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ASSESSMENT OF GROUND WATER POTENTIAL ZONE USING GEOSPATIAL TECHNIQUES

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Abstract: In present study, the groundwater potential zone for karha watershed are critically evaluated using GIS and remote sensing techniques. The study include extraction and preparation of various thematic layers using geospatial techniques. Various thematic maps like drainage density, Land use/land cover, soil map, geology map, and rainfall and slope have been integrated and assigned with weight on basis of its relative importance for assessing the groundwater recharge zones. The raster map is allocated with specific rank and weight and are statically computed to get composite map depleting zones of ground water potential.. The map is categorized into four zones those are very poor, poor, moderate and good ground water potential zone. This study computed using GIS and Remote sensing techniques will help in better planning and sustainable resource management within study area.

I INTRODUCTION

In this era, the ground water has become major source of water to support human need and annual water supply. It is estimated that approximately one third of the world's population use groundwater for drinking (Jose, Jayasree, Kumar, & Rajendran, 2012). Groundwater is the source for irrigation and domestic purpose. In which 80% of the rural areas are use groundwater for domestic purpose and 50% of the urban areas use the groundwater for domestic purpose. Due to more dependent on usage of groundwater for domestic purpose and irrigation and for other sectors may results in exploitation of groundwater resources (Shakak, 2015). The over exploitation of ground water in recent decade has lead to tremendous decrease in ground water. The exploitation and examination of ground water required knowledge of factor on which ground water potential zone depends. The study of thematic maps of this influencing factors like drainage density, geolgy, soil type, slope, etc help researcher to know its relation with ground water potential zone. The study including integration of this factors accompanied remote sensing and GIS increases accuracy of project.

The present study attempts to evaluate and assess ground water recharge zone in karha basin located in pune district. the study include integration of thematic layer and assigning each of them with specific rank based on its relative importance to evaluate ground water potential zone to guide in sustainable planning and management of ground water resources.

1.1 Study Area:

- Karha basin lies in Purandhar block in Pune District.
- It lies at 18° 15' North and 73° 52' to73° 11' East coordinates.
- The total area of karha basin watershed is 425 Km2 .
- Average annual rainfall: 750 mm
- Hot season are from from March to May, with maximum temperatures ranging from 35 to 39°C.
- The main crop grown in study area are sugarcane, maze and jowar and supplement to it crop like onion, chick peas, ladies finger, tomato, etc are grown.

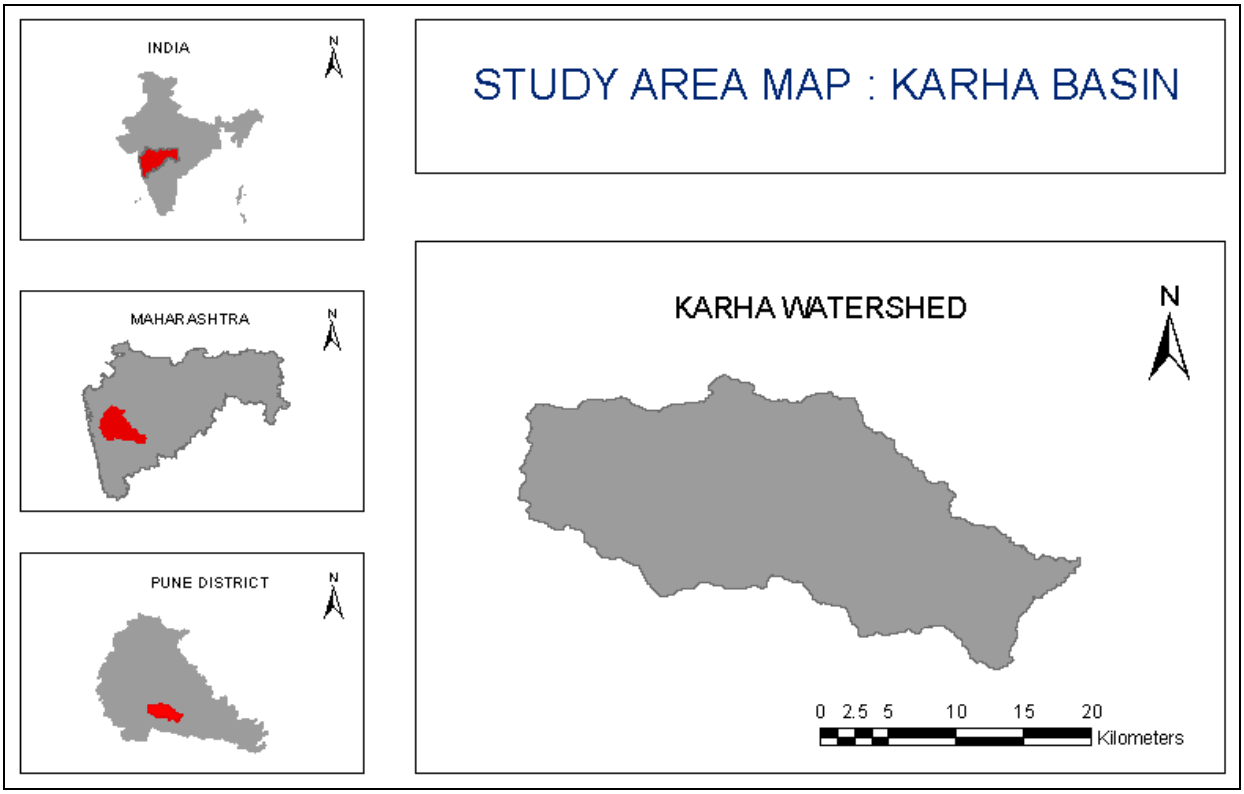

Figure no.: 1. Map of study area (self-prepared)

