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Hydro Chemical Analysis for the Coastal Belt of Srikakulam Region

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Abstract*— The ever-growing demand for freshwater for human consumption has become a worldwide cause for concern. Nowadays, groundwater reserves are exposed to intensive exploitation, which may create serious problems in coastal areas where some hydraulic connection exists between the water reservoirs and seawater. Hydraulic gradients following intensive withdrawal of freshwater in this type of aquifer can favor saltwater intrusion, which in extreme situations can strongly affect the pumping wells. The entire study area is divided into grids. The wells are identified and located in eight lines perpendicular to the coast. Around 97 wells are located for carrying the study. The water quality ionic ratios (Cl - / (Co3 + HCo3) ,Na^+ / Cl^- ,$So4^{2-}$ / Cl- ,Ca^{2+} / (HCO^{3-} + $SO4^{2-}$) Mg^{2+} / Ca^{2+}) are determined at a frequency of once in a month. The monthly variations of these ionic ratios at the well points are observed with respect to aquifer water levels and existing geology. In this paper the study is focused on western side of the map surrounded area is Nizamabad, Srikurmam and Chinnathulugu and line is perpendicular to coastal line.

Index Terms— **Ionic ratios, water levels, coastal belt, Aquifer, saltwater concentration.**

I. INTRODUCTION

Water is naturally available in space and time but not necessarily in accordance with man's numerous needs. Technological activities have made it available even more conveniently and abundantly. Water supply for drinking, agriculture, municipal and industrial purpose is some of the familiar technological activities. In view of rapid population growth and proposed economic developments there is an increasing problem of resource depletion and environment pollution. Water (Barlow, Paul M. 2003). is related to the economic development in complex manner. Therefore long term policy planning is now increasingly being emphasized in India and as a part of the same assessment, exploration and planned utilization of ground water becomes necessary in urban and semi-urban areas where the population growth is rapid.

The demand for water has increased over the years and this has led to water scarcity in many parts of the world. The situation is aggravated by the problem of water solution or contamination. India is heading towards their freshwater crisis mainly due to improper management of water supplies and environmental degradation, which has led to a lack of access to safe water supply to millions of people. This freshwater crisis is many parts of India, bearing in scheme and intensity [3] depending mainly on the time of the year. The national water policy 1987 states that water is a prime natural resource, basic human need, and precious national asset. It gives special attention to drinking water for both humans and animals over its other uses.

II. STUDY AREA

Srikakulam district is one of the important districts of Andhra Pradesh bordering Orissa on one side and Bay of Bengal on other side. This district has the longest coast line about 193 kms in the state of Andhra Pradesh. The Nagavali and Vamsadhara are the major rivers in Srikakulam district. These two river basins together constitute about 5% of the area. A large number of bore wells and open wells based spread over the area selected for the study and the water quality has been assessed for both dry and wet seasons over a period of 5 months. The study area is approximately 70 km^2 and 97 observation wells are located in the study areas shown in map 1. The study area is bounded by $18^o\ 15^1\ 50.26^{11}$ and $18^o\ 21^1\ 8.26^{11}$ latitudes and $83^o\ 59^1\ 24^{11}$ and $83^o\ 8^1\ 48^{11}$ longitudes.

III. METHODOLOGY

The study area is divided in to number of equal stripes perpendicular to coast and located (Environment Canada ,1987)around 100 wells (open wells and bore wells)for the study .The following parameters are estimated for the

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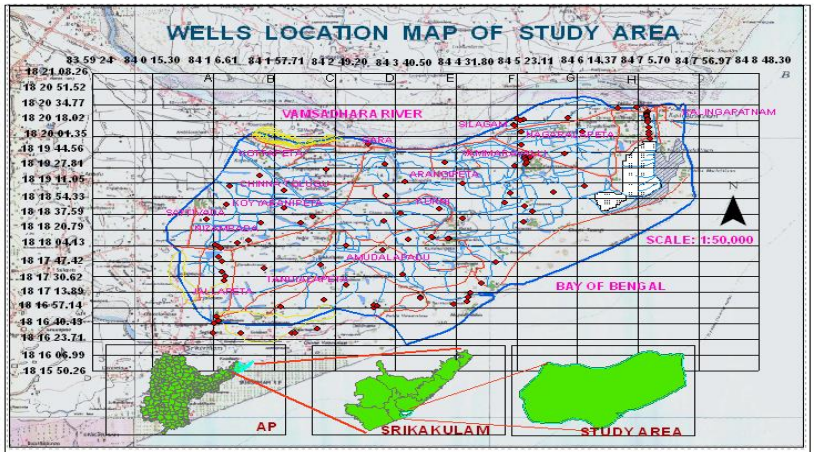
determination of pollutant concentration. (i) Determination of well ground levels [4] with mean sea levels (ii) Measurement of waters levels with MSL (iii) Analysis of water quality parameters& ionic ratios and the following procedure is applied for the water level measurement, quality analysis and Identification of well locations.



