International Journal of Geography, Geology and Environment

**P-ISSN:** 2706-7483
**E-ISSN:** 2706-7491
IJGGE 2022; 4(1): 145-153
Received: 09-02-2022
Accepted: 14-04-2022

**Rishu Pandey**
Mahatma Gandhi Chitrakoot Gramoday, Vishwavidyalaya (MGCGV), Satna, Madhya Pradesh, India

**Ravi Chaurey**
Mahatma Gandhi Chitrakoot Gramoday, Vishwavidyalaya (MGCGV), Satna, Madhya Pradesh, India

**Er. HK Solanki**
NIRDPR Govt. of India, Rajendranagar, Hyderabad, Telangana, India

**Santosh Kumar**
Mahatma Gandhi Chitrakoot Gramoday, Vishwavidyalaya (MGCGV), Satna, Madhya Pradesh, India

**Ram Moorat Singh**
National Institute of Technology (NIT), Raipur, Chhattisgarh, India

**Corresponding Author:**
**Ram Moorat Singh**
National Institute of Technology (NIT), Raipur, Chhattisgarh, India

# Groundwater prospectus mapping using well points based on remote sensing and GIS techniques in a micro-watershed

**Rishu Pandey, Ravi Chaurey, Er. HK Solanki, Santosh Kumar and Ram Moorat Singh**

**Abstract**
Evolution of the Groundwater Prospectus mapping using well points based on Remote Sensing and GIS techniques in a micro-watershed tributary Musi River, Ranga Reddy District, Southern Telangana zone State. The study area map showing a unit with horizontal in green Colour indicates that the expected yield range in that unit is 100-200 LPM and the depth range of the well is >80 M, horizontal hatchuring in red and yellow Colour indicates that the expected yield range in that unit is 50-100 LPM and the depth range of the well is >80 M, Oblique hatchuring in yellow Colour indicates that the expected yield range in that unit is 50-100 LPM and the depth range of the well is 30-80 M, The inselberg's, linear ridges, dykes; etc. in red Colour indicates that expected no yield. However, the purpose of studying the research manuscript using well points data for delineation of groundwater quality analysis and Groundwater mapping.

**Keywords:** Remote sensing & GIS, Well points, Arc-GIS, thematic layer, and groundwater modelling

## Introduction
Groundwater is the major source of drinking water in both urban and rural areas. Over the years, increasing population, urbanization and expansion in agriculture have led to the unscientific exploitation of this resource. It is an important source of water for the agricultural and industrial sectors. The demand for water has increased over the years and this has led to water scarcity in many parts of the world, especially in India. This alarming situation calls for a cost and time-effective technique for proper evaluation of groundwater resources, management and planning. Interpreted remote sensing and GIS can provide the appropriate platform for convergent analysis of diverse data sets for decision making in groundwater management and planning. The remote sensing technology and GIS tools have opened new paths in water resources studies. Temporal data from remote sensing enables the identification of groundwater aquifers and assessment of their changes, whereas, geographical information system (GIS) enables user-specific management and integration of multi-thematic data. Remote Sensing and GIS applications have been used by numerous scientists in the mapping of groundwater potential zones (venkatachalam *et al*., 1991; Ghosh, 1993; Saraf & Choudhary, 1998). The Indian Remote Sensing programmer is directed towards the realization of operational capabilities in space and ground segments of the technology for regular monitoring of earth resources and the environment (Gupta and Roy, 2000). The Spatio-temporal variations in rainfall and regional/ local differences in geology and geomorphology have led to an uneven distribution of groundwater in different regions across the country. The poor prospects and over-exploitation in certain zones are the main reasons leading to the scarcity of drinking water in many parts of the country (NRSA, 2000). Apart from visual interpretation, many researchers for deriving geological, structural and geomorphological details use digital techniques. Commonly 1: 50,000 are a good scale for hydrogeological studies (Bartarya, 1995) [2]. The main aim of the present study is to evaluate the groundwater potential in the Moinabad mandal of Ranga Reddy district of Telangana State. In order to achieve this goal, to prepare the different thematic map which is a controlling a ground water parameter like as Geology, geomorphology, slope, water level/table and land use/ cover. Finally, to prepare a ground water prospects map by integrating different controlling/indicative terrain in GIS environment.

