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Block level assessment of groundwater potential zones using hydrogeological and remote sensing and GIS data's: a scientific approach to prevent water scarcity problems

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ABSTRACT

The goal of the current study was to identify possible groundwater occurrence zones by combining the applications such as remote sensing, geographic information system and analytic hierarchy process techniques. In accordance with their impact on groundwater potential, various prepared thematic layers including lithology, geomorphology, rainfall, lineament density, land use and land cover, drainage density, soil type, slope, and soil texture were each given a weight. The results of this study are extremely positive, and the comprehensive methodology adopted has demonstrated its relevance in mapping groundwater potential areas in the drought-affected regions of Palani taluk. Have an opinion on how artificial structures may affect the vulnerability zones, and then map the artificial recharge structures for the study region of Palani taluk. Applying these methodologies, groundwater potential areas were identified, and they were divided into five zones: low, medium, medium-high, high, and very high potential. Very high favourable zones fall under value ranges beginning at 429.40, while low favourable zones fall under ranges beginning at 6.60. There is a total of 26 well locations used for observation and calculation of groundwater levels. Puliampatti has the highest groundwater level in Palani taluk 2.2 m·bgl, while Vagarai has the lowest groundwater level 10.88 m·bgl.

Keywords: Groundwater potential zones; Rainfall; Lithology; Artificial recharge structures; Drainage density

1. Introduction

Groundwater that occurs below the surface of the earth and fills some or all of the spaces left by voids in soil or geologic layers is known as groundwater [1]. In order to distinguish it from surface water, which is found in big bodies of water like lakes or oceans or flowing through streams on land, it is also referred to as subsurface water [2]. Wells and springs are examples of underground groundwater sources [3]. Groundwater is one of the most priceless natural resources on the planet, and it indirectly affects people's health and economic development [4]. Due to its many inherent qualities, including consistent temperature, widespread and continuous availability, excellent natural quality, limited exposure, low development cost, and drought reliability, it has become an important and dependable source of water supplies in all climatic areas, including both urban and rural areas of developed and developing countries [5,6].

Around 22% of the 37 M·km^3 of freshwater believed to be present in the land is groundwater, making up around 97% of the total amount of liquid freshwater potentially

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accessible for human use [7]. The hydrologic cycle demonstrates how when rain falls to the ground, some water seeps into the ground, some water evaporates into the atmosphere, some water is absorbed by plants, and some water moves along the land to streams or lakes [7]. In the technical sense, groundwater can also include soil moisture, permafrost (frozen soil), immobile water in very low permeability bedrock, and deep geothermal or oil formation water [8]. Groundwater is liquid that exists below in saturated areas below the surface of the earth [9]. Contrary to common perception, underground rivers are not formed by groundwater [10]. Sand, gravel, and other subsurface sediments, as well as cracks and pores in underground rock, are filled [11–13]. Characteristically, groundwater is conceived of as water stirring through low aquifers. It is assumed that groundwater acts as a lubricant to help faults move more easily.

The subsoil of the earth most certainly contains some water, which in some cases may be blended with other fluids [14]. Subsurface water frequently costs less, is more useful, and is less likely to be polluted than surface water. As a result, it is widely used to distribute water to the general population. Environmental problems are related to the use of groundwater [15,16]. For example, groundwater pollution is more difficult to detect and fresh up than pollution in rivers and lakes [17]. The analytic hierarchy process (AHP) is a system that combines math and psychology to organise and analyse complicated choices [18]. Saaty created it in the 1970s, and since then, it has been improved [19]. On the basis of assigning appropriate weights and ratings and following the recommendations of experts, the geographic information system (GIS-based) AHP approach is used to incorporate several characteristics for estimating groundwater potential availability at site-specific zones [20]. Due to the GIS's (geographic information system) superior capacity to manage and analyse different types of data, these criteria were applied in the GIS [21]. Additionally, the weightings of criteria were determined using the AHP approach using a matrix of pair wise comparisons [22]. The research was carried out in the region of Palani taluk, state of Tamil Nadu, India [23]. Several studies were conducted in that area, and the structures and artificial recharge structures for Palani taluk were the focus of the current study in the year of 2022 [24–26].

2. Study area

The review zone spans a 766.83 km^2 area with latitudes between 10°20′2″ and 10°38′24″ N and longitudes between 77°18′6″ and 77°35′41″ E. In addition, Fig. 1 depicts that hilly landforms encompass an area of 116.85 km^2. The review area is located in Tamil Nadu's Dindigul district. Precipitation throughout the south-western season is a key source of groundwater. For 33 y, the usual average rainfall is 690 mm (1980–2013). The review area is covered with Archean crystalline rocks, which include cracked zones where groundwater is stored. Palani is a town and the taluk's administrative centre in the western Tamil Nadu state of India. The town, which is the second largest town in the region after Dindigul, has 126,751 residents as of 2011. The Palani hills, a branch of the Western Ghats, which is where the hill town of Kodaikanal is located, serve as the town's backdrop. The two hills, Sivagiri and Sakthigiri, on which the temple is located, command the whole town's view. A number of lakes exist at the base of the hills, and they flow into the Shanmuganathi river, a branch of the Amaravathi river, which is a branch of the Kaveri river and has its source in the Palani hills. Oddanchatram, Dharapuram, Udumalaipettai, and Kodaikanal are the closest towns.

3. Material and methods

The Palani taluk's groundwater potential zones were identified using remote sensing techniques in this study

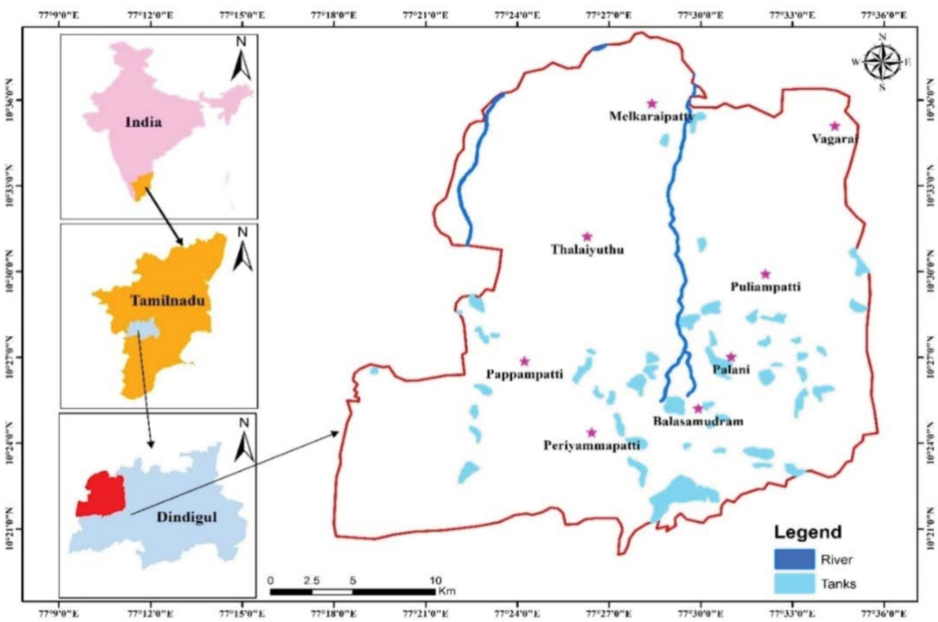

Fig. 1. Location map for the research study region Palani taluk.