Map1. Well locations map of study area

Well locations and water level measurement

The geographical coordinates of each study well is needed to be found out. A GARMIN GPSMAP 76CSx with accuracy less than 15 meters is used to identify the wells in WGS-84 datum spread [1] over the study area. At each location considerable time is spent till signal from minimum of four satellites with 100 % signal strength seen on the satellite page of the GPS. Using this instrument the latitude and longitude of location of each well is found out. At the time of collecting the water samples, we determined the[6] water level of each and every well by using water level indicator. The below picture is of the water level indicator which resembles that it can be used for determining the water level in the bore well also.

IV. RESULTS AND DISCUSSIONS

Table.1.well locations and quality ratios of November

s.no	Type of well	Latitude	Longitude	Ratio Na^+ / Cl^-	Ratio So_4^{2-} / Cl^-	Ratio Mg^{2+} / Ca^{2+}	Ratio Ca^{2+} / (HCO_3^- + SO_4^{2-})	Ratio Br^- / Cl^-	Ratio Cl / (CO_3 + HCO_3)
1	bore well	18.3151	84.03295	1.832	5.763	0.234	0.321	0.21	1.98
2	bore well	18.315	84.03291	2.765	6.321	0.342	0.432	0.24	1.54
3	bore well	18.3149	84.03234	4.786	7.453	0.543	0.110	0.19	1.55
4	bore well	18.3147	84.03216	4.903	8.543	0.675	0.112	0.17	1.26
5	bore well	18.3144	84.03132	5.298	8.716	0.7815	0.119	0.78	2.46
6	bore well	18.3024	84.03778	13.987	10.432	0.678	0.432	0.86	2.65
7	open well	18.2983	84.03674	22.35	12.619	0.423	0.645	0.65	2.89
8	open well	18.2985	84.0361	0.94	0.816	0.7142	0.132	0.56	2.65
9	open well	18.2968	84.03601	0.100	0.765	0.673	0.234	0.68	2.84
10	open well	18.2949	84.03594	0.094	0.620	0.405	0.109	0.69	3.12
11	open well	18.2947	84.03632	0.087	0.564	0.342	0.043	0.65	3.62
12	open well	18.2944	84.03478	0.076	0.432	0.224	0.456	0.55	3.39

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In this contest the study is focused on Line "B' i.e perpendicular to the coastal belt and well locations and (Bartram, J. and Ballance, R. 1996) quality ratios are given below Tables. 1, 2, 3 and 4. That are located in such way that the first point near to sea coast and 12th number is the[2] far away from the coast and study is carried out for four months i.e. November, December, January and February. After determining the water quality parameters, Ionic ratios and water level measurement of selected wells the results were presented in the following pattern.

Table.2 .well locations and quality ratios of December

s.no	Type of well	Latitude	Longitude	Ratio Na^+ / Cl^-	Ratio So_4^{2-} / Cl^-	Ratio Mg^{2+} / Ca^{2+}	Ratio $Ca^{2+} / (HCO_3^- + SO_4^{2-})$	Ratio Br^- / Cl^-	Ratio $Cl / (CO_3 + HCO_3)$
1	bore well	18.3151	84.03295	1.832	5.763	0.234	0.321	0.21	1.98
2	bore well	18.315	84.03291	2.765	6.321	0.342	0.432	0.24	1.54
3	bore well	18.3149	84.03234	4.786	7.453	0.543	0.110	0.19	1.55
4	bore well	18.3147	84.03216	4.903	8.543	0.675	0.112	0.17	1.26
5	bore well	18.3144	84.03132	5.298	8.716	0.7815	0.119	0.78	2.46
6	bore well	18.3024	84.03778	13.987	10.432	0.678	0.432	0.86	2.65
7	open well	18.2983	84.03674	22.35	12.619	0.423	0.645	0.65	2.89
8	open well	18.2985	84.0361	0.94	0.816	0.7142	0.132	0.56	2.65
9	open well	18.2968	84.03601	0.100	0.765	0.673	0.234	0.68	2.84
10	open well	18.2949	84.03594	0.094	0.620	0.405	0.109	0.69	3.12
11	open well	18.2947	84.03632	0.087	0.564	0.342	0.043	0.65	3.62
12	open well	18.2944	84.03478	0.076	0.432	0.224	0.456	0.55	3.39

