Integrating Remote Sensing and GIS for Groundwater Potential Zone Delineation: A Multi-Criteria Decision Weighted Overlay Analysis Approach

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Abstract
Groundwater is a vital resource for meeting domestic and agricultural water demands in the tropical region of Thiruvattar Firka, Kanyakumari District, Tamil Nadu, India, which covers an area of approximately 67.64 km². This study aimed to delineate groundwater potential zones (GWPZs) using an integrated Remote Sensing (RS) and Geographic Information System (GIS) approach. The methodology involved the preparation of thematic layers, including lithology, lineament density, slope, soil type, land use/land cover, geomorphology, drainage density, and rainfall, derived from satellite imagery and ancillary data. These layers were assigned weights based on their relative hydrogeological importance and integrated using a Multicriterial Weighted Overlay Index (MWOI) model. Inverse Distance Weighting (IDW) interpolation was applied to generate spatial groundwater potential maps. The resulting groundwater potential zonation classified the study area into three zones: high, moderate, and low. The analysis revealed considerable spatial variation, with moderate groundwater potential zones occupying 74.63% of the area, followed by high potential zones covering 13.43%, and low potential zones accounting for 11.94%. High-potential zones are mainly associated with weathered and fractured formations, gentle slopes, low drainage density, and favourable land-use conditions, whereas low-potential zones correspond to areas characterised by steep slopes, high runoff, and relatively impermeable lithological units. The GWPZ map was validated using field observations, which demonstrated a strong agreement between the predicted zones and observed groundwater conditions, thereby confirming the robustness of the adopted methodology. The study demonstrates that RS–GIS, integrated with the MWOI model, is an effective tool for assessing groundwater potential. Future research may focus on incorporating time-series groundwater level data, machine learning

techniques, and climate variability analyses to improve prediction accuracy and support sustainable groundwater management and artificial recharge planning.

Keywords: Groundwater, MWOI, NDWI, NDDI, NDVI, GIS.

Introduction

Although numerous studies have employed Remote Sensing (RS) and Geographic Information System (GIS) techniques to delineate groundwater potential zones across different hydrogeological settings in India, several critical gaps remain. Most existing studies focus on semi-arid or hard-rock terrains and often apply weighted overlay methods without region-specific validation, limiting their applicability to humid, tropical, coastal settings. In particular, the tropical hydrological regime of Thiruvattar Firka, characterised by high rainfall variability, intense weathering, dense drainage networks, and complex lithological controls, has received limited scientific attention in groundwater potential mapping studies. Furthermore, many previous investigations rely on subjective weighting schemes with minimal integration of field-based well yield validation, reducing the robustness of their predictions. The present study addresses these gaps by (i) focusing on an under-studied tropical region of southern Tamil Nadu, (ii) integrating rainfall as a critical controlling factor alongside terrain, lithological, and land-use parameters, (iii) applying a Multicriterial Weighted Overlay Index (MWOI) supported by spatial interpolation (IDW), and (iv) systematically validating the results using observed well yield and field data. By explicitly linking spatial groundwater potential patterns with local hydro-geomorphic conditions and validation evidence, this study advances existing RS–GIS-based groundwater assessment frameworks and provides a more reliable scientific basis for groundwater development and sustainable management in tropical coastal environments and mapping also (Kumaravel. S et al., 2012).

Water resources are inevitable for all sectors. The need to assess water resources increases every year owing to declining water levels and changes in atmospheric water. Water resources are essential for all purposes. Water is a crucial component of ecosystems and has been declining in both quality and quantity due to natural and human-induced interventions (Rajan et al., 2025). Groundwater is essential for domestic and irrigation purposes in arid and semiarid regions (Phaisonreng Kom et al., 2023). Most of the world's inhabitants rely on groundwater for their daily needs. In regions such as arid and semiarid areas, it has become the primary water source for domestic, agricultural, and industrial purposes (Kom et al., 2021). Numerous evaluation methods exist. Evaluation using geospatial technology is noteworthy due to its current results(Gurugnanam.B et al., 2009). The study concluded that remote sensing and GIS are highly fruitful and useful for assessing groundwater potential zones (Arulbalaji. P & Gurugnanam. B, 2016; Ayadi et al., 2025). In recent decades, rising population levels, industrial expansion, and accelerated urbanisation have sharply increased water demand. Consequently, groundwater has emerged as the primary source of water supply, particularly in rural settings (Demissie et al., 2023; Thapa et al., 2017).

