Use of advanced tools for mapping of potential groundwater recharge zones

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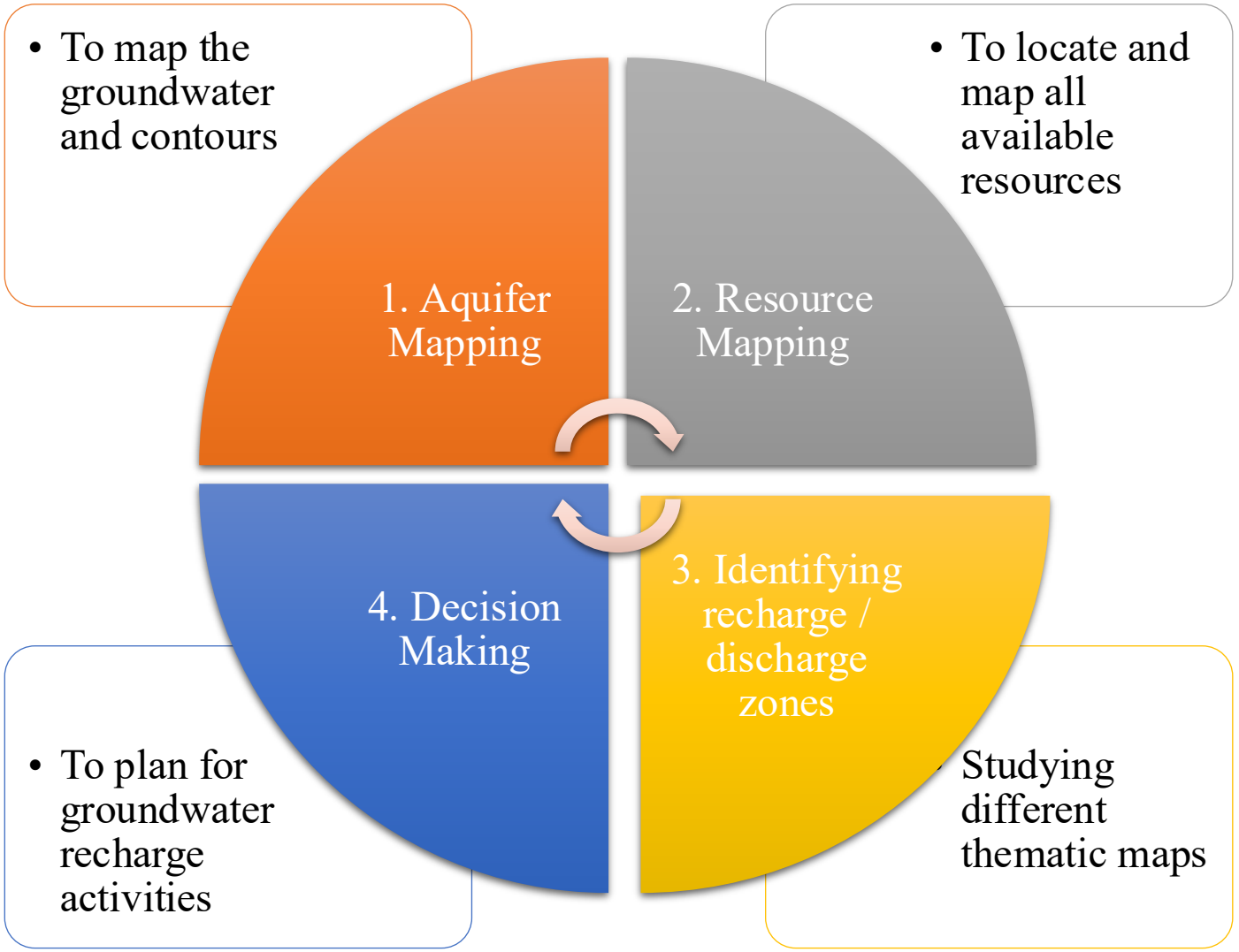
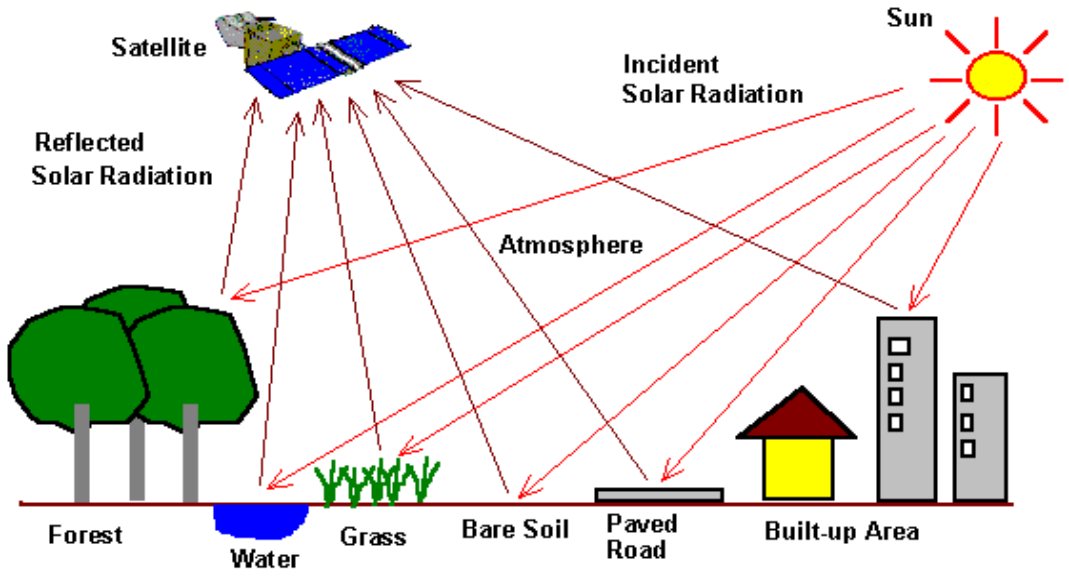
Why Geospatial Tools?