s.no	Type of well	Latitude	Longitude	Ratio Na^+ / Cl^-	Ratio So_4^{2-} / Cl^-	Ratio Mg^{2+} / Ca^{2+}	Ratio $Ca^{2+} / (HCO_3^- + SO_4^{2-})$	Ratio Br^- / Cl^-	Ratio $Cl / (CO_3 + HCO_3)$
1	bore well	18.3151	84.03295	1.534	5.876	0.673	0.321	0.22	1.25
2	bore well	18.315	84.03291	1.934	6.987	0.543	0.221	0.32	1.85
3	bore well	18.3149	84.03234	2.434	7.432	0.546	0.123	0.35	1.35
4	bore well	18.3147	84.03216	2.765	8.765	0.467	0.234	0.43	1.59
5	bore well	18.3144	84.03132	4.567	10.332	0.321	0.564	0.46	2.39
6	bore well	18.3024	84.03778	15.432	10.332	0.456	0.324	0.44	2.36
7	open well	18.2983	84.03674	24.987	0.876	0.654	0.326	0.66	2.22
8	open well	18.2985	84.0361	0.765	0.765	0.453	0.543	0.73	2.19
9	open well	18.2968	84.03601	0.712	0.321	0.556	0.453	0.79	2.15
10	open well	18.2949	84.03594	0.432	0.435	0.432	0.124	0.81	3.51
11	open well	18.2947	84.03632	0.329	0.123	0.453	0.112	0.86	3.32
12	open well	18.2944	84.03478	0.003	0.008	0.567	0.234	0.88	3.70

Table.3. well locations and quality ratios of January

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Table.4.well locations and quality ratios of February

s.no	Type of well	Latitude	Longitude	Ratio Na^+ / Cl^-	Ratio So_4^{2-} / Cl^-	Ratio Mg^{2+} / Ca^{2+}	Ratio $Ca^{2+} / (HCO_3^- + SO_4^{2-})$	Ratio Br^- / Cl^-	Ratio $Cl / (CO_3 + HCO_3)$
1	bore well	18.3151	84.03295	1.534	5.876	0.673	0.321	0.22	1.25
2	bore well	18.315	84.03291	1.934	6.987	0.543	0.221	0.32	1.85
3	bore well	18.3149	84.03234	2.434	7.432	0.546	0.123	0.35	1.35
4	bore well	18.3147	84.03216	2.765	8.765	0.467	0.234	0.43	1.59
5	bore well	18.3144	84.03132	4.567	10.332	0.321	0.564	0.46	2.39
6	bore well	18.3024	84.03778	15.432	10.332	0.456	0.324	0.44	2.36
7	open well	18.2983	84.03674	24.987	0.876	0.654	0.326	0.66	2.22
8	open well	18.2985	84.0361	0.765	0.765	0.453	0.543	0.73	2.19
9	open well	18.2968	84.03601	0.712	0.321	0.556	0.453	0.79	2.15
10	open well	18.2949	84.03594	0.432	0.435	0.432	0.124	0.81	3.51
11	open well	18.2947	84.03632	0.329	0.123	0.453	0.112	0.86	3.32
12	open well	18.2944	84.03478	0.003	0.008	0.567	0.234	0.88	3.70

Variations of Ionic Ratios with water levels are presented in the form of graphs. As shown in figure 2, 3, 4and 5 respectly for November, December, January and February