employing thematic layers of data on the region's geomorphology, lithology, land use and land cover (LULC), lineament density, soil, rainfall, drainage density and slope. ArcGIS 10.8 software was used to conduct geographical information techniques. In ArcGIS, the slope for Palani taluk is generated from SRTM 30m DEM data for the geomorphology and LULC preparation [27,28].

The optical interpretation technique was used to define the LULC and geomorphology over satellite data using National Remote Sensing Centre (NRSC) classifications [29]. The National Bureau of Soil Survey and the Geological Survey of India provided the published lithology map and soil atlas, which were then gathered and digitalized. The Indian Meteorological Department provided the rainfall data. In order to produce the geographic distribution of rainfall, an inverse distance weighted (IDW) interpolation method was employed. Lineaments were individually retrieved from Landsat data and the drainage is being digitally digitised based on a toposheet created with the help of the line polyline tool in ArcGIS software 10.8.

3.1. MCDA using GIS techniques

The significance is that the AHP model, one of the multi-criteria decision-making (MCDM) tools, was initially introduced by and is used to offer solutions for challenging decision-making situations. Each thematic layer of the groundwater prospecting component is given a normalised weight using the widely used AHP model. Each thematic layer's final weight was calculated using the primary Eigenvalue of the resulting matrix. The most popular GIS-based technique for defining groundwater potential zone (GWPZ) is MCDA utilising AHP. All topic levels can be integrated more easily using this method. There were a total of 8 different theme levels considered for this investigation. The eight theme levels are designed to control the water flow and storage variables in the region. The relative importance of these contributing factors and expert opinion is used to determine how much weight to assign groundwater occurrence. A layer with a high weight parameter has a significant impact on the global warming potential, whereas a layer with a low weight parameter has less effect. Each parameter's weights were determined using Saaty's scale of relative importance (1–9). Additionally, the weights were assigned taking into account the study of prior research and field experience.

A rating of 9 denotes the highest importance, while 8 and 7 denote very strong importance and very extreme importance, respectively. Six and five denote strong importance, while four and three denote moderate importance plus, two and one denote equal importance. The classification assigns weights to the theme layers based on their significance and water holding capacity. As a result, a pair-wise comparison matrix has been used to compare all of the thematic levels (Table 1). To provide weight, the natural breaks classification approach of the GIS platform was used to reclassify thematic layer sub-classes. Based on their respective impact on groundwater development, the sub-classes of each thematic layer rank were given on a scale of 1 to 8. Table 2 displays the given rank and theme layer weights. The following procedures are used to calculate the consistency ratio (CR): (1) by using the eigenvector approach, the principal eigen value; (2) consistency index (CI) were calculated derived from the following equation.

$$\lambda_{\max} = \frac{144}{12} = 12$$
$$\mathrm{CI} = \frac{\lambda_{\max} - n}{n-1} \quad (1)$$

where n denotes how many factors were included in the examination.

$$\mathrm{CI} = \frac{(12-12)}{(12-1)} = 0$$

The values were derived from the Saaty's standard (Table 3).

$$\mathrm{CR} = \frac{0}{1.48} = 0$$

The analysis can proceed with a CR of 0.10 or less, according to Saaty. If the consistency value is larger than 0.10, the judgement needs to be reviewed in order to identify the root reasons of the inconsistency and make the necessary corrections. The pair-wise comparison has perfect consistency if the CR value is 0, which indicates. The judgements matrix is reasonably consistent because the threshold value is not higher than 0.1. Equation was used

Table 1
Weights of eight themes used for artificial recharge zoning

Factors	LD	DD	Geomorphology	Slope	Lithology	Soil	Rainfall	Lu/Lc	Weight
Lineament density	8	7	6	5	4	3	2	1	0.32
Drainage density	8/2	7/2	6/2	5/2	4/2	3/2	2/2	1/2	0.15
Geomorphology	8/3	7/3	6/3	5/3	4/3	3/3	2/3	1/3	0.12
Slope	8/4	7/4	6/4	5/4	4/4	3/4	2/4	1/4	0.10
Lithology	8/5	7/5	6/5	5/5	4/5	3/5	2/5	1/5	0.09
Soil	8/6	7/6	6/6	5/6	4/6	3/6	2/6	1/6	0.08
Rainfall	8/7	7/7	6/7	5/7	4/7	3/7	2/7	1/7	0.066
LULC	8/8	7/8	6/8	5/8	4/8	3/8	2/8	1/8	0.064
Total									1

Table 2
Assigned and normalized weights for the individual features of the themes for artificial recharge zoning

Factors	Weight	Rank	Overall weightage
Lineament density			
Very high	32	5	160
High		4	128
Medium		3	96
Low		2	64
Very low		1	32
Drainage density			
Very high	15	1	15
High		2	30
Medium		3	45
Low		4	60
Very low		5	75
Geomorphology			
Denudational hill	12	2	24
Deep pediment		4	48
Moderate pediment		3	36
Shallow pediment		2	24
Flood plain		5	60
River		5	60
Tank		5	60
Slope in degree			
0–15	10	5	50
15–30		4	40
30–50		3	30
50–75		2	20
75–89		1	10
Lithology			
Charnockite	9	2	18
Granite, garnet granolite		5	45
Hornblende-biotite gneiss		4	36
Soil			
Cracking clay soil	8	3	24
Gravelly loam soil		4	32
Clayey soil		2	16
Loamy soil		5	40
Rainfall in mm			
620–650	6.6	1	6.6
650–680		2	13.2
680–720		3	19.8
720–750		4	26.4
750–790		5	33
Lu/Lc			
Crop land	6.4	4	25.6
Fallow land		3	19.2
Plantation		3	19.2
Built-up land		1	6.4
Forest		1	6.4
Barren rocky		1	6.4
Grass land		2	12.8
Scrub land		2	12.8
River		5	32
Tanks		5	32