Traditional geophysical investigation methods are often expensive and time-consuming (Kwami et al., 2019; Nanesso & Habtemariam, 2023). Consequently, researchers are increasingly turning to remote sensing (RS) and geographic information systems (GIS), which provide efficient and large-scale analytical capabilities for groundwater exploration and recharge site identification. Integrated RS–GIS approaches have been widely and effectively applied to delineate groundwater potential zones (Berhanu & Hatiye, 2020; Mallick et al., 2022; Yosef et al., 2024). Groundwater potential mapping typically incorporates multiple thematic layers, including lithology, geomorphology, slope, soil type, rainfall, land-use/land-cover (LULC), lineament structures, and drainage patterns (Hamdani & Baali, 2020; Lentswe & Molwalefhe, 2020).

Many researchers have attempted to map water resources using various methods. The use of remote sensing data and GIS enabled the determination of the spatial distribution of the parameters. The feature class weights are easy and useful for overlay analysis (Bagyaraj, M et al., 2014). GIS is an efficient tool for mapping and analysing spatial datasets (Jhariya et al., 2016; Kalaivanan, K et al., 2019; Khanam &

Patnaik, 2025). Identifying potential groundwater zones and integrating thematic maps prepared using remote sensing platforms and GIS provides more accurate results (Bagyaraj et al., 2013; Rehman et al., 2024). In GIS, multiple thematic map overlay analyses were performed (Suresh M et al., 2010). The Multi-Criteria Decision Support based on the Weighted Overlay Method (WOM) (Murugesan et al., 2025) was applied to develop a composite Groundwater Potential Index (GWPI).

In the present study, we attempted to use satellite data-based demarcation of water resources by analysing Lineament and Lineament Density, Land Use/Land Cover, Normalised Difference Vegetation Index, Normalised Difference Water Index, and Normalised Difference Drought Index, which were derived from higher-resolution Resource Sat LISSIV satellite data. Surface water resources, including drainage and surface water bodies, were also mapped using the Survey of India Toposheet and cross-checked against Google Map data. Changes in water bodies were another interesting result of the present study.

This study aimed to delineate groundwater potential zones by integrating Remote Sensing (RS) and Geographic Information Systems (GIS) using a multi-criteria decision-making weighted overlay approach. To achieve this,

- The thematic layers, including lithology, lineament density, slope, soil type, land use/land cover, geomorphology, drainage density, and rainfall, are compiled and pre-processed.
- Each thematic map factor was assigned an appropriate weight based on its relative influence on groundwater occurrence.
- A GIS-based overlay analysis is performed to produce a groundwater potential map, which is further classified into ranges from very high to very low potential.
- The resulting map is evaluated and validated using field observations or existing hydrogeological data to ensure its reliability and accuracy.

Study Area

The study area, Thiruvattar Firka in Kanyakumari District, Tamil Nadu (67.64 km²), lies within a warm and humid tropical belt and receives heavy monsoonal rainfall, with district-level averages ranging from 1,000 to 1,450 mm per year, supported by both the southwest and northeast monsoons. Temperatures remain high throughout the year, with typical maxima of approximately 32–33 °C and minima of approximately 23–24 °C. Elevation varies from low-lying alluvial stretches to gently undulating midlands capped by lateritic soils. Geologically, the region is dominated by highly weathered crystalline basement rocks of the Peninsular Gneissic Complex, overlain by laterite, red soils, sandy-clay mixes, and local alluvium, all of which encourage infiltration and moderate groundwater storage. These climatic and geological conditions make groundwater a critical resource for domestic and agricultural use across the Firka. (Fig. 1)

