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Research Article

DELINEATION OF GROUNDWATER POTENTIAL ZONES STUDIES USING GEOSPATIAL TECHNOLOGY IN LOWER TAMIRABHARANI RIVER BASIN, SOUTHERN INDIA

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ABSTRACT

To identify the groundwater potential zones in lower Tamirabharani River Basin, Tamil Nadu using remote sensing and GIS techniques. The study made use of thematic maps like lineament density, geomorphology, geology, land use/land cover, drainage density and soil map as GIS layers in the geodatabase and assigning weightages based on the influence of the groundwater potential. By integration of weightages to acquired more effective score to demarcate the groundwater potential zone. Lineament density and geomorphology were identified as the highest factor contributing to groundwater influence prospect with 30% and 20% respectively. The very good groundwater potential zones were defined in the eastern areas while the areas with low potential lie in the western regions. The result also shows that good groundwater potential zones occupy a coverage of about 14.1%, moderate potential constitutes 22.4%, poor holds 15.0% while saltwater intrusion represents of 23.9% of the study area respectively. Lower Tamirabharani River Basin was identified to have a very high groundwater potential within the study area. It is therefore recommended that groundwater potential zones mapping should be carried out for the entire country to serve as the guide for water resources agencies.

INTRODUCTION

Water is an extremely important natural resource. The distribution of this resources is highly uneven. Because of the uneven distribution, storage for local requirements of water can be met either by transporting from reservoirs lakes, rivers, and storage tanks, etc. or withdrawal of sub-surface water (Kurek and Ostfeld, 2013; Döll *et al*. 2012). Fortunately, groundwater is a fairly widely distributed natural, renewable resources, which gets replenished by rainfall. Groundwater is the potential source of water supply throughout the world (Gleeson *et al*. 2012; Basu & Van Meter, 2013; Magesh *et al*. 2012; Rodell *et al*. 2009; Yeh *et al*. 2009). Its use in irrigation, industry, municipality and rural areas continues to increase. In order to keep pace with the ever-increasingdemand for water, groundwater identification is an important prerequisite. In order to identify the potential groundwater area, remote sensing data are highly useful (Samson & Elangovan 2015; Gumma, &Pavelic 2013; Jasrotia *et al*. 2013; Sener *et al*. 2005). Water resource study of a given area requires knowledge of the nature of the lithological units found in the area, their structural disposition, geomorphic setup, surface water conditions, etc. Most of these aspects can be studied on satellite images. This modern technology can play a very significant role in the appraisal and development of water resources. The remote sensing data obtained from the satellite provide quick and useful information on the factors controlling the occurrence and movement of groundwater. The main factors which control the occurrence and movement of groundwater include geomorphology, lineament, geology (Rajaveni *et al*. 2017; Ibrahim-Bathis & Ahmed, 2016; Dar *et al*. 2010; Rodell *et al*. 2009). A systematic study of these factor leads to better delineation of prospective groundwater zones in a region. Such prospective zones identification for the satellite imager are normally followed up on the ground through detailed hydrological and geophysical investigation before actual drilling is carried out for exact quantitative assessment and exploration.

Study area

The study area (Fig.1) forms a lower Tamirabharani River Basin which falls within the longitudes 77°38'50" and

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78°8’22” E and Latitude of 8°26’35” and 8°54’09” N in Survey of India (SOI) toposheet 58H10, 13, 14 and 58L/2 of 1:50000 scale which lies in parts of Thirunelvelli and Thoothukudi district. It has a total study area of an about 1175.79 Sq.km. Easter part of the study area is acoastal zone of the Gulf of Mannar. The Western part of the study area is underlined by the Archaean crystalline rocks.

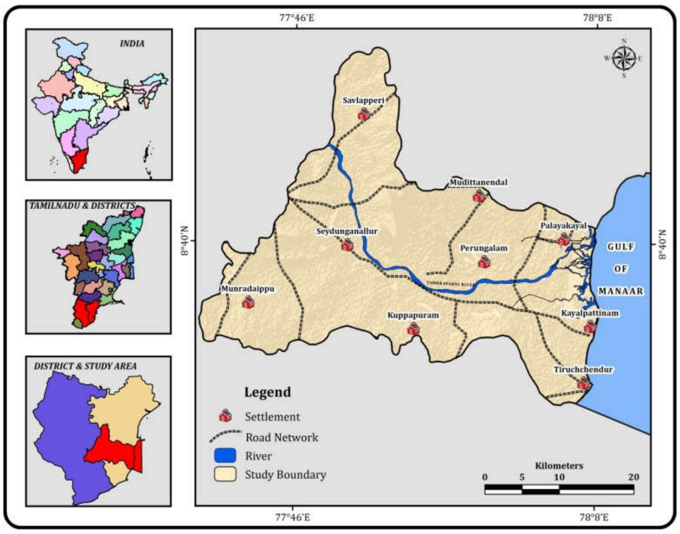

Fig 1 Key Map of the Study Area

METHODOLOGY

For the study, existing hydrogeological and relevant data on soils, geological units, geomorphologic, land use/land cover, lineament density, drainage density, slope and elevation of the study area were collated. The overall study concept involved the integration of eight thematic layers of conventional geology, soil, drainage and lineament maps as well as remotely sensed data of land-use, slope, and geomorphology using both ArcGIS 10.0 and ERDAS 9.3.1 image processing software. All of the map themes were presented in UTM Projection Zone 44N, Datum WGS84 with 30-meter resolution.

