International Journal of Civil Engineering and Technology (IJCIET)
Volume 8, Issue 8, August 2017, pp. 698–706, Article ID: IJCIET_08_08_070
Available online at http://http://iaeme.com/Home/issue/IJCIET?Volume=8&Issue=8
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

REMOTE SENSING AND GIS BASED APPROACH FOR DELINEATION OF ARTIFICIAL RECHARGE SITES IN PALANI TALUK, DINDIGUL DISTRICT, TAMILNADU, INDIA

R. Chandramohan
Research Scholar, Department of Civil Engineering, VELS University, Chennai

Dr. T.E. Kanchanabhan
Professor & HOD, Department of Civil Engineering,
Sri Ramanujar Engineering College, Chennai

N. Siva Vignesh
Assistant Professor, Department of Civil Engineering,
P.S.G. Institute of Technology and Applied Research, Coimbatore

Radha Krishnamoorthy
GIS Specialist, Global Logic (Pvt) Limited, Bengaluru

ABSTRACT

Now a day's surface water was not enough for irrigation, industrial and basic household needs, so men decide to use groundwater to match the daily requirements. The economy of a country indirectly or directly related to groundwater resources. In India, groundwater extraction is more when compared to past two decades. In India, especially in Tamilnadu *the farmers mainly depended upon ground water during the non-monsoon season, moreover, during the monsoon season, more rain water was lost through runoff. In* Palani *Taluk,* Dindigul *District groundwater level is in poor condition. Identification of the artificial recharge zone is such a good remedy to increase the groundwater level. With the help of remote sensing and GIS tools, we can distinguish our study area as excellent, moderate, good and poor artificial recharge zone.*

Key words: Groundwater Recharge, Artificial recharge, Remote sensing and GIS.

Cite this Article: R. Chandramohan, Dr. T.E. Kanchanabhan, N. Siva Vignesh and Radha Krishnamoorthy, Remote Sensing and GIS Based Approach for Delineation of Artificial Recharge Sites in Palani Taluk, Dindigul District, Tamilnadu, India. *International Journal of Civil Engineering and Technology*, 8(8), 2017, pp. 698–706.
http://iaeme.com/Home/issue/IJCIET?Volume=8&Issue=8

1. INTRODUCTION

"Recharging groundwater with the help of human-made structure recognised as artificial recharge" (CGWB) [1]. " When groundwater raised due to percolation of surface water into aquifers with the aid of human activity is seen as artificial recharge " (UNEP) [2]. Artificial recharge zones lead to preserving surface runoff, and it indirectly contributes to reducing the possibilities of the flood. Owing to the continuous extraction of groundwater may cause undesirable environmental consequences. So now a day's artificial recharge method is viewed as a cost effective method. When population increased, then the demand for water will also increase. Hence," The availability of high technology like Remote Sensing (RS), Geographical Information System (GIS) need to used and the holistic models are to be brought out to meet out the demands of the people" (P. Venkata Ramireddy et al. 2015) [3]. " At present more reviewers were concentrating on the application of remote sensing and GIS in the selection of artificial recharge zone " (Anbazhagan PhD thesis. 1994, Anbazhagan and Ramasamy .1993) [4, 5]. " Integration of thematic layers (Water level, rainfall, lineament, etc) is executed to find a suitable artificial recharge zone" (Samson, S., and K Elangovan 2015) [6].

Palani Taluk, Dindigul District, Tamilnadu, India are facing a severe water shortage problem for the irrigation, industrial and residential purposes. In recent years Monsoon period was unpredictable, and the availability of surface water cannot assure in the right quantity at the required time. Thus, most of the area in the Palani Taluk is depend upon groundwater, which gained from burrowing wells and tube wells. However, unlimited excessive pumping of groundwater has decreased the level of groundwater in a few areas of the review region. During the summer period, burrowed wells and hand pumps also dried up, inward this way of frustrating water issue a raise in Palani Taluk (R.Chandramohan et al. 2017) [7]. Therefore, the principal intention of this study is to distinguish the study area of the artificial recharge zone by using Remote sensing and GIS technology.

