Journal of Global Resources Volume 4 (02) July 2018 Page 131-137
ISSN: 2395-3160 (Print), 2455-2445 (Online)

17

DELINEATION OF GROUNDWATER POTENTIAL ZONE USING WEIGHTED INDEX OVERLAY TECHNIQUE – A CASE STUDY OF ALAND TALUK, KALABURAGI DISTRICT, KARNATAKA

Lopita Pal, [1] **Sunil Kumar Singh A.**[2] and **Madha Suresh V.**[3]

[1]Research Scholar, Department of Geography, University of Madras, Chennai, India
[1]Assistant Professor, Department of Geography, Central University of Karnataka, Kadaganchi, India
[3]Professor, Centre for Natural Hazards & Disaster Studies, University of Madras, Chennai, India
Email: lopitaphd2015@gmail.com

Abstract: *Groundwater plays a vital role which constitutes about two third of fresh water resources of the world. The groundwater is the major source for all purposes of water requirements in India. It is to be highlighted that country's economic development and food security is dependent on groundwater sources. The groundwater is the dominant factor for drinking water which records that 90 per cent of rural and nearly 30 per cent of urban populations are utilizing the resources in all aspects. The adjacent way is that due to the rapid growth of population, intensive urbanization and industrial development may tend to deplete the availability of groundwater as well as increase the demand in the global scenario. The main objective of the study is to identify the groundwater potential zone in Aland Taluk of Kalaburagi district. This research study was conducted with the source of satellite images and analyzed using geo-spatial techniques for the in-depth investigation of the objective.*

Key words: Groundwater, Urbanization, Geo-spatial, LISS III, ASTER DEM

Introduction Water an essential component to all human beings as well as equally important to both animals and plants. The existence of life without water is impossible and so the water is considered as essential element of life. One of the primary sources of water is accumulated in the reservoirs, lakes, ponds, dams etc. Apart from all other aspects the very important stay of water is ground which is called as groundwater. The areas with adaptable scarcity of water due to adequate rainfall shall be engulfed with potential groundwater for the survival of life. The various purposes like agriculture and others use groundwater for their needs whereas it may differ from area to area as per the terrain. The statistical report illustrated that more than 90 per cent of rural population is highly depend on water whereas adjacently 30 percent urban population depend on groundwater for drinking water. According to report of NRSA (2008), nearly 60 percent of the total irrigation is potential in the country. It is evident that the demand for groundwater is inflating due to intensive growth of population, industries, urbanization and increase in agricultural activities. A geological study illustrates that the rock was of low porosity and low permeability. The determining factor of slope gives the flow of water in the particular area whereas the land use highlights the usage of groundwater. The geo-informatics plays a primary role in this study to fulfil the targeted objectives. This can be achieved using satellite images data which are collected spatially and temporally.

Study Area

Aland taluk is present in the northern part of Gulbarga district (Fig 1). Aland is located at 17.57° N and 76.57° E. It has an average elevation of 480 metres. The town is spread over an area of 8 sq. km. It is a dry area, with low rainfall. A major number of populations have migrated towards cities due to lack of water, education and employment. Lack of natural resources and education has given birth to serious issues as low industrialization and high unemployment respectively in the Taluk. In Gulbarga, the southwest monsoon sets in the middle of June and extends till the end of September. Bulk of the annual rainfall occurs during this season, which constitutes over 75 percent of the annual rainfall. Gulbarga district lies in the northern plains of Karnataka and has semi – arid type of climate. Dry climate prevails for most part of the year. December is the coldest month with mean daily maximum and minimum temperatures being 29.5°C & 15° to 10°C respectively. During peak summer, temperature shoots up to 45°C. Relative humidity varies from 26 percent in summer to 62 percent in winter.

