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GROUND WATER QUALITY ASSESSMENT USING GIS

E.Sanjeeva Rayudu[1], B.J.S.Varaprasad[2] ,G.Nagesh Kumar[3]

Associate Professor, Civil Department G. Pulla Reddy Engineering College Kurnool, Andhra Pradesh, India[1]

Associate Professor, Civil Department G. Pulla Reddy Engineering College Kurnool, Andhra Pradesh, India[2]

Sr. Professor, Civil Department G. Pulla Reddy Engineering College Kurnool, Andhra Pradesh, India[3]

Abstract: Assessing the quality of groundwater is important to ensure sustainable safe use of the resources and to preserve the natural ecosystem. Groundwater monitoring is an effort to obtain qualitative information on changes in the ground water storage and changes in the physical, chemical and biological characteristics of groundwater. Groundwater quality in GPREC campus and its premises has special significance as it is the major source of residential and drinking water supply. The present study monitors the ground water quality, relates it to the land use / land cover and maps such quality using GIS techniques for a part of GPREC premises. In the present study, thematic maps such as 6 locations, overhead tanks, main roads, minor roads, etc were prepared in toposheet. Physico-chemical analysis data of the groundwater samples collected at predetermined locations, which forms the attribute database for the study, based on which spatial distribution maps of major water quality parameters are prepared in ArcGIS software. The database, which is present in the form of attribute tables were queried and data related to different themes were retrieved. Analysis is done to find the suitability of water for drinking purpose by calculating parameters such as pH, TDS, EC, TH, Total alkalinity, Sulphate, Chloride, Nitrate, Calcium, and Magnesium. This project will be useful for groundwater department for better planning and efficient management of the resources.

Keywords: Groundwater; ArcGIS; pH, Toposheet; Management; Attribute data

I. INTRODUCTION

The subsurface water is most adversely affected due to their dynamic nature and an easy accessibility for the waste disposal directly or indirectly through drains/tributaries. Since, the ground Water has become most important source of water for domestic, irrigation, industrial and other uses [1].

Groundwater chemistry, in turn, depends on a number of factors, such as general geology, degree of chemical weathering of the various rock types, quality of recharge water and inputs from sources other than water rock interaction.Such factors and their interactions result in a complex groundwater quality [2, 3]. Groundwater geochemistry explains links between chemical composition of groundwater and subsurface geological and non-geological pollutants. Subsurface rock formations control the composition of soil and hence that of water and vegetation [4].

GIS is the effective tool for water quality mapping and land cover mapping essential for monitoring, modelling and environmental change detection. GIS can be a powerful tool for developing solution for water resources problems for assessing water quality, determining water availability, preventing flooding, understanding the natural environmental, and managing water resources on a local or regional scale [5].

Assessment of groundwater quality through Water Quality Index (WQI) studies and spatial distribution of WQI utilizing GIS technology could be useful for policy makers to take remedial measures. GIS can be a powerful tool for developing solutions for water resources problems to assess water quality, determining water availability, understanding the natural environment on a local and/or regional scale [6].

In subsurface water studies, GIS is commonly used for site suitability analysis, managing site inventory data, estimation of groundwater vulnerability to contamination, groundwater flow modeling, modeling solute transport and leaching, and integrating groundwater quality assessment models with spatial data to create spatial decision support systems [7, 8].

The advancement of GIS and spatial analysis helps us to integrate laboratory data with geographic data and to model the spatial distributions of water quality parameters robustly and accurately [9]. Groundwater contamination and spatial relationships among groundwater quality, topography, geology, landuse, and pollution sources using GIS in Seoul.

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GIS has been useful in establishing the spatial relationship between pollution level and its source in this study [10]. ArcView GIS was used to map, query, and analyze the spatial patterns of groundwater in north-central Texas that includes large percentages of both urban and agricultural land uses [11,12]In the present context, a Geographical Information System (GIS) tool was used to construct thematic maps for ground water quality in and around GPREC campus. Environmental data were integrated and an overall picture about the spatial variation in the ground water quality of the GPREC campus premises has been defined. The integrated spatial maps helped to define information about ground water quality. Assessing the quality of ground water is important to ensure sustainable safe use of these resources.

Engineering Lab on all the samples to know the quality of water at each place.