Table 3
Indicator of Saaty's ratio for various values of N

Consistency indices of reciprocal matrices produced at random												
Order of the matrix												
N	1	2	3	4	5	6	7	8	9	10	11	12
RCI value	0.0	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48

to merge all eight thematic layers using weighted overlay analysis approach in GIS platform to create groundwater potential zone map of Palani taluk Eq. (2).

$$\text{GWPZ} = \sum_{i}^{n} \left(X_A \times Y_B \right) \quad (2)$$

where X – denotes the weight of the thematic layers and Y – denotes the rank of the thematic layers' sub-class, GWPZ stands for groundwater potential zone. The final GWPZ map was divided into six categories: very low, low, moderate, high, and very high. The groundwater prospective data from the Palani taluk which is used for the current study was used to validate the final output. Graphical abstract displays the flow chart used in this study's approach. The alternative parameters can be considered as an input for groundwater potential zone creation are: (a) topographic wetness index (TWI), (b) roughness, (c) topographic position index (TPI), and (d) curvature.

4. Results and discussion

4.1. Lithology

A rock unit's lithology describes the physical traits that are discernible from an outcrop, in hand or core samples, or under low magnification microscopy. Physical features include composition, grain size, colour, and texture. The lithology of the area under consideration may be divided into three categories: granite, charnockite, and hornblende-biotite gneiss. About 95% of the total survey area was covered by hornblende-biotite gneiss, with the remaining 4% or so by charnockite and 1% by granite. According to Fig. 2, charnockite has excellent groundwater prospects, hornblende-biotite gneiss has fair groundwater prospects, and granite has subpar prospects.

4.2. Geomorphology

Geomorphology is the scientific study of the physical, chemical, and biological processes occurring at or close to the earth's surface that produce topographic and bathymetric characteristics. Geomorphology, one of the key elements frequently used for the delineation of GWPZ, represent the landform and topography of an area. It includes information on processes like temperature variations, geochemical reactions, water flow, freezing and thawing, etc. as well as specifics on how various landform features are dispersed. The study area's highland region has steep topography and uneven surfaces. However, the topography in the lowland area is typically gently undulating.

The deep pediments, denudational hill, flood plain, moderate pediment, and shallow pediment are the principal geomorphic characteristics of the studied region. Fluvial origin covers good groundwater chances, and it makes up 1.6% of the entire area in terms of groundwater prospects. Surface water bodies occupy 7.2% of the total area, whereas anthropogenic origins account for a very minor 0.2%. Good groundwater prospects are covered by surface water bodies and anthropogenic origin; moderate groundwater prospects are covered by denudational origin, which occupies 75.7% of the total area; and poor groundwater prospects are covered by structural origin, which accounts for nearly 15% of the total area as shown in Fig. 3.

4.3. Land use and land cover

Maps of an area's land use and land cover (LULC) give land information to aid in understanding the current landscape [30]. The monitoring of temporal dynamics of agricultural ecosystems, forest conversions, surface water bodies, etc. will be made possible by annual LULC data on national spatial databases. Barren rocky, built-up land, crop land, fallow land, forest, grass land, plantation, river, scrub land, and tanks are the land use and land cover elements that make up the entire Palani taluk in this study. Cropland and fallow land regions encompass the entirety of the Palani taluk (Fig. 4).

4.4. Lineament density

A fault or other underlying geological structure can be represented by a lineament, which is a linear landscape feature. Faulted valleys, a series of fault- or fold-aligned hills, or even combinations of these characteristics are common manifestations of a lineament. Lineament density was determined by dividing the region under consideration by the sum of all recorded lineaments lengths. Five categories (Fig. 5) can be used to categorise the lineament density of the research area: very low (0–11.05 km/km^2), low (11.05–24.70 km/km^2), medium (24.70–57.05 km/km^2), high (54.05–77.66 km/km^2), and very high (77.66–202.07 km/km^2).

4.5. Drainage density

The drainage pattern is the shape that the lakes, rivers, and streams make in a specific drainage basin. The pattern

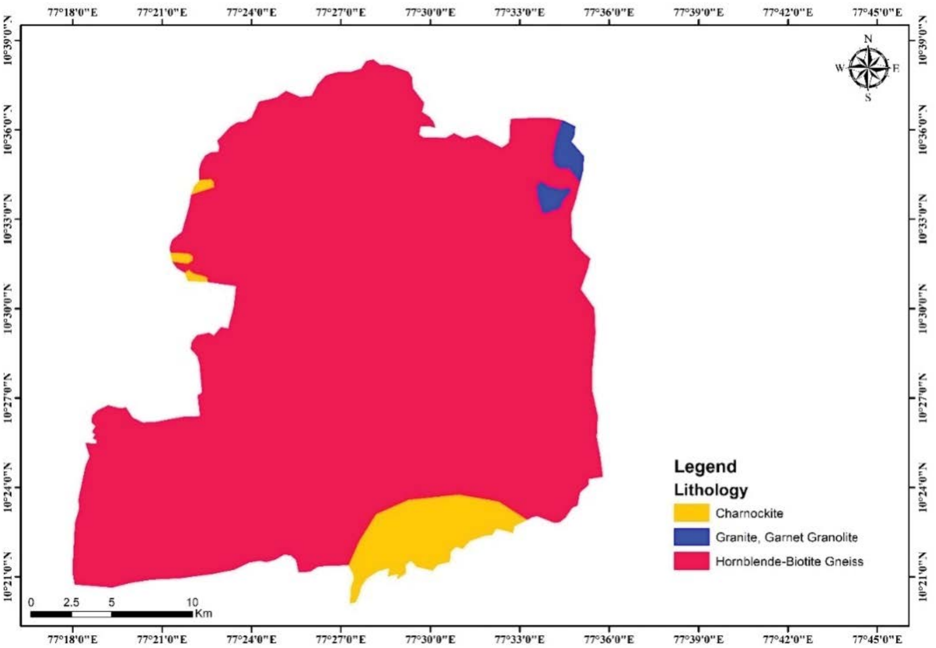

Fig. 2. Lithology map of Palani taluk region.

