	60	171	5
24	Battonibhavi	5.905	2910	1862	0	461	580	840	80	156	1.27	14.75	105	250	68

The ranges of different chemical constituents of groundwater in, the study area are given in table no 11. Ranges of different chemical constituents of Groundwater in the area:

Sl. No.	Parameter	Ranges	Units
1	pH	5.27 -6.57	
2	Electric conductance	707 – 3670	µ S/cm
3	Total Dissolved solids	452 – 2701	mg/l
4	Carbonates (CO_3^{2-})	0	mg/l
5	Bicarbonates (HCO_3^-)	230 – 725	mg/l
6	Chlorides (Cl^-)	20 – 1080	mg/l
7	Fluorides (F^-)	0.95 – 8.17	mg/l
8	Nitrates (NO_3^-)	0.35 – 100	mg/l
9	Sodium (Na^+)	7 – 693	mg/l
10	Potassium (K^+)	1 – 299	mg/l
11	Calcium (Ca^{2+})	16 – 144	mg/l
12	Magnesium (Mg^{2+})	5 – 175	mg/l
13	Sulphate(So_4)	21-300	mg/l

Data Analysis

Analytical results indicate that pH of groundwater varies from 5.27–6.57. The pH is one of the most important operational water quality parameters as it influences many chemical and biological processes within a water body. The simplest classification of water is based on the total concentration of dissolved solids. The classification is suggested by Gorrel which is shown in the following table: 12.

Quality of water	Concentration of TDS in mg/l
Fresh water	0-1000
Brakish water	1000-10,000
Salty water	10,000-100,000
Brine	>100000

The water, with TDS less than 600 mg/l is considered good for drinking purposes and water with TDS more than 1200 mg/l is considered unpalatable (W.H.O. 1984). The major dissolved constituents occurring in the groundwater of Gurjavagu watershed area are Calcium, Magnesium, Sodium, Potassium, Carbonate, Bicarbonate, Chloride, Sulfate, Fluoride, Nitrate and total dissolved solids.

Calcium

Calcium is one of the principle cation of ground water. Calcium carbonate imparts the hardness to water together with sulfates, carbonates, and bicarbonates. In the granitic terrain the calcium contents range generally from 0.20 to 5.5 ppm. The calcium range between (16 – 144 ppm). The permissible limits of calcium are 220 ppm as recommended by WHO standards.

Magnesium

Magnesium along with calcium contributes hardness to Groundwater. The solubility of magnesium carbonate in water and carbon dioxides are greater than calcium molecules. The tolerable limit of magnesium is 30 mg/l; In the study area the Mg ion ranges between (5 – 175) mg/l.

Sodium

Sodium content in groundwater is due to the weathering of plagioclage feldspar in granitic terrain. Sodium is one of the dominant cation present in the groundwater in the study area. Sodium is determined by Flame photometric method. The sodium concentration in the area ranges from (7 – 693) mg/l.

Potassium

Potassium is useful for the plants growth. The content of potassium is determined by flame photometric method. The potassium concentration in the study area ranges from (1-299)mg/l.

Carbonates, Bicarbonates, Chlorides, sulphates, nitrates, and fluorides are determined in the study area. They were studied to identify their ranges of distribution and evaluate suitability in the area for domestic, irrigation and industrial purposes.

Carbonates and Bicarbonates

The presence of Carbonates, Bicarbonates and hydroxides is the cause of alkalinity in water. The carbonates and bicarbonates are determined by titrimetric method. In the study area the carbonates ranges from (0) mg/l. But Bicarbonates varies from (230 - 725) mg/l. It is also concluded that most natural water would contain much more bicarbonates than carbonates (Chow, 1964).

Chloride

Water that contains less than 200 mg/l of chloride is satisfactory for domestic, agricultural and industrial purposes (Johnson, 1986). Water with 600 and above mg/l is disagreeable for drinking as it gives saltiest taste WHO standards. In the study area the chloride ranges from (20-1080) mg/l.

Fluoride

The Fluoride concentration in the study area ranges from (0.95 – 8.17) mg/l. The permissible limit of Fluoride for drinking water is 1.5 mg/l according to ISI (1991). Fluorite (CaF_2) is the main solid phase fluoride in rocks and is surround granites, granitic gneisses and pegmatites

(Rama Rao, 1982). Through weathering of the primary minerals, fluoride is released to the soil and groundwater, i.e., leaching of fluoride containing minerals may yield fluoride in solution. Fluoride in natural waters may originate from the solution of fluorite or apatite and more commonly from the solution of fluoride bearing micas and amphiboles. A common sink for fluoride is adsoption by kaolinite. Fluoride is common in semi-arid climate with crystalline igneous rocks and alkaline soils (Handa, 1975). Fluoride content in groundwater usually depends on rock type, interaction period with host rock, as well as the dissolution kinetics for fluorite, apatite or silicate minerals. In water, fluoride is strongly reactive or exists in free state, eventually precipitating as fluorite (main solid phase with the fluoroapatite, Ca5 [PO4] 3[F,Cl] (Handa, 1975; Alveteg and Jonsson, 1991). Concentration of high fluoride ions causes various types of dental and skeletal fluorosis (Narsimha et al., 2012). A concentration less than 0.8 mg/l results in dental carries. Hence, for these medical reasons, it is essential to maintain the fluoride concentration between 0.8 and 1.2 mg/l in drinking water (WHO, 1984).