Introduction of Remote Sensing and GIS

Remote Sensing –

The technology of acquiring information from distant objects without being in physical contact with them.



GIS –

A Geographic Information System (GIS) is a system that creates, manages, analyses, and maps all types of data. GIS connects data to a map, integrating location data (where things are) with all types of descriptive information (what things are like there).

Types of Thematic maps required to locate groundwater recharge zones

- To identify potential recharge zones or points in any rural or urban area, some specific thematic maps are required

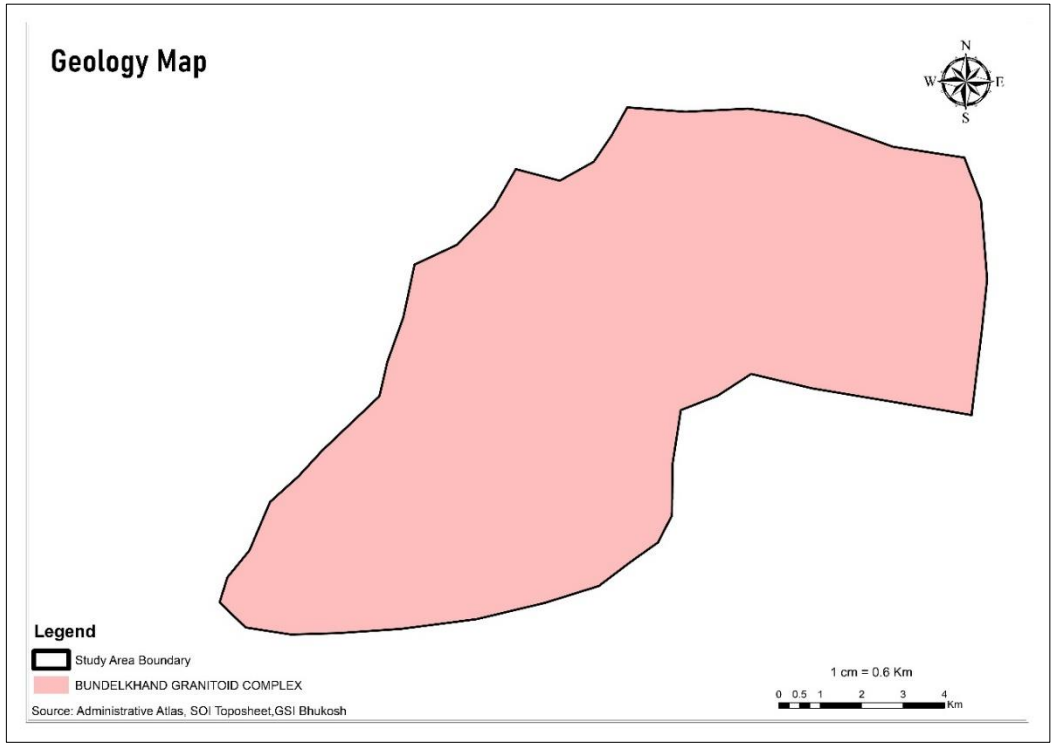
1. **Geology/lithology map**
2. **Soil map**
3. **Land use Land Cover (LULC) Map**
4. **Drainage map**
5. **Lineament Map**
6. **Digital Elevation Model (DEM) Map**