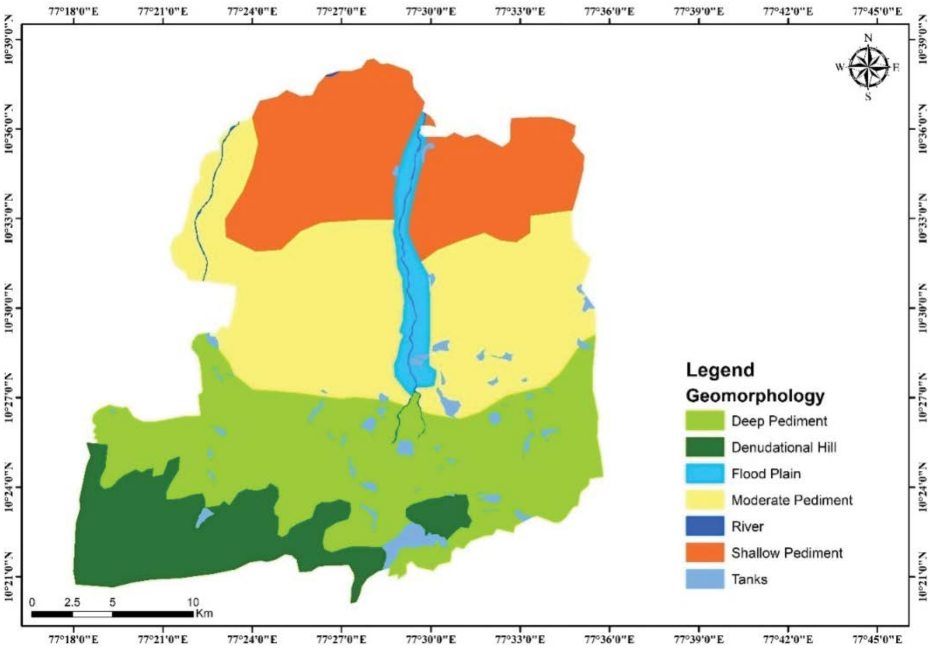

Fig. 3. Geomorphology map of Palani taluk region.

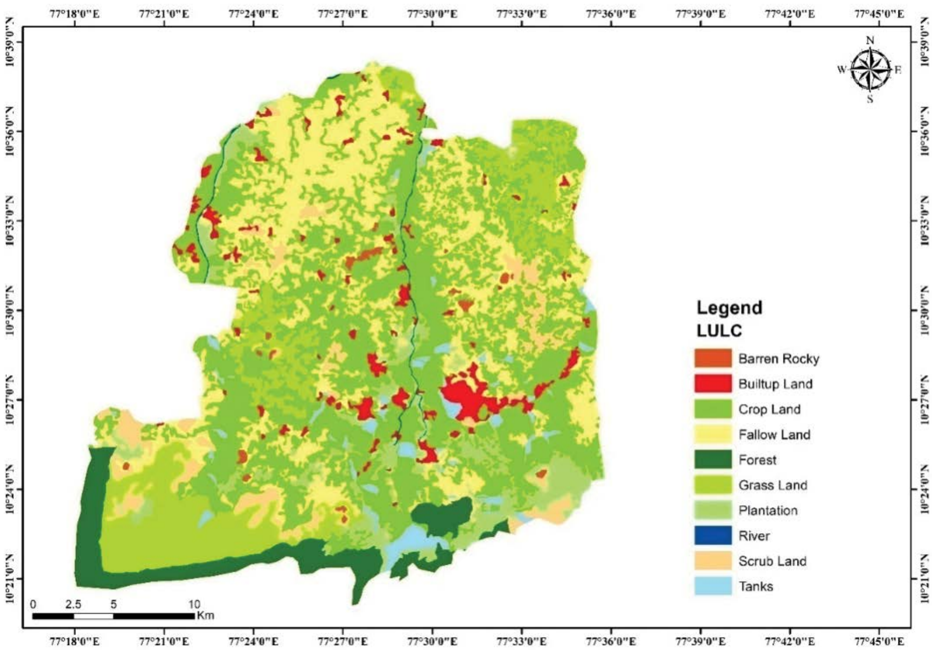

Fig. 4. LULC of Palani taluk region.

left behind by stream erosion over time reveals information about the types of rocks and geologic structures present in a region of the landscape that is subject to streams. The physical characteristics of the drainage basin and the climate both influence drainage density. The soil permeability (difficulty of infiltration) and underlying rock type have an impact on runoff in a watershed; impermeable ground or exposed bedrock can increase surface water runoff and, as a result, result in more frequent streams. Rugged places or those with high relief will also have a higher drainage density than other drainage basins if the other drainage basin parameters are the same. Very low (0–63.05 km/km^2), low (63.05–96.92 km/sq·km^2), medium (96.92–128.45 km/km^2), high (128.45–164.65 km/km^2), and very high (164.65–297.77 km/km^2) are the five basic categories of drainage density has been depicted in Fig. 6.

4.6. Slope

A slope map is a two-dimensional illustration of a surface's gradient. It displays the slope's current incline, whether it is steep or gentle. You may use slope maps to locate potential dangers, schedule building projects, and more. In order to lower construction costs, reduce the risk of natural disasters like flooding and landslides, and lessen the negative effects of the proposed development on natural resources like soils, plants, and water systems, it is crucial to take the slope of the ground into consideration. In the current study from Fig. 7, it is understood that slope has been divided into five primary categories: 0–5 very gentle sloping; 15–30 gentle sloping; 30–50 moderate sloping; 50–75 steep sloping; and 75–89 very steep sloping. Fig. 7 shows the slope map for Palani taluk.

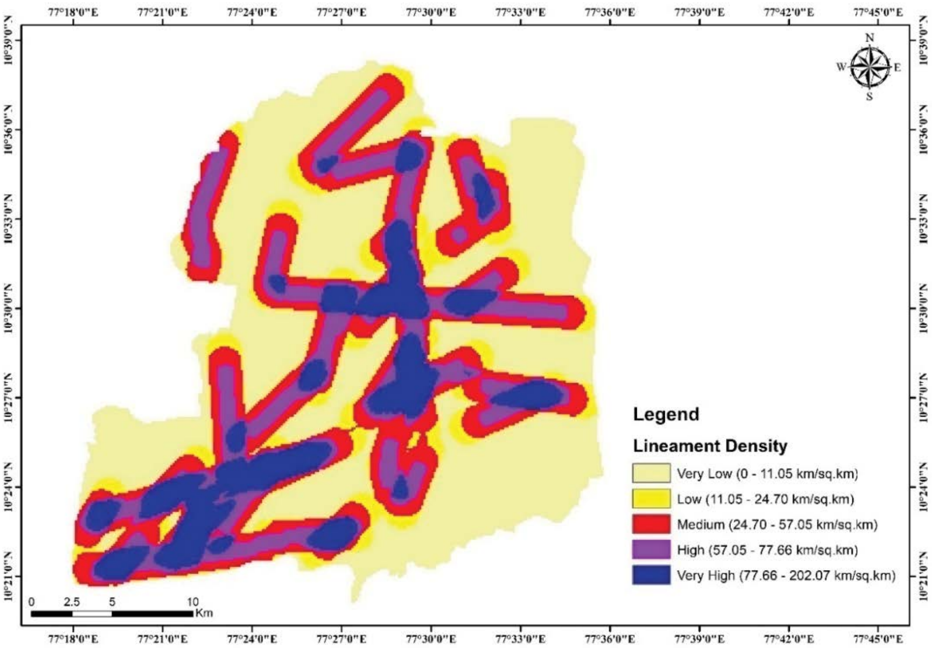

Fig. 5. Lineament density map for Palani taluk region.