Preparation of thematic layers

The analogue geological map of the study area obtained from India Geological Survey India (GSI) with scale 1:50,000 were georeferenced and digitized in ArcGIS 10.0 software platform. Lineaments are a manifestation of long linear natural features that can be identified directly on the rock units or from remote sensing data while lineaments and their intersections play a significant role in the occurrence and movement of groundwater resources in crystalline rocks (Rao 2006; Prasad *et al*. 2008). The presence of lineaments may act as a conduit for groundwater movement which results in increased secondary porosity and, therefore, can serve as groundwater potential zone (Obi Reddy *et al*. 2000). Lineament density map was computed in and expressed in terms of length of the lineament per unit area (km/km^2) in the GIS software.

In addition, land use/land cover (LULC) plays an important role in the occurrence and development of groundwater. LULC map for the study was extracted from a mosaicked Landsat TM imagery of March 2012 series through supervised classification of the false colour composite of the band 4, 3 and 2 to obtain the land use category in ERDAS image processing software platform. Also, soil zone generally has a significant role in the amount of infiltrating water and hence influences groundwater recharge. The rate of infiltration largely depends on the grain size and related hydraulic characteristics of the soils. For this study, soil map of the study area was clipped from Soil Surveyand Land Use Organization, District atlas of Tamil Nadu. Geomorphology reflects various landform and topographical features. Surface water is one of the important geomorphological agents in the development and shaping of landscapes and landforms; thus hydro-geomorphological studies are of importance in the planning and execution of groundwater exploration. Slope, on the other hand, is an aspect of geomorphologic features which controls the infiltration and recharge of groundwater system: thus the nature of slope alongside other geomorphic features can give anindication of groundwater prospect of an area. Therefore, Digital Elevation Model (DEM) of the Shuttle Rader Topographic Mission (SRTM) of 2010 at 30 m resolution was used to generate the geomorphology (Saraf and Choudhary 1998; Rao and Jugran, 2003; Prasad *et al*. 2008). This method is commonly used in the weighted overlay analysis, weights assignments, and integration of thematic maps.

RESULT AND DISCUSSION

Geology

The study area is underlain by the crystalline rocks of the Archaean metamorphic complex. Archaean to the Proterozoiccomplexterrain of the study area (lower Tamirabharani River) comprises metamorphic rock units (charnockite, granites, gneissic, ultrabasic and ultramafic). The granite and pyroxene granulite gneiss settings often from elevated topographic features, while the alluvium and fluvial sediment (sand, silt, gravel, and clay) settings form low-lying areas (Fig. 2 and Table 1). The study area is consisting of crystalline hard rock terrain, most of the study area fallshornblende-biotite gneiss followed by fissile hornblende-biotite gneiss. The small patches occurred in the following rock types such as alluvium, amphibolite, basic complex, calk granulite and limestone, charnockite, fluvial, fuchsite quartzite, gabbro, granite, granite (Thiruchengode granite), magnetite quartzite, pink migmatite, pyroxene granutite, ultra-basic, and ultramafics. As highlighted earlier, the geology of the study area is dominated by the Hornblende biotite gneissic rock units consisting of metamorphic rock units.

Table 1 Result of the geology spatial distribution

Sl. No	Geology	Area in Km^2	Area in %
1	Aeolian (Qa)	9.06	0.77
2	Calc-granulite and limestone (Akcg)	0.3	0.03
3	Charnockite (Ac)	17.6	1.50
4	Fluvial (Qf)	156.02	13.27
5	Fluvio-marine (Qfm)	85.43	7.27
6	Hornblende-biotite gneiss (Amh)	706.65	60.10
7	Marine (Qm)	128.3	10.91
8	Quartzite (Akq)	53.94	4.59
9	Sandstone with clay (N1Cs)	18.49	1.57

The hornblende biotite gneissic, fluvial and marine are widespread over the study area covering about 706 km^2, 156.02km^{2}and 128.3 km^2, respectively. Fluvio-marine, quartzite, sandstone with clay and charnockite are limited to bothsides of the river area covering about 85.43 km^2, 53.94 km^2, 18.49 km^{2}and 17.6 km^2, respectively.

