ASSESSMENT OF GROUNDWATER QUALITY USING GEOGRAPHIC INFORMATION SYSTEM FOR RAICHUR CITY CMC LIMIT AREAS

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Abstract

The purpose of this work is to evaluate the quality of groundwater and map it using the Geographic Information System (GIS) of the Raichur City CMC limit areas. The toposheet of Raichur viz., which was utilized to base map the study, is one of the main data sources for the investigation. Based on the digitally scanned survey of India map, water bodies and the road system were created. The widely used desktop GIS program ArcGIS served as the platform for the thematic map digitization and analysis. Using field kits testing of pH, total hardness, calcium hardness, total alkalinity, chloride, fluoride, and iron content were carried out, three to four sample site points were chosen for ward-wise water quality analysis tests. The format was pre-prepared and included field data that was obtained from all 35 wards. In ArcMap, 85 sample locations were discovered and subsequently uploaded as attribute data. Field data pertaining to the sampling locations, gathered from all 35 wards, was also added. GIS analysis was performed following the addition of all the data. This study demonstrates how geo-informatics technique may be used to prepare baseline data that is more reliable and consistent for predicting groundwater quality.

Keywords: *Ground water quality analysis, Arc GIS, Thematic Maps.*

INTRODUCTION

The best possible use of water resources greatly depends on the quantity and quality of groundwater being assessed. In urban areas, groundwater is the primary supply of water for home, industrial, and drinking needs. However, it is frequently overused. Groundwater becomes unusable for future usage due to degradation brought on by rapid urbanization and poor solid and hazardous waste management techniques in metropolitan areas. According to Milovanovic [1], ground water pollution poses a threat to human health, economic growth, and social prosperity in addition to lowering the quality of the water. According to Ketata Mouna et al. [2], the physical, chemical, and biological characteristics of water are typically used to describe its quality. The Water Quality Index (WQI) is used to measure this quality and determine whether or not the water is suitable for human use. Based on a number of water quality criteria, WQI produces a single figure that represents the total water quality at a specific area According to Yogendra and Puttaiah, [3]. In addition to serving as a preventative indicator of possible environmental health issues, a groundwater quality map becomes an important metric for assessing potability.The most reliable and precise modeling of the spatial distributions of water quality parameters is made possible by the advancement of geographic information systems (GIS) and spatial analysis. These techniques also aid in the integration of laboratory analytical data with geographic data. With the advancement of GIS and remote sensing, decision makers may now better comprehend challenges through visual aids and field data inputs where various parameters can be adjusted for problem analysis. The objective of the investigation is to evaluate and map Raichur City CMC limits groundwater quality throughout all 35 wards.

Literature Review

Balakrishnan, N. P. [4] The study uses Geographic Information System (GIS) to investigate spatial changes in ground water quality in Gulbarga City, India. Water samples were collected from 76 open and bore wells in the area. Physico-chemical parameters like TDS, TH, and Cl were measured in a laboratory using conventional techniques. The results were compared with standards. GIS spatial interpolation technique was used to create ground water quality information maps for each characteristic. The findings and GIS spatial database will be used to monitor and manage groundwater pollution in the region. If a better alternative source was unavailable, mapping was coded for both potable and non-potable zones based on the water quality of the area.

Magesh, N.S., Chandrasekar [6] The current study examined the physicochemical data of groundwater samples from 49 distinct bore wells in the Virudunagar district, both before and after the monsoon. Using a geographic information system, spatial distribution maps were created for a range of physicochemical parameters. The World Health Organization's guidelines for the most desired, maximum permitted, and not permissible categories are used to further categorize these maps. To further comprehend the groundwater quality in the study area, a map of the water quality index (WQI) was also created.