Nitrate

Nitrate contamination in groundwater is one of the major issues in water quality studies (Schilling and Wolter, 2007; Raju et al., 2009). Numerous sources in the environment contribute to the total nitrate content of natural water (Handa et al., 1982). In the pure water, NO_3^- is seldom present (Deepali et al., 2011). The source of NO_3^- in groundwater is due to decaying organic matter, sewage wastes, leakage of septic tanks and fertilizer (Subrahmanyam and Yadaiah, 2000). The concentration of nitrogen in groundwater is derived from the biosphere (Saleh et al., 1999). Nitrogen is originally fixed from the atmosphere and mineralized by soil bacteria into ammonium. The high concentration of nitrate in drinking water is toxic and causes blue baby disease/methemoglobinaemia in children and gastric carcinomas (Comly, 1945; Gilly et al., 1984). Nitrate produces no color or odor in water and can cause cancer in humans when consumed over a long period of time (Jahed et al., 2008). The high concentration of nitrate is due to the intensive urbanization and industrialization (Raju et al., 2009). Nitrate concentration in the groundwater of the study area varies from 0.35 to 100 mg/l.Acceptable limit of NO_3^- content in drinking water is 45 mg/l(BIS, 1991). Presence of high concentration of nitrate in drinking water not only causes methemoglobinemia in infants, but has also been reported to cause cancer (Dissanayake and Weerasooriya, 1987). Nitrate acts in the blood to convert haemoglobin to

methemoglobinemia, a form that does not carry oxygen to the body cells, which in large amounts can lead to death from asphyxiation (Ozha et al., 1993).

Sulphate

Sulphate is a major anion present in water. The sources of sulphate in rocks are sulfur minerals, sulfides of heavy metals which are of common occurrence in the igneous and metamorphic rocks, gypsum and anhydrite found in some sedimentary rocks. Sulphate can originate from surface contamination sources such as fertilizers and also from the oxidation of sulfide minerals (Min et al., 2003; Chae et al., 2004). The sulphate concentration of the groundwater samples of the study area ranges from 21 to 300 mg/l. which is below the permissible limit of 400 mg/l (BIS, 1991). Higher concentration of sulphate in drinking water is associated with respiratory problems (Maiti, 1982; Subba Rao, 1993).

Total dissolved solids

Total dissolved solids in water comprises of all inorganic salts including carbonate, bicarbonate, chloride, fluoride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, and potassium (Sawyer, 1994). TDS is mostly due to dissolved ionic matter and bear a relationship with the electrical conductivity of water (Kapil and Bhattacharyya, 2008). The total dissolved solids indicate the concentration of dissolved salts present in water. The sum total of different cation and anions present in groundwater is expressed as Total dissolved solids (TDS). Total dissolved solids of the groundwater, in the study area, is varying from 452 to 2701mg/l. The higher conductivity and total dissolved solids values may cause a gastrointestional irritation in the consumers (Howard and Bartram, 2003). According to BIS, 1991 the maximum acceptable concentration of TDS in groundwater for domestic purpose is 500 mg/l and excessive permissible limit is 2,000 mg/L. All groundwater samples have total dissolved solids values well within permissible limit of BIS, 1991.

pH

The pH of ground water in the study area is varying between (5.27- 6.57). it is observed that most of groundwater is acidic in nature. Water 5.27 - 6.57 mg/l.

Summary & Conclusions

The study area occurs in the western part of Nalgonda district Narayanapur Mandal and lies between latitudes 17^0 02′ - 17^0 12′ N and longitudes 78^0 46′ - 78^0 59′ E covering Survey of India toposheet no 56 k/16. Major part of the investigated area falls in western part of the Nalgonda district. The study area covering of 252 Sq.km comprises 24 revenue villages. Scale: 1:50,000. The study area Narayanapur watershed is unique in its drainage and geomorphology, hence the topic so chosen. The **pH** of ground water in the study area is varying between(5.27-6.57). It is observed that most of groundwater is alkaline in nature. Electrical Conductivity (Ec) varies between (707-3670) µS/cm at 25°C. High conductance was observed in most of the groundwater samples and this may be attributed to high chloride concentrations in groundwater. Total dissolved solids (TDS) of groundwater in the study area vary from (452-2701). The principal ions contributing TDS are carbonates; sodium, nitrate, potassium, calcium and magnesium are contributing ions for TDS. The high concentrations of TDS are due to the combined effect of litho chemistry, sewage contamination and industrial effluents. Calcium & Magnesium concentrations are varying from (16-144) and (5-175) mg/l. The concentration of Ca& Mg is due to the weathering of pyroxene, plagioclase feldspars, apatites and sphene present in the granites and plagioclase feldspars. Chloride concentrations are varying from (20-1080) mg/l. Apart from natural sources, domestic sewage and industrial effluents also contribute for chloride in groundwater. Nitrate concentrations vary from (0.35-100) mg/l. 45% of the samples are exceeding in desirable limit. The source of medium - high nitrate concentrations in the study area

is attributed to the anthropogenic sources and improper disposal of domestic and industrial wastes. TDS values the groundwater of the study area has been classified and observed that 100% of groundwater falls into the fresh category. The Fluoride concentration in the study area ranges from (0.95-8.17) mg/l. The sulphate concentration of the groundwater samples of the study area ranges from 21 to 300 mg/l. which below the permissible limit of 400 mg/l (BIS, 1991).

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