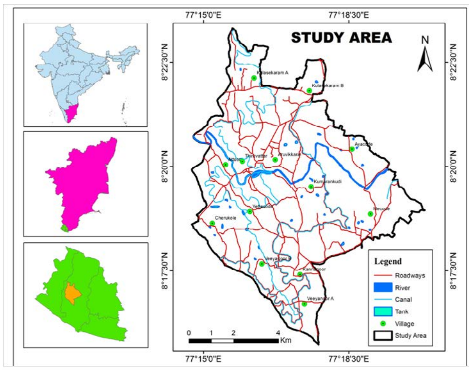

Figure 1 Study Area Map of Thiruvattar Firka

Methodology

The methodology adopted for preparing the groundwater potential zone map integrates Survey of India toposheets, remote sensing datasets, and GIS-based spatial analysis. Initially, the toposheets were georeferenced and interpreted to extract the drainage network and major waterbodies, which play crucial roles in groundwater recharge and surface–subsurface hydrological interactions. Simultaneously, multispectral satellite imagery was processed to derive key thematic layers, including land use/land cover, lineaments and their density, and spectral indices such as the Normalised Difference Vegetation Index (NDVI), Normalised Difference Water Index (NDWI), and Normalised Difference Drought Index (NDDI). Land use/ land cover information helped assess infiltration characteristics, whereas lineament mapping provided insights into the structural controls on groundwater flow. Spectral indices were employed to evaluate vegetation health, moisture availability, and drought influence, which are factors that indirectly reflect groundwater conditions. All derived thematic layers were standardised, reclassified, and integrated in a GIS environment using weighted overlay techniques to delineate groundwater potential zones. Finally, the combined analysis yielded a spatially explicit groundwater potential map, allowing for the systematic identification of areas with varying recharge capabilities and groundwater availability. The methodology flowchart is shown in Fig.2

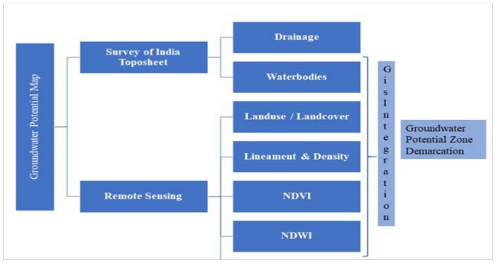

Figure 2 Detailed Methodology Flow Chart

The relative weightage of each feature in the thematic maps given above, as determined by the existing literature, is achieved in GIS through the MVOA.

Results and Discussion

Surface water Body

Surface water bodies, such as lakes and ponds, were mapped using toposheets and satellite images. It has a direct relation to water resources. The water body zone was buffered by 20 m. A relatively higher weightage is assigned to water resource mapping. The total of 1.93 Square km that the water body covers in the study area (Fig.3). The output results are presented in Table 1.

Table 1 Spatial Distribution Results of Surface Water Bodies

Surface water bodies	Rank	Suitability	Area in Km^2
River	3	High	1.74
Canal	2	Moderate	65 (length)
Tank	1	Low	0.187

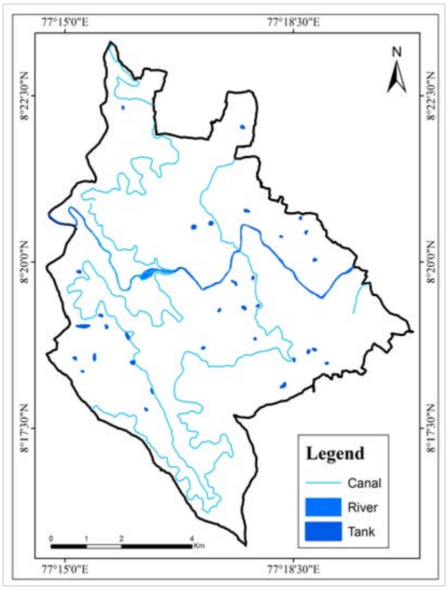

Figure 3 Spatial Distribution Map of Surface Waterbodies

Drainage and Drainage Density

Drainage is the surface movement path of rainwater. It is always moving towards a lower slope. This area actsas a pathway for recharging groundwater. The drainage map of the study is prepared from the Topographic Sheet, and the drainage density map is prepared using ArcGIS software; the map is shown in Fig. 4. The results of this study are summarised in Table 2.