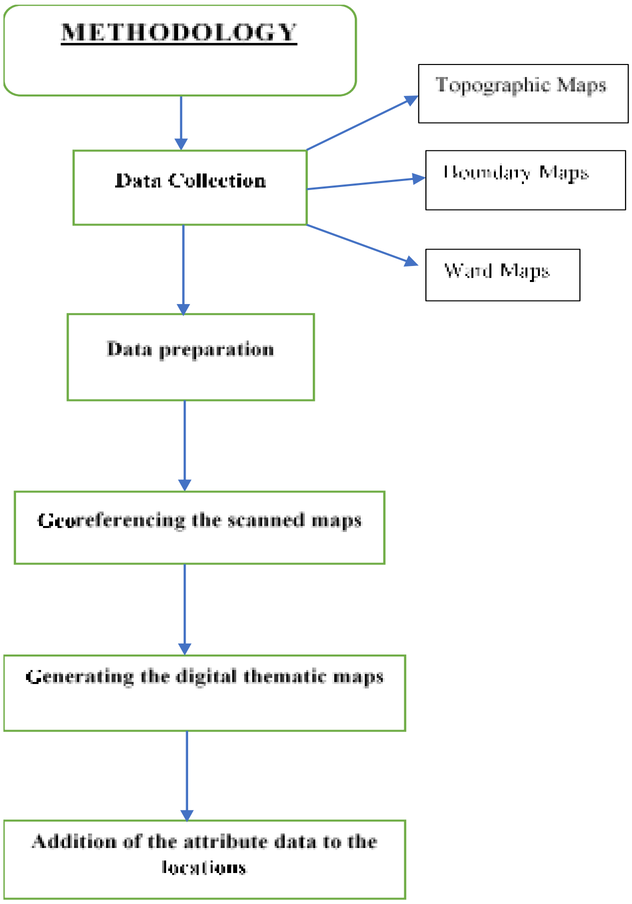
Pande, C.B., Moharir, K[5] For the purpose of creating groundwater quality maps, the groundwater quality samples were analyzed for parameters including pH, electrical conductivity, TDS, Cl, and Mg. Using IWD interpolation techniques, the parameters pertaining to groundwater quality were analyzed for each sampling location. ARC GIS software was utilized to produce and merge the maps of spatial variation. The spatial distribution of groundwater quality characteristics in the basaltic hard rock area was obtained using the interpolation tool. As a result, it has been determined that the groundwater in the basaltic hard rock area is appropriate for irrigation and drinking based on the results of a large-scale groundwater analysis.

Duraisamyet al [7] Geographic information system (GIS) was used to create choropleth (zonation) maps in order to comprehend the spatial variation of hydrogeochemical parameters over the study area. Using GIS, all of the spatial plots were overlaid, and the overall groundwater quality zones were defined. Based on the WHO's drinking-water criteria, three groundwater quality zones were established: (1) most desirable, (2) maximum permitted, and (3) not permissible. According to this study, 49% of the study area lacks access to drinkable groundwater. The "most desirable" category makes up around 21% of the space, while the "maximum allowable" category for drinking purposes occupies the remaining 30%. The region's groundwater is Mixed CaMgCl type, according to the Piper's trilinear diagram. Nearly 49% of the whole area has poor groundwater quality, so treatment is required before using the water for drinking. To increase groundwater quality and quantity, artificial recharging of the aquifer is also necessary.

STUDY AREA

The Raichur city serves as the district headquarters, with 35 wards and 234,073residents, the city municipal council's jurisdiction covers an area of 60 sq-kms Raichur is situated between the Krishna and Tungabhadra rivers, which flow between 20 and 30 kilometres away from the town. The town is home to the most prominent and lucrative power producing facility, the eight-unit, 210 MW Raichur Thermal Power Station. Furthermore, there are a lot of small-scale industries in and around the town. The state of Karnataka's north-eastern region is home to the Raichur district. It is situated between latitudes 15º 12' North and longitudes 77º 21' East, in the northern median region. The location is 400 meters above mean sea level.

