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Study and Analysis of GIS-based Groundwater Quality Monitoring System

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ABSTRACT–

As the foundation of social and economic infrastructure, water is indispensable for a healthy society and sustainable development. The daily demand for water is rising due to a significant increase in population density, urbanisation, industrialization, and agricultural activities. As a result, both surface water and subterranean water levels continue to decline.The most popular alternative to surface water is groundwater, but its quality is deteriorating due to human activities in our nation. Therefore, groundwater quality monitoring has become essential. It is not possible to monitor the quality of ground water in every location by conducting a survey, and undertaking multiple analyses requires a considerable amount of time. Using GIS, however, analyses can be conducted by combining multiple data sets, and maps for distinct parameters by year can be generated. As a result, the GIS-based models facilitate understanding of annual distribution and provide a database for future use. Using GIS and data collected from the Madurai Public Works Department, this paper analyses the subsurface water quality in the Madurai district. In order to display relevant wells, a query-based analysis is performed. Using GIS-based maps, the outcomes of the strategic analysis are represented.

Keywords- *GIS, Groundwater quality, Query analysis,GIS-based Models,Hydrogeology.*

1. INTRODUCTION

Without water, it is impossible to sustain existence on Earth. Every living thing, including animals and plants, requires water to fulfil their daily requirements. As a result, humans must rely on subterranean water, which may or may not be potable, to fulfil their needs. It is essential to investigate the geochemistry of ground water used for human consumption. Ground water is the water that exists beneath the Earth's surface in soil pores and granite fissures. An aquifer is a unit of rock or an unconsolidated deposit that yields a usable quantity of water. The water table is the depth at which soil pore spaces or fractures and cavities in rock become completely saturated with water. Groundwater is naturally replenished from the surface and ultimately flows to the surface; natural discharge occurs frequently at springs and fissures and can create oasis or wetlands. By constructing and operating extraction wells, groundwater is frequently extracted for agricultural, municipal, and industrial use. The study of the distribution and movement of groundwater is hydrogeology, also known as hydrology of

groundwater. Groundwater is frequently less expensive, more accessible, and less susceptible to contamination than surface water. Consequently, it is frequently used for public water supplies. The groundwater in the Madurai region could be contaminated by improper refuse disposal and agricultural practises. The quality of the groundwater in and around Madurai is potable. Everyone utilised groundwater for domestic purposes. The agricultural communities used groundwater for agriculture on their respective lands. Today, however, the situation is entirely different. Water quality monitoring in the district of Madurai Show in figure 1. In many areas of the Madurai region, the use of groundwater is obsolete. Very few monitoring wells are located within the corporation's boundaries. The water level in these regions is affected by the proliferation of structures and bore wells. In turn, this will impact water quality. Therefore, water quality monitoring is required in the district of Madurai.