Tab.1 Characteristics of Water samples at various points

Location	EC	TDS	TH	Cl	NO2	SO4	TA	Mg	Ca	pH
T&P	905	597	152	70	0	30	557	111	41	7.7
Main Gate	1012	668	253	93	1	50	692	75	178	7.5
Temple	1006	664	242	102	1	80	715	82	160	7.6
Hospital	1263	834	233	106	2	40	732	202	31	7.3
Bore water	880	580	186	46	0	40	650	100	86	7.5
House	957	632	223	37	0	30	632	161	62	7.5
Dental College	1072	708	242	67	0	80	680	156	86	7.6
Mineral Plant	740	488	125	0	0	25	500	77	47	7.7
Orphanage	896	591	145	15	0	35	605	65	80	7.7
GNBVG	1042	688	240	77	1	40	672	80	160	7.6

II. METHODOLOGY

A. Study Area

The study area selected in and around GPRCE campus. Six points are selected in GPREC campus i.e. main gate, TNP, GNBVG, Temple, hospital and Dental College. Remaining four points are, two points at the backside of GPREC campus i.e. one at independent house and other one is the boring pump, one point is taken at mineral water plant present at the east of GPREC College and one point at orphanage present at the south east of the GPREC campus.

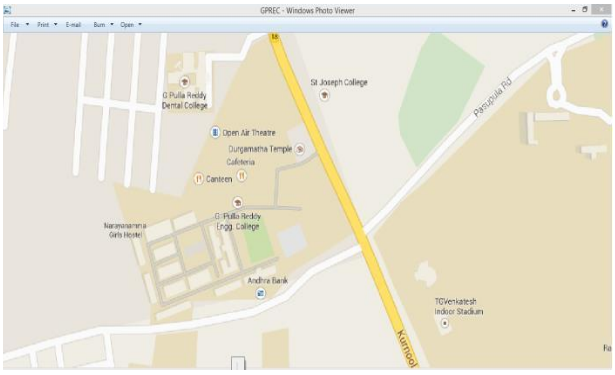

Fig. 1 GPREC campus and its premises

B. Sample collection and analysis

Sample should be collected in polythene or glass containers of 2liters capacity. Before taking the sample, the bottle is sterilized either by heating or treating with nitric acid. Residual acid must be removed by washing with distilled water. After this treatment the bottles can be used at the site of sample collection. The container is 1st half is filled, shaken and emptied later it is completely filled and then Stoppard. The collected water made to analyse as early as possible. The collected water is preserved is Environmental Engineering Lab. Recovered tests are to be conducted in Environmental

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C. Development of GIS Model

The layout of Kurnool map is prepared from the toposheets obtained from saved files. The same map was imported to Are View for the analysis. The digitizing is done manually on the computer monitor. The map is digitized in Arc View and the ultimate goal of digitizing in Arc View is to get the data in vector format exported map using Arc View soft ware. Required GPREC area map is selected from the toposheets of Kurnool town. Then give coordinates in each corner using "add control points" in "Geo referencing". It should be remembered that these coordinates are given in clockwise direction. Then this map is saved where ever required in the computer and this path is remembered. Then shape file is taken to create a new shape file. After creating shape file our points are located in the map by entering coordinates of our points. These coordinates are entered by giving a click on XY which is presented on the left tool bar to the map. Total points are located by this process. Star marks appeared in the map are our required points. Attribute table is to be prepared for these located points. The test values are entered in this table for each point. The test values of pH, Nitrite, TDS, EC, TH, TA, Calcium, magnesium, Sulphate, Chlorides. While entering these values type, scale, precision is correctly given. Values are entered by selecting "Start Editing" in editor and after entering the values select "Stop Editing" in that same Editor tool.

III. RESULTS AND DISCUSSION

A. General

In order to assess the ground water quality 10 sampling points are identified throughout the GPREC Campus and water samples have been collected. The major water quality parameters such as pH, TDS, TH, Sulphate, Chloride, Calcium have been estimated. The tested data of 10 locations for each parameter have been converted into attribute and spatial variation using GIS