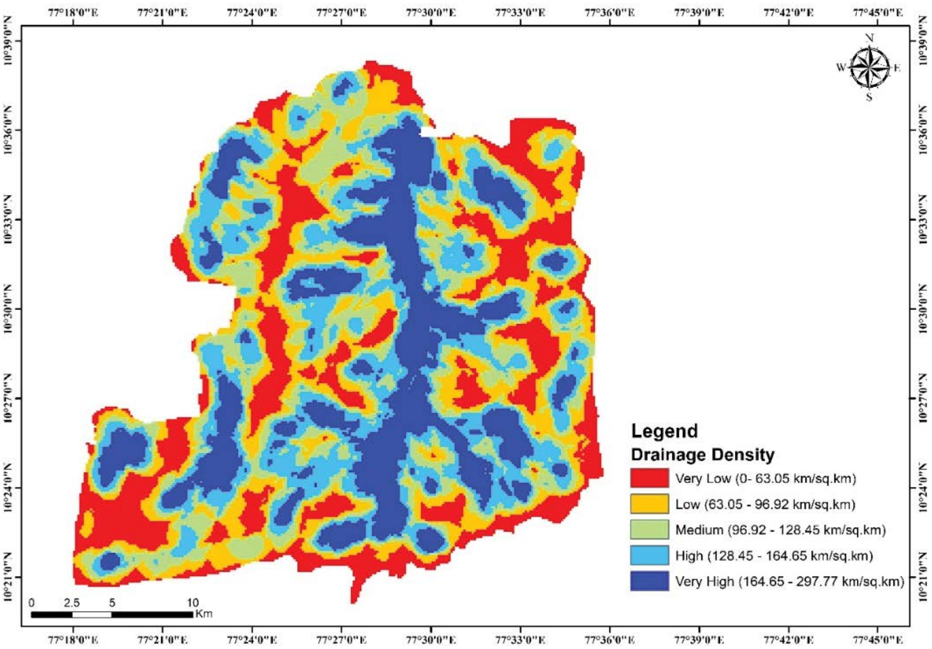

Fig. 6. Drainage density map for Palani taluk region.

4.7. Soil

A soil map is a geographical illustration of the area of interest that demonstrates the variety of soil types and/or soil attributes (soil pH, textures, organic matter, depths of horizons, etc.). It usually represents the conclusion of a soil survey inventory. In the current study, Palani taluk's four types of soils – clayey soil, cracking clay soil, gravelly loam soil, and loamy soil cover the entire region. Gravelly loam soil type covers the majority of the Palani taluk's coverage area. Next, some portions of the Palani taluk region are covered in loamy soil (Fig. 8).

4.8. Rainfall

The regional and temporal rainfall variability for typical, dry, and wet years can be analysed using the digital rainfall image maps. To illustrate the amount and distribution

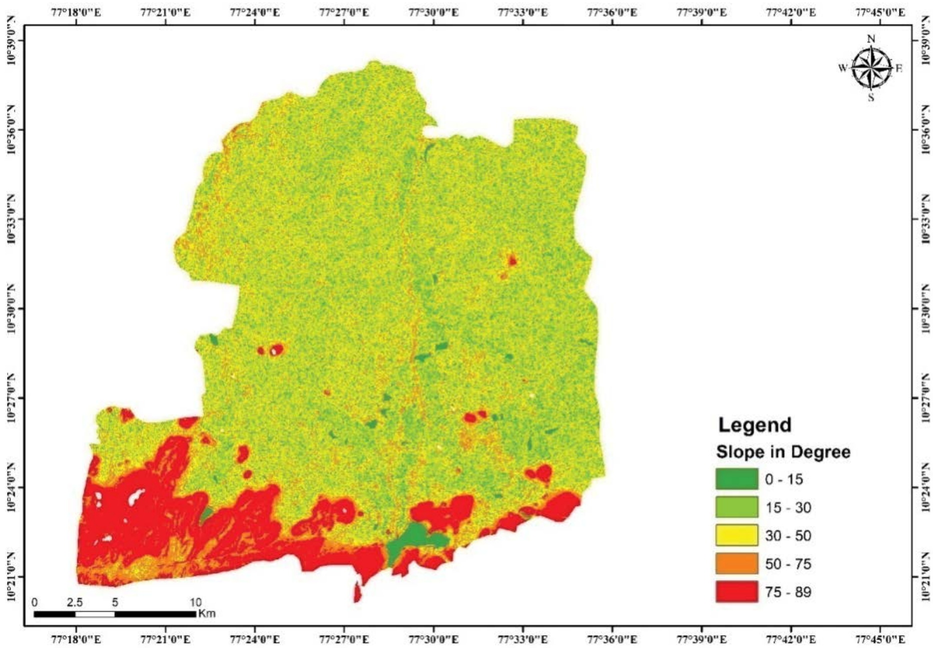

Fig. 7. Slope map of Palani taluk region.