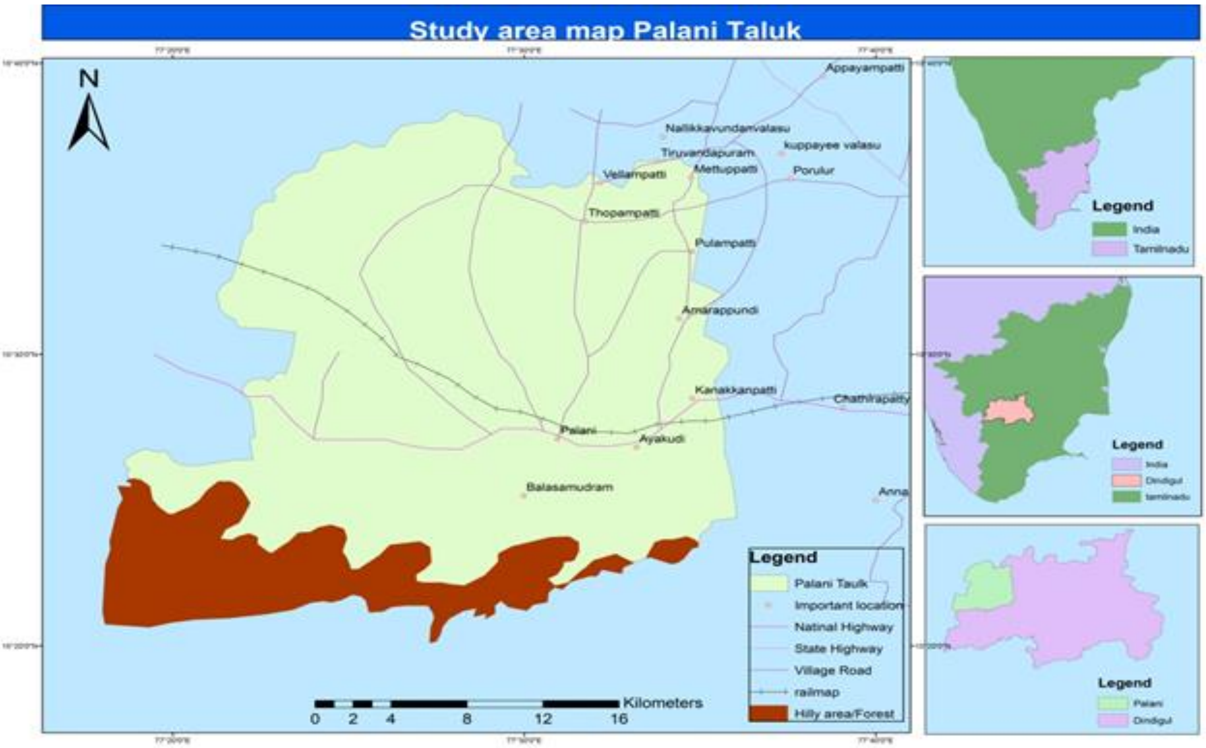


Figure 1 Palani Taluk map, Dindigul District, Tamilnadu, India

2. STUDY AREA

The review zone latitudes lie between 10°20’2’’ N to 10°38’24’’ N as well as longitudes 77°18’6’’ E to 77°35’41’’ E covering a region of 766.83 km^2. Out of which hilly landforms cover an area of 116.85 km^2 shown in Figure 1 (R.Chandramohan et al. 2017) [7]. The review territory comes in Dindigul District of Tamilnadu. The significant source of groundwater is precipitation, south-west season. The normal average rainfall is 690mm for 33 years (1980 – 2013). The groundwater depth level was varied in-between 4 to 11.7m in Palani Taluk.

3. METHODOLOGY

Base Map, geology map was gathered from Survey of India (SOI) toposheet of scale 1: 50,000. Geomorphology, lineament, Landuse and Landcover map prepared from Resoursesat–I, LISS III image and slope map prepared from Cartosat satellite image. Groundwater depth level data collected from existing bore wells of the review zone, and rainfall data information gathered from the Statistics Department, Dindigul District. The collected map was scanned, traced, digitised and Geo-referenced in Remote Sensing programming & GIS software to prepare various thematic layers. All the thematic layers reclassified and suitable rank and weight assigned to them. All reclassify thematic layers overlaid by using spatial analysis tools in GIS software to determine suitable site selection for artificial recharge zones. Flow chart of the present study illustrated in Figure 2.