Geology/lithology map:

A geological map shows the information of the rock types in the area also different types of rocks are mapped and shown in a geological map. To plan a groundwater recharge or water harvesting system, it is important to understand the geology of any area of interest. There are certain rocks (e.g. quartzite, shale etc.) which do not allow groundwater recharge, and in these cases, harvested rainwater can be stored in artificial storage structures. Areas of sandstones are favorable for groundwater augmentation. .

- **Use in Recharge Zone Identification:** Different rocks have different porosity and permeability, affecting how water moves and is stored underground.

- **Source-** National geoscience data repository (NGDR)- https://geodataindia.Gov.In/

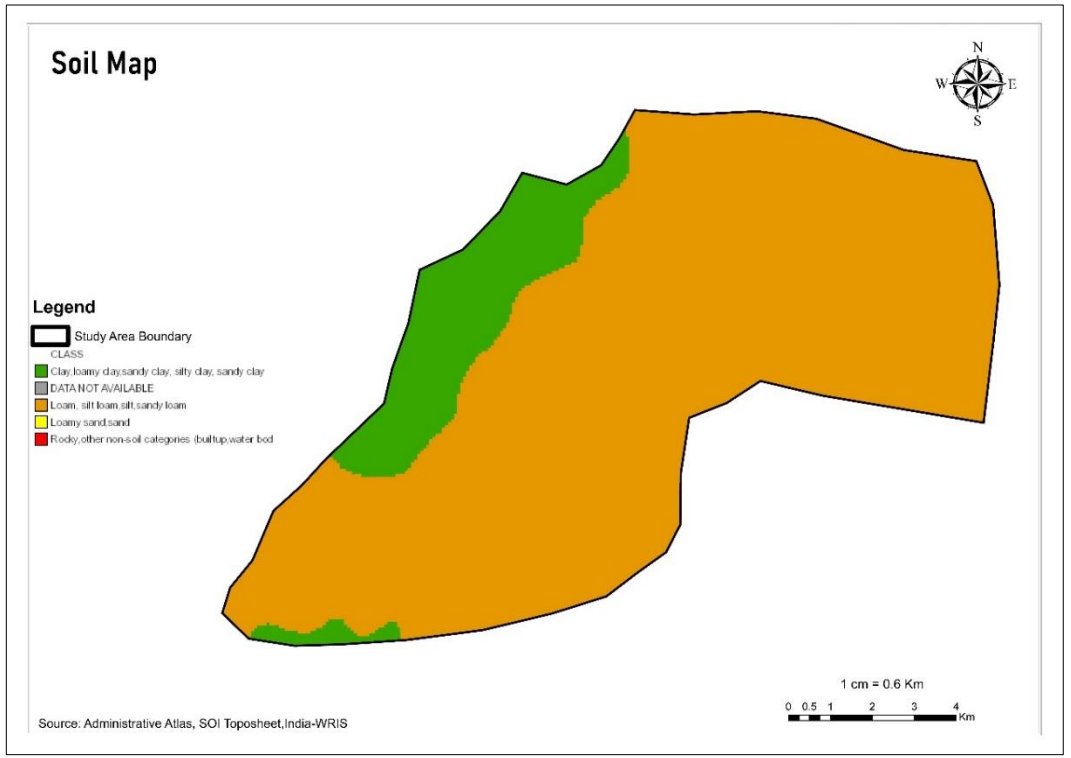


Soil Map

A soil map depicts different types of soil present in a watershed. The knowledge of soil type in a watershed helps in understanding the type of groundwater recharge structures suitable in different types of soil. The superimposition of a soil map on a geology/lithology and geomorphology makes the decision on the type and location of groundwater recharge structures more precise .