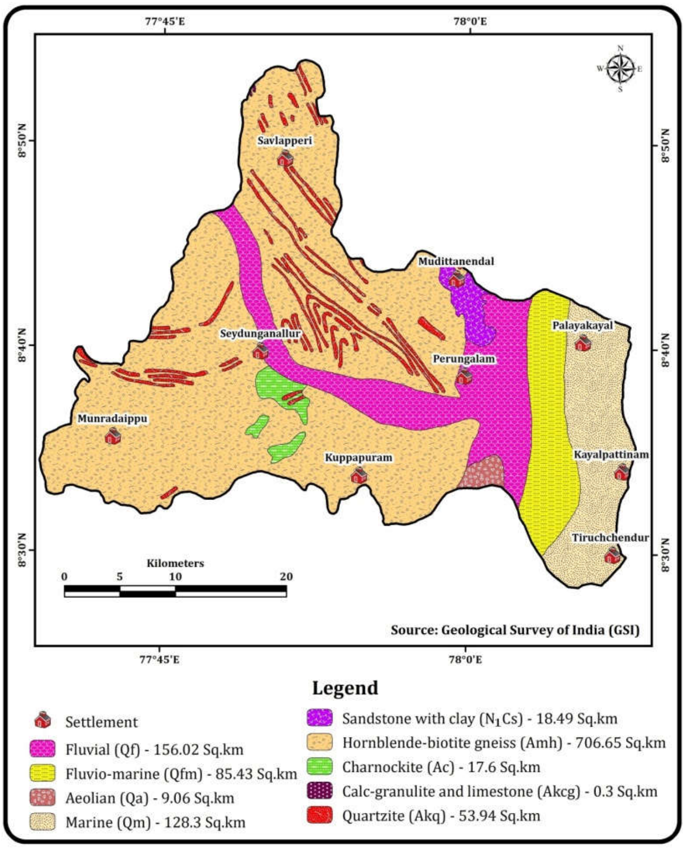

Fig 2 Geology map of the Study Area

Geomorphology

Hydrogeomorphological characterization is one of the main factors for groundwater quantity studies. The description of various landforms such as drainage characteristics and structural features could have a direct control on the availability and flow of groundwater (Sree Devi *et al*. 2001). The landforms identified from the satellite image are helpful in identifying favorable for groundwater potential zones. The various researchers were reported, the hydrogeomorphologic units are closely related to the groundwater identification studies have been carried out in different parts of India by Haridas *et al*.. (1994), Dubey & Trivedi (1994), Lokesh&Shenoy (1996), Palanivel *et al*. (1996) for groundwater prospects.

In this study, eighteen geomorphological units were identified and delineated with respect to the groundwater possible zones (Fig. 3 and Table 2). Pediplain lands are characterized by the presence of relatively thick weathered rock formation. These landforms consist of fairly thick weathered zones underlined by agneissic rock. Supplementary for this land forms classified such as shallow, moderate and deep. These are shallow weathered/buried pediplain, alluvial plain canal command representing and moderately weathered/buried pediplain covering about 516.99 km^2, 158.34 km^2 and 112.11 km^2 of the study area, respectively. Shallow and moderate weathered/buried pediplain is a basement landform of the study region. Therefore it is classified as poor to moderate groundwater possible zone.

Shallow Flood Plain feature is formed by the river (Running water), so it is fresh water region (2858 Sq.km). Adjoining the river portions landforms such as Alluvial Plain Canal Command (158.34 Sq.km), Pediplain Canal Command (7.71 Sq.km), Shallow Alluvial Plain (47.83 Sq.km) are the good groundwater quality and quantity zones. Ridge type Structural Hills (11.12 Sq.km) were classified as poor groundwater possible zone, but around the hill portions (Pediment) is fresh groundwater potential area.

Rest of the landforms like Older Coastal Plain Deep (63.63 Sq.km), Coastal Plain Deep (58.61 Sq.km), Sand Dune (22.40 Sq.km), Salt flat (16.74 Sq.km), Mudflat (10.33 Sq.km), Brackish water Creeks (7.13 Sq.km), Paleo Beach Ridge (4.58 Sq.km) and Beach (0.1 Sq.km) occurred poor quality of groundwater. It may be sea water intruded in this regions.

Table 2 Result of the Geomorphology spatial distribution

Sl. No.	Geomorphology	Area in Km^2	Area in %
1	Alluvial Plain Canal Command	158.34	13.47
2	Beach (Young Coastal Plain)	0.1	0.01
3	Brackish water Creeks (Young Coastal Plain)	7.13	0.61
4	Coastal Plain Deep	58.61	4.99
5	Dome type Residual Hills	0.36	0.03
6	Linear Ridge / Dyke	9.67	0.82
7	Moderately Weathered / Buried Pediplain	112.11	9.54
8	Mud flat (Young Coastal Plain)	10.33	0.88
9	Older Coastal Plain Deep	63.63	5.41
10	Paleao Beach Ridge (Old Coastal Plain)	4.58	0.39
11	Pediment	99.33	8.45
12	Pediplain Canal Command	7.71	0.66
13	Ridge type Structural Hills (Large)	11.12	0.95
14	Salt flat (Young Coastal Plain)	16.74	1.42
15	Sand Dune	22.4	1.91
16	Shallow Alluvial Plain (Younger/ Lower)	47.83	4.07
17	Shallow Flood Plain	28.58	2.43
18	Shallow Weathered / Buried Pediplain	516.99	43.98

Lineaments and Lineament Density

Lineaments are the weaker zones of bedrock which are formed due to the movement of the earth intersection of lineaments are considered as the good occurrence of groundwater potential zones (Rao *et al*. 2003). Lineaments occur as linear, curvilinear and rectilinear lines in satellite imageries. Numerous lineaments in the study area identified from the satellite imagery are illustrated in the Fig. 4. These extend over a length of less than 1 km to more than 5 km. Most of the lineaments trend in the direction of NNE-SSW to ENE–WSW with medium to the steep reversal of dips from SW to NE indicating a series of tightly packed antifoam and conforms. These lineaments were classified into two groups, major and minor lineaments depending on nature and aerial extent. Keeping the lineament map as the base map, a lineament density map (Fig. 5 and Table 3) was prepared using GIS. It was observed in the field that water level fluctuations were low in the regions having higher lineament density.