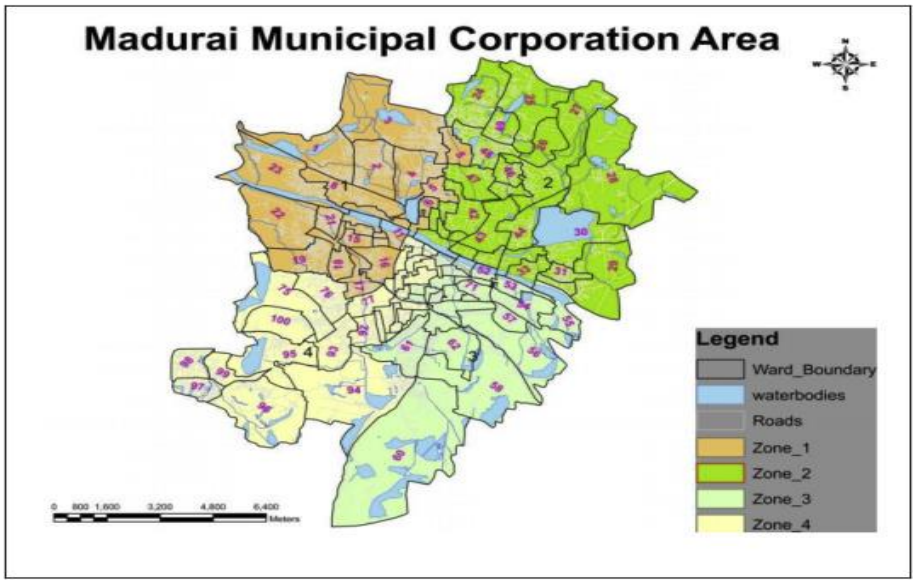

Fig. 1: Water quality monitoring in the district of Madurai

2. OBJECTIVE OF THE STUDY

1. To delineate the groundwater potential zones using relevant data.

2. To develop a GIS model, Spatial variation map of major water quality parameters like pH, TDS, Chloride.

3. GIS is used to evaluate the quality of ground water in Madurai region.

4. Total Hardness were prepared for Madurai district for pre monsoon and post monsoon.

3. METHODOLOGAL ANALYSIS

This research methodology consists of various phases. The initial phase is the data collection phase, during which PWD (Public Work Department) and LANDSAT 7 satellite data for the Madurai district are collected. On the other hand, water quality parameters for the Madurai district are obtained from the Madurai Public Work Department (PWD) . These data are incorporated into the GIS system. Using an interpolation instrument, the spatial variation of water quality parameters is then determined. By conducting query analysis, it is possible to determine which wells are acceptable and which are not. The methodology's flowchart is shown below.

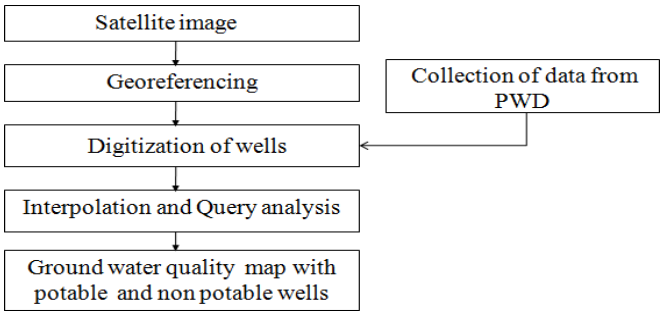

Fig. 2: The methodology's flowchart

- **Geo Reference**

Define something's existence in physical space, i.e., establish its location in terms of map projections, is to georeference it. Various maps may employ distinct projection systems. Collecting Ground Cross Point (GCP) and transmitting it to satellite data is how georeferencing is accomplished.

- **Digitization of wells**

Digitization is the process of identifying the geographical component of spatial data by generating shape files. The shape files may contain points, lines, or polygons. The wells' latitude and longitude are incorporated into the GIS as point features. Each dot on the satellite image depicts a well. The Add XY data option in the ArcGIS software allows for this. After integrating these points as point features, they were stored as a point shape file.

- **Interpolation**

Interpolation is a technique used to estimate the value of a cell lacking sample points. It is founded on the spatial autocorrelation or spatial dependency principle, which measures the degree of relationship/dependence between objects in close proximity. Spatial autocorrelation determines whether or not values are related.Relationships between values determine the spatial pattern.

- **Query Analysis**

Query analysis is utilised to select the specific feature that satisfies the specified condition. By constructing a query based on the various conditions, the geographical regions that meet those conditions are projected. These queries are composed using the query builder.

4. RESULTS

In the Madurai area, GIS is used to assess the quality of the ground water. For the Madurai district, a spatial

variation map of the key water quality metrics pH, TDS, Chloride, and Total Hardness was created for both pre- and post-monsoon conditions. A comprehensive ground water quality map of the Madurai district was created using GIS based on these spatial variation maps of the key water quality indicators. This comprehensive ground water quality map aids in our understanding of the current ground water situation in the research region. The interpolation tool is used to discover these spatial variances. By creating queries, it is possible to find wells that are extremely suited, acceptable, and not acceptable. This allows arc GIS to produce a graph for appropriate wells in taluk order. As a consequence, neither the north nor the south of Madurai have any wells that are fit for drinking water. Despite having previously examined the spatial variance for these wells, none of the taluks' wells were satisfactory.