II LITERATURE REVIEW:

Groundwater potential of karha river basin for watershed design. (by Satish S Deshmukh and Abhaykumar Wayal, December 2016)

This study includes spatial techniques and Artificial Neural Network techniques (ANN) to demarcate the groundwater prospecting zones. The spatial database like hydro-geomorphology, land use/land cover, hydraulic soil group , slope, geological study and rainfall-runoff model are used to perform study. The parameter influceing ground water potential zone are integrated using Artificial Neural Network techniques to achieve results.

Identification of groundwater potential zones using GIS and remote sensing (by Dr. S. Vidhya Lakshmi and Y. Vinay Kumar Reddy, November 2015)

In this paper, author have discussed on method for delinating ground water potential zones. The objective of this paper is to review techniques and methodologies applied for identifying groundwater potential zones using GIS and remote sensing. The

paper mainly focus on accuracy between conventional and advance GIS based methods AHP, frequency ratio model and WOM .The study also emphasis on importance of each thematic layer and its weight in delination of the location for groundwater potential zones using groundwater conditions.

Identification of Groundwater Potential Zone using Remote Sensing and GIS Technique (by M.L.Waikar and Aditya P. Nilawar, May 2014)

In this casestudy, author mainly emphasis on use of GIS and remote sensing techniques for extraction of ground water potential zone in study of area. The Charthana in Parbhani district is considered as study area for performing study. The study consist of preparation of thematic maps and overlay analysis of map with help of analytical hierarchical process. The outcome of study depicet four zone of ground water potential .

Watershed Management Structures and Decision Making Frameworks (by Anil Kumar Misra & Ankit Pachouri Amandeep Kaur, October 2015)

This paper consist corrective and preventive measure for ground water recharge. the study suggest location for ground water recharge structure like Horizontal shaft , vertical shaft and Horizontal shaft with check dam on basis of stream order. Authors of this paper also suggested some measures, which need to be implemented on priority basis within the watershed to deal with water scarcity problem.

III METHODOLOGY:

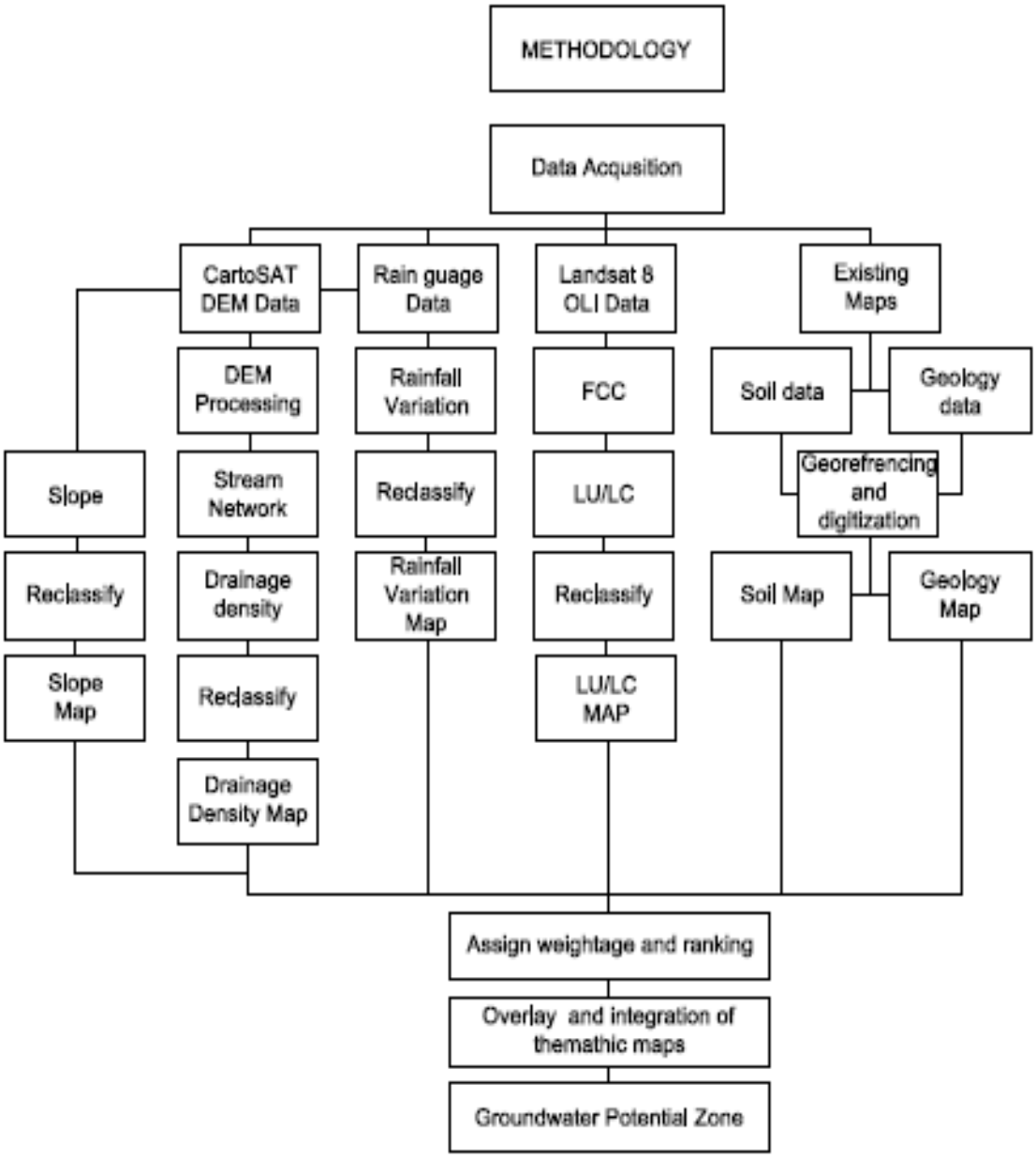

Figure no.: 2. Methodology (Self prepared)

IV RESULT AND DISCUSSION:

Rainfall:

Rainfall is most vital factor influencing the recharging of ground water. The annual rainfall data is taken from the Indian Meteorological Department (IMD) and TRMM map. Rainfall is the major source of groundwater availability. The availability of ground water increases with rainfall , if rainfall is less than groundwater will be less. Rainfall may be varies from one region to another region. From annual rainfall data of last 36 year rain gauge staion and TRRMM map, the rainfall varialtion within the watershed is interpolated using kriging interpolation method. the rainfall in karha basin varies from 454mm to 797mm. The rainfall is maximum in central and southern-east region of watershed.

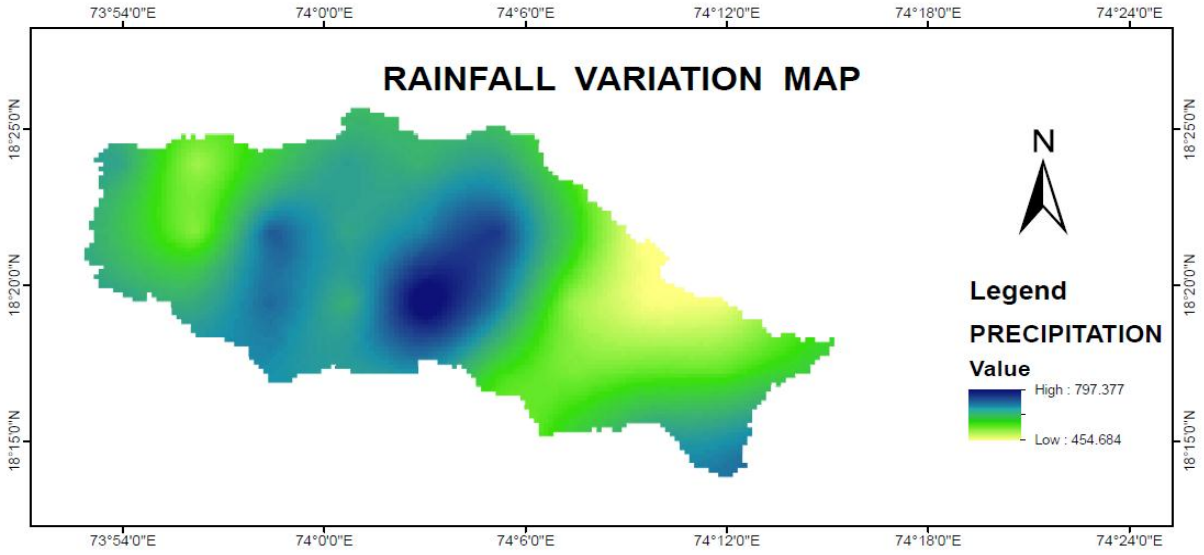

Figure no.: 3. Rainfall Variation Map (self prepared)

Slope:

Slope is one of major factor for identifying groundwater potential zone.the slope widely affect the speed and extent of runoof. The higher degree of slope is indicative of rapid runoof. The slope map was derived from a CatroSAT data of the study area. The slope is classified into 4 categories. The study area shows low slope (0–5%) is indicative of the presence of good groundwater potential. Medium slope (5-15shows moderate groundwater potential, the slope of (15-35%) of study area indicates low groundwater potential with relatively high runoff and poor infiltration capacity. High slope (>35%) indicates presence of poor groundwater potential. The greater slope is present in western and Sothern region of basin.