Methodology

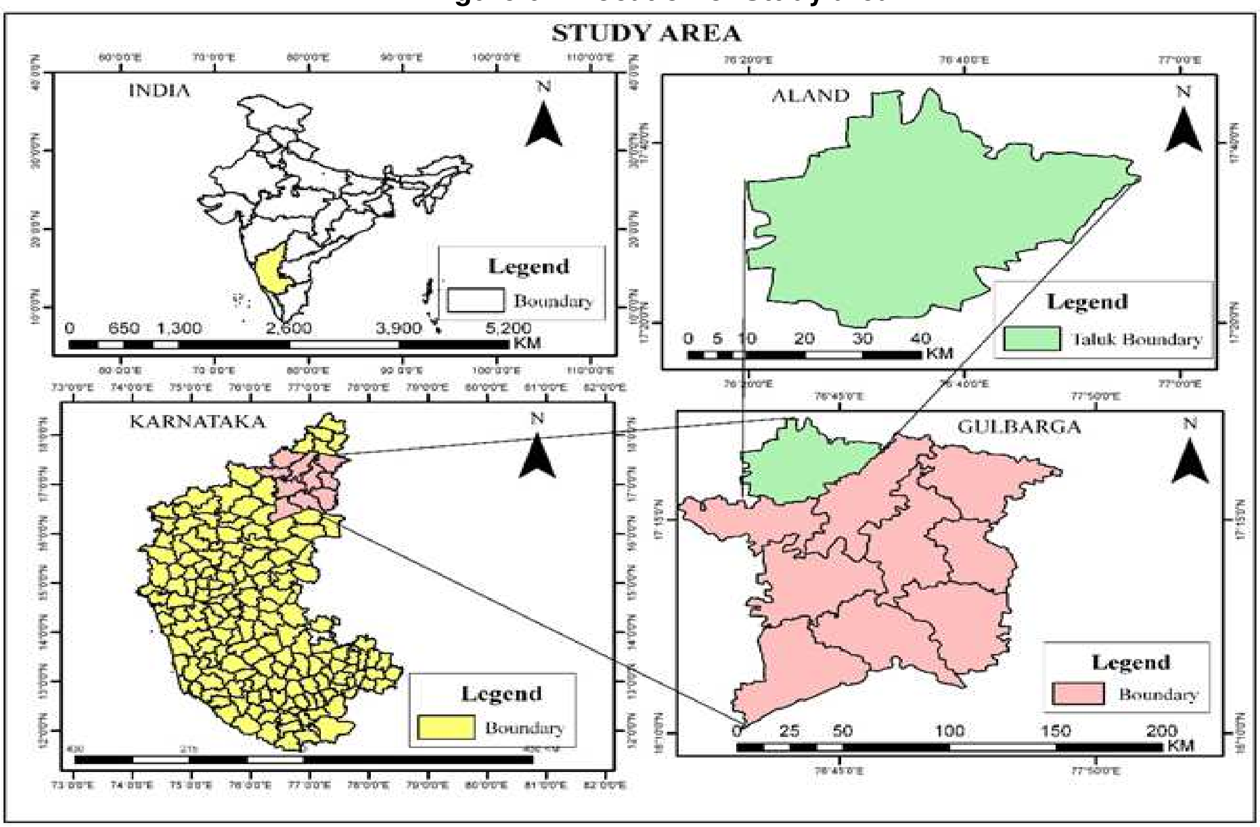
The methodology adopted for the study was creating a shape file derived from different inputs such as topographical sheet, aster data, cadastral maps and LANDSAT images. The generation of thematic layers such as density, slope, lineament density and geomorphology was done in a geographical platform and conversion of raster format with suitable weightage for the betterment of results. As a result of weighted overlay analysis the potential ground water zone map was created.

Table 01: Dataset Used

#	Name of Datasets	Product_id	Spatial Resolution
1.	LISS III	IRS-P6	23.5 meters
2.	LANDSAT TM	Thematic Mapper	30 meters

The above data sets (table1) are processed in geographical platform such ARCGIS 10.3 and ERDAS 2010 for identification of ground water potential zone.

Figure 01: Location of Study area



RESULT AND DISCUSSION

Geomorphology

The geomorphological representation shown in the figure 2a represents a plateau which is intended deeply with ravines. The figure clearly shows that the southern parts are highly undulating terrain with sparsely distributed knolls and tors. The prominent hill ranges in the region have an altitude of 580 m above mean sea level. The highlighted record is that the ground elevation varies significantly from 340m above mean sea level in southeast to 620 m above mean sea level in the north. The regional slope is towards south and southeast. The geological topography shown in the figure 2b with Deccan Trap basalts.