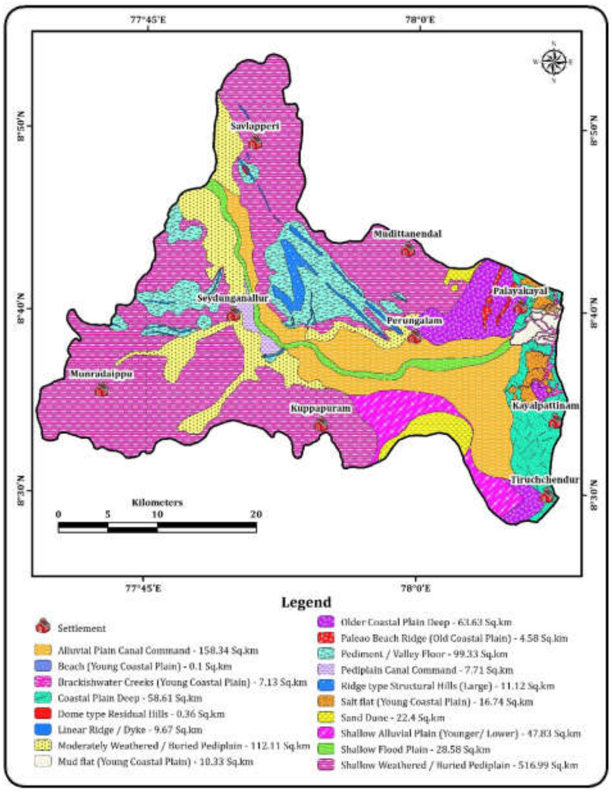

Fig 3 Geomorphology map of the Study Area

Usually, lineament density map is a measure of the quantitative length of linear feature per unit area which can indirectly reveal the groundwater potentials as the presence of lineaments usually denotes a permeable zone. For most of the study area, the lineament density varies from less than 2000 m/km^2 which covers a total area of 561.05 km^{2}and 2000 to 4000 m/km^2 with a total area of 277.77 km^2 (Fig. 5). Though the lineaments are widespread across the study area, however, the distribution of lineaments suggests geologic control with areas underlain by hornblende-biotite gneiss and quartzite having relatively higher lineament density (of > 8000 m/km^2). Thus areas with higher lineament density are regarded as good for groundwater potential zone.

Table 3 Result of the Lineament density spatial distribution

Sl. No.	Lineament Density	Area in Km^2	Area in %
1	Very low lineament density (< 2000 m/Sq.km)	561.05	47.72
2	Low lineament density (2000 - 4000 m/Sq.km)	277.77	23.62
3	Moderate lineament density (4000 – 6000 m/Sq.km)	101.1	8.60
4	High lineament density (6000 - 8000 m/Sq.km)	99.03	8.42
5	Very high lineament density (> 8000 m/Sq.km)	136.84	11.64