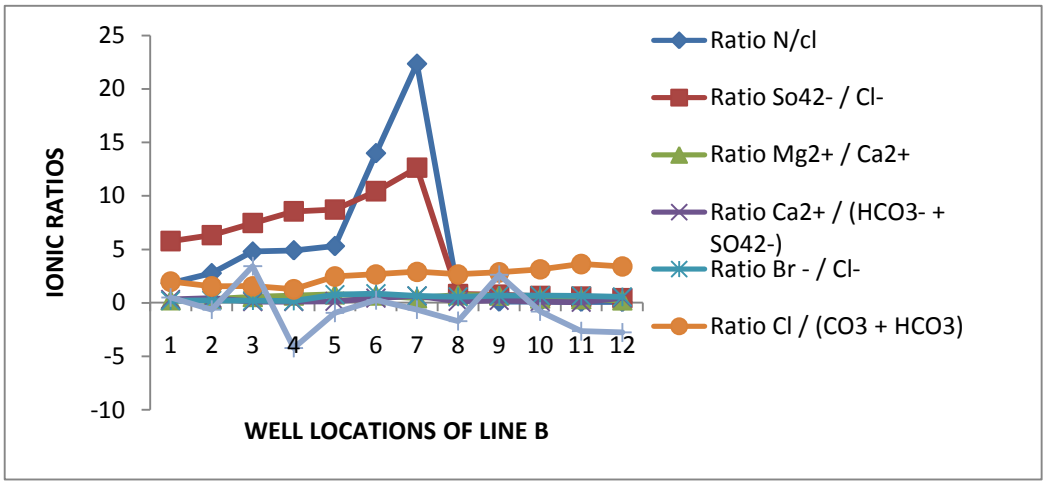

Fig 2: Variations of ionic ratios with respect to water level in November

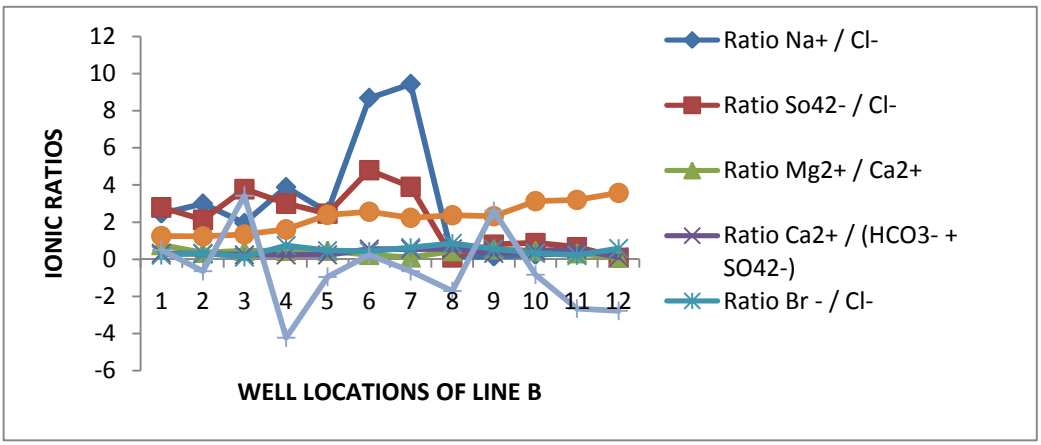

Fig 3: Variations of ionic ratios with respect to water level in December

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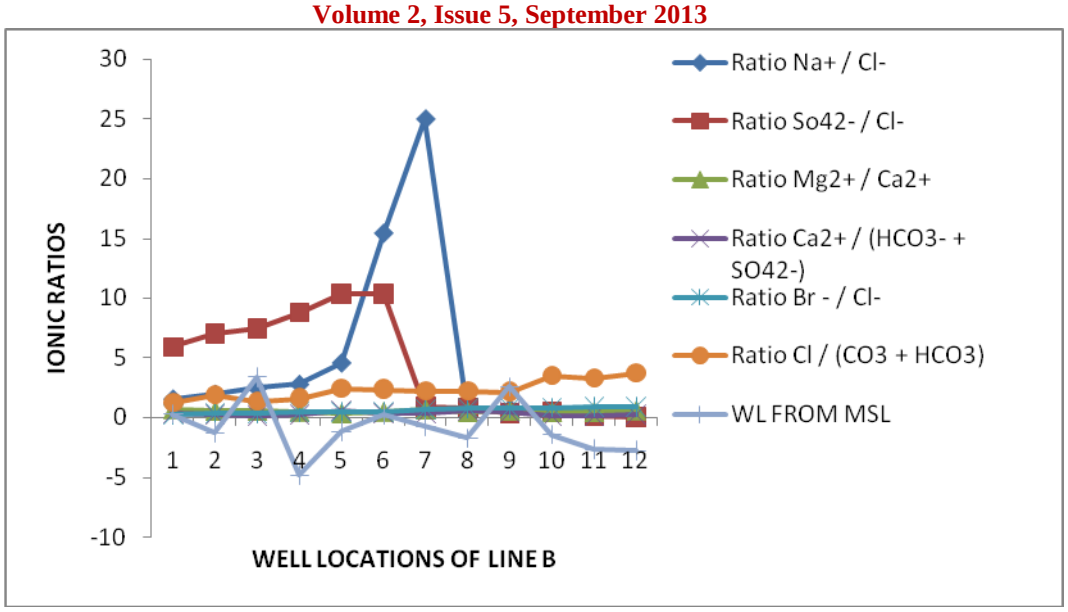