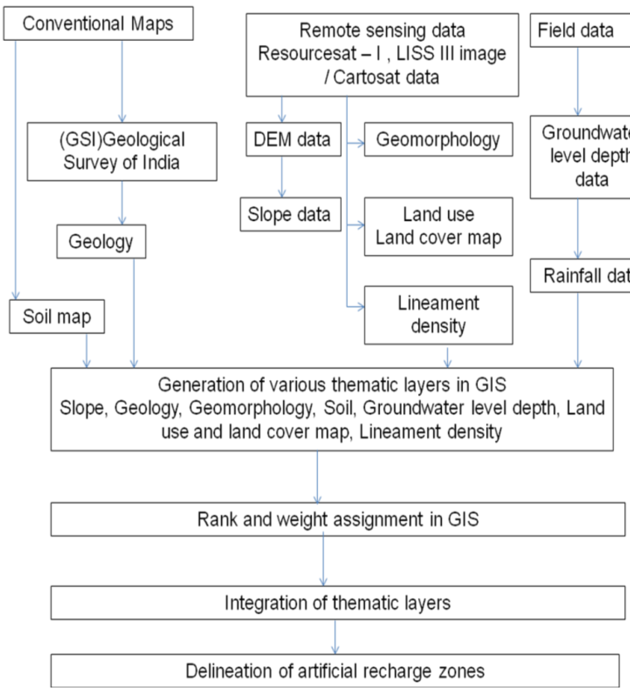


Figure 2 Methodology

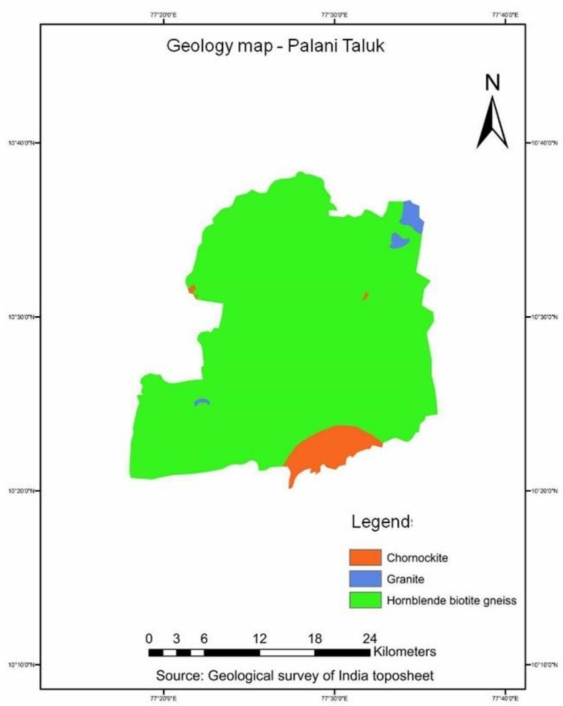


Figure 3 Geology map of Palani Taluk

4. GEOLOGY MAP OF PALANI TALUK

The study region has the following rock types. They are Charnockite, Granite, and Hornblende biotite - gneiss is shown in Figure 3 (R.Chandramohan et al. 2017) [7]. The total coverage area of each geological type was shown in Table 1. Due to more lineaments, charnockite has more groundwater holding capacity when compared to granite and Hornblende biotite – gneiss.

5. GEOMORPHOLOGY MAP OF PALANI TALUK

Geomorphology map equipped from Resourcesat – I, LISS III imagery which scanned, traced and digitised in GIS software were shown in Figure 4 (R.Chandramohan et al. 2017) [7]. There are 5 different natures of geomorphology was occupied in the study region such as Denudational origin, water bodies, structural origin, fluvial origin and anthropogenic origin. The total area governed by each type shown in Table 1. The groundwater holding capacity is more for the fluvial region when compared to other alternatives and ground water holding capacity in a hilly area is very poor.