Figure: 02 (a)

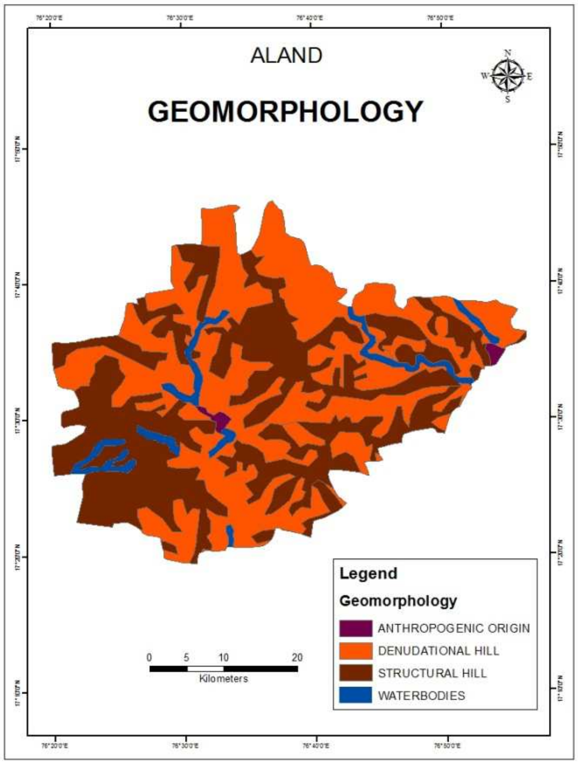
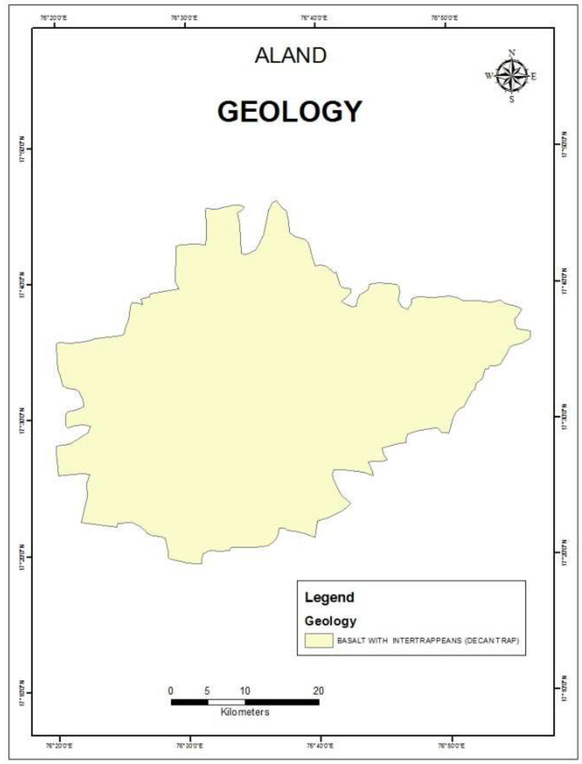


Figure 02: (b)



Drainage

The stream order from one to four is clearly classified in the fig 3a, 3b which constitute a basin of Amarja river. Drainage density is defined as the closeness of spacing of stream channels. It is a measure of the total length of the stream segment of all orders per unit area. The drainage density is an inverse function of permeability. The drainage density is classified into five classes whereas the centre part of the figure illustrates the fine drainage pattern and adjacently western part highlights the coarse density. As a conclusion it is evident that ground water potential is highly dominant in the areas of high density due to the factor of infiltration which allows more water to recharge.

Lineament Map

In the context of ground water, lineament is highly important as they control the movement and have sufficient capability for the storage of ground water. The major and minor lineaments show in the figure 04a were delineated which embrace faults, fracture, cracks, etc. The lineament density map as shown in the figure 04b was divided in to five class highlights the higher lineament density and recharge the groundwater. This indirectly increases the ground water potential.

Digital Elevation Model

A three dimensional representation of terrain surface is called as digital elevation model (DEM)which is often used as a generic term to exhibit the height information without any further definition about the surface The figure 04c shows the North and North- East part of the proposed study is highly elevated. The figure 04d, slope plays a vital role in recharge of ground water. The areas which have gentle slope may tend to reduced runoff whereas high slope may have tendency to sweep out rapidly results to poor ground water potential.