METHODOLOGY



SURVEY OF INDIA TOPOSHEET OF THE STUDY AREA

Fig.1 Raichur SOI Toposheet

Base layers creation-water bodies, roads, rail etc

The survey of India toposheet map was digitized to create a water bodies map showing the ponds and lakes in the Raichur city.

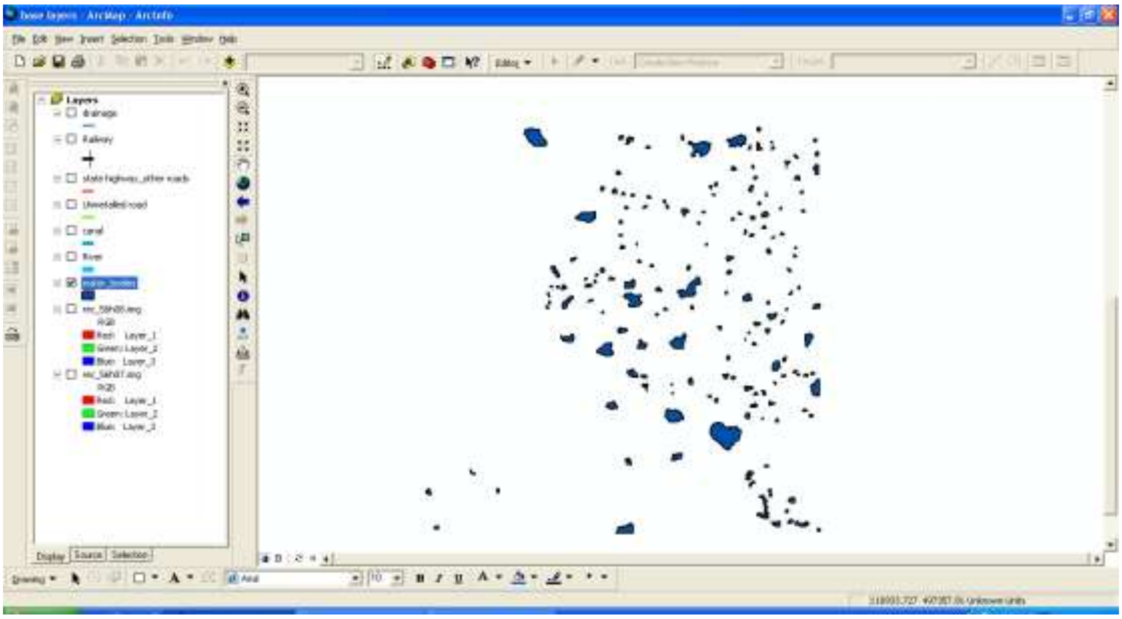


Fig.2 Map showing Base layer creation

Ward wise maps

Raichur city area ward wise maps that were created by digitizing the SOI toposheet.

