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GROUND WATER VULNERABILITY STUDIES AT NORTH GUJARAT BY USING GIS TECHNOLOGY

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North Gujarat is facing problem of ground water contamination from natural causes as well as from anthropogenic activities. This is facing contamination problem not only from the surface. Ground water vulnerability study has been carried out for the fourdistrict namely Banaskantha,Sabarkantha,Arvalli and Mehsana of the North Gujarat using Remote sensing and GIS techniques.

DRASTIC method has been adopted for the preparation of ground water vulnerability map. Seven parameters have been determined using GIS for the development of vulnerability map. In the study area DRASTIC score range varies from 50 to 170. The area has been divided into three classes of ground water vulnerability 1. Low ground water vulnerability, 2. Medium ground water vulnerability (100-140), 3. High ground water vulnerability. These classes represent the relative pollution potential in case of contamination within the study area.

Integrated GIS study has helped in the development of various vulnerability maps including DRASTIC vulnerability Index map for the study of ground water hazard from the contaminations.

Keywords: *Aquifer Vulnerability, DRASTIC Method, GIS, North Gujarat*

1. Introduction

Groundwater is used for drinking water by more than 50 percent of the people in the Gujarat, including almost everyone who lives in rural areas. The largest use for groundwater is to irrigate crops.All the voids within a geological stratum Should be occupying by the groundwater. Groundwater is water located beneath the earth's surface in soil pore spaces and in the fractures of rock formations. In arid regions, groundwater is often the only reliable source of water for irrigation. Groundwater has been as important water resource throughout the ages. It is not an unlimited source and hence has to be managed against exploitation and contamination. Water contained in saturated zones is important for engineering works, geological studies , and water supply development. Unsaturated zones are usually found above saturated zones and extend upward to the ground surface; because water in this zones includes soil moisture within the root zone , it is a major concern of agriculture , botany , and soil science. No rigid demarcation of waters between the two zones is possible, for they possess an interdependent boundary, and water can move from zone to zone in either direction.

Ground water vulnerability is evaluation of the risk of ground water pollution and in the development of management option to preserve the quality of groundwater. Ground water vulnerability assessment is a important part of integrated land-water protection policy and management. Ground water vulnerability assessment is done on the idea that the aquifer is not of same features at all the locations and the aquifer is not of same features at all the locations and that some specific area are more vulnerable to deterioration terms of quality and quantity. Hence , it delineates the area which are more vulnerable or susceptible to contamination, and can help scientist to remediate, protect and prevent and policy makers to manage the resources in sustainable manner so as to assure the sustainable use of this precious resources , therefore leading to sustainable which is now the core aim of the economics of the world. There are two types of vulnerability.

Sabarkantha & Arvalli :- The area should be 7390 sq km. of these districts. Average annual rainfall is 810 mm.Major soil type of these district are Sandy soils & Loam, Brown to black soils, Black cotton soils .And Major Drainages are Sabarmati, Vatrak, Hathmati, Meshvo, Hamav & Khari .

Banaskantha & Mehsana :- Area of that district is 10303 and 4371 sq km. average annual rainfall is 721 827 mm. major soil types are Sandy soil, rocky soil **.** Major drainages are rupen and khari.

Principal crops of these districts are Rice, Jowar, Bajra, Wheat, Total Cereals, Gram, Other Pulses, Total Pulses, Total Food Grains, Groundnut, Seasemum, Rapes and Mustard, Total Oil Seeds.

II. STUDY AREA

This all four (Sabarkantha,Mehsana,Arvalli,Banashkantha) district are located in north east side of Gujarat between 24.29° North latitude to 72.02° Longitude. It is surrounded by patan at west side , Kutch at north west and Rajasthan State at north east side.this four district has a geological area should be 22064 sq.kms.

The following data are used for Flood Ground water vulnerability of north Gujarat.