## Study Site

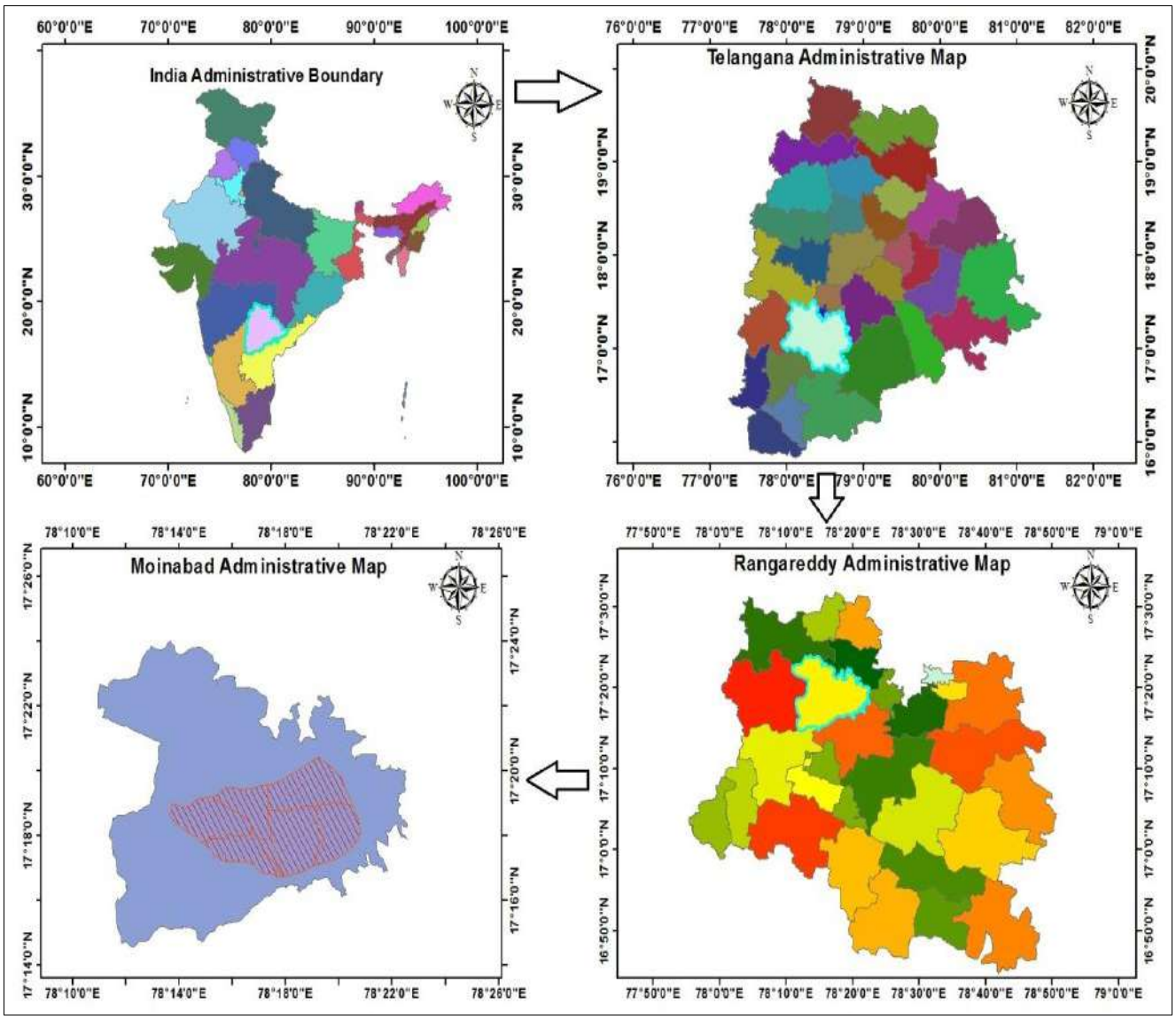


**Fig 1:** Study Area Map

The study area is the river part of Musi River basin, Moinabad Mandal of the Dist. Ranga Reddy Telangana State, India. Autonomous region and covers 52 Sq.km. (approx.). The study area located between 17.3267°N 78.2752°E (approx) and at an altitude of 566 m. Ranga reddy district also known as the 'Land of Red Soil is well known for its culture values. There is one major reservoir in the Musi basin, namely Himayatsagar. Drainage of the Eastern Ghat is coarse and dendritic with steep and narrow valleys. The study area is bounded in the north by Gandipet Mandal, in the east by Rajendra Nagar Mandal, in the south by Shamshabad Mandal and on the west by Chevella Mandal.

Reddy. The district lies between North latitudes 17.3267°N 78.2752°E and at an altitude of 566 m. The Mandal is bounded in the north by Gandipet Mandal, in the east by Rajendra Nagar Mandal, in the south by Shamshabad Mandal and on the west by Chevella Mandal. Before the re-organization of districts, the village was under the jurisdiction of Chevella revenue division and in Ranga Reddy district. The Administrative map of Moinabad Mandal is presented in the fig.no.1 and 2. Delineated the micro-watershed of the study site at the MSc Applied Geology 4$^{th}$ semester dissertation work.