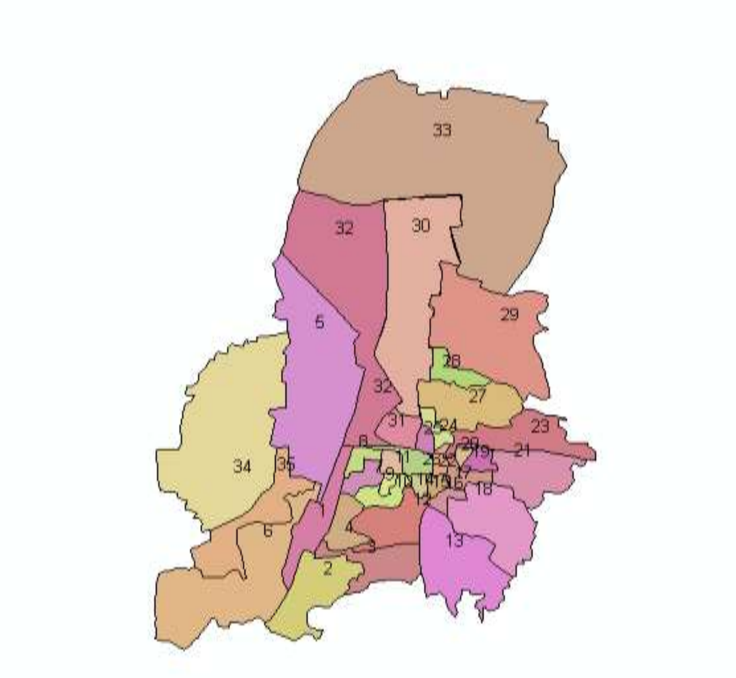


Fig.3Raichur ward wise boundary map

Results and Discussion

The toposheet of Raichur viz., which served as the study's base map, is one of the main data sources. Based on the digitized map of India, water bodies and the road network were created. Within the parameters of the well-known desktop GIS program Arc GIS Desktop 9.2, the thematic maps were digitized and analysed.

A field test of samples was conducted for the designated sampling points after two to three sample location points were established for ward-wise water quality analysis.The format was pre-prepared and included field data taken from all 35 wards.

ward no	Ward name	Sample point	latitude	longitude	pH	T H	C. H	Total alkalinity	Chloride	Fluoride	Iron

Table.1Data collected from the selected sample sites

A total of 35 wards' field data on sampling location points were gathered and applied as attribute data to the 85 sample location points that were discovered and produced in ArcMap. Following the addition of all the data, analysis was done for the following parameters are pH,Total hardness, Calcium hardness, Total alkalinity, Chloride, Fluoride and Iron content.