Table 2 Spatial Distribution Results of Drainage Density of Thiruvattar Firka

Drainage density	Weight Age	Suitability	Area (Km^2)
Low	4	High	38
Moderate	3	Moderate	12
High	2	Low	14
Very High	1	Very low	5

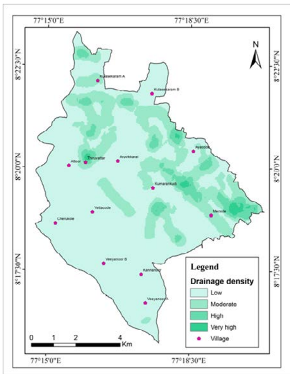

Figure 4 Spatial Distribution Map of the Drainage Density

Remote Sensing

Lineament and Lineament Density

A lineament is a weaker natural, long, linear feature. The lineament map was prepared using satellite imagery (Fig. 5). This has a direct relation to water resources. The lineament density is prepared using satellite imagery. The higher the lineament density, the higher the possibility of groundwater. Based on this character, the lineament density zone weights were derived in the Table 3.

Table 3 Spatial Distribution Results of Lineament Density of Thiruvattar Firka

Lineament Density	Weight Age	Suitability	Area (Km²)
Very high	4	High	38
Moderate	3	Moderate	12
High	2	Low	14
Very High	1	Very low	5

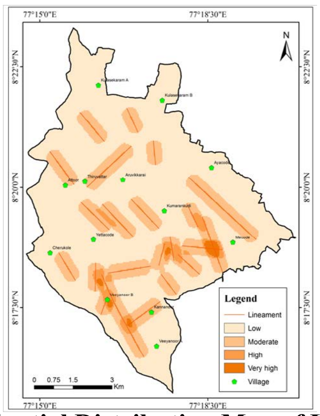

Figure 5 Spatial Distribution Map of Lineament Density

Landuse/Land Cover

A land-use and land-cover map was prepared using satellite data (Balasubramaniyan et al., 2025). The data were downloaded from the USGS data source. Landsat images are used to estimate LULC changes (Chrisben Sam S &Gurugnanam, 2023). The data was taken to ArcGIS, and the FCC was prepared. Using ground control information, supervised classification is employed to demarcate the various land-use and land-cover regions in the study area. The details of the spatial distribution are presented in Table 4, and a spatial map is shown in Fig. 6. Owing to urbanisation and industrial growth, there has been a loss of agricultural land, vegetation, forest land, water bodies, and mineral wealth (Arulbalaji&Gurugnanam, 2014). Relative weightage was assigned to the maps for groundwater potential mapping.

Table 4 Spatial Distribution Results of Land use and Land Cover of Thiruvattar Firka

LULC	Weightage	Suitability	Area (Km²)
River	7	Very high	5
Vegetation	5	High	43
Waterbodies	6	High	0.6
Fallowlands	4	High	2
Settlements	2	Low	2
Barrenlands	1	Very low	3
Roadways	3	Moderate	12

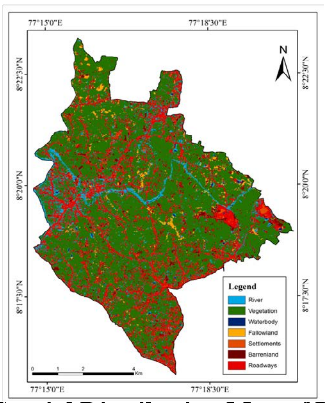

Figure 6 Spatial Distribution Map of Land use / Land cover

Normalized Difference Vegetation Index

NDVI, or Normalised Difference Vegetation Index, is a remote sensing metric that measures vegetation health and density. It is calculated by comparing the amount of light that plants reflect in the visible (red) and near-infrared (NIR) bands of the electromagnetic spectrum. Healthy, green vegetation reflects more NIR light and absorbs more red light for photosynthesis. Geospatial technology, combined with a vegetation index, helps identify the water zone, and GIS helps demarcate it (Arulbalaji et al.,2014a). Plants absorb red light for photosynthesis and reflect large amounts of near-infrared light owing to the structure of their leaves. Calculation: NDVI uses these differences in reflectance to create a value that ranges from -1 to 1.