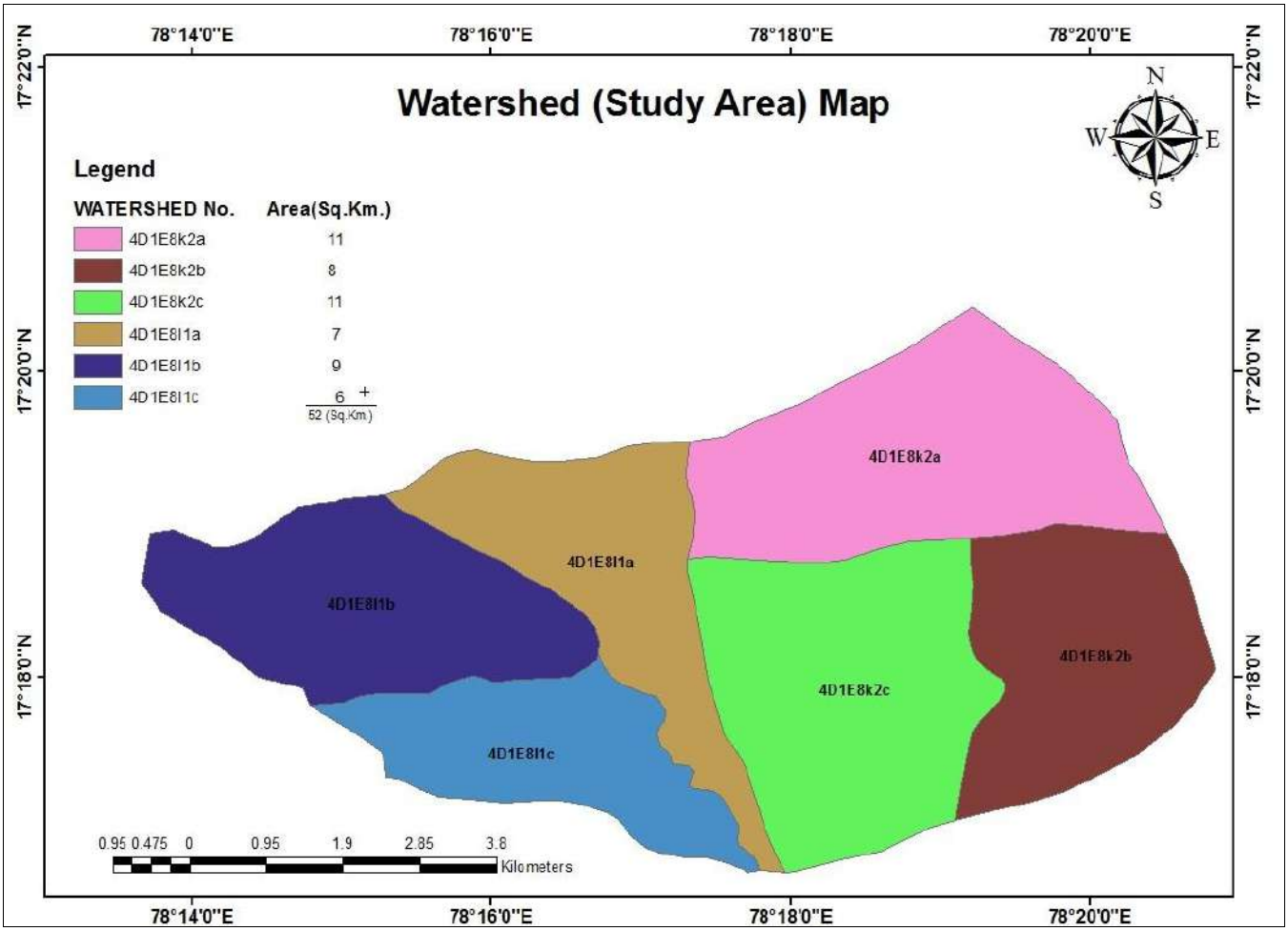


**Fig 2:** Watershed Map

## Methodology

RS and GIS techniques were applied in this paper to depict the groundwater prospect zones.

The Spatial database has been developed using Survey of India (SOI; Toposheets Download http://www.surveyofindia.gov.in/pages/display/189-open-series-maps(osm)) from this source, the status of 1:50,000 open series maps (OSM) and IRS-P6 Satellite sensors LISS-IV (Linear Imaging self-scanning sensor) image used the research activity and data interpretation, LISS-IV image (spatial resolution 5.8 m.) from the National Remote Sensing Centre (NRSC; https://nrsc.gov.in/) and United States Geological Survey (USGS; https://search.earthdata.nasa.gov/) respectively.

The Cartosat-1 DEM and Shuttle Radar Topography Mission (SRTM GL1) Global 30m DEM from open topography (https://portal.opentopography.org) data has been used to obtain digital elevation model map (observed the Mean value and Standard deviation), slope, and drainage network generate to the Arc-GIS 10.3 software using the drainage and lineament density map is created in GIS environment using the drainage and lineament layer. DEM data was used to delineate the basin boundary (Oh *et al*., 2011) [8] with the support of the hydrology tool in GIS software.

Satellite data with supporting ancillary information used in UTM (Universal transverse Mercator) Projection, spheroid datum WGS-84 (World Geodetic System).

The methodology has been developed keeping in view the concept discussed above. It is basically a systematic procedure evolved to prepare a groundwater prospects map using satellite data and GIS techniques in conjunction with limited fieldwork. Various steps involved in the preparation of groundwater prospects maps are furnished as a flow chart.

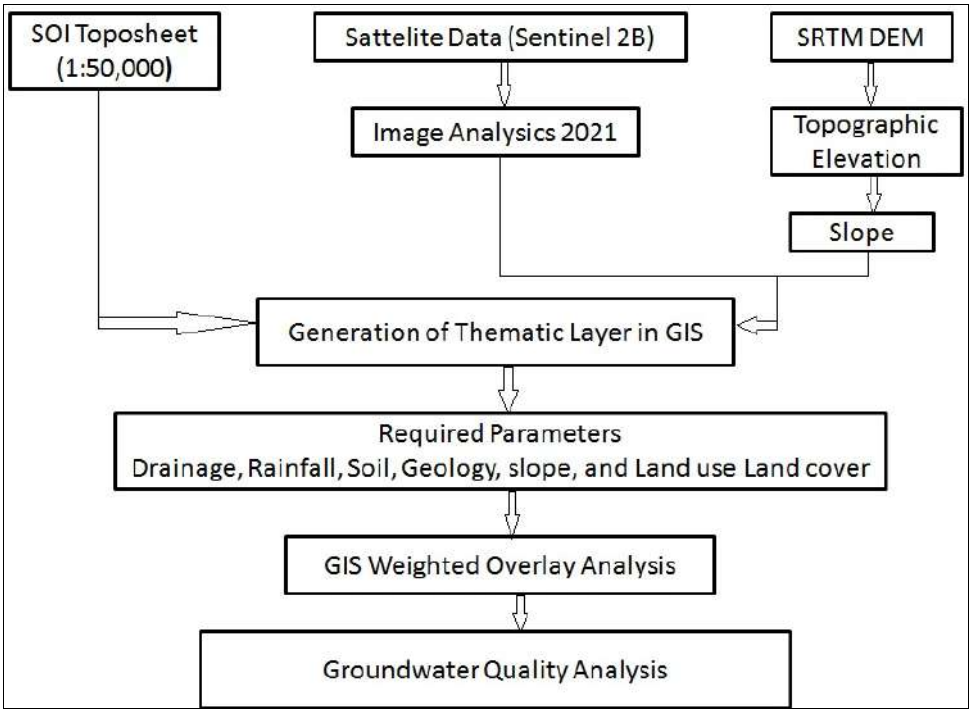


**Fig 3:** Flow Chart of the study area

**Table 1:** Thematic layers derived from different thematic layer Resources

| Thematic layers | Data and sources |
|---|---|
| Soil | The Digital Soil Map Of The World (http://www.esri.com/) |
| Lithology/Geology | Survey of India: (https://bhukosh.gsi.gov.in/Bhukosh/Public/) |
| Geomorphology | Survey of India: (https://bhukosh.gsi.gov.in/Bhukosh/Public/) |
| Land use/Land cover | Copernicus Sentinel Data (https://lta.cr.usgs.gov/), Sentinel 2B |
| Drainage/Drainage density | Copernicus Sentinel Data (https://lta.cr.usgs.gov/), Sentinel 2B |
| Slope | Copernicus Sentinel Data (https://lta.cr.usgs.gov/), Sentinel 2B |
| Rainfall | CHRS Data Portal (https://chrsdata.eng.uci.edu/) |

## Result and Discussion

### Parameters Influencing Groundwater

The groundwater quality analysis for the study area were generated through the integration of various thematic maps *viz*., Drainage, Rainfall, Soil, Geology, slope, and Land use Land cover using remote sensing and GIS techniques.