- **Use in Recharge Zone Identification:** Understanding soil types is crucial as certain soils (like sandy soils) have higher permeability, making them ideal for groundwater recharge.

- **Source-** Soil and Land Use Survey of India (SLUSI) https://slusi.da.gov.in/ & https://indiawris.gov.in/wris/#/Geoviewer

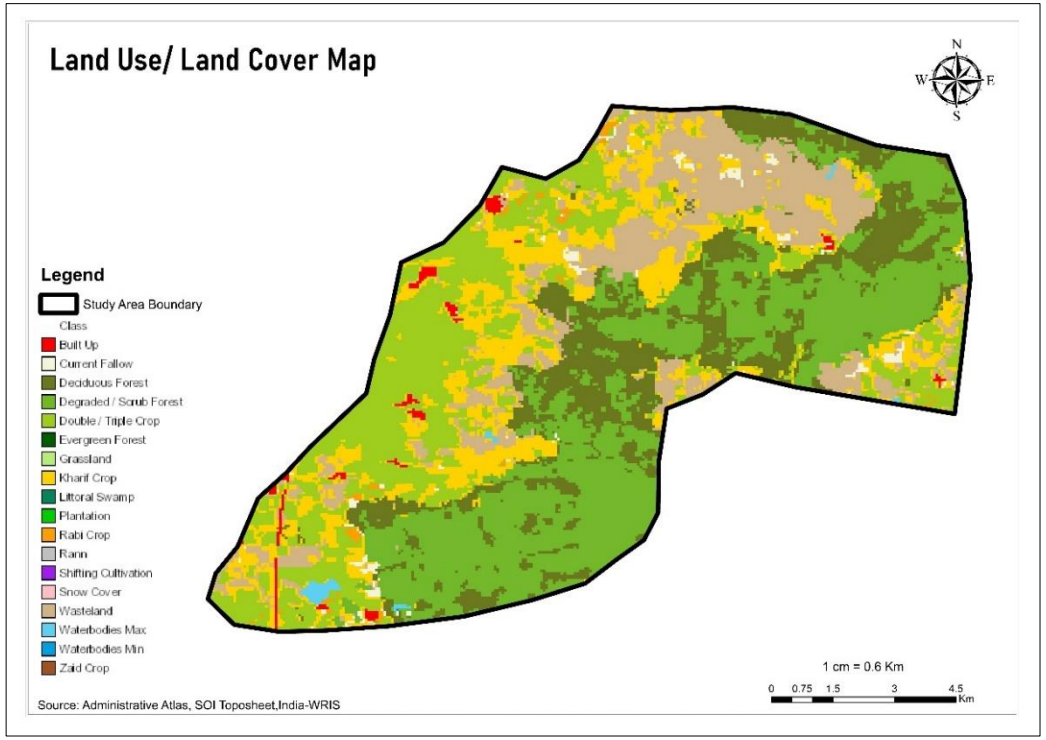


Land use Land Cover (LULC) Map

- A LULC map is a representation of type of land use in any area of interest. There are various categories of land use such as agriculture, forest, barren, wasteland, habitations etc. To locate any recharge structure, it is important to understand the land use types of an entire area. For example, agricultural land cannot be used for groundwater recharge. In agricultural lands, only farm ponds can be constructed

- **Use in Recharge Zone Identification**: Land use influences surface runoff and infiltration rates. For example, urban areas with impermeable surfaces have lower recharge potential compared to vegetated areas.