Figure: 03 (a)

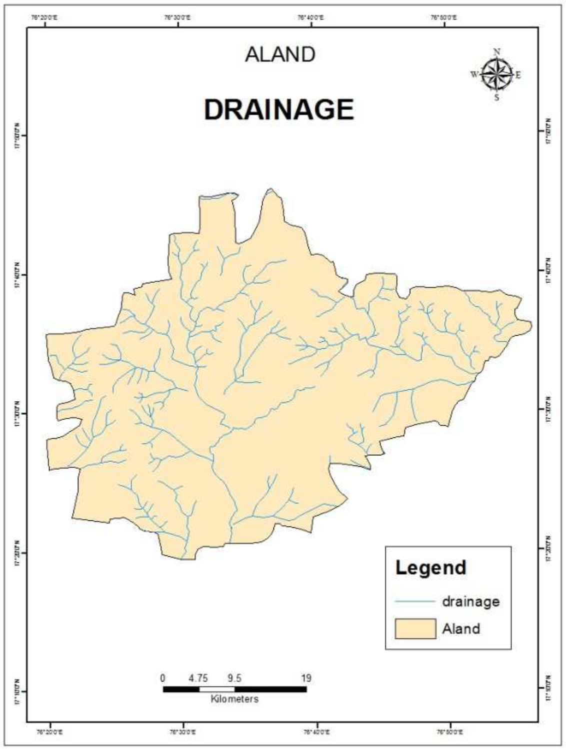


Figure: 03 (b)

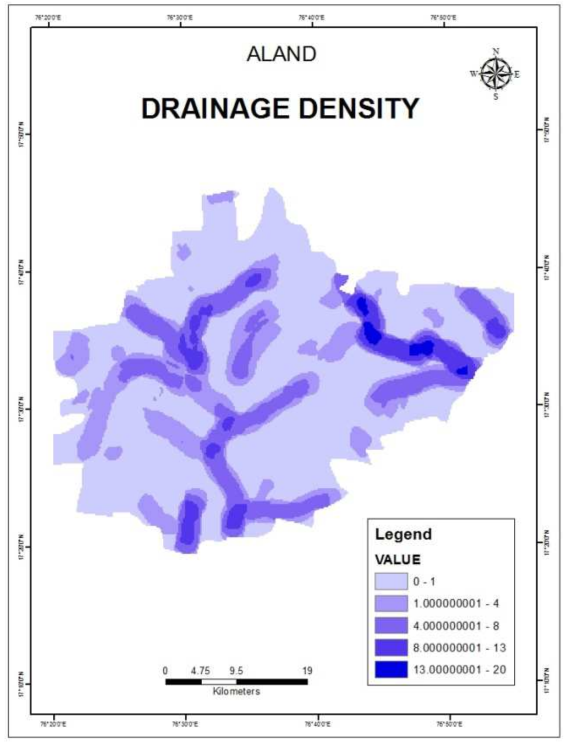


Figure: 04(a)

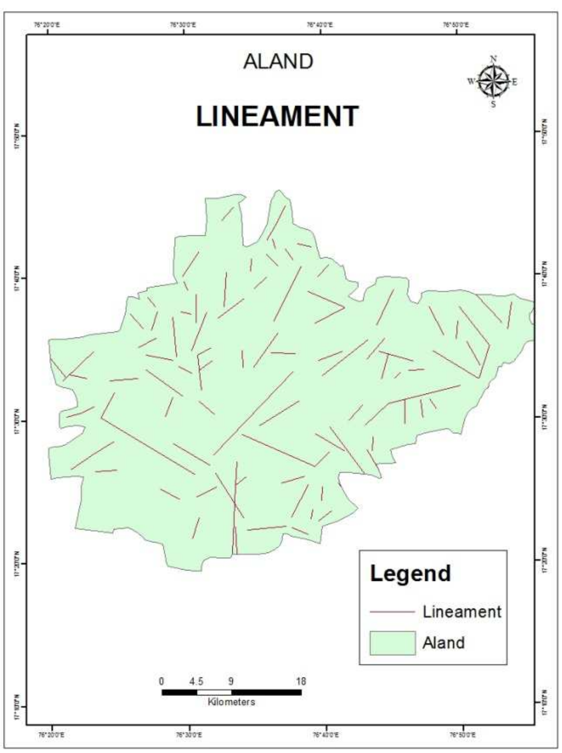


Figure: 04(b)