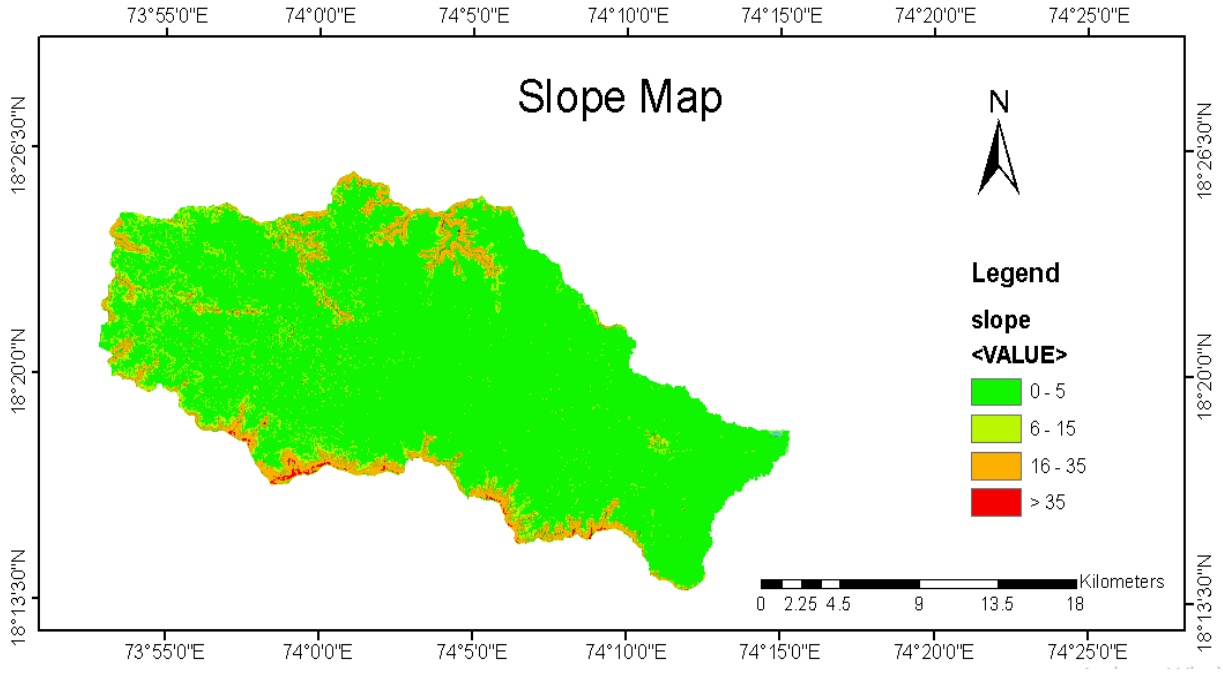

Figure no.: 4. Slope Map (self prepared)

Geology:

The geology is important factor which widely affect the ground water.The study area shows two lithological units belonging to Diveghat formation and Purandar formation respectively. Diveghat formation shows 65.76% of study area with poor groundwater potential and Purandar formation with 34.24% study area shows moderate ground water potential (Satish S Deshmukh, 2016).

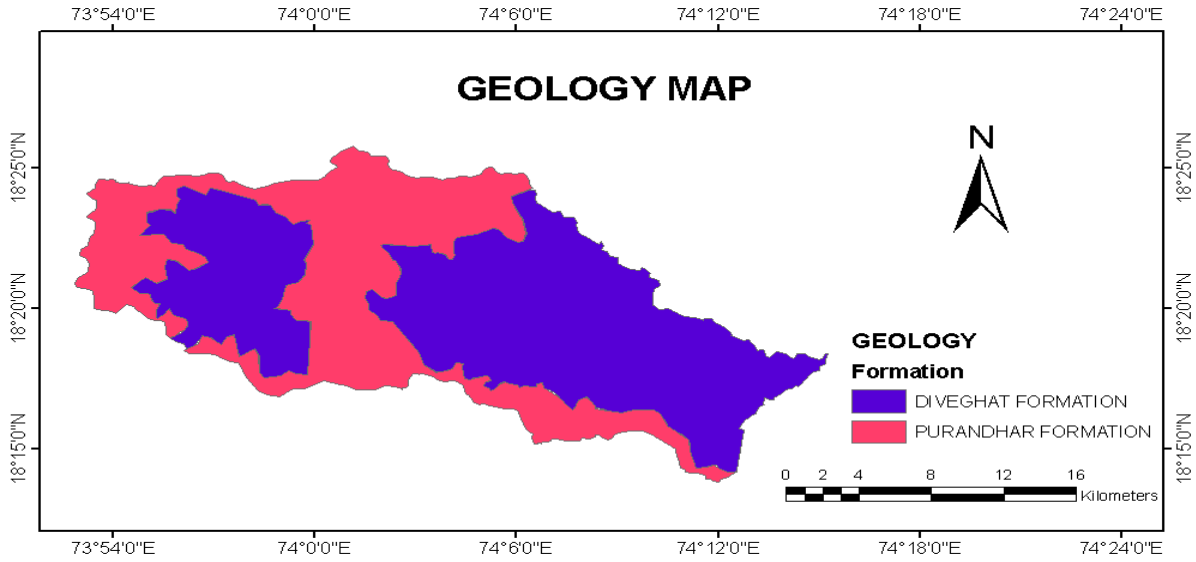

Figure no.: 5. Geological Formation Map (Satish S Deshmukh, 2016)

Drainage Density:

Drainage density (in terms of Km/Km2) is indicative of clossness ofa spacing of stream. It can be defined as as total stream length in particular basin of all order per unit drainage area of same basin. It highly influence flow and infiltration capacity. High drainage density shows presence of impermeable strata and fine texture, whereas course texture and permeable surface is observed in area with lower drainage density. Higher drainage density is usually observed along the path of streams.