### 1. Drainage & Drainage density

Drainage and Drainage density is an important factor for delineating the groundwater mapping. This map is also prepared from survey of India toposheets on 1:50,000 scale. The pattern of drainage is generally dendritic with wide valleys in western pediplain. Drainage of the Eastern Ghat is coarse and dendritic with steep and narrow valleys According to drainage density; the study area is divided into five subclasses, i.e., Very Poor, Poor, Moderate, Good and Very Good covering an area of 646.11, 516.89, 387.66, 258.44 and 129.22 km, respectively of the total area 1938.32 km. show in Figure No. 4 and 5 after that drainage and drainage density map geo-processing tools in Arc-GIS 10.3 software's of used in thematic layer.

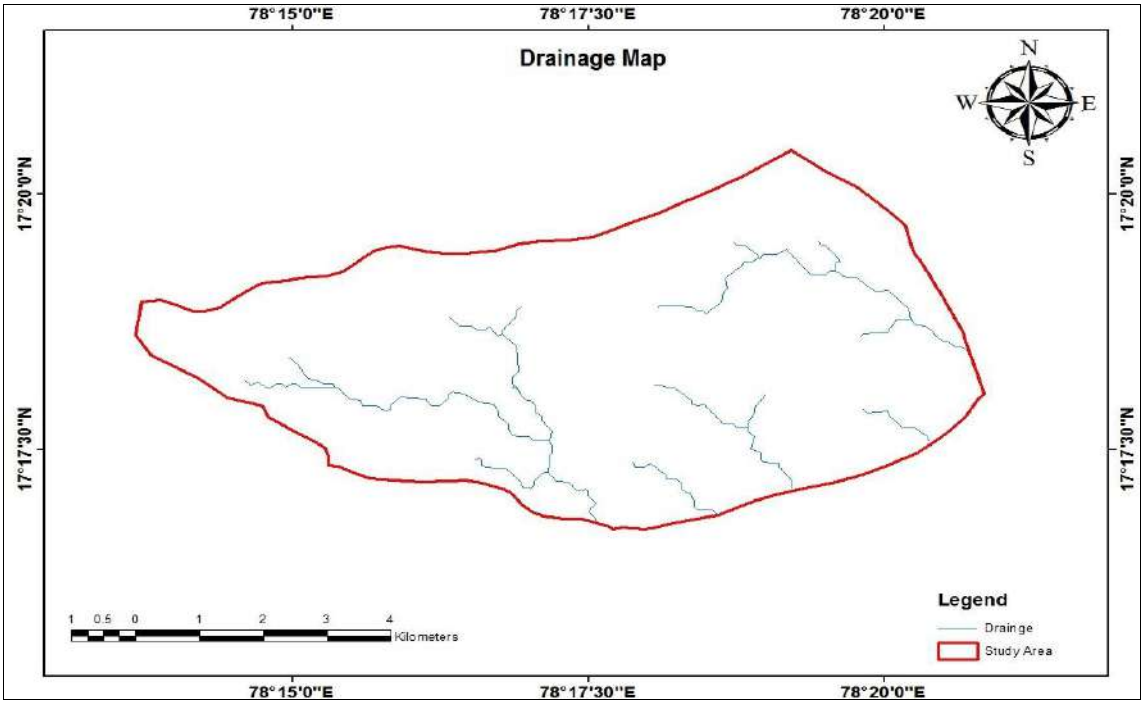


**Fig 4:** Drainage Map

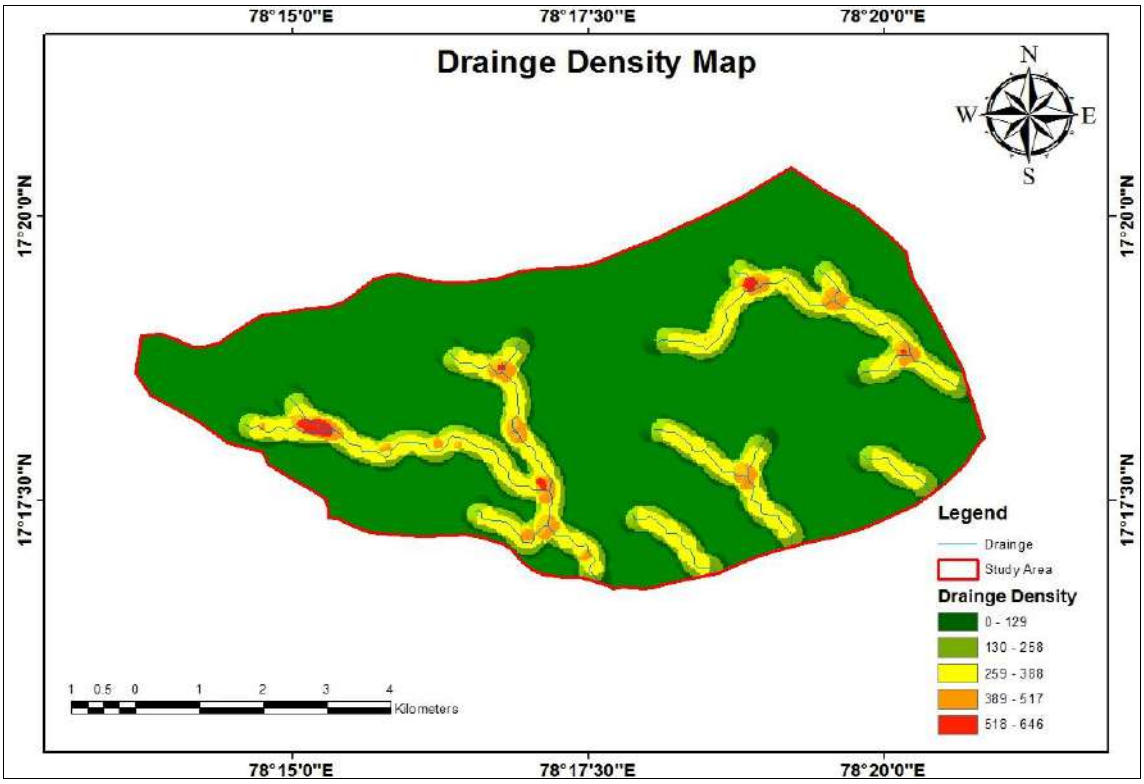


**Fig 5:** Drainage Density Map

## 2. Rainfall

Studied the rainfall map was prepared with the help of data collected from the climate research unit, time series data of last 10 years. The average rainfall data was prepared with the help of IDW techniques in Arc-GIS 10.3 software's. The average rainfall of the area ranges from 1646.109 MM to 1787.45 MM show in Figure No. 6 from the rainfall map we can see that the rainfall is increasing as we move from West to East. More than 90% of the total annual rainfall occurs during monsoon season spread over from June to October. The rainfall is not continuous but occurs in spells of varying durations and intensities.