1. Daily Rainfall Data
2. Ground water Data.
3. Administrative Map
4. Metrological Data

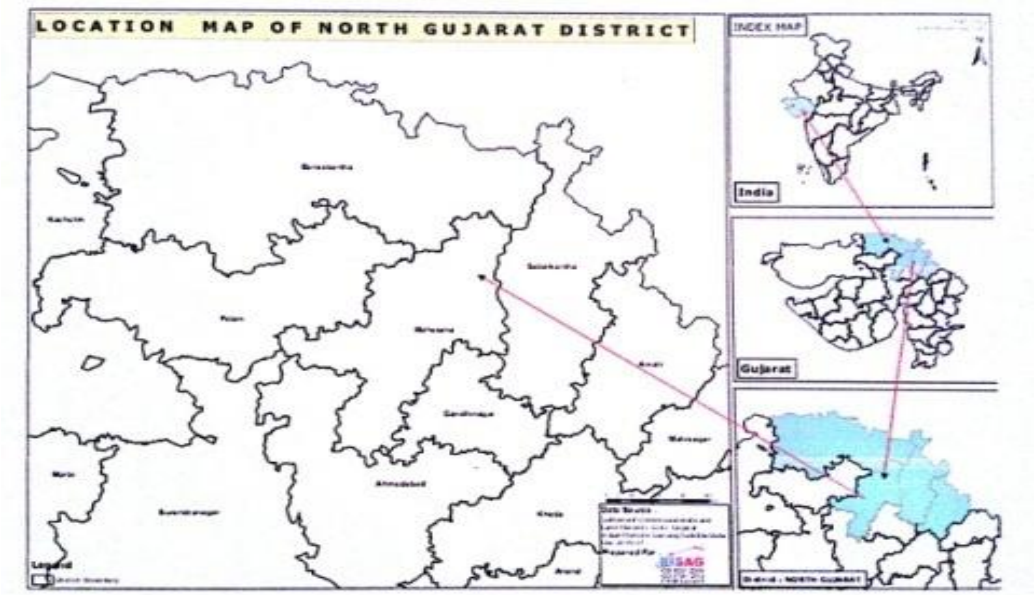


Fig 3.1 Location Map of North Gujarat
Source : (BISAG)

III METHODOLOGY

In this vulnerability studies there are the different steps of methodology.

1. study and collected of data related with topography, geo-hydrology from government and non government organizations.

2.Preparation of various thematic maps: like land-use map, slope mae, geologi map, soil map using Arc GIS and RS.

3. integration of various thematic layers with geospatial data.

4. analysis & classification of standard ratings and weights of DRASTIC and SINTACS parameter ranges.

5. Calculation and classification of DRASTIC Vulnerability index.

6. Preparation of DRASTIC parameter map in Arc GIS.

7. Overlay all the parameter map and develop vulnerability map of study area.

DRASTIC METHOD:

DRASTIC method is part of overlay index method. DRASTIC method is proposed by Aller et al (1987) can be applied on the regional scale and intrinsic vulnerability of the aquifer.
DRASTIC is one of the most widely used method among many of methods because it is very easy to apply with insufficient data of the area, where monitoring has been scare and also allow systematic evaluation of parameters under study.

DRASTIC method consist seven parameters. Like **D**epth Of Water Table, Net **R**echarge. **A**quifer Media, **S**oil Media, **T**opography, **I**mpact Of Vadose Zone, Hydraulic **C**onductivity. For overlay analysis the weights and ratings are applied to each seven parameters. The weights are ranges in 1 to 5 where , 1 is least significant and 5 is most significant and ratings are scaled of 1-10, in which 1 is for the least vulnerable and 10 is denotes most vulnerable areas.
The drastic vulnerability index is calculated by linear addition of the weights and ratings.

FORMULA: DVI = DrDw +RrRw+ ArAw+ SrSw+ TrTw+ IrIw + CrCw

Where : DVI is DRASTIC Vulnerability Index. w is weighting factor for each parameter. r is rating for each parameter. D,R,A,S,T,I and C are the seven parameters .