Formula: NDVI = (NIR-Red) / (NIR+Red).

Higher values indicate dense, healthy green vegetation (e.g., values between 0.5 and 1.0). Lower values indicate areas with little to no vegetation, such as barren land, water, or snow (e.g. values close to 0 or negative). The results of the NDVI map are shown in Fig. 7 and Table 5.

Table 5 Spatial Distribution Results of NDVI of Thiruvattar Firka

NDVI	Weightage for Water Resources	Suitability	Area (Km^2)
Water body	3	High	7
0.5-1	2	Moderate	18
Close to 0 and a negative value	1	Low	43

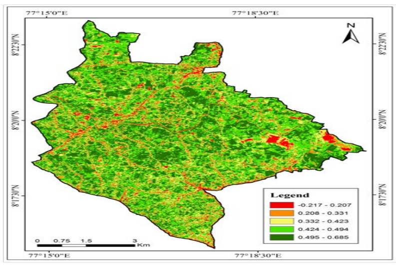

Figure 7 Spatial Distribution Map of NDVI of Thiruvattar Firka

Normalized Difference Water Index (NDWI)

The Normalized Difference Water Index is a satellite-based index used to map open water bodies and monitor water content in vegetation and soil. It is calculated by subtracting the near-infrared (NIR) band from the green band and dividing the result by the sum of the NIR and green bands. Higher values typically indicate a greater water presence. It is useful for water body mapping, delineating open water features such as lakes, rivers, and oceans from land. Vegetation water content: Monitors the amount of water in plant leaves, which is useful for tracking plant health and stress. Agriculture: Enhances irrigation management by identifying areas that require water and minimising waste. Drought monitoring: Supports monitoring of drought conditions and soil moisture.

Calculation and Interpretation

Formula: $NDWI = (Green - NIR)/(Green + NIR)$

Bands: The formula uses the green and near-infrared bands from satellite imagery.

Value Range: Values range from -1 to +1.

Interpretation

Water Bodies: Typically have values greater than 0.5.

Vegetation: Has lower values, which helps differentiate it from water.

Built-up Areas: Show positive values between 0 and 0.2

The results of NDWI are given in Figure8 and Table 6

Table 6 Spatial Distribution Results of NDWI of Thiruvattar Firka

NDVI	Weightage for Water Resources	Suitability	Area (Km^2)
Water body	3	High	7
0.5-1	2	Moderate	18
Close to 0 and a negative value	1	Low	43

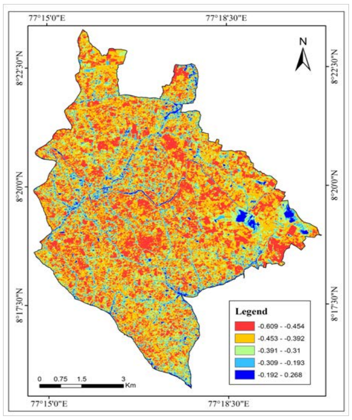

Figure 8 Spatial Distribution Map of NDWI of Thiruvattar Firka

Normalized Difference Drought Index (NDDI)

The Normalised Difference Vegetation Index (NDVI) is a remote sensing tool used to monitor and measure drought severity. This is a remote sensing index used to assess drought by analysing a satellite's spectral bands, primarily the Near-Infrared (NIR) and Short Wave Infrared (SWIR) bands. It is calculated using the normalised Difference Vegetation Index (NDVI) and the Normalized Difference Water Index (NDWI). Values range from -1 to 1, with more negative values indicating more severe drought stress. It helps in monitoring water stress in vegetation and is crucial for drought-related challenges in agriculture and water management. The NDDI map is prepared using satellite data and is given in Fig. 9. The NDDI results are presented in Table 7. Accordingly, the relative weightage of water is given in the attribute. Table 7 Spatial Distribution Results of NDDI of Thiruvattar Firka

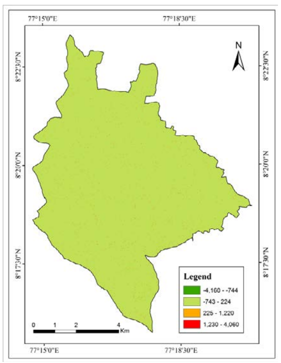

Figure 9 Spatial Distribution Map of NDDI of Thiruvattar Firka

Groundwater Potential Zone using Overlay Analysis

The Groundwater Potential Map (GPM), which utilises the overlay of Land Use/Land Cover (LULC), Drainage Density, Lineament Density, NDVI, NDWI, and NDDI, is a geospatial map that visually classifies the study area into zones of relative groundwater potential.