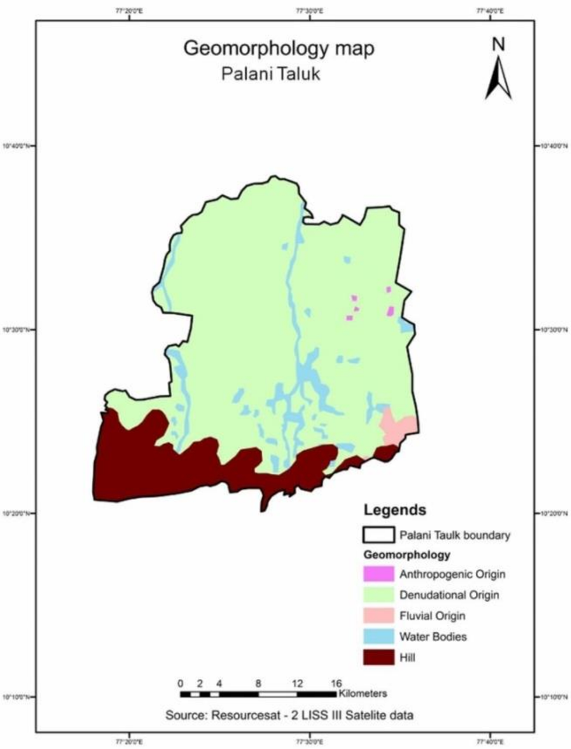


Figure 4 Geomorphology map of Palani Taluk

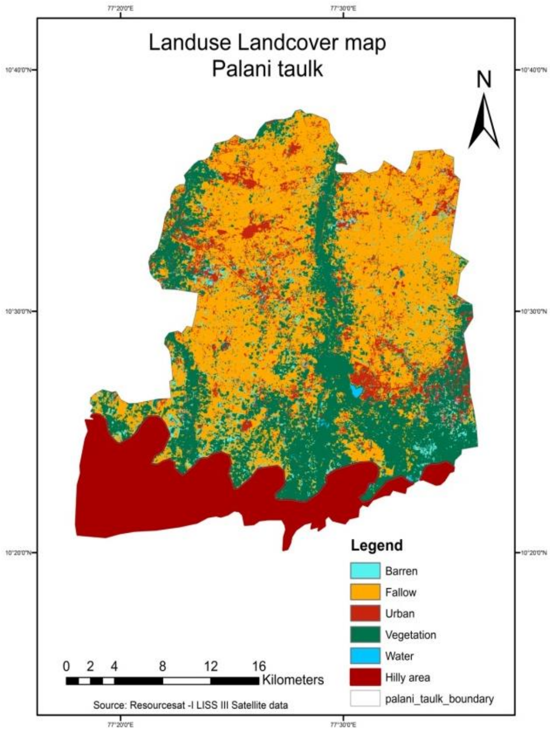


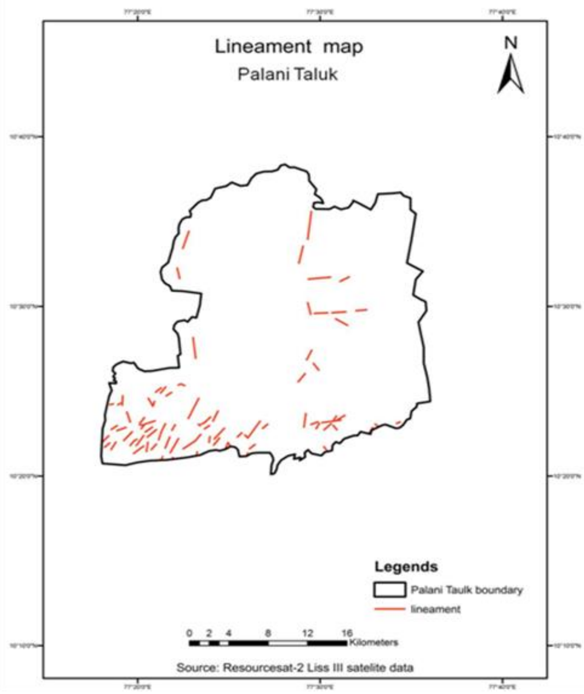
Figure 5 Landuse Landcover map of Palani Taluk

6. LANDUSE LANDCOVER MAP OF PALANI TALUK

Landuse Landcover map was primed from Resourcesat – I, LISS III satellite image. By Remote Sensing software the collected image was geo referenced, and by supervised classification tool the satellite image was classified into various Landuse and Landcover types. Landuse Landcover map is quite important in groundwater studies. By Landuse Landcover map, we can easily distinguish the area by its infiltration capacity. If the discharge is more, infiltration of water is less, and if there is a reduced in discharge, infiltration is more on that surface. For example, in vegetation areas, runoff is less and infiltration is more, and in urban areas, infiltration is less The satellite image is shown in Figure 5. LULC types, the total area occupied by each type presented in Table 1.