IV Results and Analysis

Water table depth refers to the depth of water surface in an unconfined aquifer.
Available sub surface water level data has been analyzed for the period 199 to 2016 and depth wise water level map have been created in GIS environment which show variations of water level in pre monsoon and post monsoon month of the study area.
As rainfall occurred more in year 2016 as compared to 1996 to 2011 depth of water level is increase in 2016 . which is indicate that manage ground water quality from contamination

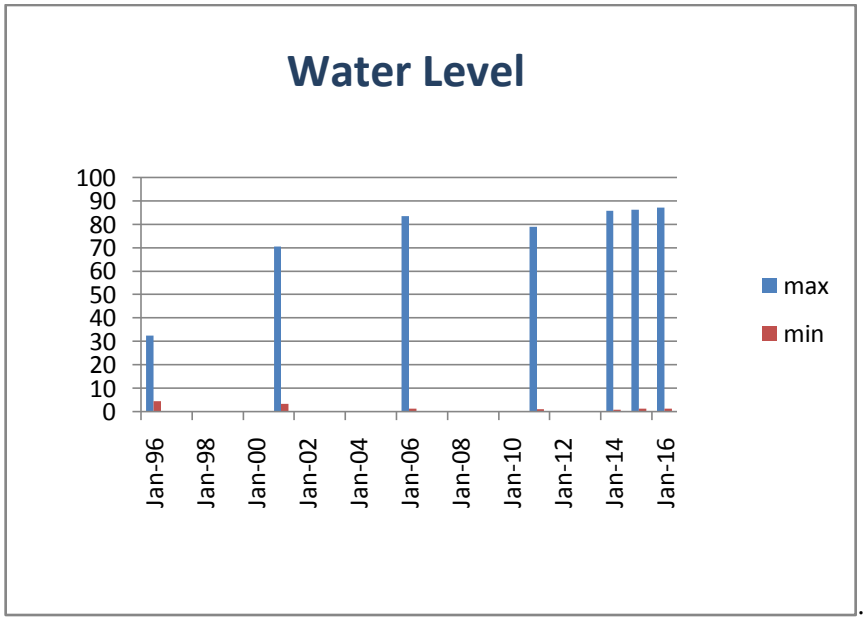


