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Ground Water Quality Assessment in Medchal District using GIS

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Abstract:

Groundwater and Surface water are the major sources of drinking water. In Telangana, the major water supply is contaminated due to the rapid increase in population, industrial growth, and activities of the people with industrial effluents discharged on the lake water and on the soil. The uncontrolled hazardous waste sites are involved in contaminating the groundwater and surface waters. The Surface water and groundwater are contaminated it is difficult to restore the water quality. It is very much essential to protect the surface water bodies in order to maintain the ecological balance and provide proper management plans for conservation and water management. Environmental problems are highly complex, and management procedures have to be developed to achieve coordination for the need to initiate environmental measures for protection. This study presents an assessment of groundwater quality over the Medchal district, Telangana, India, using Geospatial and statistical approaches. In this study, we are chosen a location for analyzing the water quality parameters i.e. 10 locations in the Medchal district, and analyzing their groundwater qualities. This district has been subjected to rapid urbanization and industrialization in recent years. The groundwater quality parameters viz., Ph ,Turbidity ,Electric Conductivity , Alkalinity , Chlorides (Cl-), Iron Content ,Hardness, BOD (Biochemical oxygen demand), COD (chemical oxygen demand) are obtained over the study area. The suitability for human drinking purposes is assessed by comparing the concentration of parameters at each site with respect to their permissible limits recommended by the Bureau of Indian Standards(IS 10500: 2012). The geospatial mapping of the water quality parameters is carried out to visualize their variations. Key words : Geospatial , statistical approaches

1.INTRODUCTION:

General Water is the most important natural resource on the planet. Water covers 71% of the earth's surface. Nearly 96 percent of the water in the oceans is unfit for human use, while the remaining 4% is used for human consumption in the form of rivers, lakes, canals, and groundwater. Most living organisms, including plants, animals, and humans, rely on water in their daily lives and use it for a variety of purposes, including residential use, irrigation, and industrial use. Water use increases in daily life as the population grows rapidly, and as a result, water becomes limited. Water quality is described as all the required properties of the water, such as physical, chemical, and biological factors, that are usually within respective limitations for its suitability for certain usage. Good quality water should be suitable for their intended use, such as irrigation, home usage, industrial use, and hydropower generation, with all required qualities falling within the specified limits. If they do not, action should be made to enhance the water quality. Water quality has a significant impact on ecosystem

health, human safety, and drinking water, all of which are dependent on the availability of water. There are many water quality standards that are widely accepted around the world and are involved in their respective uses. In India, the "Bureau of Indian Standards" established some water quality protocols that can be used throughout the country to live a healthy life and maintain a good ecosystem. Making decisions based on water quality data is critical in a drinking water quality assessment. Water resource professionals have traditionally communicated their opinion on drinking water quality status by comparing specific metrics to guideline levels. Water drawn from the ground is not always fit for drinking or domestic use. The water drawn from the ground should be tested and treatment should be done for the required purpose. There are various treatment processes for the purification and filtration of water for drinking purposes in industrial, commercial, and residential use. RO-Reverse Osmosis filtration is one of the most adopted filter methods for drinking purposes in various locations. Groundwater quality comprises the physical,chemical, and biological qualities of ground water. Temperature, turbidity, color, taste, and odor make up the list of physical water quality parameters. Since most ground water is 2 colorless, odorless, and without specific taste, we are typically most concerned with its chemical and biological qualities. Although spring water or groundwater products are often sold as “pure,” their water quality is different from that of pure water. Naturally, ground water contains mineral ions. These ions slowly dissolve from soil particles, sediments, and rocks as the water travels along mineral surfaces in the pores or fractures of the unsaturated zone and the aquifer. They are referred to as dissolved solids. Some dissolved solids may have originated in the precipitation water or river water that recharges the aquifer. A list of the dissolved solids in any water is long, but it can be divided into three groups: major constituents, minor constituents, and trace elements (Table 1). The total mass of dissolved constituents is referred to as the total dissolved solids (TDS) concentration. In water, all of the dissolved solids are either positively charged ions (cations) or negatively charged ions (anions). The total negative charge of the anions always equals the total positive charge of the cations. A higher TDS means that there are more cations and anions in the water. Total Hardness The tendency of water to precipitate insoluble calcium and magnesium salts of higher fatty acids from soap solutions is referred to as hardness. There are two forms of hardness: permanent hardness and transitory hardness. The presence of calcium and magnesium bicarbonates causes temporary hardness. Permanent hardness is non-carbonate hardness caused by the presence of calcium and magnesium sulfates, chlorides, and nitrates. Water hardness is an important factor to consider while using it in the home. Total hardness in groundwater is determined by calcium and magnesium levels and many more p1.