7. LINEAMENT MAP OF PALANI TALUK

In the current study area, the lineaments primed from a LISS III Resoursesat - I satellite image, which shown in Figure 6. In Palani Taluk, most of the lineament associated with geomorphic lineament. The length of the lineament varies from 0.11km to 3.25km. Once the lineament digitised in the GIS software, the density of the lineament was prepared with the help of spatial analysis tool and depend upon the density it was divided into five different types. Lineaments expressed in (Km/Km^2). The map of lineament density classified into 5 types with total area covered by each type was exposed in Table 1 and shown in Figure 7



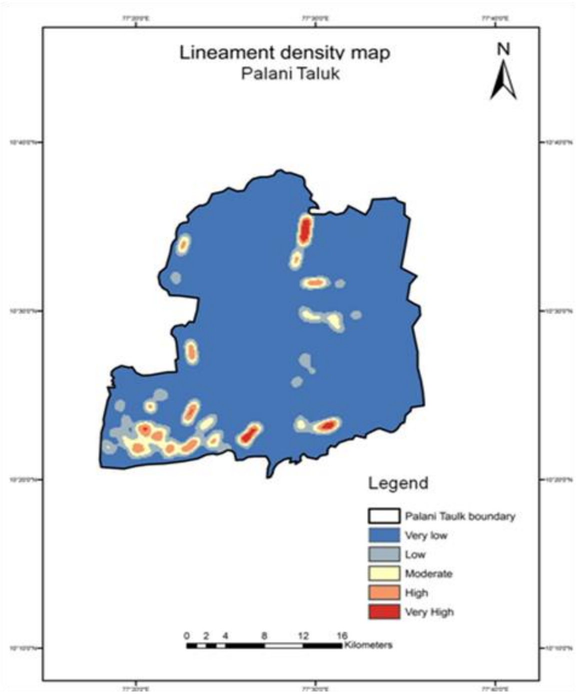


Figure 6 Lineament map of Palani Taluk

Figure 7 Lineament density map of Palani Taluk

8. SLOPE MAP OF PALANI TALUK

The slope map was primed from CARTOSAT-I, DEM satellite image. By Remote Sensing software, the DEM image was converted into slope map. In the present study region, the slope expressed in degrees was shown in Figure 8. The slope map was classified based on the groundwater prospects, the gentle slope indicates flatter terrain and steeper slope indicates hilly terrain. The overall study region divided into five distinct classes of slopes. The total area governed by each type was exposed below in Table 1.

9. SOIL MAP OF PALANI TALUK

In Palani Taluk, the soil map exposed in two different categories. 1) Black soil and 2) red soil was shown in Figure 9. The red soil produced in the crystalline rocks like Genesis and the rate of groundwater penetrability is high. Black soil is exceptionally sticky and marginally plastic under wet condition (Maheswaran, G et al. 2016) [8]. It has low penetrability. The total area covered by each type presented in Table 1.