Fig: Avg. Ground Water depth of study area

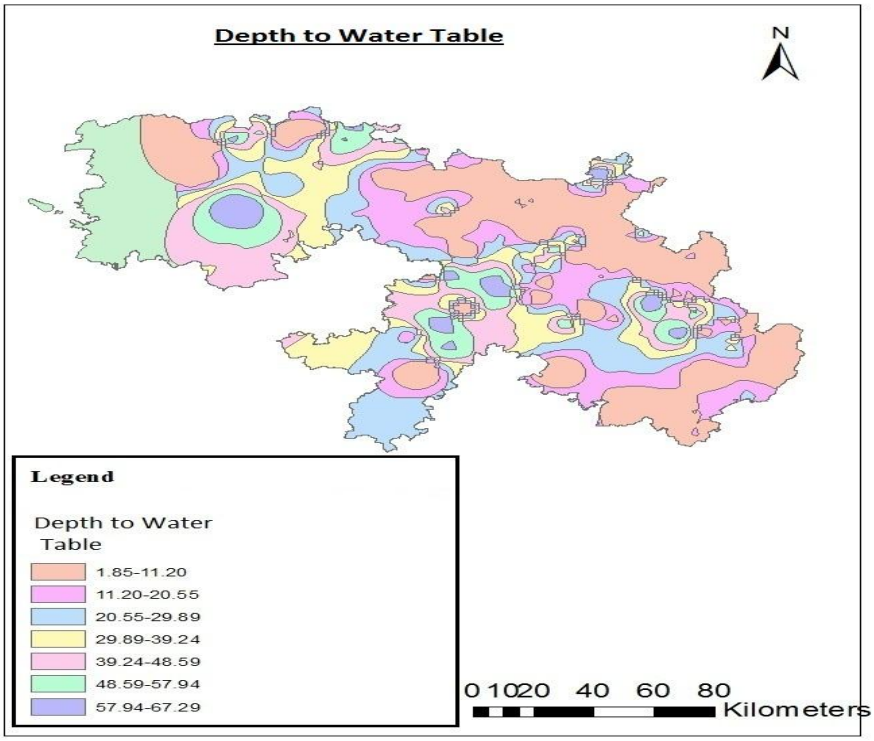


Fig MAP of Depth to Water Table

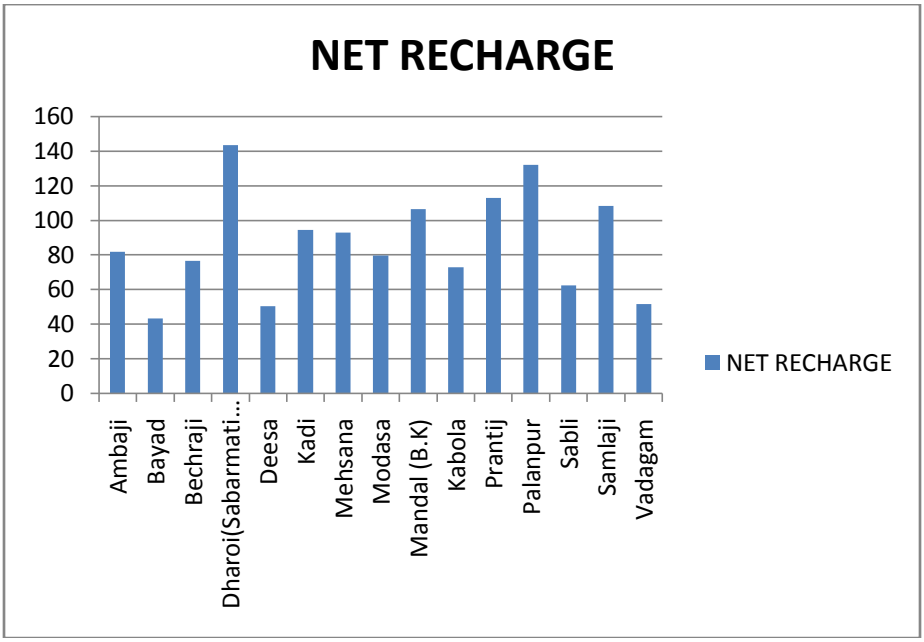


Fig Column chart of net recharge