Fig 4: Variations of ionic ratios with respect to water level in January

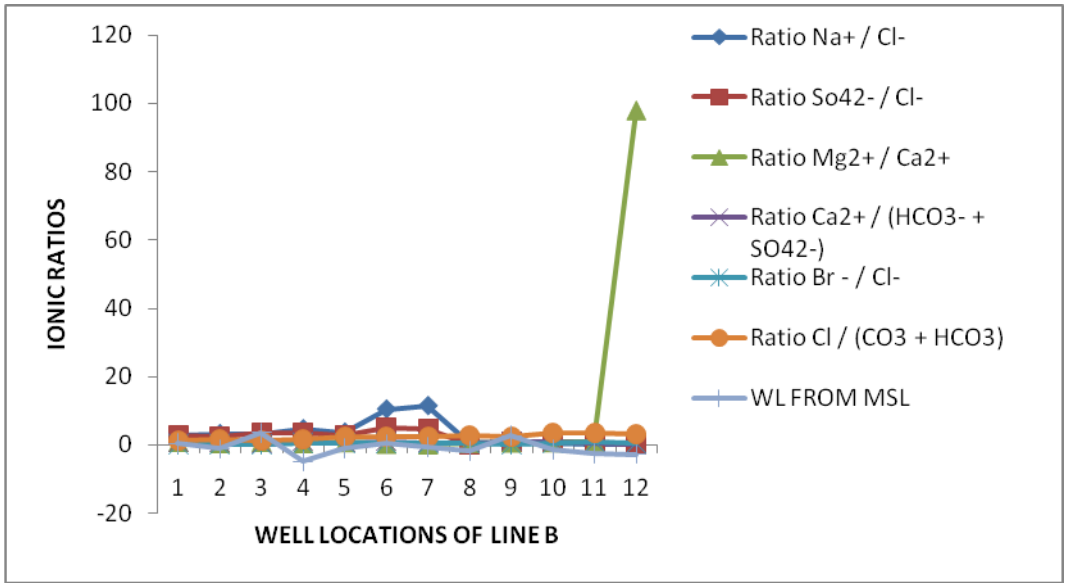

Fig 5: Variations of ionic ratios with respect to water level in February

V. DISCUSSIONS

(1) The ratio of Na^+ /Cl^- is maximum for Well point seven among all the Well points taken in this line.(2) The ratio of So_4^{2-}/Cl^- is maximum for Well point sevsn among all the Well points taken in this line..(3) The ratio of Mg^{2+}/Ca^{2+} for this line is within the permissible limit.(4) The ratio of $Ca^{2+} / (HCO_3^- + SO_4^{2-})$ is maximum for Well point sevsn among all the Well points taken in this line.(5) The ratio of Br^- / Cl^- is maximum for Well point 6 among all the Well points taken in this line.(6) The ratio of $Cl^- / (CO_3^{2-} + HCO_3^-)$ is maximum for Well point eleven among all the Well points taken in this line. (7) Based on above result, Well points six and eleven are moderately affected and well point seven is severely affected.

VI. CONCLUSION

The ratio of So_4^{2-}/Cl^- exceeds the permissible limit in all wells in the entire study area of line 'B' with time and it refers that there is a salt water concentration in the aquifer.

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