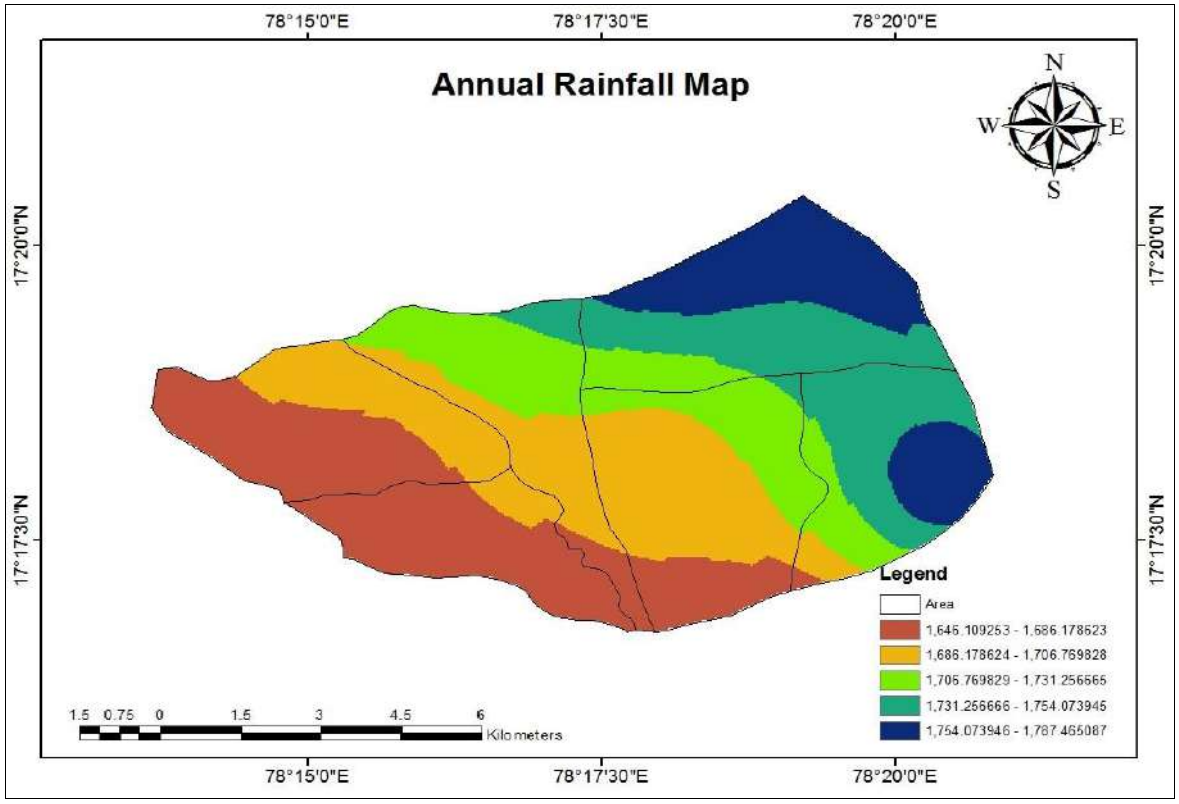


**Fig 6:** Annual Rainfall Map

### 3. Soil

Soil is an important factor for delineating the groundwater mapping. The analysis of the soil type reveals that the study area is predominantly covered by red lateritic soils and black cotton soils. (In deeply buried pediments and moderately buried pediments) red soil, and loamy soil, at some places as shown in earth Surface is dark brown Laterite soil, show in Figure No. 7 during research found the study area soil characteristics.