This map is created by integrating the quantitative influence of each of your listed thematic layers using a Geographic Information System (GIS) Weighted Sum Method.

High/Excellent Potential: These areas have the most favourable combination of all input factors (e.g., high lineament density, low drainage density, water bodies/moist vegetation cover). These sites are the best for drilling boreholes.

Moderate/Good Potential: Areas where the influencing factors are neither extremely favourable nor unfavourable.

Low/Very Poor Potential: Areas with poor conditions (e.g., steep slopes, dense drainage, built-up areas, or dry bare soil) for recharge and storage.

The final map's score at any point reflects the combined influence of all your chosen parameters. In the Weighted Overlay Analysis, each layer is assigned a weight, and classes within each layer are assigned a rank based on their impact on groundwater storage and movement Table 7.

Table 7 Overall Weightage Table for Each Layer

Thematic layer	Layer weight	Class	Rank
Surface waterbody	20	River	3
		Canal	2
		Tank	1
Drainage Density	25	Low	4
		Moderate	3
		High	2
		Very high	1
Lineament Density	12	Low	1
		Moderate	2
		High	3

		Very high	4
Land use/ Land cover	18	River	7
		Vegetation	5
		Waterbodies	6
		Fallow lands	4
		Settlements	2
		Barren lands	1
		Roadways	3
NDVI	10	Water body	3
		Vegetation	2
		Barren land	1
NDWI	8	Water body	3
		Vegetation	2
		Barren land	1
NDDI	7	Low	3
		Moderate	2
		High	1

Multicriteria Weighted Overlay Index Map for Groundwater Potential Zones

In GIS, the relative weightings are assigned with respect to water resources. GIS is an efficient tool for integrating mapping to locate groundwater zones (Gurugnanam et al., 2008). A total of 10 thematic layers, including geomorphology, geology, lineament density, land use/land cover (LULC), soil, drainage density, rainfall, slope (Kom et al., 2024), Curvature, and topographic wetness index (TWI), were created and analysed for groundwater potential zone delineation. Using the Union analytical tool, the maps as shown in the methodology are integrated one over the other. All thematic maps of water were prepared and integrated into a comprehensive map. All the themes were integrated into the GIS platform (Kalaivanan. K et al., 2019). The results of the integration were classified into three categories: High, Moderate, and Low groundwater. The use of remote sensing and GIS is highly fruitful and useful for assessing groundwater potential zones (Arulbalaji & Gurugnanam, 2016). The spatial map of the output is shown in Fig. 10, and the results are summarised in Table 8.

Table 8 Spatial Distribution Results of Groundwater Potential Zones of Thiruvattar Firka

Groundwater potential	Weightage for Water Resources	Area (Km^2)	Area%
High	3	9	13.43
Moderate	2	50	74.63
Low	1	8	11.94

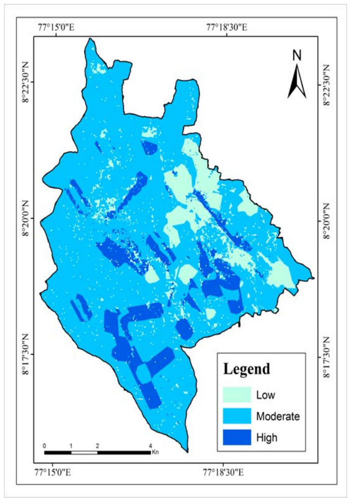

Figure 10 Spatial Distribution Map of Groundwater Potential Zones of Thiruvattar Firka

Suggestions and Future Research Directions

The findings of this study provide a scientific basis for groundwater resource planning in Thiruvattar Firka; however, several aspects warrant further investigation to enhance the robustness and applicability of groundwater potential assessments.