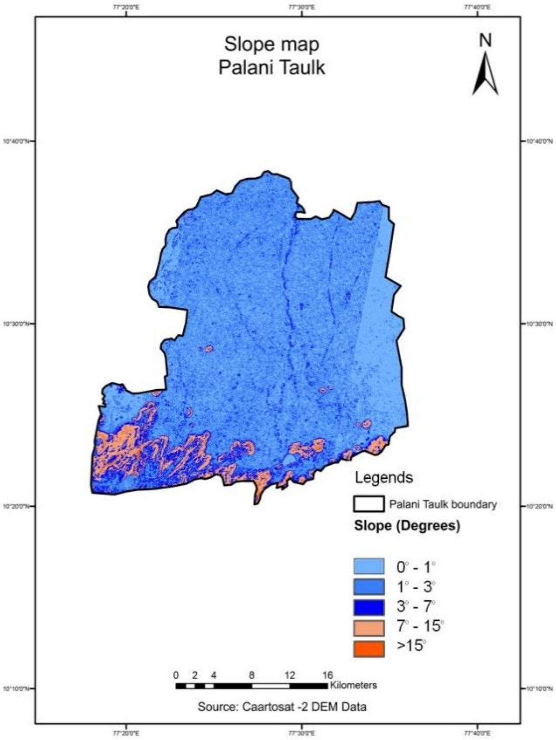


Figure 8 Slope map of Palani Taluk

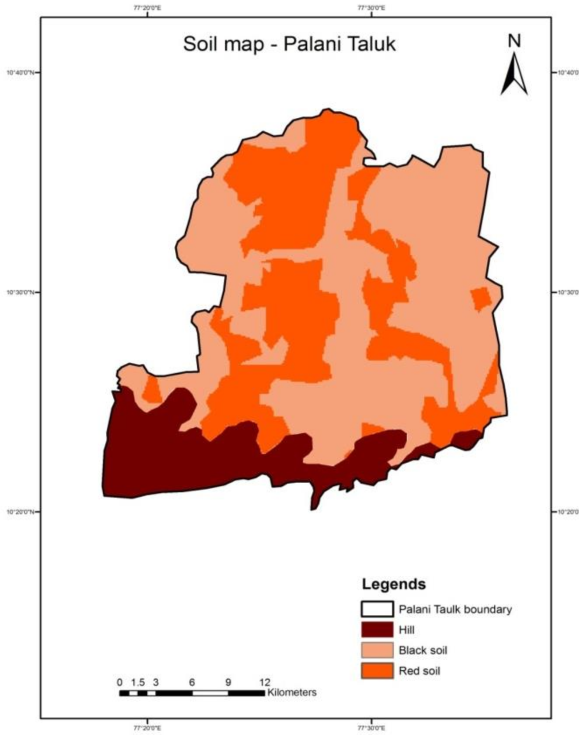


Figure 9 Soil map of Palani Taluk

10. RAINFALL MAP OF PALANI TALUK

Palani Taluk rainfall data collected from the Statistics Department, Dindigul for the past 3 decades that are from 1980 to 2014. Once data gathered on the spreadsheet was imported into GIS software, and the rain gauge station imported as a point feature, spreadsheet data imported to GIS program to generate a spatial distribution map for rainfall data with the help of an Inverse Distance weighted tool in GIS software. The rainfall map is shown in Figure 10 (R.Chandramohan et al. 2017), which gives an average rainfall of Palani Taluk for the past 30 years. The entire rainfall map categorised into five classes based on average rainfall collected in Palani Taluk shown in Table 1.

11. GROUNDWATER LEVEL MAP OF PALANI TALUK

When compared to all other thematic layer Groundwater depth level is so important to categorise artificial recharge zones of the present study region. As per Central Groundwater Board Report, the most of the area in Palani Taluk, groundwater depth level decrease and it is categorised as an over-exploited zone. Existing bore well's location was randomly identified to determine the groundwater depth level. It determined for the past three years (2014 – 2016), both in Pre & post monsoon period. Once field data collected the data was imported to GIS environment, and existing bore well points were converted into point feature, and the collected field integrated with it. By using the IDW tool in GIS spatial distribution map of groundwater depth level maps generated for Palani Taluk. The groundwater depth level map was shown in Figure 11 (R.Chandramohan et al. 2017).