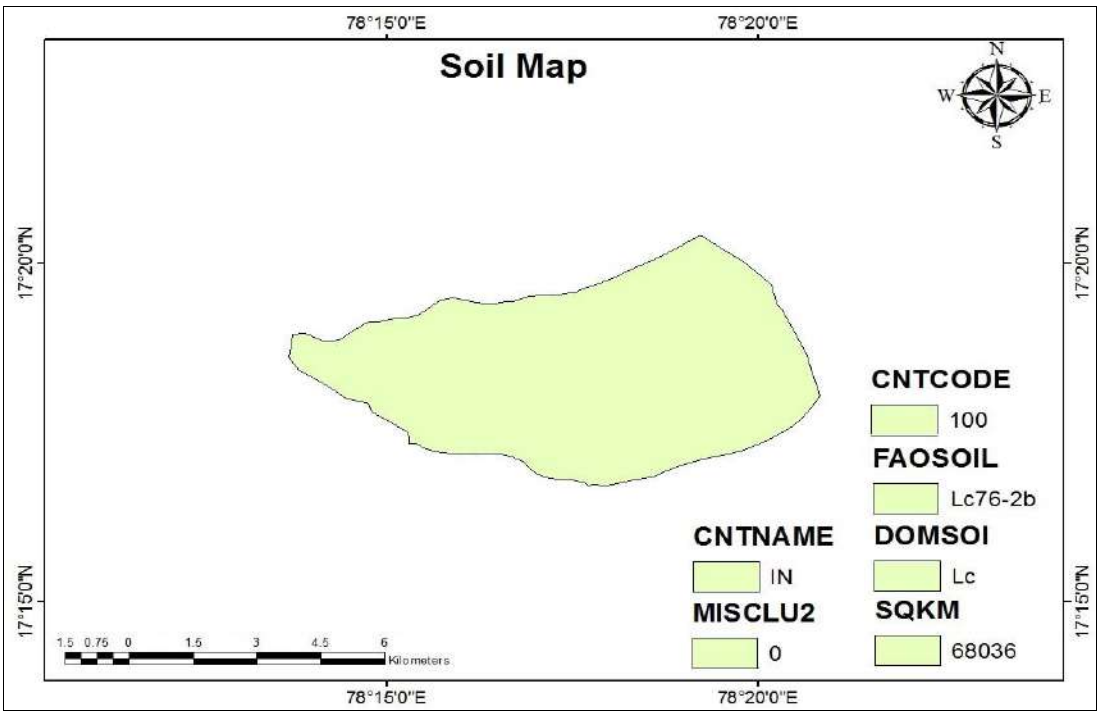


**Fig 7:** Soil Map

### 4. Geology

Geology is an important factor for delineating the groundwater mapping. The study area is underlain by various geological formations like Archaean granites and gneisses, Proterozoic Bhima series and the younger Deccan traps. The Archaean crystalline rocks occupy nearly three fourths of the district comprising older metamorphic rocks, peninsular gneissic complex (migmatites) and younger

intrusive rocks. Intrusive of dolerite dyke are common in the area. The upper pretoerozoic sediments of Bhima group comprising of limestone and shale occur in the western most corner of the study area. Show in Figure No. 8.

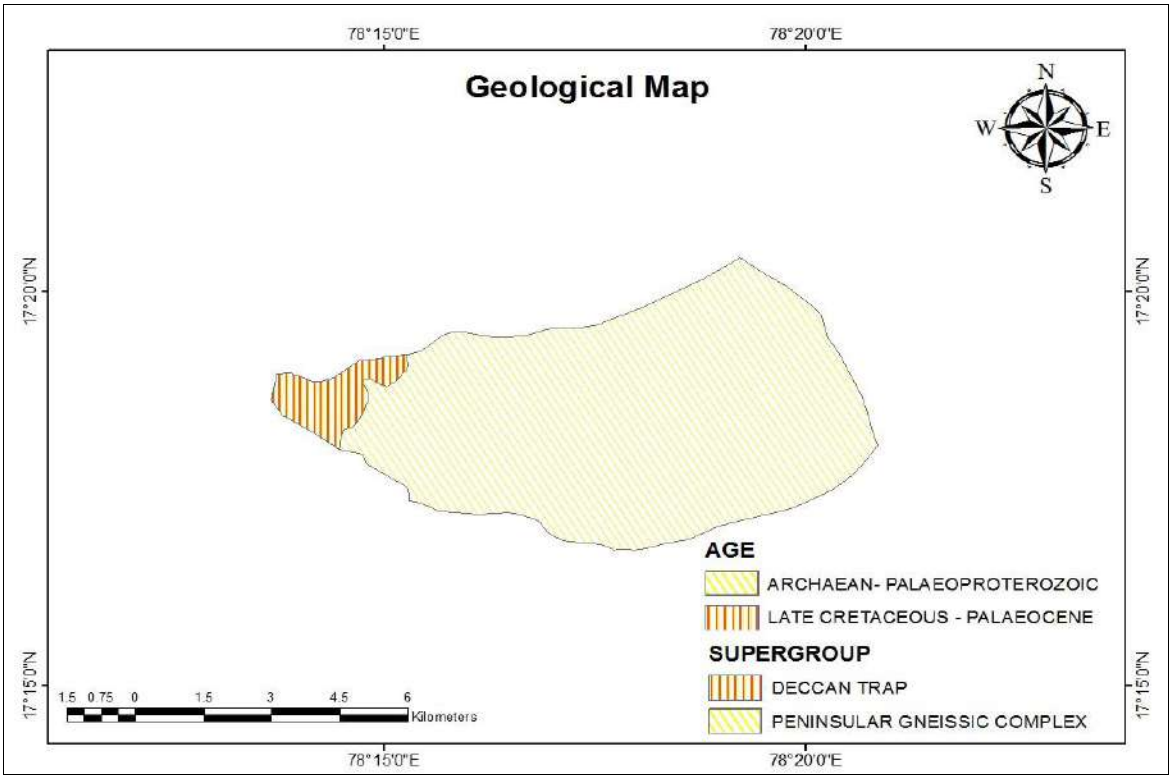


**Fig 8:** Geological Map

**5. Slope**

Slope is one of the important terrain parameters which are explained by horizontal spacing of the contours. In general, in the vector form closely spaced contours represent steeper slopes and sparse contours exhibit gentle slope whereas in the elevation output raster every cell has a slope value.

Slope is calculated in percent. Analysis of slope within the study area resulted from DEM data which showed that the study area falls under low to moderate slope areas. The slope of the study area varies from 1% to >50%. An increasing percentage of slope decreases the infiltration capacity of the soil and formation hence promoting runoff. The majority of the study area falls under >15 % slopes. Show in Figure No. 9.