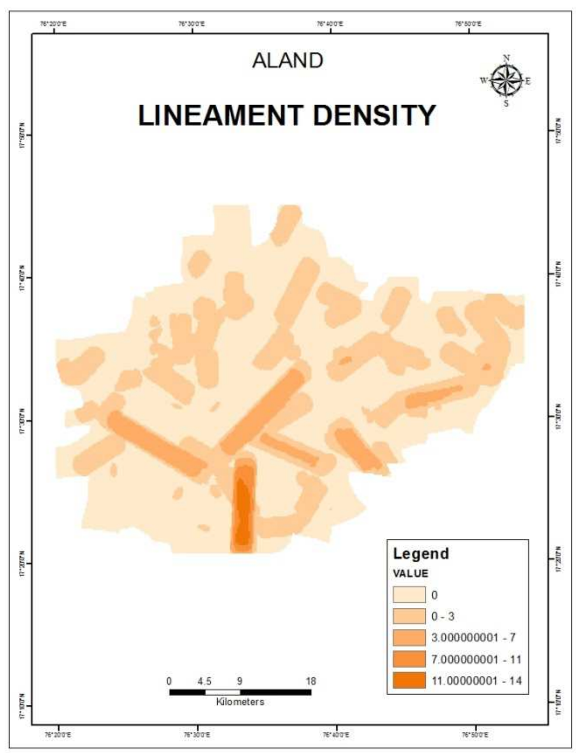


Figure: 04(c)

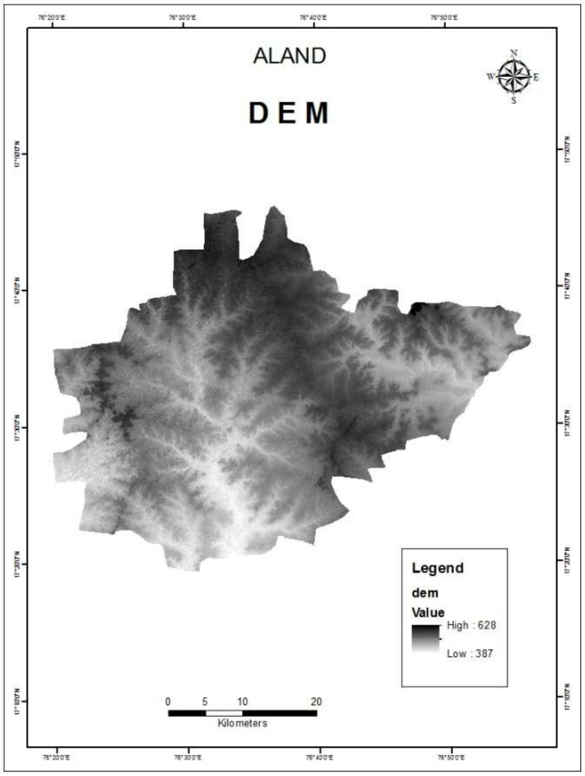
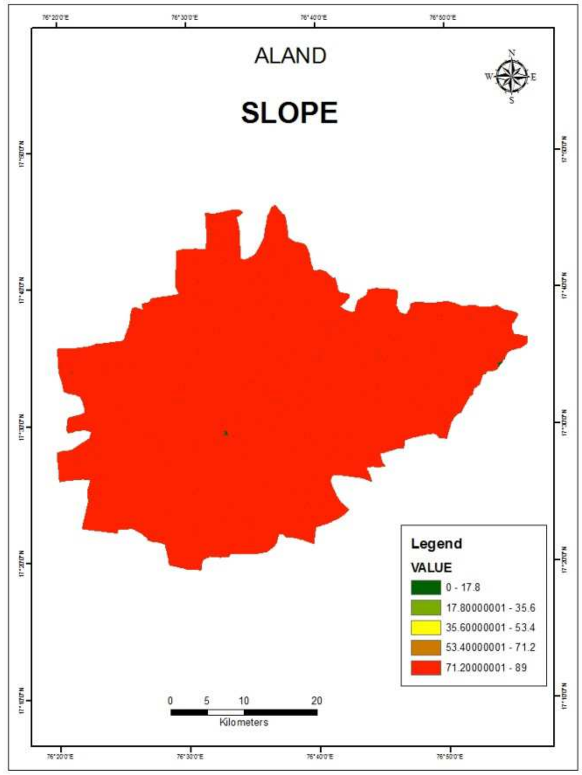