As far as technical implications of assessing the groundwater in the study area, the following study would help technically to improve. Future studies should incorporate long-term, time-series groundwater level and well yield data to capture seasonal and interannual variability in aquifer response, particularly under changing monsoonal rainfall patterns. The integration of advanced data-driven approaches, such as machine learning and hybrid models (e.g., Random Forest, Support Vector Machine, and ensemble techniques), could further improve prediction accuracy and reduce subjectivity associated with conventional weighting schemes. Additionally, the use of higher-resolution satellite datasets, geophysical surveys, and detailed subsurface information would enable better characterisation of fracture networks and aquifer geometry in weathered and hard-rock terrains. Climate change scenarios and land-use dynamics should also be incorporated to evaluate their long-term impacts on groundwater recharge and sustainability.

From a management perspective, the delineated high- and moderate-groundwater potential zones can be prioritised for artificial recharge structures, rainwater harvesting, and regulated groundwater extraction. Future research may also focus on developing a decision-support system by integrating groundwater quality parameters with quantity-based potential maps to support holistic and sustainable groundwater management in tropical coastal environments.

Conclusion

The conclusion regarding the groundwater potential in a study area summarises the findings on the occurrence, availability, and expected yield of groundwater, based on an analysis of various influencing factors, and an integrated approach combining GIS and remote sensing.

The results classified the area into specific groundwater potential zones: high groundwater potential (13.43%), moderate potential (74.63%), and low potential (11.94 %). This systematic methodology was effective in delineating zones with varying groundwater prospects, offering a valuable tool for sustainable water resource management in similar regions. The model validation demonstrated high accuracy, with 80% agreement between the predicted groundwater potential zones and actual borehole yield data. This is usually the main quantitative outcome. In essence, the conclusion confirms the location and extent of areas suitable for groundwater development, providing a scientific basis for future resource planning and management.

References

Arulbalaji, P., and B. Gurugnanam. "Evaluating the Normalized Difference Vegetation Index Using Landsat Data by ENVI in Salem District, Tamil Nadu, India." *International Journal of Development Research*, vol. 6, no. 9, 2014, pp. 1844-1846.

Arulbalaji, P., and B. Gurugnanam. "Geospatial Science for 16 Years of Variation in Land Use/Land Cover Practice Assessment around Salem District, South India." *Journal of Geosciences and Geomatics*, vol. 2, no. 1, 2014, pp. 17-20.

Bagyaraj, M., et al. "Assessment of Soil Erosion Probability in Kodaikanal, India Using GIS and Remote Sensing." *Disaster Advances*, vol. 7, no. 2, 2014.

Bagyaraj, M., et al. "Application of Remote Sensing and GIS Analysis for Identifying Groundwater Potential Zones in Parts of Kodaikanal Taluk, South India." *Frontiers of Earth Science*, vol. 7, no. 1, 2013.

Balasubramaniyan, G., et al. "AHP and Geospatial Technology-Based Assessment of Groundwater Potential Zones in Natham Taluk, Tamil Nadu, India." *Scientific Reports*, vol. 15, no. 1, 2025, article 28045.

Berhanu, K. G., and S. D. Hatiye. "Identification of Groundwater Potential Zones Using Proxy Data: A Case Study of Megech Watershed, Ethiopia." *Journal of Hydrology: Regional Studies*, vol. 28, 2020, article 100676.

Chrisben Sam, S., and B. Gurugnanam. "Spatiotemporal Detection of Land Use/ Land Cover Changes and Land Surface Temperature Using Landsat and MODIS Data across the Coastal Kanyakumari District, India." *Geodesy and Geodynamics*, vol. 14, no. 2, 2023, pp. 172–181.

Demissie, E. S., et al. "Groundwater Recharge Estimation in Upper Gelana Watershed, South-Western Main Ethiopian Rift Valley." *Sustainability*, vol. 15, no. 3, 2023, article 1763.