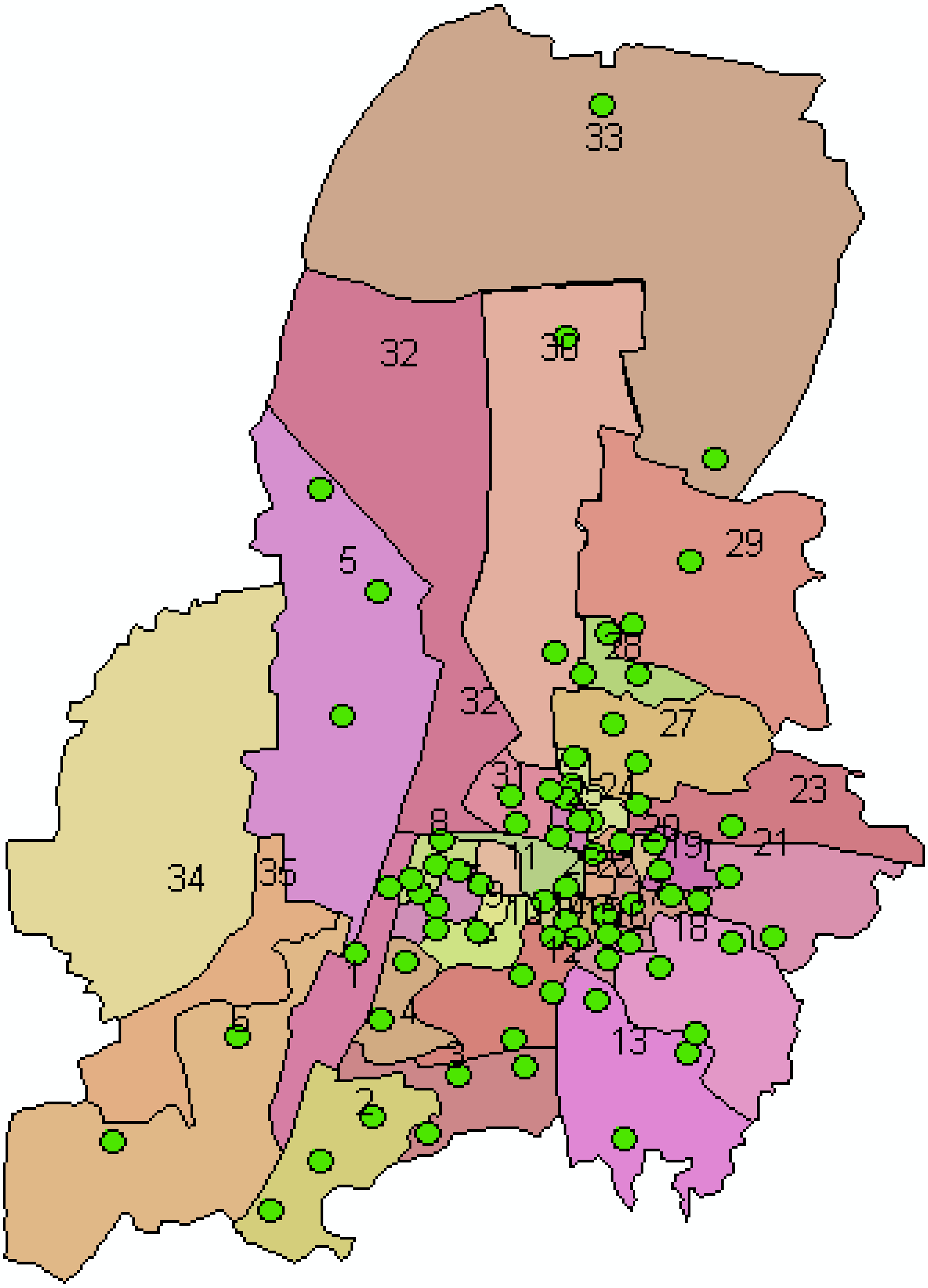

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Fig.4 Bore well location map

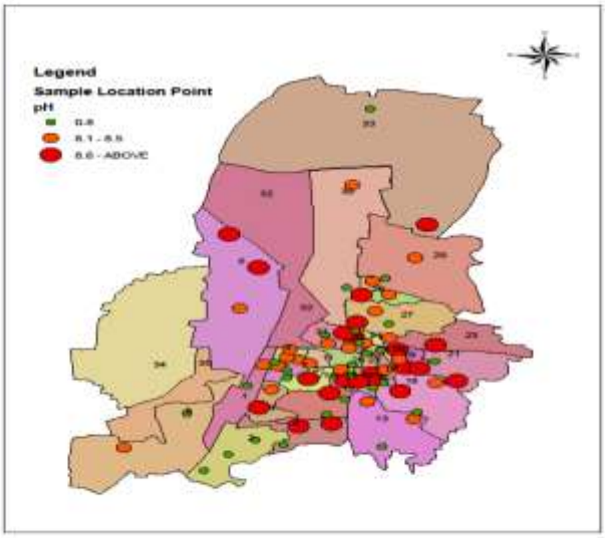

Fig.5pH distribution map

Fig.5 shows that in the wards no. 3, 4, 5, 9, 10, 20, 21, 22, 23, 27, 28, 30, and 33, the pH concentration is more than 8.5 mg/l in most of the area.The highest amount that can be allowed is between 6.5 and 8.5 mg/l.

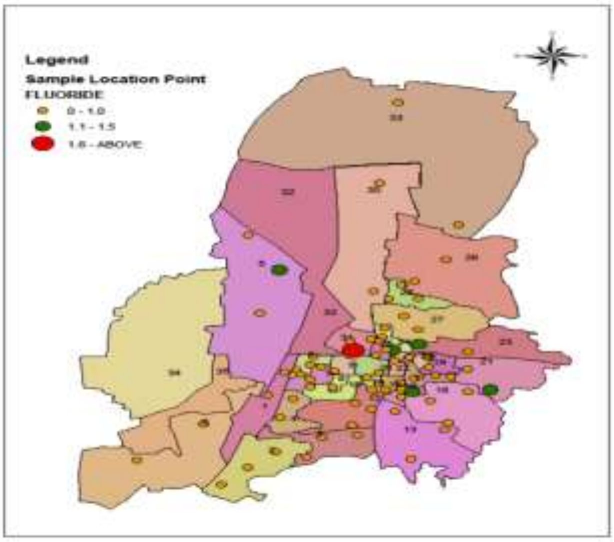

Fig.6Floride distribution map

Fig.6 shows that the fluoride concentration is also within the range of permissible limit of 1.5 mg/l throughout the study area except ward no 31.