Attributes of 09032015

FID	Shape*	Id	pH	EC_MH_cm_	TDS_ppm	TH_ppm	Cl_ppm	SO4_ppm	TA_ppm	Mg_ppm	Ca_ppm	NO2_ppm	Latitude	Logitute_E
0	Point	1	7.7	905	597	152.5	70.013	30	557.5	111.25	41.25	0	15.7738	78.0577
1	Point	2	7.5	1012	668	253.75	93.94	50	692.5	75	178.75	1	15.7745	78.0586
2	Point	3	7.6	1006	664	242.5	102.8	80	715	82.5	160	1	15.7748	78.0587
3	Point	4	7.3	1263	834	233.75	106.35	40	732.5	202.5	31.25	2	15.7754	78.0582
4	Point	5	7.5	880	580	186.25	46.08	40	650	100	86.25	0	15.7727	78.0506
5	Point	6	7.5	957	632	223.75	37.22	30	632	161.25	62.5	0	15.7732	78.0514
6	Point	7	7.6	1072	708	242.5	67.35	80	680	156.25	86.25	0	15.7765	78.0559
7	Point	8	7.7	740	488	125	0	25	500	77.5	47.5	0	15.7717	78.0562
8	Point	9	7.7	896	591	145	15.95	35	605	65	80	0	15.7725	78.0529
9	Point	10	7.6	1042	688	240	77.103	40	672.5	80	160	1	15.7748	78.0558

Fig. 2 Attribute table showing different tests values for selected location

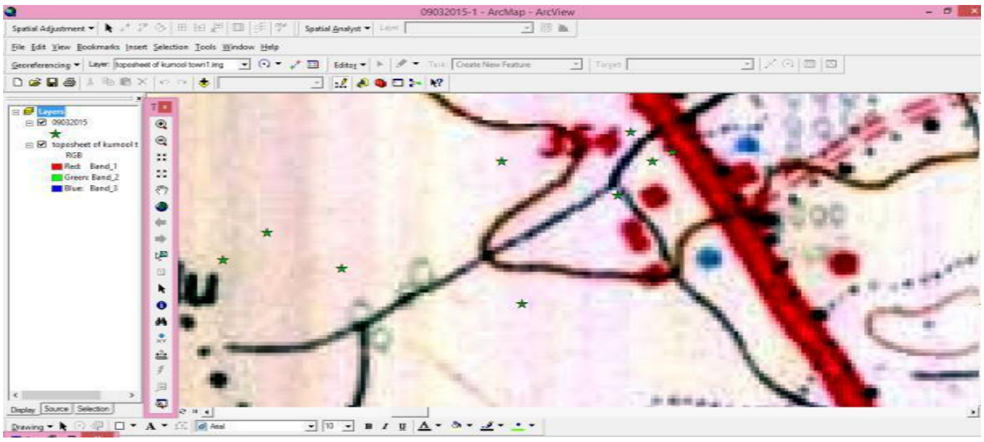

Fig. 3 Location of points

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B. Showing Data for Individual Point

To check the values for an individual point on special data, click the identity and then click on a particular point to which it is needed to display all test values. It shows values of a selected point as shown in fig. 4

C. Bar Graph

Bar graph is developed which shows the variation on Calcium at different points. In this bar graph, ID i.e., sample number is taken on X-axis and related values of Ca are taken on Y-axis. The value of Ca is very high at 2nd sample and low at 4th sample. This variation is shown in following fig. 5

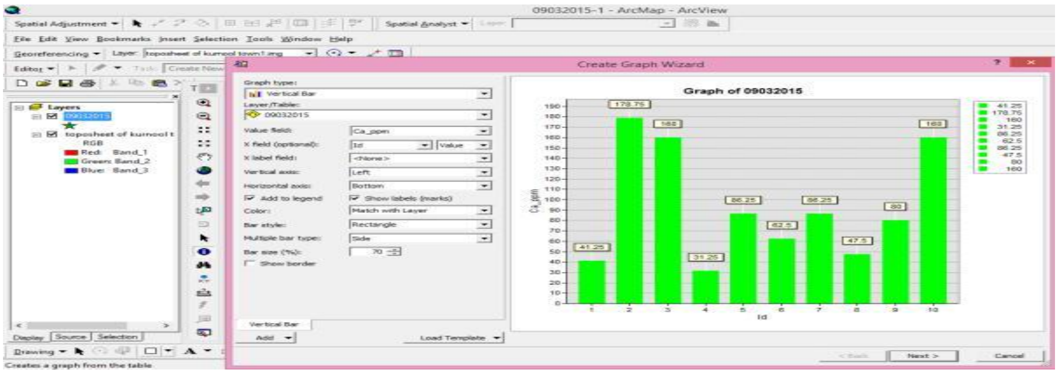

Fig. 5 Values of Calcium at different locations showing in bar chart

D. Locating points by interpolate to raster

Points can also be located by using this feature where same procedure is followed as mentioned above for previous features. For this there are different sub features. In that, inverse distance weighted is selected. Sufficient value is given in the dialogue box which is appeared on giving a click on inverse distance weighted. Results are shown in fig. 6

