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Hydrogeochemistry Study of Madhurawada Panchayat, Visakhapatnam District, Andhra Pradesh, India

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Abstract:

Groundwater contamination due to sea water intrusion is a well known problem in Madhurawada panchayat(group of villages). This study attempt to give answers the hydrogeochemistry nature of groundwater chemical parameters in Madhurawada Panchayat. In the study we apply existing field bore well and dug well observation which incorporate with laboratory water sample examination according to WHO and BIS standards and of course indirect questioning with the villager. The result has shown the contamination level of EC, TDS, TH, Ca+, Na, Cl-, F-, and Fe in the Paradesipalem, Boravanipalem, KommadiJn, Marikavalasa, Thotlakonda, Jodugullapalem and Boddapalem in both bore well and dug wells above the limit of permissible limit for drinking limit. Calcium and magnesium are the dominant cations present in groundwater next to sodium and chloride in this region. Therefore, requisition should be taking at the time of groundwater usage.

Key words: hydrogeochemistry, Groundwater samples, groundwater chemistry, water quality standards, water quality parameters

Introduction

The environmental problems existing in the urban areas of developing countries, waste management and its impact on groundwater quality have been the most prominent in the recent years (Rajkumar et al., 2010). The Greater Visakhapatnam Municipal Corporation (GVMC) is the second biggest municipal corporation in the state of Andhra Pradesh, India. There are no major surface water bodies in the area and the dependable groundwater resources are being polluted at an alarming rate. Presently, groundwater quality is the major concern and therefore emerged as one of the most important environmental issues. Water demand for drinking and domestic purposes has been increasing due to change of life styles of people and demographic pressures (Swarna Latha et al., 2013). The industrial effluents of the Zinc smelter-Aluminum factory in Mindi Visakhapatnam move in the direction of groundwater movement and flow towards marsh land through residential areas due to topographic control (Reddy and Rao, 1995).Hence, this study has been taken up to ascertain hydrogeochemistry characteristics of groundwater in the Madhurawada Panchayat, Visakhapatnam district, Andhra Pradesh.

Study Area

The study area is covering approximately 102 km2. In the year 2004 the Madhurawada is major panchayat in Visakhapatnam district, in the year 2006, 100 km2 Visakhapatnam Municipal Corporation was extended to 545 km2 area of Greater Visakhapatnam Municipal Corporation (GVMC). In this contrast the Madhurawada Panchayat was merged in Greater Visakhapatnam Municipal Corporation (GVMC). The GVMC is famous for major industries, often called as Industrial City or Visakha Steel City. The area has four major hill ranges viz.,

Kailassa, Yarada, Naraka and Kambalkonda. The rest of the area is characterized by undulating topography. The drainage is generally dendritic to sub-dendritic (Fig. 1).

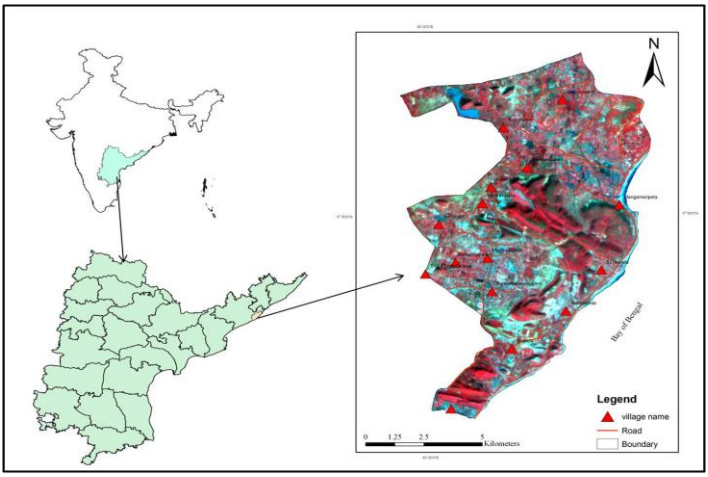

Figure 1: Location of the study area

Methodology

In post monsoon, about 14 groundwater samples were collected covering the entire Panchayat during February, 2014. In Monsoon, about 27 water samples were collected adjacent to the unlined sewage drains (gedda) during August 2014 to identify the water quality parameters in terms of physical and chemical on the basis of APHA standard methodology (2005). Systematic work has not been carried out for the accumulation of higher toxicants in these areas. The concentrations of physical, chemical parameters in groundwater samples were compared with the Bureau of Indian Standards (BIS) and World Health Organization (WHO). The samples were analyzed for determining the concentrations of various chemical elements such as PH, EC, TDS, TH, BOD, COD, TA, Ca+, Mg2+, HCo3, Cl-, F-, and Fe. Samples were analyzed in laboratory using Flame Photometer for, Ca+ and Mg2+ elements, they were analysed by EDTA Titri metric method. NO3-, PO4-3, Fe were

analysed using UV Visible Spectrophotometer method, SO4- by Gravimetric method, F- by Orion Ion selective method, Cl- by Argentometric Method. All these procedures are part of APHA methodology for the examination of water quality. The data are presented by using piper diagram to see the concentration level of hydrogeochemical ion.