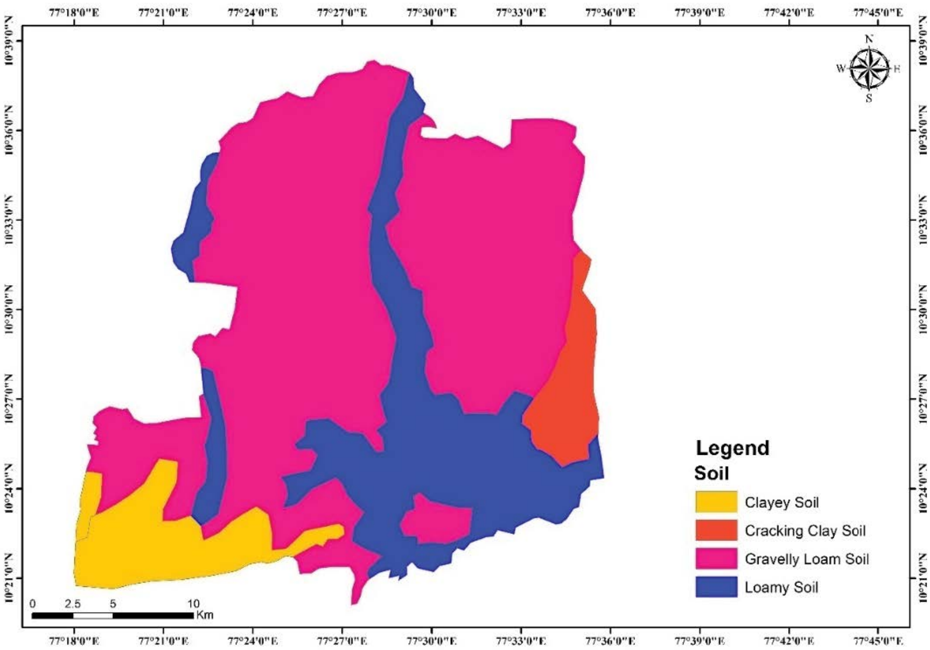

Fig. 8. Soil map of Palani taluk region.

of rainfall throughout various time periods and geographic regions, rain is sometimes shown as a map. Even if the area and time period are the same, many of these maps will appear different and appear to show somewhat varying rainfall quantities. The rain fall data for Palani taluk has been obtained from Meteorological Department and State Groundwater and Surface Water Data Centre, Tharamani, Chennai [31,32]. In the current study, rainfall has been divided into five primary categories from Fig. 9: 620–650 mm, 650–680 mm, 680–720 mm, 720–750 mm, and 750–790 mm in the Palani taluk. The majority of the total regions cover in which the precipitation falls on 680–720 mm and 720–750 mm.

4.9. Groundwater potential zone

Groundwater is a resource that can be replenished, but in the last four to five decades, recharge of this priceless life-sustaining reserve has been greatly diminished as a result of different anthropogenic activities and imbalanced development. Although geology, hydrogeology, and geomorphology play a big role in determining groundwater potential, human activities are now having an increasingly large impact on it because they can modify land use and cover, impact groundwater level variance, and affect groundwater quality. The total amount of aquifers' available permanent storage is referred to as groundwater storage potential in this context. The amount of open space in rocks that might retain water and the porosity of the rocks determine how much groundwater can be stored underground. Planning and sustainable development of a region require a thorough grasp of the groundwater potential. This sequence is necessary for the design and functioning of structure for counteractive actions to enhance the processes of groundwater renew. The hydrological settings of the Palani taluk region show that the rock types of charnockite, granite, garnet granolite, and hornblende-biotite gneiss are where groundwater is found. Geomorphology, lithology, LULC, lineament density, soil, slope, drainage density, and rainfall are the factors that are occupied into account here.

The groundwater potential zones in the Palani taluk region were created using the weighted overlay method. The groundwater potential zones on the resulting map (Fig. 10) are classified as very high, high, moderate, low, and very low, with the aerial spread of each category being 166.34, 118.14, 149.35, 228.92 and 104.08 km^2 accordingly and also represented the aerial extent percentage values in Table 4. As it can be observed from the figure, lowland and midland regions are where extremely high and high GWPZ are most common. Areas with substantial rainfall and great infiltration potential are often the only places where zones with extremely high and high groundwater potential exist. River flow in such areas is a major factor in high and very high GWPZ.

The process of layering the groundwater potential map with the existing boreholes reveals that the best locations for obtaining good fresh groundwater are likely to be over high and moderate-high potential areas, primarily located in alluvial, sandy, and dunes formations, which are aquifer recharging zones. The majority of the profitable boreholes, which are located in alluvial riverbeds with a high potential for groundwater storage, were also found to have been dug there, according to this investigation. Table 5 shows the different parts bore well details of the study area. Fig. 11 shows the artificial recharge structures map of Palani taluk region.

Fig. 12 shows the groundwater potential validation with groundwater level map of Palani taluk region. The moderate GWPZ are typically found in Palani taluk's

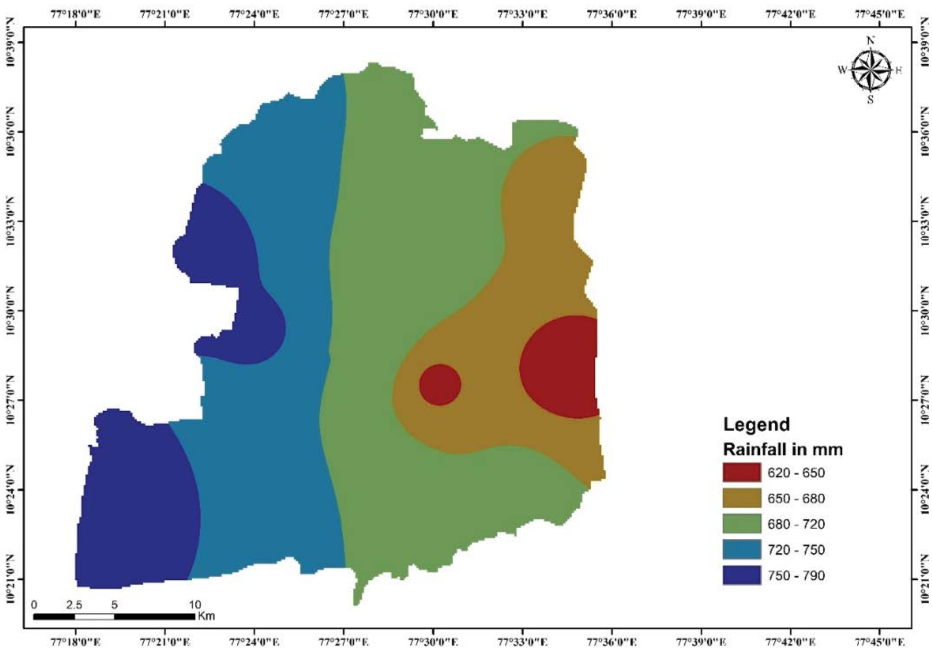

Fig. 9. Rainfall map of Palani taluk region.