(i) Pre-Monsoon

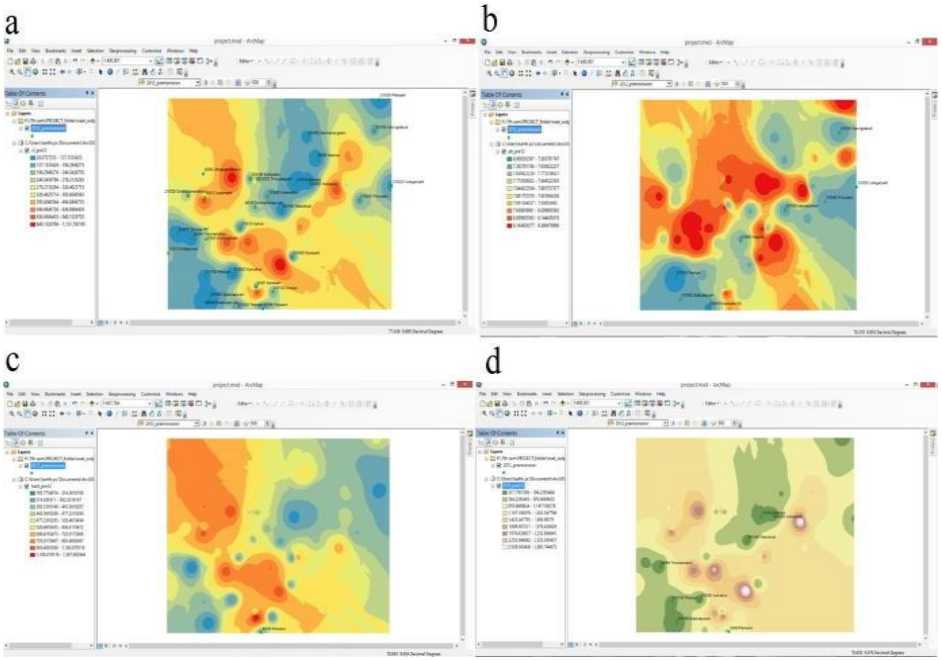

Fig. 3: a. Interpolation result for Chloride (mg/L)
b. Interpolation result for pH
c .Interpolation result for hardness (mg/L)
d .Interpolation result for TDS (mg/L)

(ii) **Post-Monsoon**

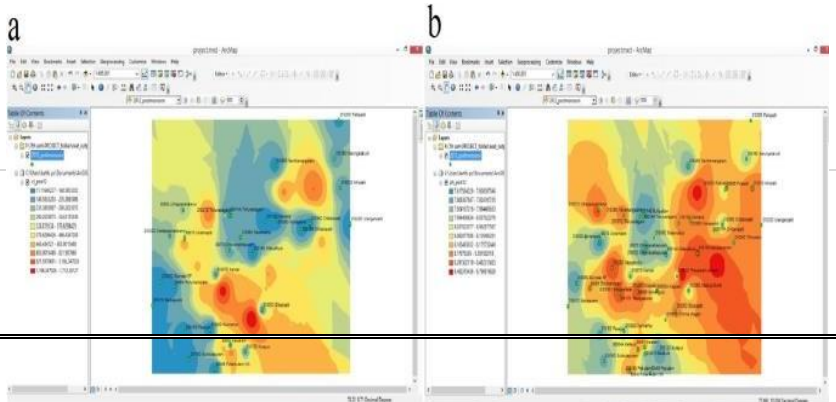

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Fig 4: .a . Interpolation result for Chloride (mg/L)

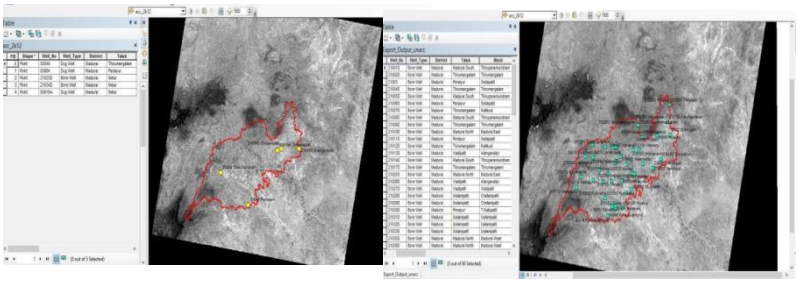
b. Interpolation result for pH

Fig.5. Acceptable wells **Fig.6. Not Acceptable wells**

The approved and unacceptable wells are shown in the query's result above. The wells that meet all four requirements are acceptable wells, whereas the ones that don't are not.

C. Interpolation result for hardness (mg/L) d .Interpolation result for TDS (mg/L)

The result above show the geographical distribution of the parameters Chloride, pH, Total Hardness, and TDS for pre- and post-monsoon. Both before and after the monsoon, there are differences in the geographical pattern of water quality. It lists the names of the wells whose water quality is suitable for drinking. It should have a pH of 6.5 to 8.5.It should be fewer than 120 mg/L for chloride (Cl).Total Hardness (TH) levels should range from 120 to 180 mg/L.It should be less than 500 mg/L for TDS. The wells that meet these conditions are shown, along with their geographical distribution.