Results

The chemical parameters obtained in this analyses revealing that the pH varies from 6.12 to 7.76 of alkaline nature within the permissible limits. The electrical conductivity (EC) values are in between 0.99 ms to 840 ms. The concentrations of Ca+, Mg2+, F- and Cl- ions are observed closer to the maximum permissible limits in the villages of Boyapalem, Paradesipalem, Boravanipalem, Mangamaripeta and Kapulauppada. These villages are in downstream areas of Kapulauppada landfill site. The concentrations of TDS and TH and Na+ and Fe have exceeded maximum permissible limits in Kapulauppada, Thotlakonda and Mangamaripeta. The higher contents in these villages could be seepage from the unlined sewage drain. These elements cause cardio vascular diseases which are reported in soft water areas. So far, no case has been reported regarding polluted groundwater in the area. The main source for sodium in groundwater resources is plagioclase feldspars, feldspathoids and clay minerals. Sodium content around 200 mg/l may be harmful to persons having cardiac and renal diseases and in women with toxemia associated with pregnancy (NAS, 1977).

The concentration of sodium varies from 10 mg/l to 540 mg/l. Two samples found to be excess of Na+ than the maximum permissible limits in Kapulauppada and Thotlakonda. The calcium is a major constituent of most igneous, metamorphic and sedimentary rocks. The principal source of Ca+ in groundwater is members of the silicate mineral groups like plagioclase, pyroxene and amphibole among igneous

and metamorphic rocks and limestone, dolomite and gypsum among sedimentary rocks. Disposal of sewage and industrial wastes are also important source of calcium. Concentrations upto 1800ppm has been found not to impair any physiological reaction in man (Lehr et al., 1980). The calcium ranges in between 16-160 mg/l. The magnesium concentrations in the study area varies from 5 mg/l to 136 mg/l. Kapulauppada and Mulagada samples are having excess content than the permissible limits in (Table 1)

Table 1: Seasonal wise concentrations of ions in groundwater samples

S. No.	Constituents	Bureau of Indian Standard (IS-10500:1991)	Pre-monsoon (Aug 2011)	Post-monsoon (Mar 2011)
			Range	Range
1	pH	6.5 – 8.5	6.15 - 7.71	6.43 - 7.74
2	EC	700-3000	0.50 - 2.51	1.20 - 840
3	TDS	500-2000	572 - 1146	220 - 2840
4	TH	300-500	140 - 907.5	120 - 860
5	BOD	-	0.50 - 3.00	0.2 - 28
6	COD	-	5.8 - 0.90	0.5 - 66
7	TA	-	140 - 860	90 - 980
8	Ca+	75-200	61 - 151	78 - 160
9	Mg2+	30-100	21.69 - 756.5	5 - 136
10	Na+	200-300	-	10 - 540
11	K +	10	-	0.1 - 3.4
12	HCO_3	500	85.40 - 378.20	28 - 524
13	Cl^-	250-1000	69.58 - 442.3	18 - 880
14	F^-	1.5	0.65 - 1.90	0.68 - 1.76
15	NO_3^-	45	2.20 - 5.80	1.4 - 12.4
16	SO_4^-	150-400	28 - 150	10 - 298
17	PO_4^-	-	-	0.8 - 3.5
18	Fe	1.0	0.19 - 1.20	0.09 - 2.4

Calcium and magnesium are the dominant cations present in groundwater next to sodium and chlorine in this

region. However, the formation of bicarbonate is almost at negligible rate. The reason why the concentration of carbonate increases in this study might be due to the available carbonates In these rock might have dissolved and added to the groundwater system during irrigation, rainfall infiltration and groundwater movement. Moreover, if the$Ca^{2+}$and Mg^{2+} solely originated from carbonate and silicate weathering, these should be balanced by the alkalinity alone. However, most of the points are placed in the Ca^{2++} Mg^{2+} side, which indicates excess calcium and magnesium derived from other process such as reverse ion exchange reactions (Fig. 2).

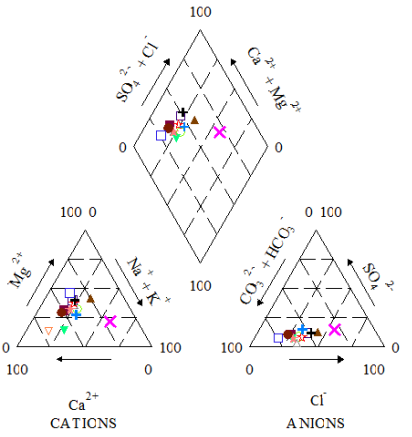

Figure: 2. Piper diagram of hydrogeochemistry of the study area.

Conclusion and recommendation

This research work intended to get answer about hydrogeochemistry of Madhurawada panchayat, Visakhapatnam District, Andhra Pradesh, India. Investigations in study area revealed that, rapid growth in population during the recent decades resulted in increasing the usage of groundwater. During this study, it is observed that the higher content of different elements in groundwater is due to effluents, from industries and leachates from improper handling of urban

solid wastes. Therefore appropriate sewerage for the industrial waste is high recommended.

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