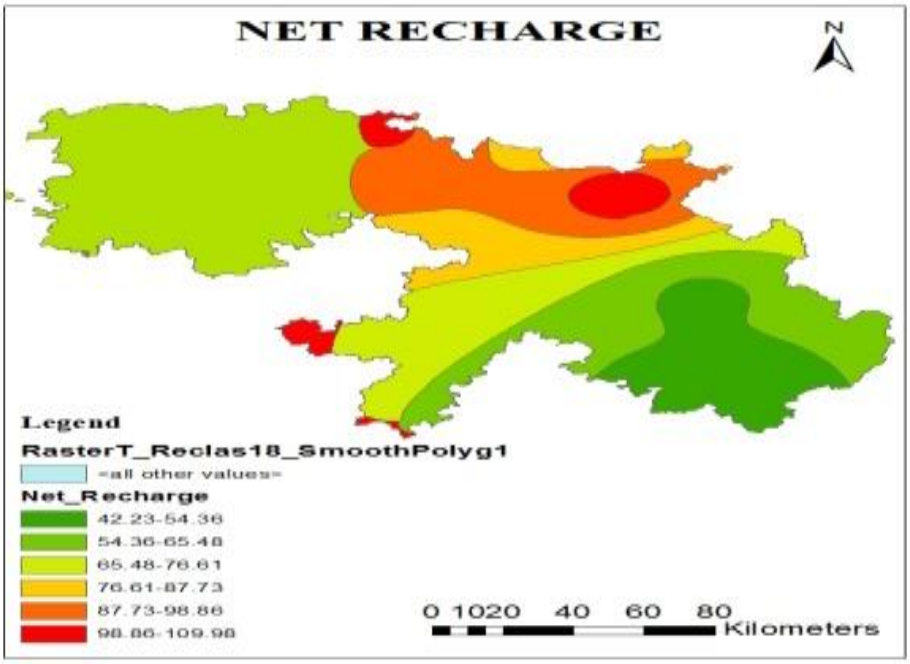
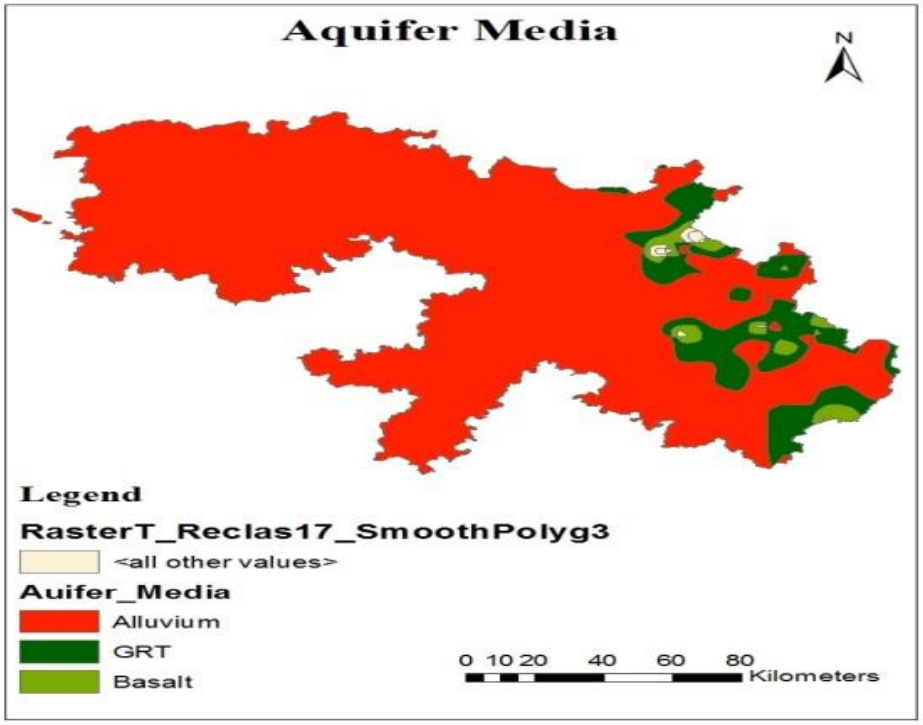
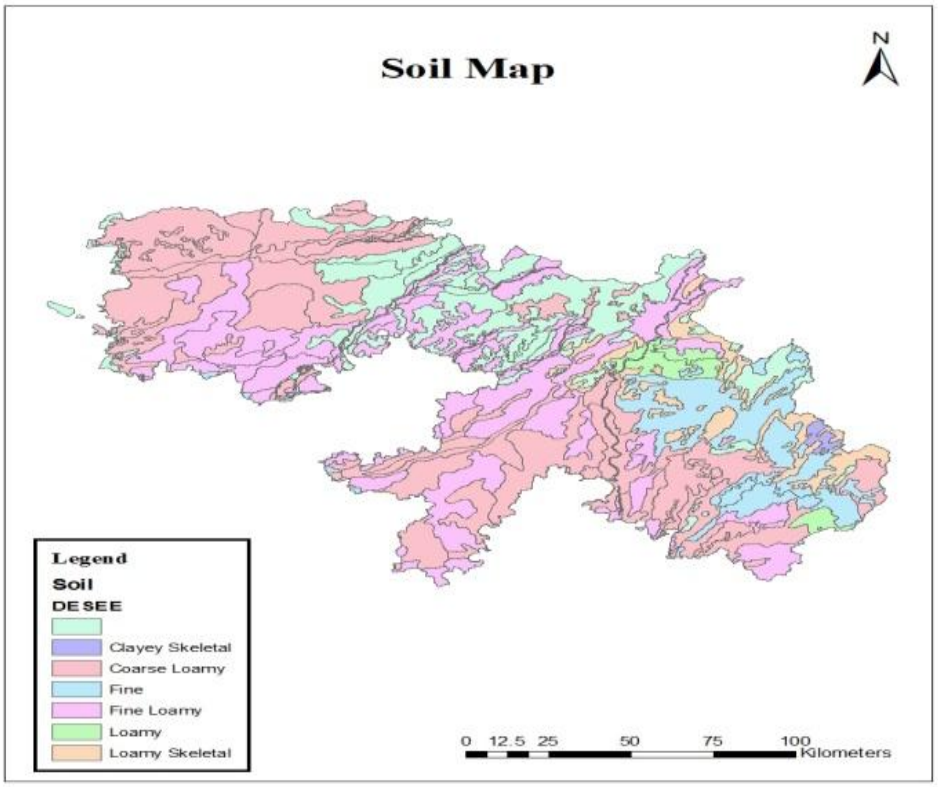
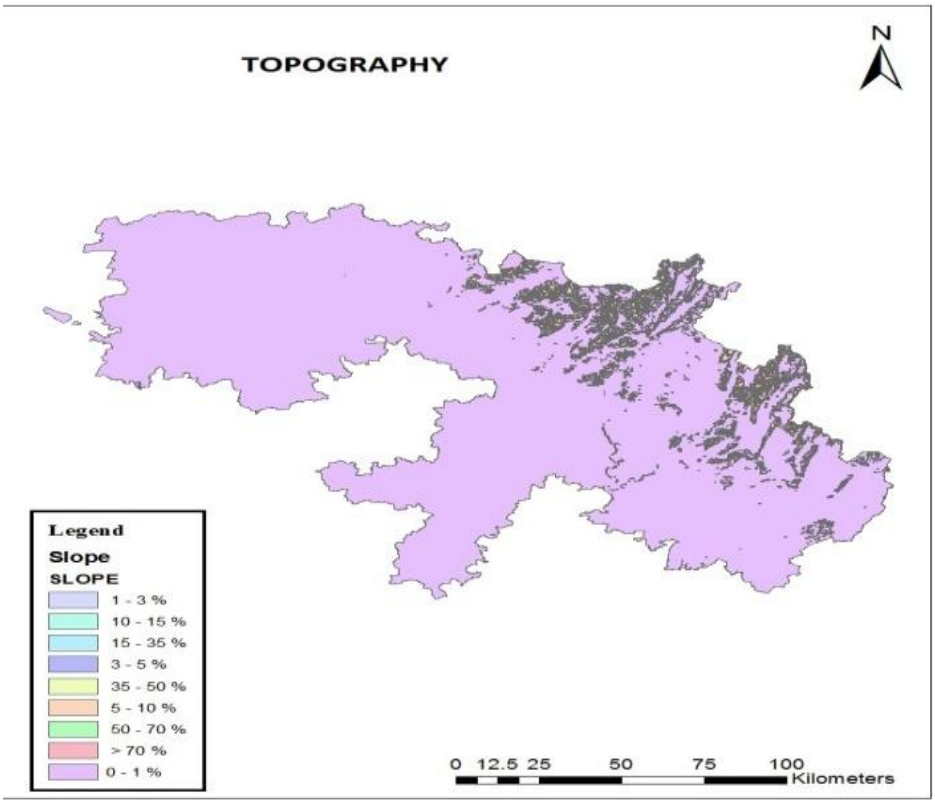
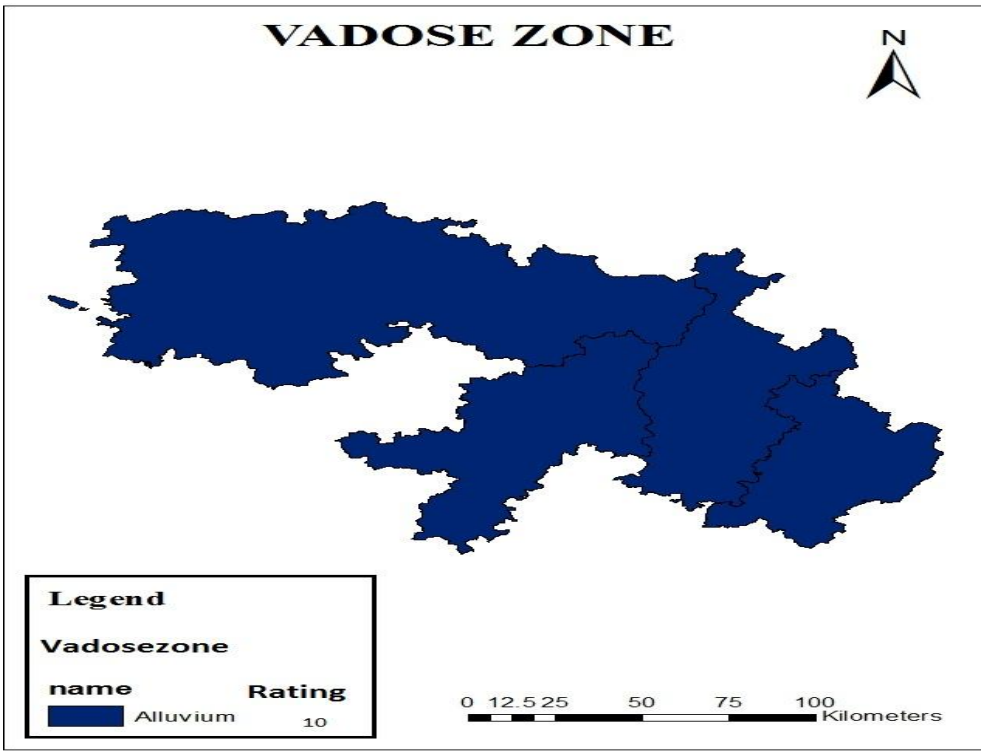