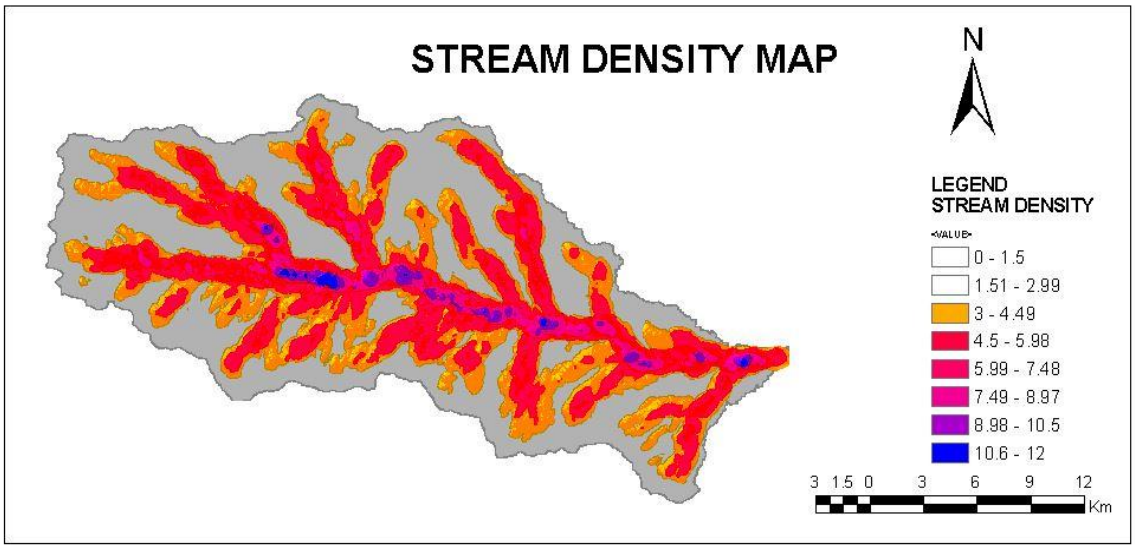

Figure No.:6 Stream density map of Karha Basin (self prepared)

Soil map:

The soil in study area can be classified under three hydraulic groups, i.e. HSG-B, HSG-C and HSG- D (Satish S Deshmukh, 2016). Soil in group B have moderate runoff and are of silt loam. soil in group c have high run off potential when thoroughly wet. This soil is sandy clay loam with moderate infiltration rate . HSG-D have high runoff potential. This means the there is restriction to movement of water when it is thoroughly wet. This soil include clay loam, silty loam and silty clay. It has very low infiltration rate. (Satish S Deshmukh, 2016).