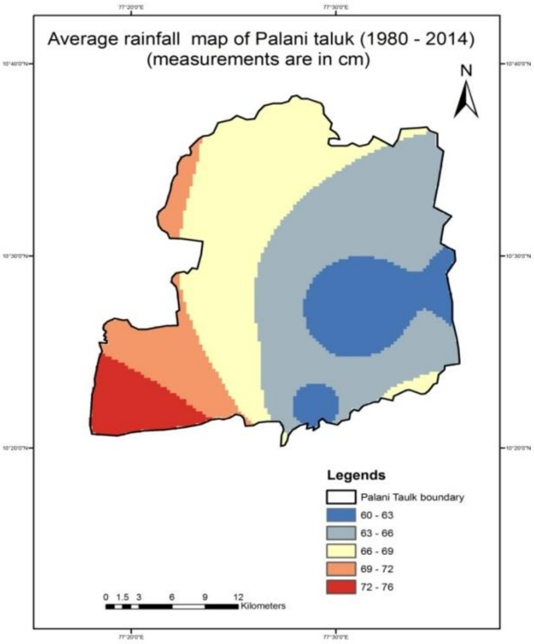


Figure 10 Rainfall map of Palani Taluk

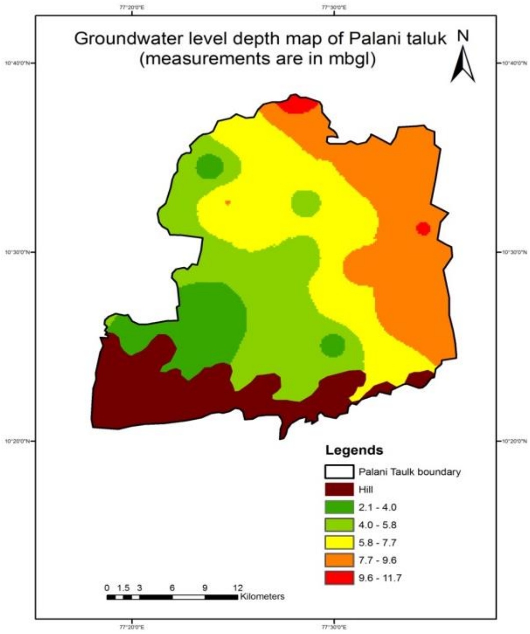


Figure 11 Groundwater level map of Palani Taluk

12. RESULTS AND DISCUSSION

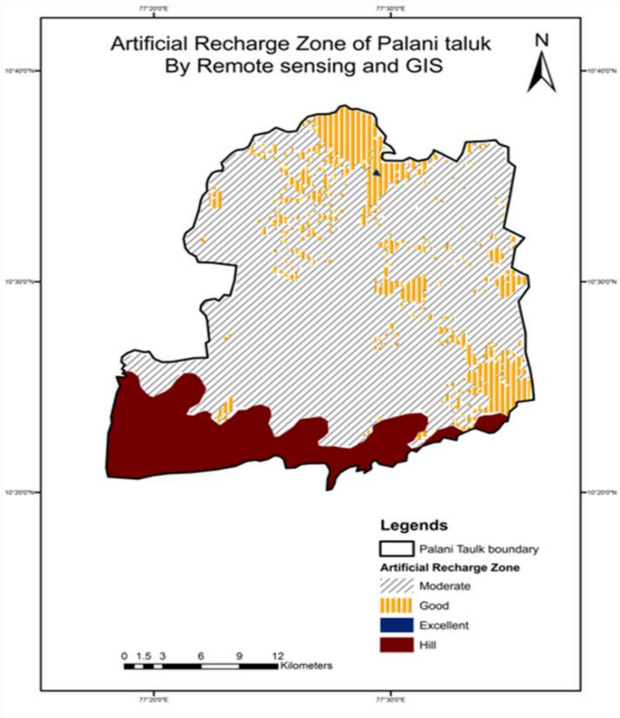


Figure 12 Artificial Recharge map of Palani Taluk

Different thematic maps reclassified by a spatial analysis tool by GIS program. With the help of reclassifying tool in GIS software, all thematic maps reclassified and based on the ground water holding capacity with proper rank was assigned to each legend of every thematic map. The rank was assigned from 1 to 5 for each of every legend in the thematic map. In this ranking of 1 indicates the very poor artificial zone, 2 indicates poor, 3 indicates moderate, 4 indicates good, and 5 indicates excellent artificial zones. Once reclassification is over, by the overlay tool in GIS software proper weight in percentage was allotted for each thematic map to get the result. The weight and rank for distinguishing artificial recharge zone shown in Table 1. The output map presented in Figure 12 generated, and it reveals that the study region lies between moderate artificial recharge regions to excellent artificial recharge region. The 71.37% total area covered by a moderate artificial zone and the excellent artificial recharge zone covers only 0.04% of the total area shown in Table 2.