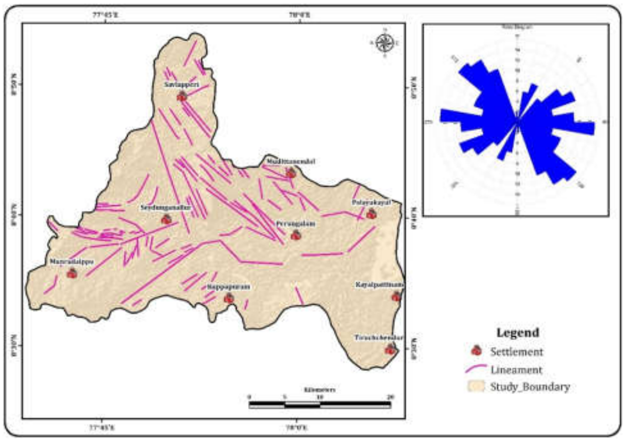

Fig 4 Lineament map

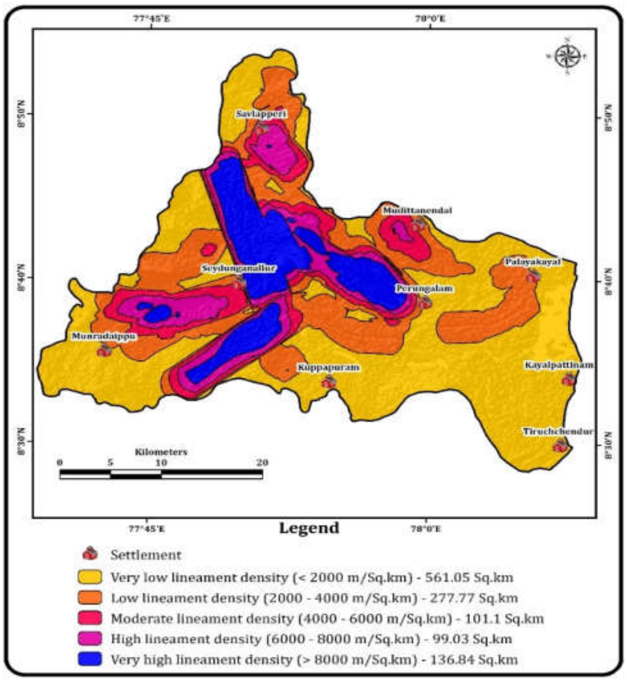

Fig 5 Lineament density map of the Study Area

Soil

The study of Soil characteristics plays an important role in groundwater quality as well as quantity. Soils are derived from rocks, due to the weathering and erosion of the geological agents like a river, wind, and rainwater depending on the climate. The detailed study about the soil types of lower Tamirabharani River Basin. The soil is an important factor in delineating the groundwater quality and quantity zones. The soil spatial distribution map (Fig. 6 and Table 4) reveals that the entire study regions covered by brown soil except for small portions (black soil and red soil). 91.06% of the study area covered above the surface is brown soil, so water infiltration and quality are moderate. The entire groundwater quality may be poor to moderate.

Table 4 Result of the Soil spatial distribution

Sl. No.	Soil	Area in Km^2	Area in %
1	Brown soil	1070.62	91.06
2	Black soil	78.63	6.69
3	Red soil	26.54	2.26

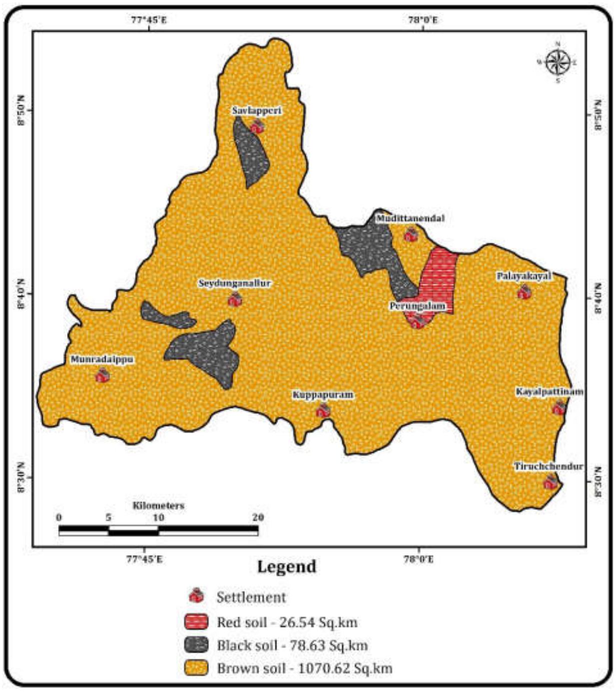

Fig 6 Soil map of the Study Area

Land use/land cover

Land use refers to man's activities in the land, various use which is carried out on land, whereas land cover denotes the natural vegetation, water bodies, rock / soil, artificial cover and others resulted due to land transformation. The remote sensing data records the information essentially on land surface from which the information on land use has to be inferred. The land use/land cover classification system for standardizing different agro-climatic zones by the Department of Space, Government of India has been adopted in this study. Identified land use/land cover features from the satellite imageries of the study area are built-up land, crop land, dense, fallow land, hill and forest, land with scrub, land without scrub, mining process, plantations, river & water bodies, wetland (Fig. 7). Employing the above classification and using visual interpretation and GIS techniques, with limited field checks, land use/land cover in the study area were estimated (Table 5).

Land use/land cover plays an important role in the occurrence and development of groundwater. Consequently, the identified land use/land cover features for this study from the thematic map are agricultural area (cropland and fallow land), wasteland (land with scrub and land without scrub) water bodies (stream, lakes and pond), built-up areas/settlements as well as open bare soils surfaces/outcrops areas (Fig. 7). Agricultural area, as the dominant land use types, covered an area of about 462.83 km^2 representing about 39.37 % of the total area followed by Waste land (land with scrub and land without scrub) 423.11 km^2 (35.99 %). River & Water bodies areas constitute only 123.98 km^2 (10.55 %) while about and 64.65 km^2 (5.50 %) are covered by built-up areas/settlements, hill and forest (81.96 km^2) 6.97 %.The distribution of land-use/land cover is expected to enhance groundwater potential zone is depending on the underlying soil and geologic conditions.