2.OBJECTIVES:

1.To Carry out the Physico-chemical analysis of groundwater samples obtained from a different location in the Medchal district.

2.To create a spatial geodatabase for groundwater quality parameters using GIS.

3. To generate thematic maps for individual water quality parameters for Medchal district.

Scope Of The Project

1.Existing ground water quality condition monitoring and management of pollutant areas are identified using GIS software.

2.GIS based ground water quality mapping and its suitability evaluation can be used for industrial and domestic purpose.

METHODOLOGY:

Study area description and selection criteria Medchal district in Telangana, India, is a rapidly urbanizing and industrializing region of about 697 square kilometers bordered by Hyderabad and Rangareddy districts to the south and west respectively. Its diverse land uses, geology, and semi-arid climate with low rainfall and high evaporation rates may impact groundwater quality. A groundwater quality assessment is crucial to identify potential sources of contamination and develop appropriate management strategies for sustainable groundwater use. With an increase in population and economic activities, there has been a significant rise in groundwater exploitation, especially for domestic and industrial purposes, leading to a negative impact on groundwater quality. Thus, the assessment will help understand groundwater quality trends and develop management strategies accordingly. 3.2. Data Collection Methods and Sources: For this study, the primary source of data was field measurements of groundwater quality parameters. A total of 10 sampling locations were selected across the Medchal district based on their land use, geological formations, and proximity to potential sources of contamination. The sampling design involved collecting groundwater samples from bore wells at each location. During the field sampling, standard protocols were followed to ensure the accuracy and reliability of the data. Quality control measures were implemented, such as blank samples and duplicates, to assess the precision and accuracy of the measurements. The samples were analyzed for pH, electrical conductivity, total dissolved solids, total hardness, calcium (Ca2+), magnesium (Mg2+), sodium (Na+), potassium (K+), bicarbonate (HCO3), chlorides (Cl-), sulfate (SO4-), nitrate (NO3-), and fluoride (F-) using appropriate laboratory methods. The results of this study will provide valuable insights into the groundwater quality in Medchal district and will help identify potential sources of contamination and management strategies for sustainable groundwater use. 18 3.3.Water Quality Parameters and Analysis Methods: 3.3.1. pH Experiment: Aim: To measure the pH of groundwater samples. Apparatus: 1. pH meter, 2. Electrode 3. Beaker 4. Pipette. Reagents: 1. pH buffer solutions. Reagent preparation: pH buffer solutions are commercially available or can be prepared by dissolving the buffer salt in water according to the manufacturer's instructions. Procedure: ¬ Follow the manufacturer's directions for calibrating the pH metre. ¬ Choose a standard buffer solution with a pH comparable to that of the treated water. ¬ Set the temperature control to the buffer's temperature. ¬ Set the metre to the buffer's pH at the desired temperature. ¬ Measure a second standard buffer solution with a different pH to check the electrode response. ¬ After stabilizing the system, immerse electrodes in the sample and record the pH. Note: The

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electrodes are stored in distilled water between measurements. New or dried up glass electrodes should be prepared for use by soaking in 0.1 N HCl for 8 hours or following the manufacturer's instructions

IMPLEMENTATION:

1. Data Collection and Preparation: Collecting and organizing the necessary data for mapping, such as shapefiles, satellite images, or GPS points. The data must be cleaned, formatted, and properly referenced to a common coordinate system.
2. Importing Data into ArcGIS: The collected data is then imported into the ArcGIS software, where it is stored as a layer in the map document.
3. Creating a Base Map: A base map is created by adding features such as roads, water bodies, and administrative boundaries to the map. This provides a visual reference for the study area and helps in the interpretation of other map layers.
4. Creating and Editing Layers: Data layers are created or imported into the map document and edited to match the desired symbology, scale, and projection.
5. Spatial Analysis: ArcGIS provides various spatial analysis tools for analyzing and processing data, such as buffering, overlay, and proximity analysis.
6. Interpolation: Spatial interpolation methods, such as Kriging, IDW, or Spline, are used to estimate values for unsampled locations based on nearby sampled points.
7. Visualization: Data visualization techniques, such as choropleth mapping or heat mapping, are used to represent the data in a meaningful way.
8. Output: The final map product is then exported as a digital image or printed out for use in reports or presentation

RESULTS:

The spatial and the attribute database generated are integrated for the generation of spatial variation maps of major water quality parameters pH, TDS, Ca,Cl,SO4,NO3,F. Groundwater quality maps has been showed below for each parameter. In this study groundwater quality data were prepared using Arc Map 10.5software. This integration of the groundwater quality maps helps us to know the existing groundwater condition in the area