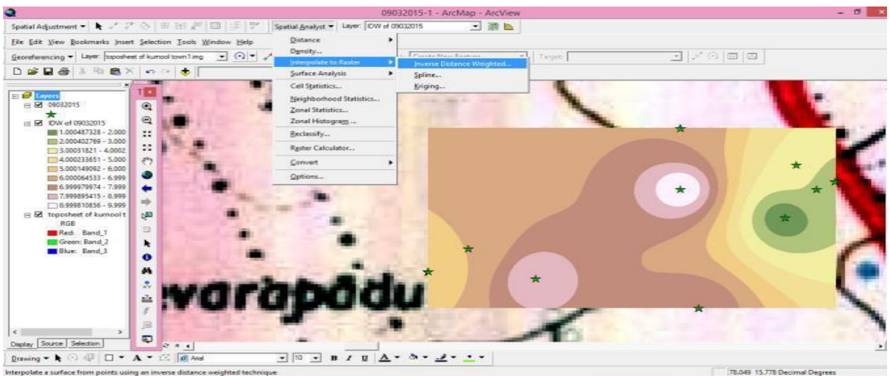

Fig. 6 showing points by using Interpolate to raster

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E. Build a query on Calcium and Hardness

A query can also be build by selecting different fields. A query is built comparing Calcium and Total Hardness. The figure shows results on a query 3, we can see the query which is visible on the left side of the figure 7.

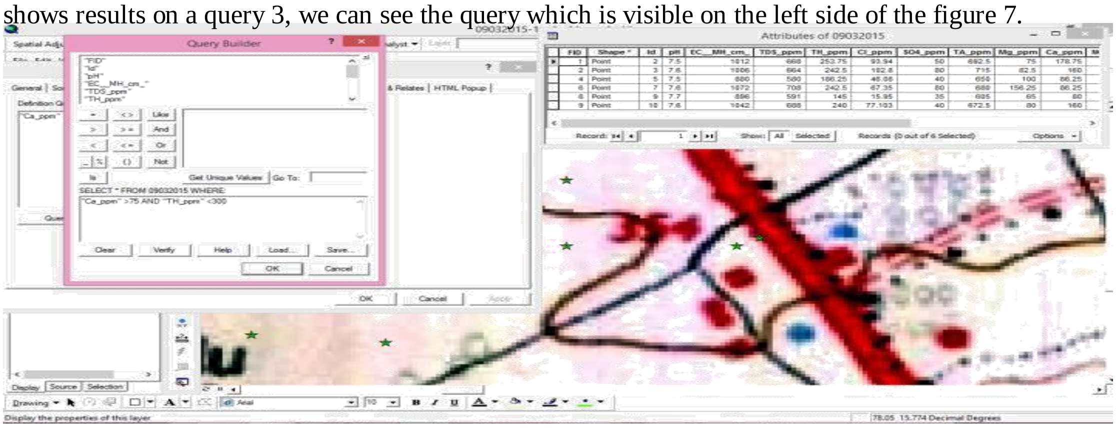

Fig. 7 showing comparison between Calcium and Total Hardness

IV. CONCLUSIONS

The ground water in all the sample areas does not meet WHO water standards. So they require proper treatment before using for drinking purpose. As per calculated values, samples 2, 3, 4 and 10 at GPREC main gate, temple, hospital and GNBVG respectively are of bad quality and remaining samples are of medium quality. Based on the analysis, some parameters like Total Alkalinity require treatment for entire study area. Whereas Nitrites and Calcium require treatment in some particular study areas only. Some parameters like pH, SO4, EC, TDS; Total Hardness satisfies the permissible limits in entire study area. According to analysis, samples 2, 3, 4 and 10 at GPREC main gate, temple, hospital and GNBVG respectively contains Nitrites which is a symbol of contamination which require compulsory treatment. The produced ground water quality related database would serve as an important information source for GPREC.

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