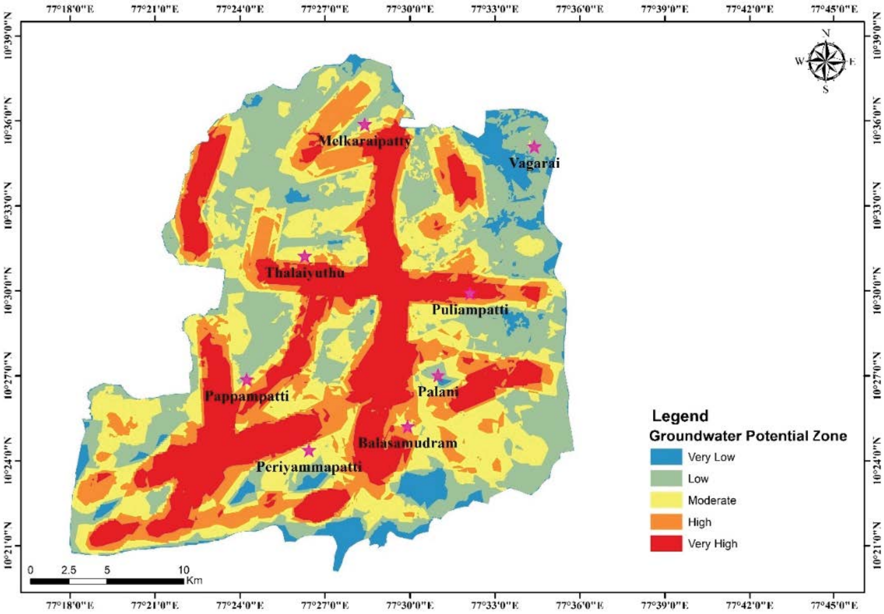

Fig. 10. Groundwater potential zone map of Palani taluk region.

Table 4
Areal coverage of groundwater recharge potential zone map

S. No.	Groundwater recharge potential zones	Area in km^2	Area in %
1	Very low favourable	166.34	21.70
2	Low favourable	118.14	15.40
3	Medium favourable	149.35	19.47
4	High favourable	228.92	29.85
5	Very high favourable	104.08	13.57

low-lying parts and high-drainage areas. The low and very low GWPZ are primarily found in the highlands and lowlands, while relatively little of it is found in the midlands. The granite and charnockite rock type zones are where the low and very low GWPZ are located. Based on the findings of the GWPZ, as well as according to the 1–4 stream orders, it was advised to influence the construction of check dams, Nala bunds, and percolation tanks in order to maintain the GWPZ (Fig. 13). The majority of buildings are located in areas with high stream orders and low beneficial groundwater zones. GWPZ were analysed, and the results ranged from low favourable to high favourable. By using field measured water level, the favourable zone has been validated. Regarding to the theories, high favourable zones need high water level occurrences and low favourable zones needs low water level occurrences which was shown in Fig. 12. According to concepts high favourable zones are showing high water levels which include Puliampatti, Balasamudram, Pappampatti, Madathukulam, Kolumakondan, Keeranur and Ayakudi shows 2.2, 3.2, 3.8, 3.2, 2.3, 3.2 and 2.6 m·bgl low favourable zones are resulted low water level occurrences which include Vagarai, Periyammapatti, Kavadikottam, Sangampalayam, Sithraikulam, Andipatti, Puliampatti,

Table 5
Location and characteristics of the observation (GWL) groundwater

S. No.	Block name	Latitude	Longitude	GWL (m·bgl)
1	Vagarai	10.57683	77.55635	10.8
2	Periyammapatti	10.35818	77.46382	10.2
3	Kavadikottam	10.38765	77.51317	9.9
4	Sangampalayam	10.61247	77.41035	8.6
5	Sithraikulam	10.47950	77.41584	8.5
6	Periyammapatti	10.39108	77.44463	8.3
7	Andipatti	10.36846	77.31919	9.8
8	Andipatti	10.41575	77.35552	8.8
9	Puliampatti	10.48224	77.56046	10.3
10	Puliampatti	10.50143	77.48644	2.2
11	Balasamudram	10.42535	77.49672	3.2
12	Balasamudram	10.41027	77.53716	3.6
13	Periyammapatti	10.38628	77.40350	7.8
14	Velusamudram	10.47127	77.38774	3.8
15	Pappampatti	10.43700	77.43503	4.6
16	Pappampatti	10.46442	77.45902	3.2
17	Kasanayampaaty	10.53707	77.41789	8.7
18	Madathukulam	10.54804	77.37746	8.4
19	Komarampalaiyam	10.58368	77.41173	2.3
20	Marichilambu	10.53707	77.56869	3.2
21	Kolumakondan	10.58505	77.45011	2.6
22	Keeranur	10.59471	77.48436	5.1
23	Ayakudi	10.44383	77.55020	5.3
24	Narikalpatti	10.53984	77.45418	3.4
25	Paraippatti	10.53847	77.52962	10.8
26	Pappampatti	10.41982	77.40137	10.2

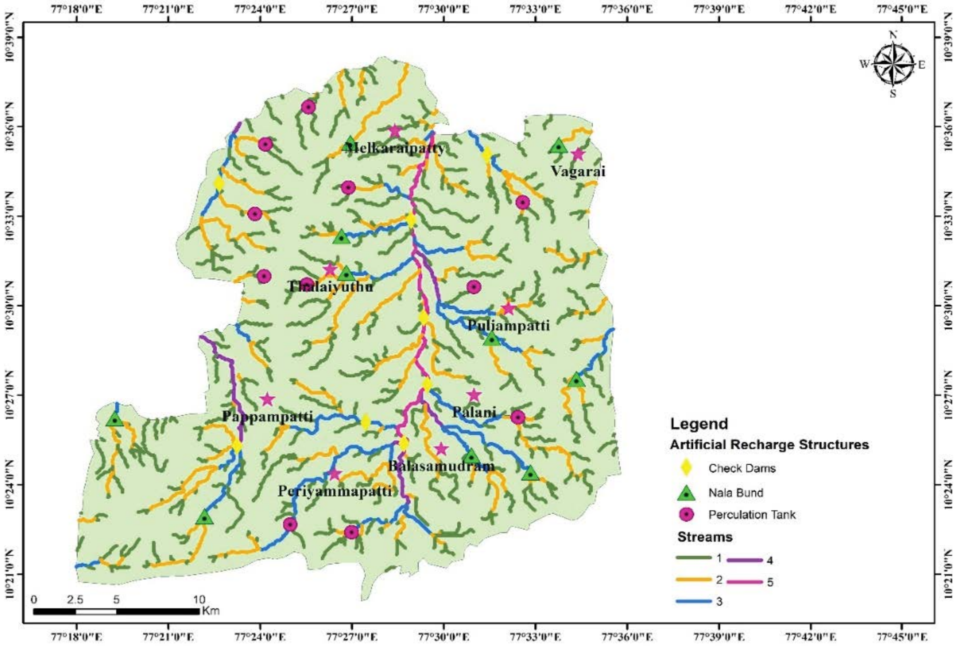

Fig. 11. Artificial recharge structures map of Palani taluk region.