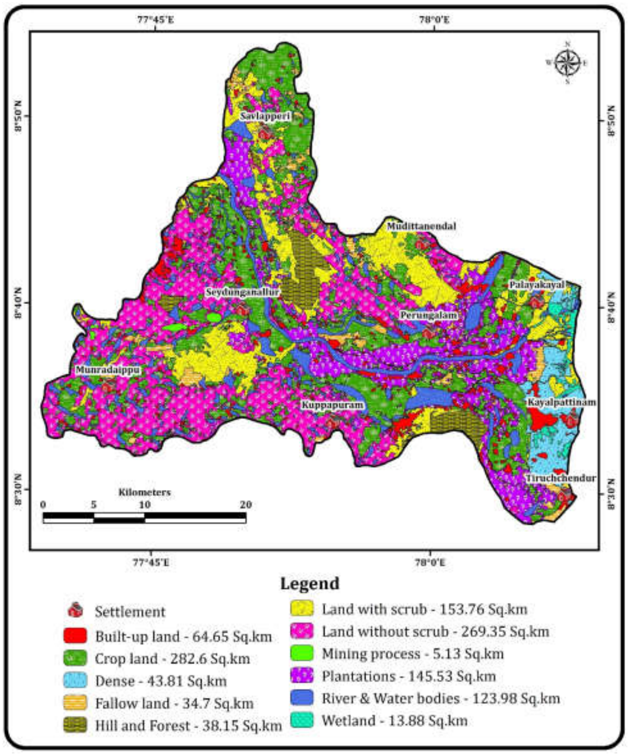

Fig 7 Land use/land cover map of the Study Area

Table 5 Result of the Land use/land cover spatial distribution

Sl. No.	Land use/Land cover	Area in Km^2	Area in %
1	Built-up land	64.65	5.50
2	Crop land	282.6	24.03
3	Dense	43.81	3.73
4	Fallow land	34.7	2.95
5	Hill and Forest	38.15	3.24
6	Land with scrub	153.76	13.08
7	Land without scrub	269.35	22.91
8	Mining process	5.13	0.44
9	Plantations	145.53	12.38
10	River & Water bodies	123.98	10.54
11	Wetland	13.88	1.18

Drainage and Drainage Density

The sub-surface hydrological condition of any area is controlled by the drainage characteristics of the basin that leads to deciphering the groundwater condition. The drainage density can indirectly indicate the groundwater potential of an area due to its relation to surface runoff and permeability. The drainage map of the study area along with different tributaries was prepared from the SOI topographical maps on 1:50,000 scale and updated using the satellite imageries. The dendritic pattern is generally observed in the study area (Fig. 8). It is influenced by factors like initial slope, differences in rock resistance, structural controls, and morphological history of the basin. Drainage pattern is most helpful in interpreting the geomorphic features and tracing the evolution of landforms. The map was further used for the preparation of drainage density map (Fig. 9). Drainage density was measured and ranged as <1000 km/km^2, 1000 to 2000 km/km^2, 2000 to 4000 km/km^2, 4000 to

6000 km/km^2 and more than 6000 km/km^2 (Table 6). The zones of high drainage density will have poor groundwater prospects, and gradually the zones of lower and lower drainage density zones will have better groundwater prospects. An area of high drainage density also increases surface runoff compared to a low drainage density area. The lower drainage density zones in the area indicate relatively higher permeability and the presence of more fractured rock.

Table 6 Result of the Drainage density spatial distribution

Sl. No.	Drainage Density	Area in Km^2	Area in %
1	Very low lineament density (< 2000 m/Sq.km)	561.05	47.72
2	Low lineament density (2000 - 4000 m/Sq.km)	277.77	23.62
3	Moderate lineament density (4000 – 6000 m/Sq.km)	101.1	8.60
4	High lineament density (6000 - 8000 m/Sq.km)	99.03	8.42
5	Very high lineament density (> 8000 m/Sq.km)	136.84	11.64