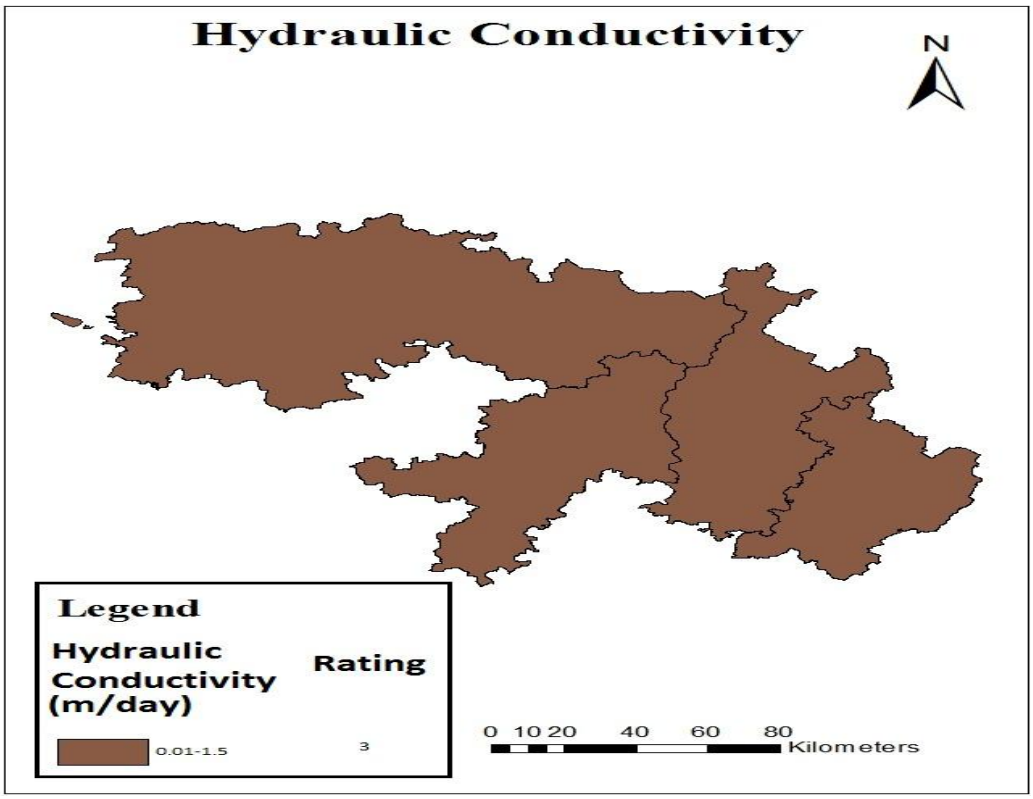
Fig: NET RECHARGE

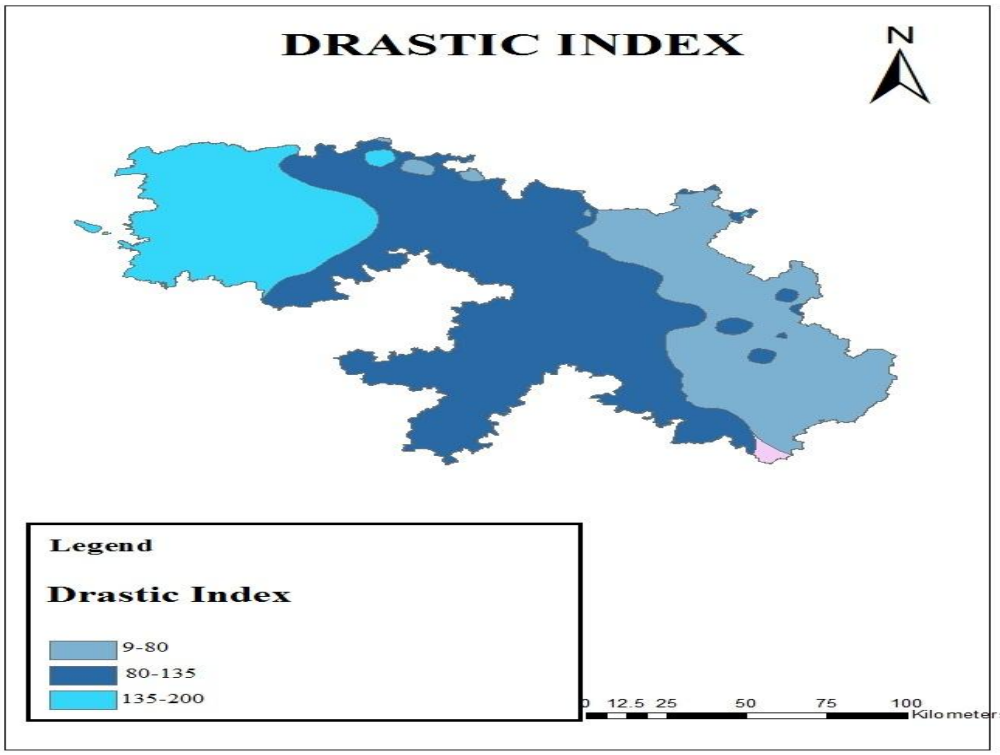












Final Vulnerability DRASTIC Index Map

V CONCLUSIONS

From the collection of spatial and departmental data, various thematic maps of DRASTIC parameter and Water quality parameter are prepared. Then rating and weight is applied to DRASTIC parameter. Calculation of DRASTIC index and preparation of final vulnerability map is remaining. Analysis and interpolation of vulnerability map for development groundwater management plan.

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