TABLE:1

5.1 pH pH is a significant parameter in evaluating acidity or alkalinity of water. The computation of pH is to determine the intensity or alkalinity and measures the concentration of hydrogen ions. The study area pH value ranges from 7.40 to 8.13 with an intermediate value of 7.86. As per IS 10500:2021[3] standards the study area pH value classified into three categories of Good (6.5 to 7.5) and Moderate (7.5 to 8) and poor (>8) as shown in fig 3. The higher proportion of pH is by the influence of high biological activity and can also by the uptake of CO2 by photosynthesizing organis

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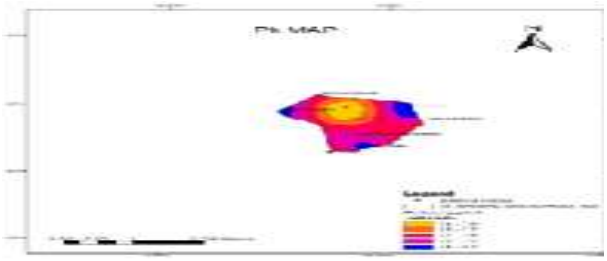

FIG:1

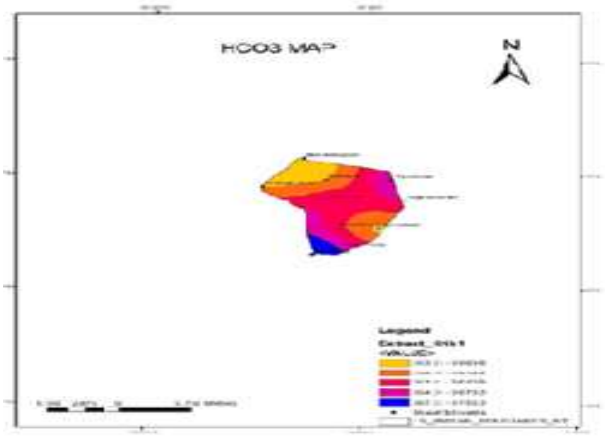

FIG:2

CONCLUSION :

The spatial representation of groundwater quality analysis indicates that the study area needs a few measures of treatment before utilization of groundwater. The study facilitates to understand the existing groundwater quality conditions and to develop appropriate management practices to protect the groundwater sources. 1. This study demonstrates the use of spatial interpolation and statistical methods in mapping of groundwater quality parameters in Medchal district, Telangana, India. Groundwater quality exceeded limits for drinking use for most ions at certain locations. Groundwater quality of different water samples in Medchal district has been analysed and evaluated. Therefore, the groundwater samples were collected from wells located in basin area. The groundwater quality parameters were studied to investigate the water quality for drinking and irrigation. Arc GIS software has been used for groundwater quality parameters analysis and spatial mapping of big storage of data and result making so that groundwater quality constructed studies have done successfully. 2. The study of hydrochemistry parameters was dominated by alkali and strong acids. As per comparison with WHO and ISI standard, 80% of groundwater has potable for domestic and drinking purpose with few irregularities. The spatial difference maps in the groundwater quality parameters were observed different values in the basaltic hard rock area. The present study of groundwater quality maps can be used for irrigation and drinking purpose in the saline area. 3. Higher TDS and EC values were observed in western-central and eastern-western part of the study area dominated by agricultural practices and industrial dominance. Higher concentration was noted in post-monsoon season following summer. 4. The present result presented appropriateness of groundwater for drinking and irrigation purposes. The study benefits us to understand the quality of the groundwater resources to improve proper management in area. In this area, Deccan rock weathering, geochemical weathering process and evaporation procedures are the main role in hydro-geochemical analysis impact for the concentration of main ions in groundwater quality. In this present study water quality analysis such as minimum and maximum observation values shows pH (7.96–8.13 on scale), electrical conductivity (1605–2250 S/cm), total dissolved solids (1027–1440 mg/l), 60 carbonate (0 mg/l), bicarbonate (329–427 mg/l), chloride (280–320 mg/l), sulphate (27–78 mg/l), nitrate (66–122 mg/l), calcium (66–70 mg/l), magnesium

(33–43 mg/l), sodium (228–260 mg/l), potassium (2–22 mg/l), sulphate (26–78 mg/l), bicarbonate + carbonate (53–125 mg/l). 5. Use of Integrated Land Information maps is offering value added services like development planning, welfare schemes etc. by maintaining all the records in the prescribed integral digital format ina central repository is possible

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