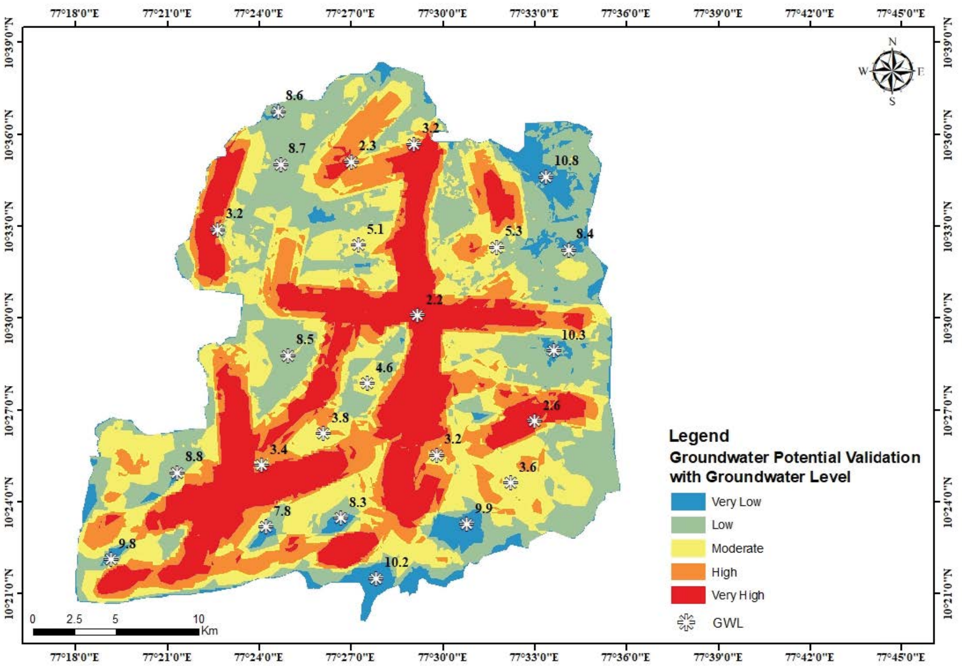

Fig. 12. Groundwater potential validation with groundwater level map of Palani taluk region.

Komarampalaiyam and Marichilambu shows 10.8, 10.2, 9.9, 8.6, 8.5, 9.8, 10.3, 8.7 and 8.4 m·bgl.

5. Conclusion

The present study attempts to delineate the GWPZ using a mix of AHP and GIS methodologies. In this study, the GWPZ were defined using a total of 8 thematic layers, including geomorphology, lithology, soil, LULC, lineament density, rainfall, drainage density, and slope gradient. The study region can be divided into five unique GWPZ, including very high, high, moderate, low, and very low, according to the final output map. Low and very low GWPZ are found in the granite and charnockite complex formation of

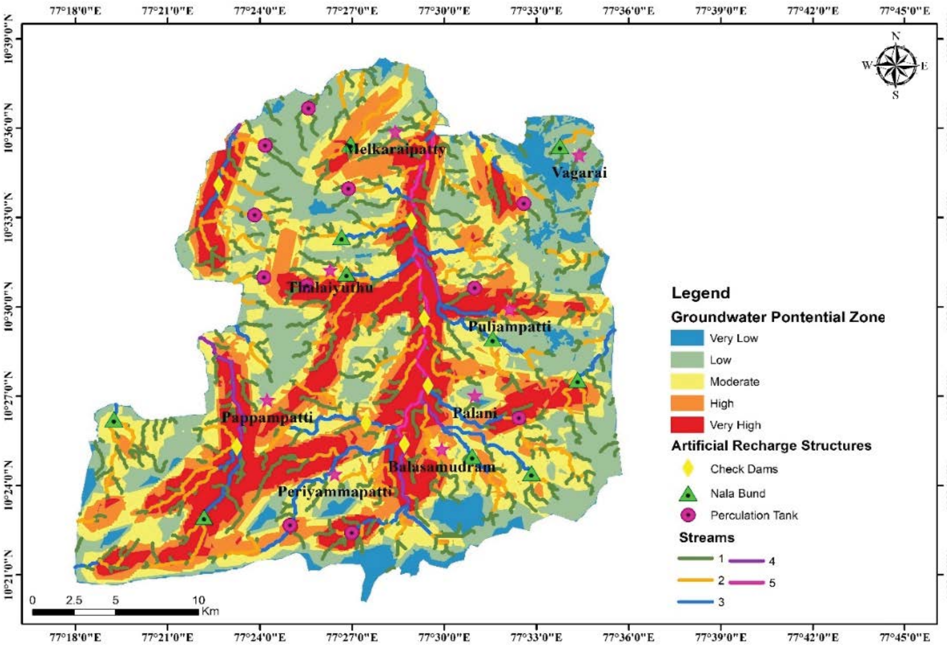

Fig. 13. Groundwater potential zones along with the artificial recharge structures map of Palani taluk.

terrain, whereas very high and high GWPZ are mostly found in river regions. Over the low-lying portion of the research region, there is a moderate GWPZ. Decision-makers can get insights from the GWPZ map of the current study for efficient groundwater planning and management for urban and agricultural applications. The majority of the study area is comprised of agricultural land, thus the research will help increase agricultural productivity there and enhance the irrigation system. It was suggested to build check dams, Nala bunds, and percolation tanks in places with high stream orders like the fourth and fifth stream orders along with low groundwater potential zones. Check dams were also suggested to be built along riverside flows in areas like Balasamudram, Vagarai, Melkaraipatty, Thalaiyuthu, and the other two weaker zones are indicated for construction of Nala bands. There are six to seven locations where percolation tanks should be built in the Palani taluk regions, including Madathukulam, Komarapalayam, Kaniyur, Marichilambu, Puliampatti, Palani, and Periyammapatti. Totally 26 well locations taken as observation and calculates the values of groundwater levels. According to ideas, high-favourable zones with high water levels include Puliampatti and Balasamudram, which display readings of 2.2 and 3.2 m·bgl, respectively, low favourable water level occurrences, such as those at Vagarai and Periyammapatti, which indicate 10.8 and 10.2 m·bgl. As the result of low favourable zone having highest groundwater level in Palani taluk is 2.2 m·bgl at Puliampatti and high favourable zone having lowest groundwater level in Palani taluk is 10.8 m·bgl at Vagarai.

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