Gurugnanam, B., et al. "Geographic Information Technology for Hydrogeomorphological Mapping in Parts of Vellar Basin, Central Tamil Nadu." *Journal of the Geological Society of India*, vol. 72, 2008, pp. 471-478

Gurugnanam, B., et al. "GIS-Based Micro-Level Approach for Hydrogeochemical Studies in Upper Manimuktha Sub-Basin, Vellar, South India." *Indian Journal of Science and Technology*, vol. 2, no. 11, 2009, pp. 5-10.

Jhariya, D. C., et al. "Assessment of Groundwater Potential Zone Using Remote Sensing, GIS and Multi-Criteria Decision Analysis Techniques." *Journal of the Geological Society of India*, vol. 88, no. 4, 2016, pp. 481-492.

Kalaivanan, K., et al. "Geoelectrical Resistivity Investigation for Hydrogeological Conditions and Groundwater Potential Zone Mapping of Kodavanar Sub-Basin, Southern India." *Sustainable Water Resources Management*, 2019.

Khanam, L. A., and S. K. Patnaik. "Identification of Groundwater Potential Zones Using GIS Techniques in East Karbi Anglong District, Assam, India." *Asian Journal of Geographical Research*, vol. 8, no. 3, 2025, pp. 472-487.

Kom, K. P., et al. "Hydrogeochemical Assessment of Groundwater Quality for Drinking and Irrigation Purposes in Western Coimbatore, South India." *International Journal of Energy and Water Resources*, vol. 6, no. 4, 2021, pp. 475-494.

Kumaravel, S., et al. "Quantitative Estimation of Shoreline Changes Using Remote Sensing and GIS: A Case Study in Parts of Cuddalore District, East Coast of Tamil Nadu, India." *International Journal of Environmental Sciences*, vol. 2, no. 4, 2012, pp. 2482-2490.

Kwami, I. A., et al. "Delineation of Aquifer Potential Zones Using Hydraulic Parameters in Gombe and Environs, North-Eastern Nigeria." *Heliyon*, vol. 5, no. 7, 2019, article e01927.

Mallick, J., et al. "Proposing Receiver Operating Characteristic-Based Sensitivity Analysis with Swarm-Optimized Ensemble Learning Algorithms for Groundwater Potentiality Modelling in Asir Region, Saudi Arabia." *Geocarto International*, vol. 37, no. 15, 2022, pp. 4361-4389.

Murugesan, B., et al. "Deciphering Groundwater Potential Zones in Hard Rock Terrain Using GIS Technology with AHP Statistical Methods: A Case Study of Nilgiri, Tamil Nadu, India." *Scientific Reports*, vol. 15, no. 1, 2025, article 26463.

Nanesso, D. A., and D. N. Habtemariam. "Identification of Groundwater Potential Zones Using Geospatial Technologies in Meki Catchment, Ethiopia." *SSRN,* 2023.

Phaisonreng Kom, K., et al. "Sources and Geochemistry of High-Fluoride Groundwater in Hard Rock Aquifer of a Semi-Arid Region: Special Focus on Human Health Risk Assessment." *Total Environment Research Themes*, vol. 100026, 2023, pp. 1-19.

Rajan, M., et al. "Assessment of Groundwater Suitability for Drinking and Irrigation Purposes with Probable Health Threats in a Semiarid River Basin of South India." *Water Environment Research*, vol. 97, no. 2, 2025.

Rehman, A., et al. "Groundwater Potential Zone Mapping Using GIS and Remote Sensing-Based Models for Sustainable Groundwater Management." *Geocarto International*, vol. 39, no. 1, 2024, article 2306275.

Suresh, M., et al. "GIS Analysis for the Delineation of Groundwater-Bearing Fracture Zones Using Geophysics in Upper Thirumanimuthar Sub-Basin, Cauvery River, Tamil Nadu, India." *Indian Society for Earth, Planetary and Environmental Sciences*, 2010.

Thapa, R., et al. "Assessment of Groundwater Potential Zones Using Multi-Influencing Factor (MIF) and GIS: A Case Study from Birbhum District, West Bengal." *Applied Water Science*, vol. 7, no. 7, 2017, pp. 4117-4131.

Yosef, Z. M., et al. "GIS-Based Suitability Mapping of Managed Aquifer Recharge (MAR) in Dire Dawa Catchment, Eastern Ethiopia." *International Journal of River Basin Management*, 2024.

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