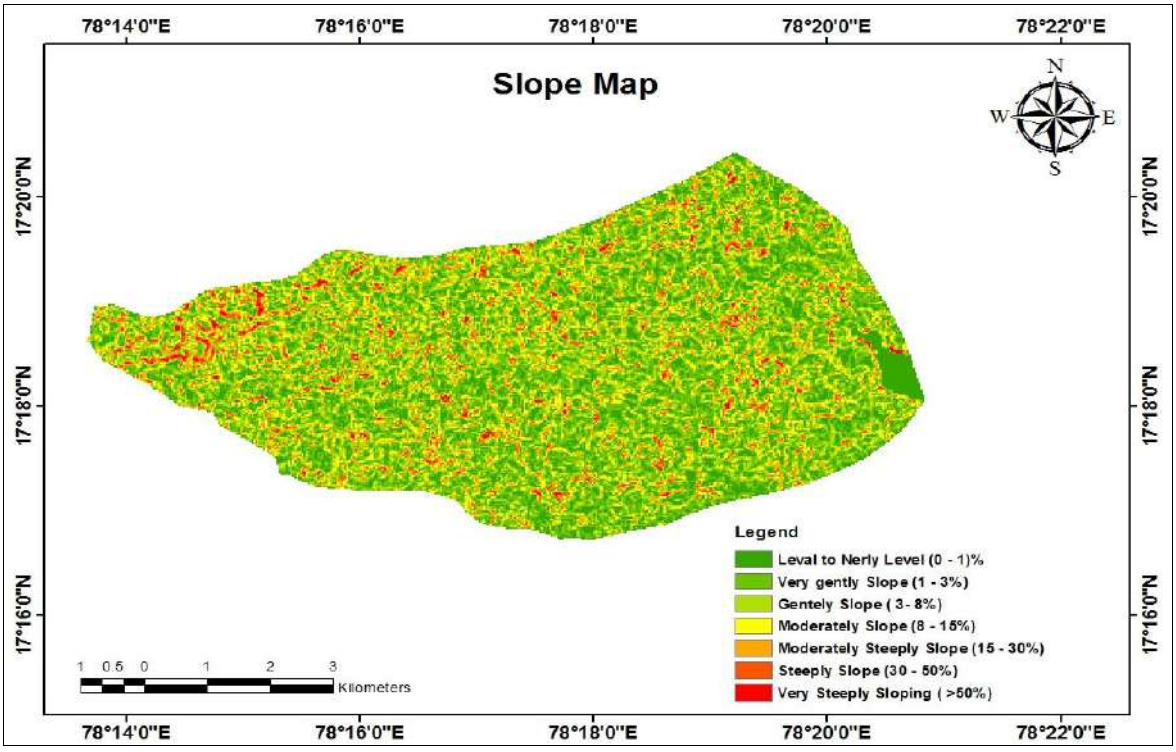


**Fig 9:** Slope Map

### 6. Land use Land cover

Land use Land cover mapping is one of the important applications of remote sensing. Land use plays a significant role in the development of groundwater resources. Remote sensing provides excellent information with regard to spatial distribution of vegetation type and land use in less time and low cost in comparison to conventional data groundwater research manuscripts reviewed literature. The majority of the area is comprised of Built-up area (40.90%), followed by agricultural/cropland (15.71%), build-up area (9.87%), water bodies (10.89%) and barren/waste land (20.38%). show in Figure No. 10.

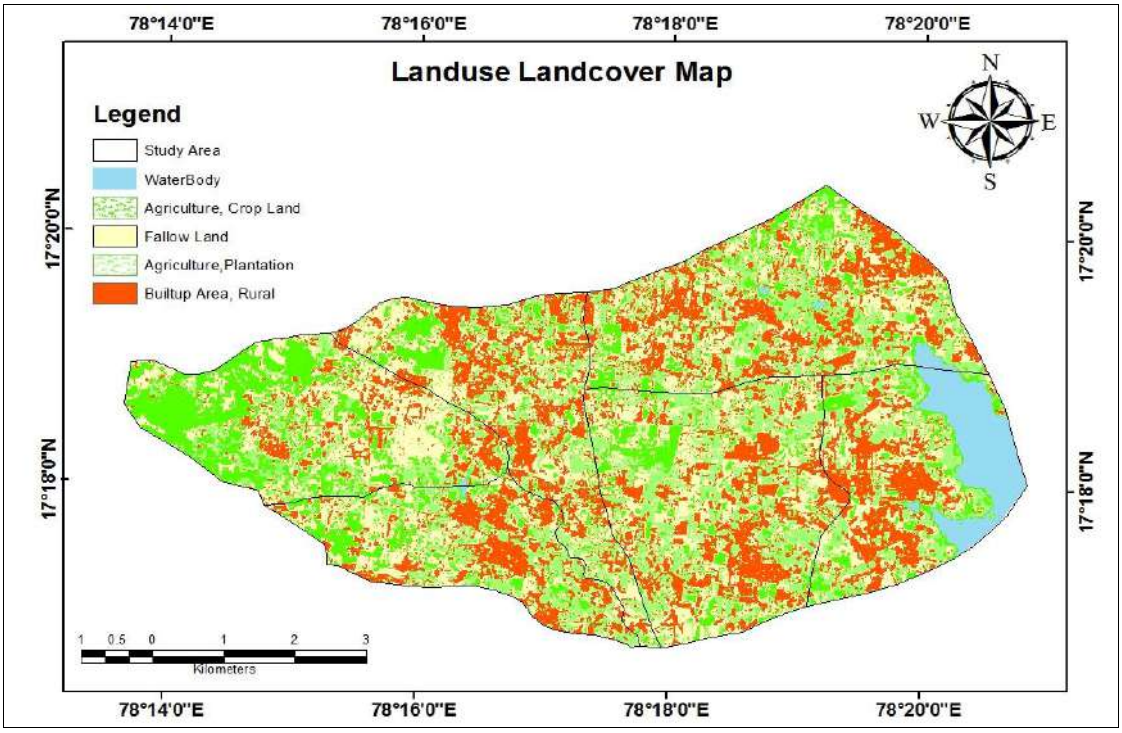


**Fig 10:** Land use Land cover Map

### 7. Groundwater quality analysis

The study area map showing unit with horizontal in green colour indicates that the expected yield range in that unit is 100-200 LPM and the depth range of the well is >80 M, horizontal hatchuring in red and yellow colour indicates that the expected yield range in that unit is 50-100 LPM and the depth range of the well is >80 M, Oblique hatchuring in yellow colour indicates that the expected yield range in that unit is 50-100 LPM and the depth range of the well is 30-80 M, The inselberg's, linear ridges, dykes; etc in red colour indicates that expected no yield. Show in Figure No. 11. However, identified the groundwater mapping that is the very important research at the human beings and save the surface water and groundwater that's a very good gifts of the new generations.