Figure: 04(d)



Weighted Overlay Analysis

Based on the multi-criteria evaluation technique the above identified thematic layer was assigned with suitable rank and weight

Table 02: Ground Water Potential Scale and Rank

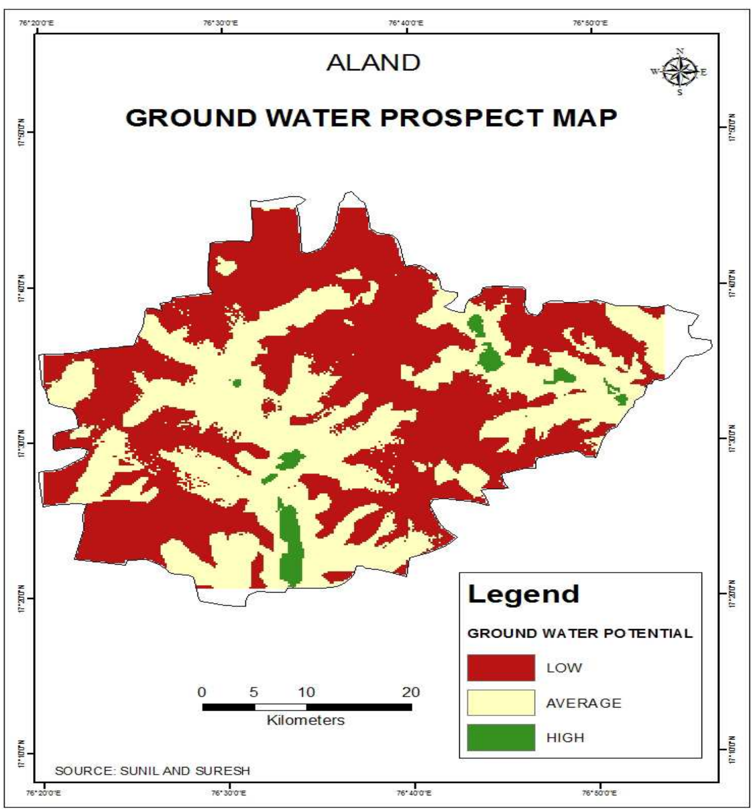
Scale	Rank
Very Poor	1
Poor	2 to 3
Moderate	4 to 5
Good	6 to 7
Very Good	8 to 10

Based on the interpolation of above weightage the ground water prospect was processed with the categorization of three classes namely, high, average and low potential regions. It is to be noted that the southern and eastern section shows high potential of groundwater due to appropriate lineament density whereas western and northern section show very low potential due to slope and at last the central portion shows moderate potential of groundwater prospect. The processed result fig 5.5 so obtained map so obtained was verified with field visit and it was found that the area showing high groundwater potential have very high yield of ground water.

Table 03: Weighted Overlay Analysis

Parameter	Class	Weightage (%)	Ground Water Prospect	Rank
Geomorphology	Denudation Hill	15	Moderate	4
	Structural Hill		Poor	2
	Water Bodies		Good	6
	Anthropogenic		Very good	9
Geology	Basalt	5	Moderate	5
Drainage density in (km/square km)	0-1	30	Very poor	1
	1-4		Poor	2
	4-8		Moderate	5
	8-13		Good	7
	13-20		Very good	9
Lineament density (km/square km)	0	30	Very Poor	1
	0-3		Poor	2
	3-7		Moderate	5
	7-11		Good	8
	11-14		Very good	9
Slope(in percentage)	0-17	5	Very good	9
	17-66		Good	8
	36-54		Moderate	6
	54-72		Poor	2
	72-89		Poor	1
DEM	High elevation	15	Moderate	3
	Low elevation		High	9