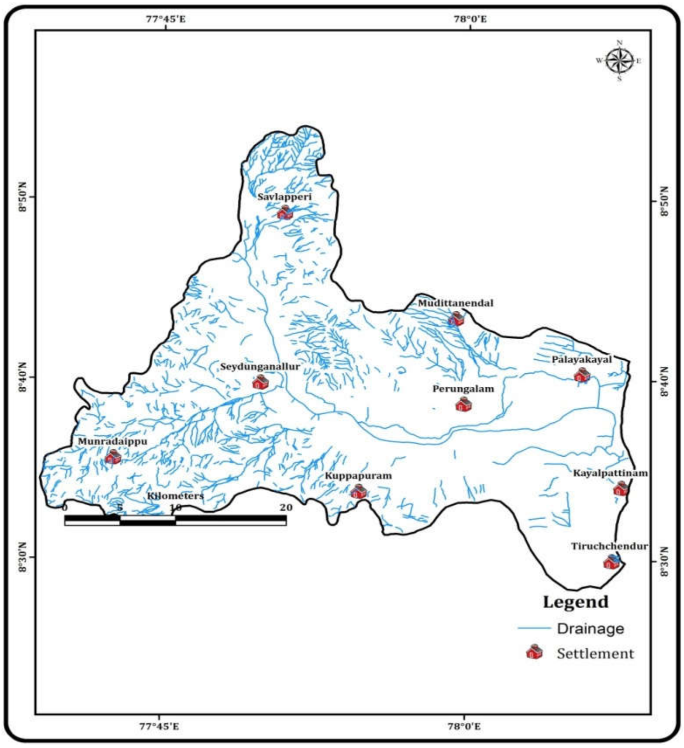

Fig 8 Drainage map of the Study Area

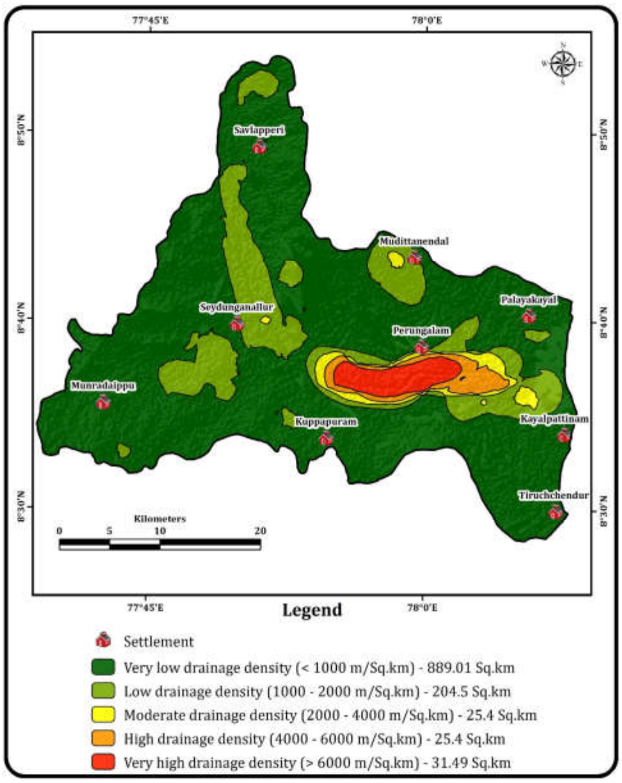

Fig 9 Drainage density map of the Study Area

Weighted Overlay Analysis (WOA)

The identification of groundwater potential zones involves an integrated approach taking into account on various parameters like geomorphology, geology, land use/land cover, drainage density, lineament density, soil, etc.. By using remote sensing and GIS techniques, thematic data has been integrated for evaluation of groundwater potential zones of the study area. The groundwater prospect map is also prepared by integrating the geological map, hydrogeomorphic map, land use land cover, lineament density map, and drainage density map of the areas with limited information on groundwater level.

Different geological features in a variety of landforms such as a structural hill, pediments, buried pediments, valley fill bear different capacities to hold water thereby showing varied aquifer qualities. Weighted overlay analysis (WOA) is a simple and straightforward method for a combined analysis of multiclass maps. The advantage of this method is that the human judgment can be integrated with this analysis. A weight represents the relative importance of a parameter and the objective. There is no standard scale for a simple weighted overlay method. For this purpose, criteria for the analysis are defined, and each parameter is given its due importance (Saraf and Choudhury 1998). Thematic maps on geology, geomorphology, lineament density, land use/land cover and drainage density provide valuable information on the occurrence of groundwater. In order to get all this information unified, it is necessary to integrate these data with a proper factor, and it is also possible to superimpose this information manually (Horton 1945). Therefore, numerically this information is integrated through the application of GIS. Various thematic maps are reclassified on the basis of weightage assigned.

Depending on the groundwater potentiality, each theme geomorphology, lineament density, geology and land use/land cover are qualitatively placed into the following categories viz., (i) Good (ii) Moderate (iii) Poor and (iv) Saltwater intrusion. Suitable weightage on a scale of 'six' was given to each class of a particular thematic layer based on their contribution towards groundwater potentiality. All the thematic maps were then registered with one another through ground control points and integrated by normalized aggregation method in GIS for computing groundwater potential influence of each feature. The weight and rank assigned to different classes of all the themes are presented in Table 7. The groundwater conditions in crystalline hard rock terrain are multivariate due to the heterogeneous nature of the rock formations displaying varying composition, compaction, and degree of weathering.

Final integration output map (Groundwater potential map) Fig. 10 was prepared based on the above techniques. From that, it is observed that the good potential zones possess suitable surface and subsurface conditions such as the occurrence of lineaments and permeable formations. The map shows four categories of groundwater potential zone viz, high, moderate and poor (Fig. 10). Good groundwater potential zone covers an area of 508.06km^2 (43.22%), moderate groundwater potential zone covers an area of 408.59km^2 (34.76%) and poor groundwater potential zone covers an area of 237.57km^2 (1.81%).

Groundwater potential map in Fig. 10 and Table 8 gives a quick assessment of the occurrence of groundwater resources in the study area with the help of geospatial technology. The final integration groundwater potential map revealed that the major portion of the study area generally has high groundwater potentials with area coverage of about 43.22 %, while the major portion and adjoining river basin, and moderate potentials representing about 34.76 % of the study area.

Low groundwater potential zone occurred most of the study area as reflected by 1.81% coverage is a validation of ground truth information as the limit edaquiferous capability of basement complex hard rock terrain. Furthermore, a closer assessment of the groundwater potential map revealed that the distribution is more or less a reflection of the soil patterns and the geological control. In addition, areas underlain by fluvial, alluvium and gneiss especially in the southern and eastern with western sections of the study area which are characterized by relatively high annual rainfall have high groundwater potential on the one hand. On the other hand, areas underlain by pediplain canal command, due to the presence of lineament and apparently deep weathering exhibit high groundwater potential while areas underlain by hornblende-biotite gneiss rocks have medium potential. Moreover, moderately slope percentages, shallow buried pediplain and predominance of rock outcrops can be attributed to the observed low groundwater potentials at the outer portion of the river of the study area. However, high drainage density Tamirabharani river water which can enhance infiltration of water into the groundwater system can be attributed to the observed high groundwater potential exhibited by the entire river portions of the study area.