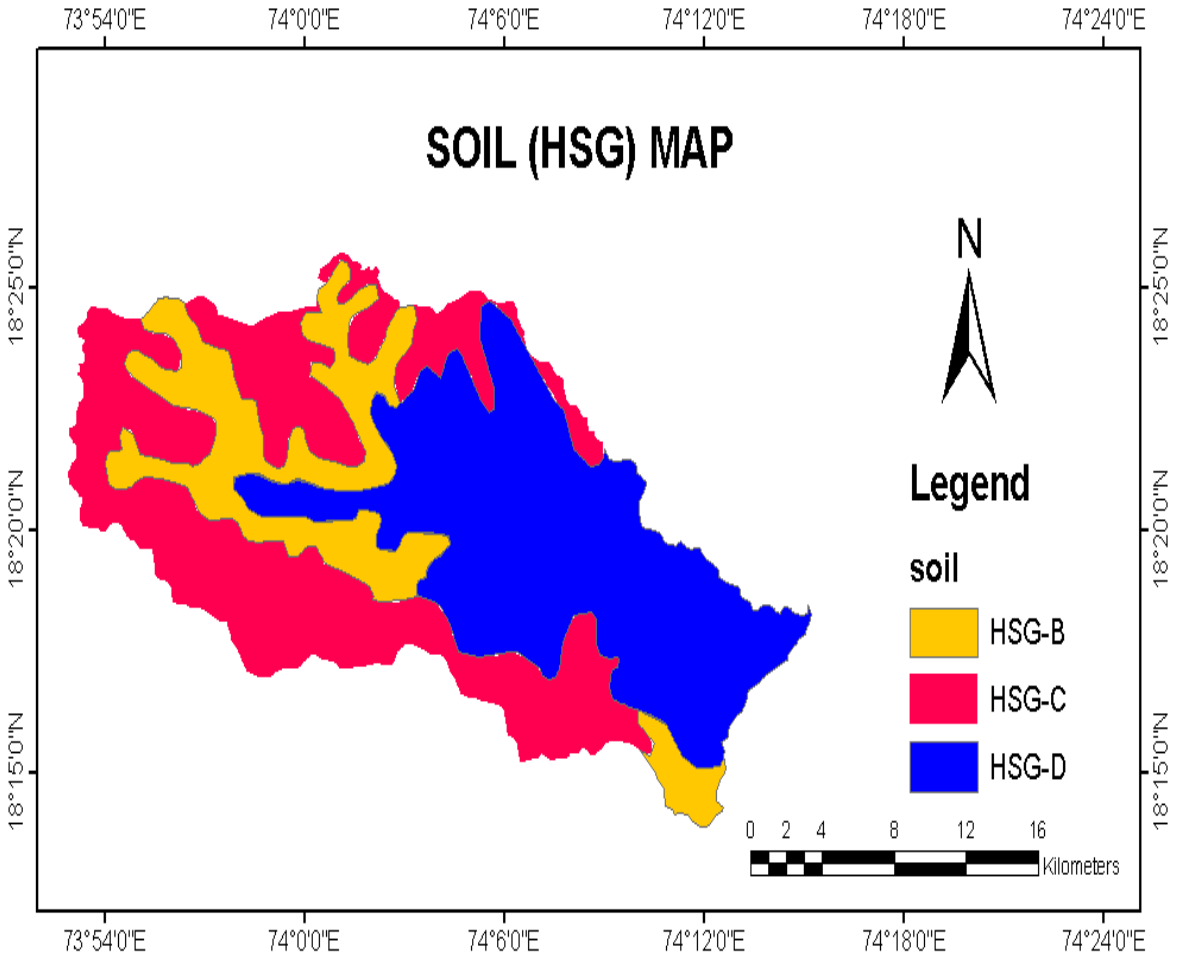

Figure no.: 7. Soil Map (HSG) (Satish S Deshmukh, 2016)

Land use land cover map:

The study of land use land cover map is important for groundwater potential mapping. the lulc map is prepared using Landsat 8 data and processed using supervised classification tool in Erdas Imagine software. The major land-use type in the study area are barren land, agriculture land, fallow land, water bodies and settlement. The water bodies and agriculture are best site for ground water exploration and have high ground water potential, the fallow land have moderate ground water potential and settlement have low ground water potential. major hydrological process like evapotranspiration, surface runoff and infiltration are dependent on LULC. The congested, compacted and rough surface like vegetation provide resistance to runoff and increases infiltration, thus increases the ground water potential of that area.

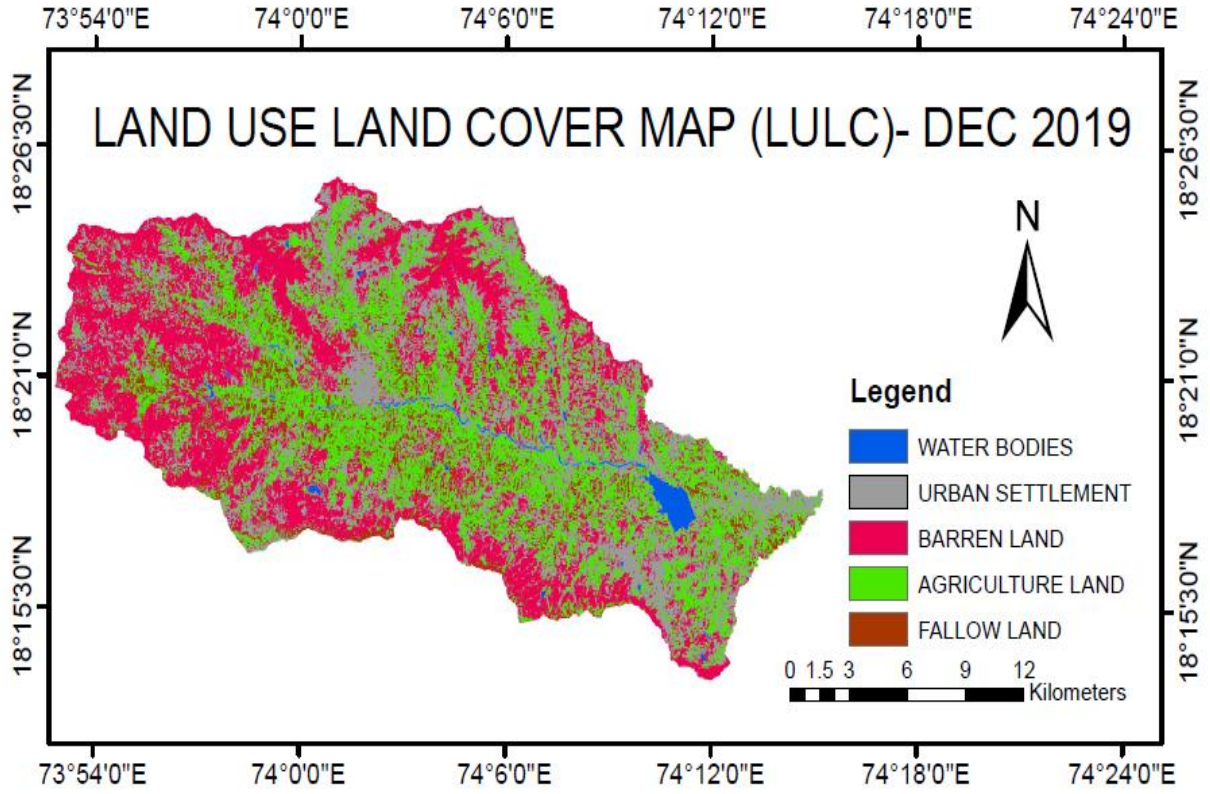

Figure no.:8. Land Use/ Land Cover Map (self prepared)