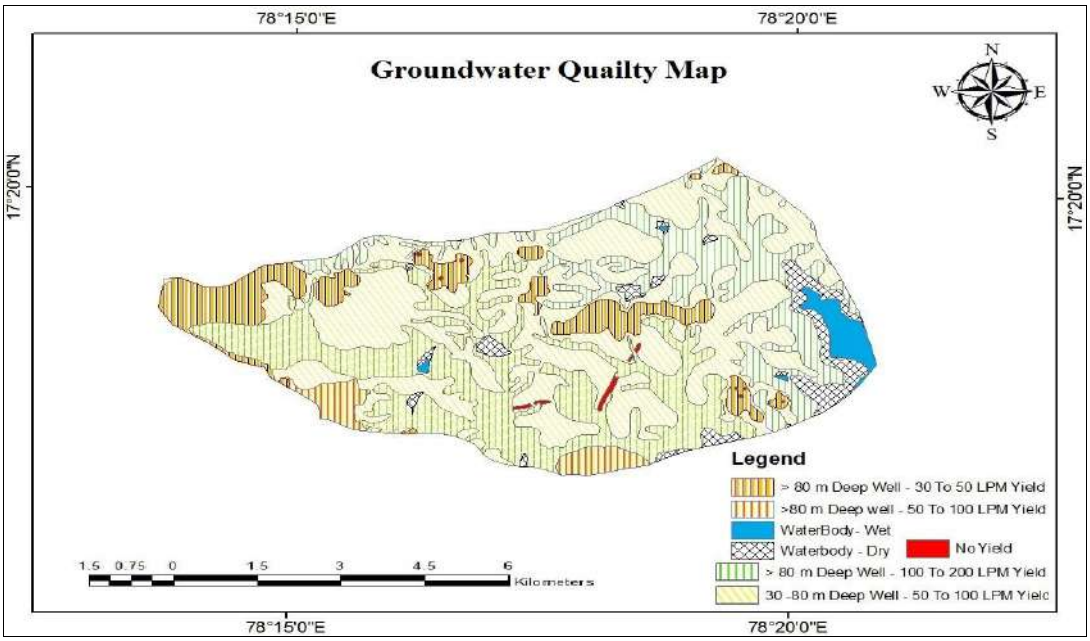


**Fig 11:** Groundwater Quality Map

## Conclusion

Satellite imageries, topographic maps and conventional data were used to prepare the thematic layers of Drainage, Rainfall, Soil, Geology, slope, and Land use Land cover. The various thematic layers are then integrated in the GIS environment to prepare the groundwater mapping of the study area. According to the groundwater mapping in 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. This is an empirical method for the exploration of groundwater mapping using remote sensing and GIS techniques and it succeeds in proposing study sites for groundwater zones. This method can be widely applied to a vast area with rugged topography for the exploration of suitable sites.

## Acknowledgement

Rishu Pandey M.Sc. Applied Geology IV$^{th}$ Semester dissertation from M.G.C.G.V Chitrakoot, Satna, Madhya Pradesh. highly thankful to the National Institute of rural development & Panchayati Raj, Ministry of rural and development, Govt. of India, Rajendranagar, Hyderabad Telangana State, India to Er. H. K. Solanki, Sr. Assistant professor for Support to provide all necessary facilities to carry out this research work. The authors express their heartiest thanks to Dr. Ravi Chaurey, Associate Professor (M.G.C.G.V Chitrakoot Satna Madhya Pradesh India) for his valuable guidance for complete the research work. We also thank to Mr. Ram Moorat Singh, Research Scholar from National Institute of Technology (NIT), Raipur, Chhattisgarh, contribute for improving the manuscript for his critical comments. We would like to thank Santosh Patel, Research Scholar, (M.G.C.G.V Chitrakoot Satna Madhya Pradesh India) for her support in the research work.

## Declaration of interests

We declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Reference

1. Boonstra J. Groundwater Survey. Groundwater Balances. Lecture Note. Twenty Ninth International Course on Land Drainage (1990), ILRI, Wageningen, The Netherlands, 1988.
2. Bartarya SK. Hydrogeology and Water Resources of Intermountane Doon Valley Journal of Himalayan Geology. 1995;6(2):17-28.
3. Devi, Wankhede. Landform Analysis Related To Environmental Appraisal, Slope Stability and Hydromorphogeological Studies in Part of Giri and Bata Valley (H.P. and Haryana), 1995.
4. De Marsily G. Quantitative Hydrogeology, Academic Press. de Ridder, N. A. (1974). Groundwater Investigations, In: Drainage Principles and Applications, ILRI Publication 1986, 16.
5. Groundwater Resource Estimation Methodology- 1997. Report of the Groundwater Resource Estimation Committee, Ministry of Water Resources, Government of India, New Delhi, 1997 Jun.
6. Koopmans BN. A comparative study of lineament analysis from different remote sensing imagery over areas in the Benue Valley and Jos Plateau Nigeria. Int. Jour. of Remote Sensing. 1986;7:1763-1771.
7. Moore JE. Contributions of Groundwater Modelling to Planning, Journal of Hydrology. 1979;43:121-128.
8. Oh HJ, Kim YS, Choi JK, Park E, Lee S. GIS mapping of regional probabilistic groundwater potential in the area of Pohang City, Korea. Journal of Hydrology. 2011;399:158-172. DOI:10.1016/j.jhydrol.2010.12.027.
9. Roy AK. Water Resources in Doon valley: Development and Constraints related to Hydrogeologic Environment, Journal of Himalayan Geology, 1995, 6(2).
10. Santosh Kumar, Dr. Ravi Chaurey, Ram Moorat Singh, Dr. Rakesh Dubey, Anoop K Patel. Identification of Groundwater Potential Zone using Geoinformatics in part of Mandakini River Basin, Chitrakoot, India. IJARIIE, (PRSC-ISG National Conference, February 21-23, 2018, Ludhiana, Punjab, (India). 2018;4(3):33-39.
11. Singhal BBS, Gupta RP. Applied Hydrogeology of Fractured Rocks, Springer, 2010.
12. Semere Solomon. Remote Sensing and GIS: Applications for Groundwater Potential Assessment in Eritrea. Environmental and Natural Resources Information Systems. Royal Institute of Technology SE-100 44 Stockholm, 2003, 147pp.
13. Zemansky GM. Interpretation of Groundwater Chemical Quality Data, Proceedings, 14th Annual Waste Testing & Quality Assurance Symposium, 1998, Arlington, Virginia, 1998 Jul 13-15, 192-201.