Table 7 Weight and rank assigned to various parameters

Geomorphology		Lineament density		Geology		Land use/Land cover		Soil		Drainage density	
Weight # 20	**Rank**	**Weight #30**	**Rank**	**Weight #15**	**Rank**	**Weight # 15**	**Rank**	**Weight # 10**	**Rank**	**Weight # 10**	**Rank**
Alluvial Plain Canal Command	14	Very low lineament density	5	Aeolian	14	Built-up land	5	Brown soil	5	Very low drainage density (< 1000 m/Sq.km)	10
Beach (Young Coastal Plain)	14	Low lineament density	10	Calc-granulite and limestone	13	Crop land	13	Black soil	10	Low drainage density (1000 - 2000 m/Sq.km)	6
Brackish water Creeks (Young Coastal Plain)	14	Moderate lineament density	18	Charnockite	12	Dense	4	Red soil	8	Moderate drainage density (2000 - 4000 m/Sq.km)	4
Coastal Plain Deep	12	High lineament density	23	Fluvial	16	Fallow land	8			High drainage density (4000 - 6000 m/Sq.km)	3
Dome type Residual Hills	8	Very high lineament density	28	Fluvio-marine	18	Hill and Forest	6			Very high drainage density (> 6000 m/Sq.km)	2
Linear Ridge / Dyke	8			Hornblende-biotite gneiss	11	Land with scrub	4				
Moderately Weathered / Buried Pediplain	12			Marine	13	Land without scrub	4				
Mudflat (Young Coastal Plain)	13			Quartzite	16	Mining process	6				
Older Coastal Plain Deep	13			Sandstone with clay	14	Plantations	12				
Paleo Beach Ridge (Old Coastal Plain)	12					River & Water bodies	12				
Pediment / Valley Floor	13					Wetland	5				
Pediplain Canal Command	12										
Ridge type Structural Hills (Large)	8										
Salt flat (Young Coastal Plain)	12										
Sand Dune	12										
Shallow Alluvial Plain (Younger/ Lower)	11										
Shallow Flood Plain	13										
Shallow Weathered / Buried Pediplain	11										

Table 8 Result of the Groundwater potential spatial distribution

Sl. No	Drainage Density	Area in Km^2	Area in %
1	Good groundwater potential zone	508.06	43.22
2	Moderate groundwater potential zone	408.59	34.76
3	Poor groundwater potential zone	237.57	20.21
4	Salt water intrusion	21.3	1.81

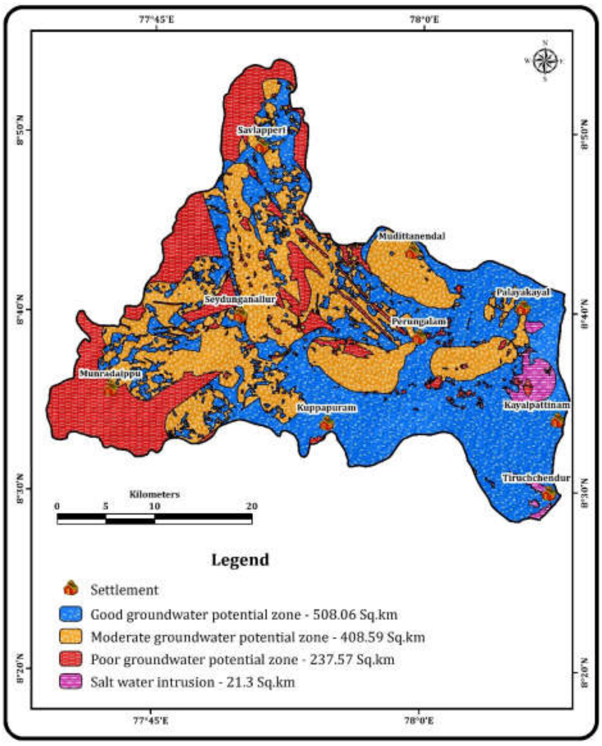

Fig 10 Groundwater potential zone map of the Study Area

CONCLUSION

In the present study, remote sensing and GIS approaches have been used to integrate various geological and hydro-geomorphological thematic maps, which play amajor role in theoccurrence of groundwater. The integrated groundwater potential map has been categorized on the basis of weightage index to different features of thematic maps. The higher weightage index lineament density falling in Pediment/Valley floor, quartzite and hornblende biotite gneissic indicate good groundwater potential zones.The overall integration of the thematic layers revealed that the study area could be categorized into three different groundwater potential zones: high, medium and low. The medium groundwater potential zones occupy about 408.59 km^2 representing about 34.76 % of the total area while goodand poor groundwater potential zones constitute about 43.22 % (508.06 km^2) and of the total area. The overall potential map suggests the dominant influence of geology and geomorphological features in the delineation of the groundwater zone; the areas underlain by hornblende biotite gneissic, fluvial and marine settings have high groundwater potentials compared to medium potentials in the areas characterized by weathered/fractured gneiss.

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