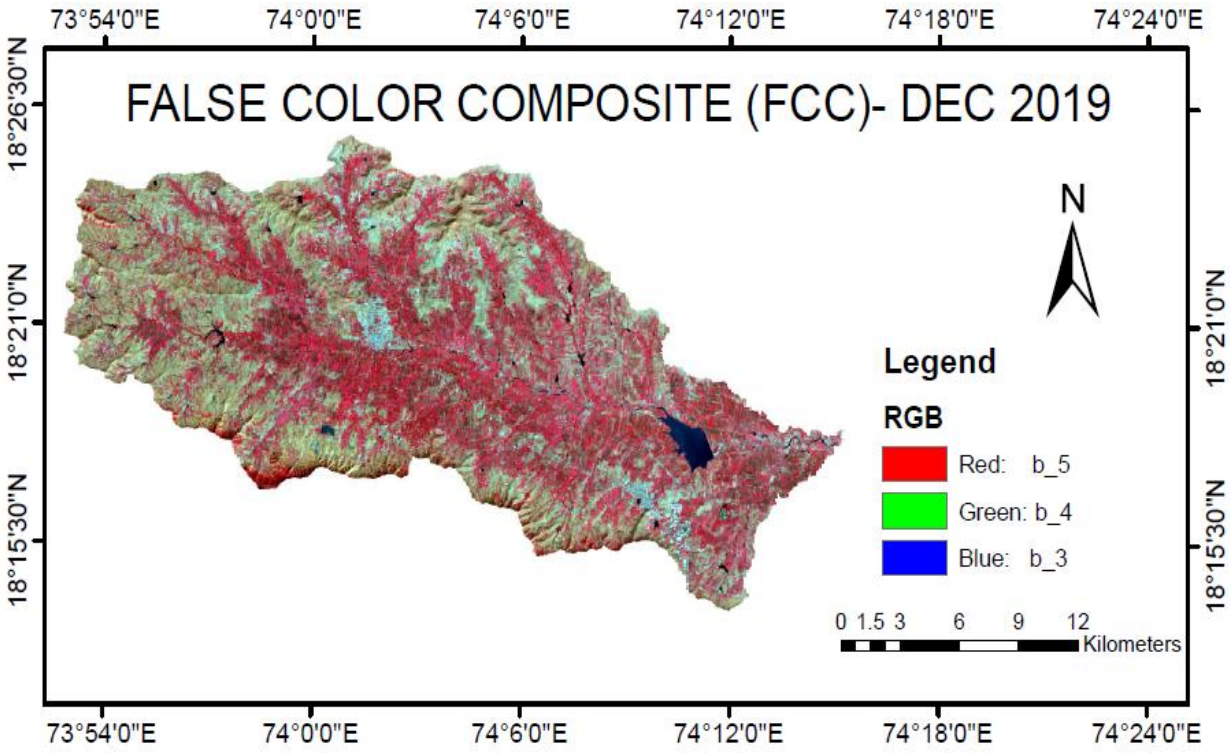

Figure no.: 9. False Color Composite
(LandSat 8 Image-December 2019, USGS)

Delineation of ground water potential zone by Multi Criteria decision analysis:

Sr. No.	Weight (% Influence)	Criteria	Sub-feature	Sub-rank
1	16	Land Use/Land Cover	Water Bodies	5
			Urban Settlement	2
			Barren Land	1
			Agriculture Land	4
			Fallow Land	3
2.	12	Slope	0-5	5
			6-15	4
			16-35	3
			>35	2
3.	20	Rainfall	454.68 - 523.22	1
			523.23 - 591.76	2
			591.77 - 660.3	3
			660.31 - 728.84	4
			728.85 - 797.38	5
4.	16	Geology	Diveghat Formation	2
			Purandar Formation	4
5.	16	Drainage Density	0 - 0.497	1
			0.498 - 1.634	2
			1.635 - 3.055	3
			3.056 - 4.795	4
			4.796 - 9.057	5
6.	20	Soil	HSG - B	5
			HSG - C	3
			HSG - D	1

Table no.: 1. weight overlay analysis (prepared using AHP calculator)

Various parameter like drainage density, land use land cover (LULC), soil, Geological formation, rainfall and slope were integrated to get ground water potential map. The demarcation of groundwater potential zones for the study area was made by integration of various layer by weighted overlay method in ARCGIS. During the weighted overlay analysis, the ground water potential zone map is obtained by integrating all thematic maps and assigning weightage and influence value to each of them. The soil and drainage density were assigned with higher weightage. The art of assigning weightage generally varies researcher to researcher on basis of knowledge of researcher of study area and method adopted for zoning. After assigning weightage, individual parameter is further ranked into different classes on basis of its sub variable as shown in table No. : 1.1 shows The LULC is

ranked into 5 classes based on its type of land cover. The water bodies were ranked as 5th, which mean very good ground water potential, following it agriculture, fallow land were assigned with 4th and 3rd rank, which mean good and moderate potential and settlement and barren land were assigned with poor and very poor ground water potential. Similarly other maps were also classified into class and were ranked subsequently. As far as slope is concerned, the highest rank value is assigned for gentle slope and low rank value is assigned to higher slope. The ground water potential map is computed on basis of all above factor. The map is categorized into four zone very low, low, moderate and high ground water potential zone.