Figure: 05



Conclusion

This research makes the evident that the application of geo-informatics and remotely sensed satellite data can be a good methodology for the study of groundwater potential zone. This was proved in this study through ground truth verification. Integration of remote sensing data and the geographical information system (GIS) for the exploration of groundwater resources has become a breakthrough in the field of groundwater research, which assists in assessing, monitoring, and conserving groundwater resources. The delineation of groundwater potential zones in Aland Taluk, Kalaburagi District using remote sensing, GIS and multi criteria techniques is found to be much efficient to minimize the time, labor and money and thereby enables quick decision-making for sustainable water resources management. Satellite imageries, topographic maps and conventional data were used to prepare the thematic layers of lithology, lineament density, drainage density and slope. The various thematic layers are assigned proper weightage through multi-criteria technique and then integrated in the GIS environment to prepare the groundwater potential zone map of the study area. The results of the present study can serve as guidelines for planning future artificial recharge projects in the study area in order to ensure sustainable groundwater utilization.

References

1. Agricultural Research Station, Paramakudi, Research stations of TNAU, Tamil Nadu agricultural university http://www.tnau.ac.in/pmk/index.html
2. Agriculture contingency plan for district: Ramanathapuram, Tamil Nadu.
3. Anita, G., et. al (2011), “Ground water scenario in major cities of India”, Ministry of water resources, Central Ground water board, Government of India, 2011.
4. Balachandar .Det. al. (2010), “An investigation of ground water quality and its suitability to irrigated agriculture in Coimbatore district, Tamilnadu, India- A GIS approach”, International Journal of Environmental Sciences, Vol 1 (2), pp. 176-190. ISSN 0976-4402.
5. Balachandran. A, Scientist-D (April 2009), Technical Report “District ground water brochure Ramanathapuram district, Tamilnadu”, Central Ground Water Board, Chennai.
6. District Action plan, Joint Director of Agriculture, Department of Agriculture, Ramanthapuram.
7. Gorai A.K. and Subhash, K., (2013), “Spatial distribution analysis of groundwater quality index using GIS: A case study of Ranchi municipal corporation (RMC) area”, Geoinformatics & Geostatistics: An overview, Vol 1 (2).
8. Jaganathan. R, Chelvaraajhan. K, Mahalingam. S (2010), “Geomatics Based Assessment on Land use Changes and its Impact over the Groundwater Conditions in a newly developing sub urban area –A Case of Southern Chennai”, International Journal of Geomatics and Geosciences, Vol. 1(3). ISSN 0976- 4380
9. Muhammad, S.S., et. al. (2002), “Irrigational quality of under-ground water in Kasur district”, Asian Journal of Plant Sciences, Vol. 1(1), pp. 53-54.
10. Nag S.K. and Poulomi, G (2011), “Groundwater quality and its suitability to agriculture – GIS based case study of Chhatna block, Bankura district, West Bengal, India”, International Journal of Environmental Sciences, Vol 1(7), pp. 1770-1784. ISSN 0976-4402.
11. Nagarajan. M., Singh, S. “Assessment of Groundwater potential zones using GIS technique”, journal of Indian society of Remote sensing, Vol.37, March 2009, pp 69-77
12. Narsimha. A, Sudarshan. V et.al. (2012), “Ground water quality and its suitability for drinking and agricultural purpose around Chityal area, Nalgonda district, Andhra Pradesh, India”, Water research and development, Vol. 2(3), pp.68-75. ISSN: 2249-2003.
13. Paramakudi municipality (August 2008), “City corporate cum business plan”, Final Report, Tamilnadu urban infrastructure financial service limited, government of Tamilnadu.
14. Pradhan. S., et.al. (2011), “Characterization of groundwater quality for irrigation in Gohana block of Sonepat district, Haryana”, Journal of Agricultural Physics, Vol. 11, pp. 63-70. ISSN 0973-032X.
15. Prasanth, S.V., and Sarath (2012), “Evaluation of ground water quality and its suitability for drinking and agricultural use in coastal stretch of Alappuzha district, Kerala, India”, Application of water sciences, Vol. 2, pp. 165-175.
16. Varade, A.M., Wath, P., Dongre, K., Khare, Y.D., and Khandare, H. (2011), “Integrated approach using remote sensing and GIS for assessment of groundwater situation in parts of Chandrapur and Gadichiroli districts of Maharashtra”, Journal of Indian Geophysics Union, Vol. 15, No. 4, pp. 195-206.