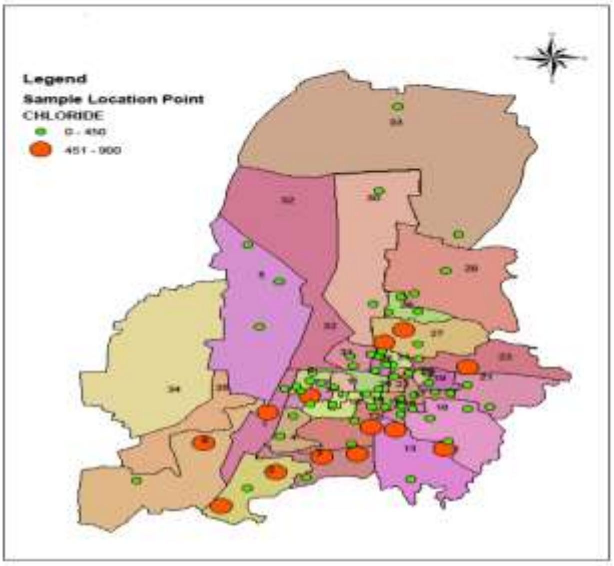

Fig.7Chloride distribution map

Fig.7 shows that theChloride concentration is within the permissible limit for the wards 1-35.

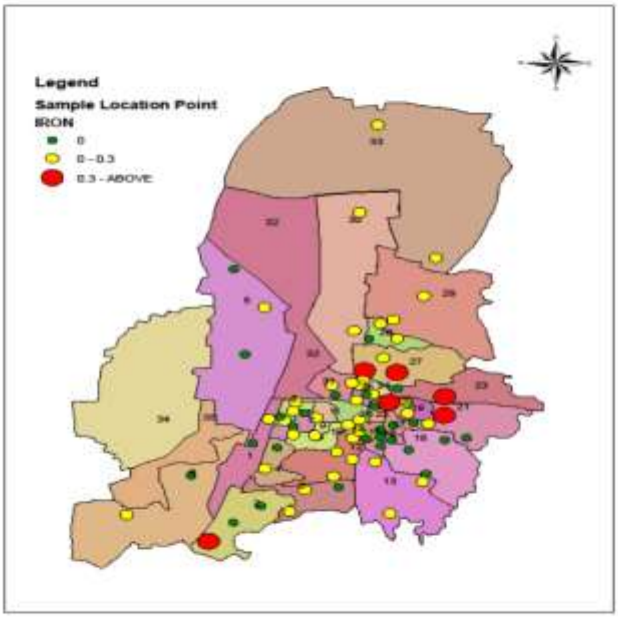

Fig.7 **I**ron distribution map

Fig.7 shows that the iron concentration is exceeding the permissible limit of 0.3 to 1.0 mg/l in the wards no: 21, 22, 23, 27 and 28 .

Conclusion

The research shows that in the wards no. 3, 4, 5, 9, 10, 20, 21, 22, 23, 27, 28, 30, and 33. The pH concentration is more than 8.5 mg/l in most of the area. The highest amount that can be allowed is between 6.5 and 8.5 mg/l. Additionally, the combined hardness concentration in Wards Nos. 1, 6, 12, 29, and 31 is higher than the allowable limit of 600 mg/l. With the exception of ward number 12, the calcium hardness content is nearly within the 200 mg/l allowable limit. All of the research area's fluoride concentrations, with the exception of ward number 31, are within the 1.5 mg/l allowable limit. Both the total alkalinity and the concentration of chloride are within allowable bounds. The allowed level of iron is being exceeded.

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