Table 1 Assigning weight-age and rank for identifying artificial recharge zone

Parameters	Classes	Area covered in %	Weight (%)	Rank
Geomorphology	Fluvial Origin	1.6	13	3
	Anthropogenic origin	0.2		2
	Water body	7.2		2
	Denudation origin	75.7		1
	Structural origin	15.3		Restricted area
Slope classes	Nearly level (0^0-1^0)	41.6	10	5
	Very gently sloping (1^0-3^0)	43.6		4
	Gently Sloping (3^0-7^0)	5.7		3
	Moderately sloping (7^0-15^0)	6.5		2
	Strong sloping (>15^0)	2.6		1
Average Rainfall (1980 – 2014) (cm)	60 - 63 cm	14.71	9	1
	63 - 66 cm	36.36		2
	66 - 69 cm	31.66		3
	69 - 72 cm	10.69		4
	72 - 76 cm	6.58		5
Lineament Density Km/Km^2	0 - 0.6	87.7	13	1
	0.6 -1.17	6.7		2
	1.17 - 1.76	3.4		3
	1.76 - 2.34	1.7		4
	> 2.34	0.5		5
Land use / Land cover	Vegetation	26.4	10	3
	Water body	0.4		5
	Fallow land	43.4		2
	Urban	8.6		1
	Barren land / Hill	21.2		1
Geology	Charconite	4.4	14	3
	Hornblende biotite genesis	94.4		2
	Granite	1.1		1
Soil types	Red soil	32.51	10	4
	Black soil	52.19		2
	Hill/Forest	15.3		Restricted area
Groundwater depth level (mbgl)	Hilly area	15.3	21	1
	4 - 5.8	14.42		2
	5.8 – 7.8	31.38		3
	7.8 – 9.6	25.6		4
	9.6 – 11.7	13.3		5

Table 2 Total area coverage of Artificial recharge zone types (percentage (%))

S.No	Artificial recharge zone types	Area coverage in percentage (%)
1	Hill or Restricted area	15.30
2	Moderate	71.37
3	Good	13.29
4	Excellent	00.04

13. CONCLUSIONS

Thus the study has confirmed that the potential of using Geographical Information System and Remote Sensing for demarcation of various artificial recharge zones of groundwater and integrated technique of Remote sensing and GIS offers more realistic output, by using this output we can erect an appropriate artificial structure to improve the groundwater level.

REFERENCES

[1] Central Ground Water Board (2017) Manual on Artificial Recharge of Groundwater, The Government of India Ministry of water resource.

[2] UNEP website - http://www.unep.or.jp/ietc/publications/techpublications/techpub-8e/artificial.asp.

[3] Anbazhagan S. (1994). Remote Sensing based integrated Terrain Analysis for Artificial recharge in Ayyar Basin, central Tamil Nadu, India. PhD thesis. School of Earth Sciences. Bharathidasn University, Tiruchirapalli

[4] Anbazhagan S. and Ramasamy SM. (1993). The Role of Remote Sensing in the geomorphic analysis for water harvesting structures. Proceedings of the national seminar on water harvesting. June 25-26 at Dept. Of Civil Engg. Regional engineering college, Tiruchirapalli

[5] P.Venkata Ramireddy, G.V.Padma, N. Balayerikala Reddy (2015). Identification of groundwater recharge zones and artificial recharge structures for part of Tamil Nadu, India- a geospatial approach, *International Journal of Engineering Sciences & Research Technology*

[6] Maheswaran, G A Geetha selvarani, and E Elangovan. 2016. Groundwater Resource exploration in Salem District, Tamilnadu using GIS and Remote Sensing. *Journal of Earth System Science*.

[7] R. Chandramohan, Dr. T.E. Kanchanabhan, N. Siva Vignesh and Radha Krishnamoorthy, Groundwater Fluctuation in Palani Taluk, Dindigul District, Tamilnadu, India. *International Journal of Civil Engineering and Technology*, 8(7), 2017, pp. 1041–1049

[8] Samson, S., and K Elangovan. 2015. Delineation of groundwater recharge potential zone in Namakkal district, Tamilnadu, India, using Remote Sensing and GIS. *Journal of the Indian Society of Remote Sensing*.

[9] B. Ramyaa Sree and SS. Asadi A Remote Sensing and G IS Based Critical Evaluation of Change Detection Study in Thimmaipally Watershed for Land Resources Management, *International Journal of Civil Engineering and Technology* , 8(4), 2017, pp. 2110-2124.

[10] M. Satish Kumar ,SS. Asadi , S.S. Vutukuru , Assessment of Heavy Metal Concentration in Ground Water by Using Remote Sensing and GIS , *International Journal of Civil Engineering and Technology* , 8(4), 2017, pp. 1562-1573