5. CONCLUSIONS

The most important ingredient for life is water. Groundwater is a priceless resource with a limited supply. The scientific use of groundwater throughout time has resulted in a water stress state due to population growth, urbanisation, and agricultural development. Due to serious difficulties with water shortages and environmental degradation, the Madurai district is in danger. Due to pollution, the quality of the ground water in the Madurai district has declined. Therefore, it is essential to check the quality of groundwater. GIS technology may provide a suitable platform for convergent analysis of significant amounts of data from several disciplines, allowing for efficient decision-making for ground water investigations. For guidance in projecting the ground water quality in new locations, refer to the GIS naked zoning of ground water quality map. The research also concludes that GIS is an effective tool for graphical methods to ground water concentration monitoring. In addition, compared to hard copy format, the graphical presentation of GIS techniques makes the presentation of ground water more fascinating to the users and simpler to grasp. Ground water quality maps are vital for the purpose of urban planning and may be used as new databases or to update existing ground water data in the region.

REFERENCES

[1] Mohamed, A., Othman, A., Galal, W. F., and Abdelrady, A. (2023). "Integrated Geophysical Approach of Groundwater Potential in Wadi Ranyah, Saudi Arabia, Using Gravity, Electrical Resistivity, and Remote-Sensing Techniques." Remote Sensing, MDPI AG, 15(7), 1808.

[2] "Evaluation of Groundwater Quality Using Remote Sensing and GIS Techniques in Tirunelveli District, India." (2020). Journal of Xidian University, Engineering Skill Development, 14(4).

[3] Lee, S., Hyun, Y., Lee, S., and Lee, M.-J. (2020). "Groundwater Potential Mapping Using Remote Sensing and GIS-Based Machine Learning Techniques." Remote Sensing, MDPI AG, 12(7), 1200.

[4] Harini, P., Sahadevan, D. K., Das, I. C., Manikyamba, C., Durgaprasad, M., and Nandan, M. J. (2018). "Regional Groundwater Assessment of Krishna River Basin Using Integrated GIS Approach." Journal of the Indian Society of Remote Sensing, Springer Science and Business Media LLC, 46(9), 1365–1377.

[5] A, R., Kuruppath, N., and Kannan, B. (2017). "Identification of Potential Groundwater Recharge Zones Using Remote Sensing and Geographical Information System in Amaravathy Basin." Journal of Remote Sensing & GIS, OMICS Publishing Group, 06(04).

[6] Nagaraju, A., Sreedhar, Y., Thejaswi, A., and Dash, P. (2016). "Integrated Approach Using Remote Sensing and GIS for Assessment of Groundwater Quality and Hydrogeomorphology in Certain Parts of Tummalapalle Area, Cuddapah District, Andhra Pradesh, South India." Advances in Remote Sensing, Scientific Research Publishing, Inc., 05(02), 83–92.

[7] T.Naveen Raj, S.Sam Moses. "Ground Water Quality Assessment using Geo Spatial Technology in Part of Lower Vaigai Basin, Madurai District, Tamil Nadu". International Research Journal of Engineering and Technology (IRJET). Volume:03 Issue: 01 .Jan 2016.

[8] F.R.Islam; A.Mamun."GIS based water quality monitoring system in pacific coastal area: A case study for Fiji". 2nd IEEE Asia Pacific World Congress on Computer Science and Engineering, December - 2015.

IJARSE
ISSN 2319 - 8354

[9] Khanam, Z. and Singh, V. (2014) Groundwater Quality Assessment near Polluted Canal Area in Kichha Town, Utta- rakhand, India. International Journal of Recent Scientific Research, 5, 362-368.

[10] Sedhuraman, M., Revathy, S.S. and Suresh Babu, S. (2014) Integration of Geology and Geomorphology for Ground- water Assessment Using Remote Sensing and GIS Techniques. International Journal of Innovative Research in Science, Engineering and Technology, 3, 10203-10211.

[11] Uwidia, I.E., and Ukulu, H.S. (2013) Studies on Electrical Conductivity and Total Dissolved Solids Concentration in Raw Domestic Wastewater Obtained from an Estate in Warri, Nigeria. Greener Journal of Physical Sciences, 3, 110- 114.

[12] Liming Zhang; Haowen Yan. "Implementation of a GIS- based water quality standards syntaxis and basin water quality prediction system". Geomatics for Integrated Water Resources Management (GIWRM), October - 2012

[13] Raghu, V. and Reddy, K.M. (2011) Hydrogeomorphological Mapping at Village Level Using High Resolution Satellite Data and Impact Analysis of Check Dams in Part of Akuledu Vanka Watershed, Anantapur District, Andhra Pradesh. Journal of Indian Geophysical Union, 15, 1-8.