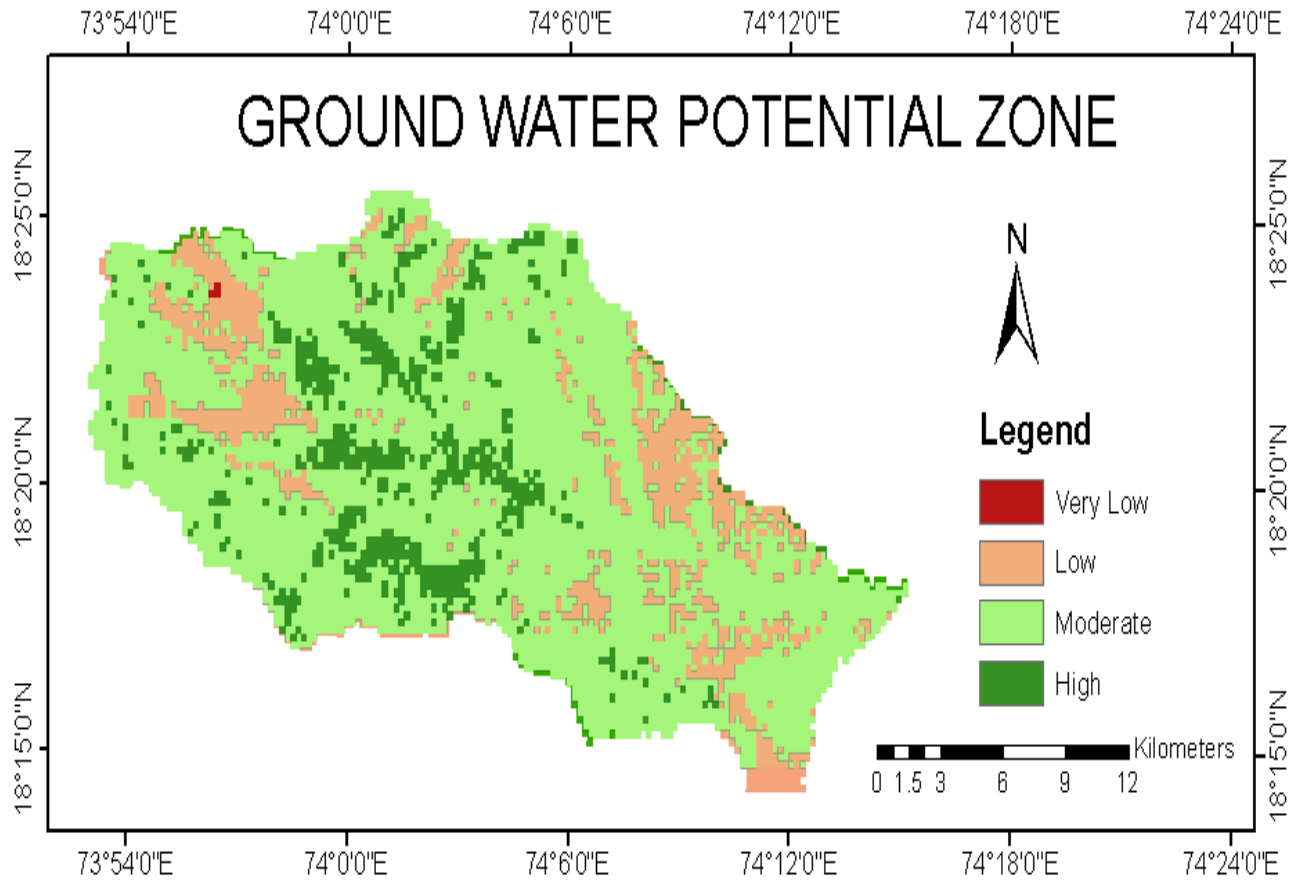

Figure no.:10. Ground Water Potential Zone Map (self prepared)

V CONCLUSION:

This study has shown that remote sensing and GIS as powerful and cost effective tool to identify the Groundwater potential zones. According to the groundwater potential zone map, Karha Basin is categorized into four different zones, namely ‘high, ‘moderate’, ‘low’, and ‘very low’. This study computed using GIS and Remote sensing techniques will help in better planning and sustainable resource management within study area. The study area with slope. The study has found efficient to reduce labor-some, tedious job and time consuming task included in conventional methods and tends to be effective method for identifying groundwater recharge zones.this study can also serve as guideline for better planning and sustainable resource management within study area.

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