- **Source –** Bhuvan Geo Portal & WRIS
  https://bhuvan-app1.nrsc.gov.in/thematic/thematic/index.php
  https://indiawris.gov.in/wris/#/Geoviewer

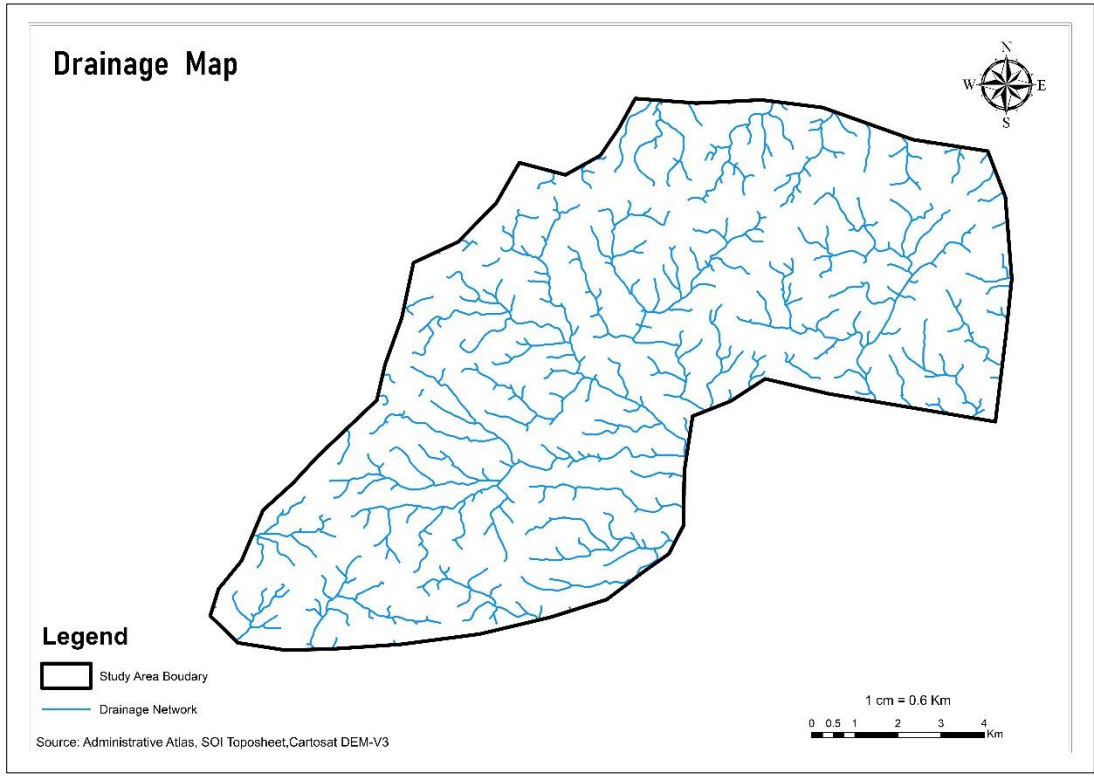


Drainage Map

- A drainage map shows all the streams, rivulets, rivers and their tributaries in a specific watershed. The drainage pattern shows the flow of all streams/rivulets etc. The streams can be of any order (i.e. level of branching; lower orders indicate lower levels of branching. Branching is always defined by a whole number, e.g. first order, second order etc.)—from first order at the ridge to a higher order near the end of the watershed. The terrain and slope of the watershed influences the drainage network. The more undulating the terrain, the higher the drainage density.

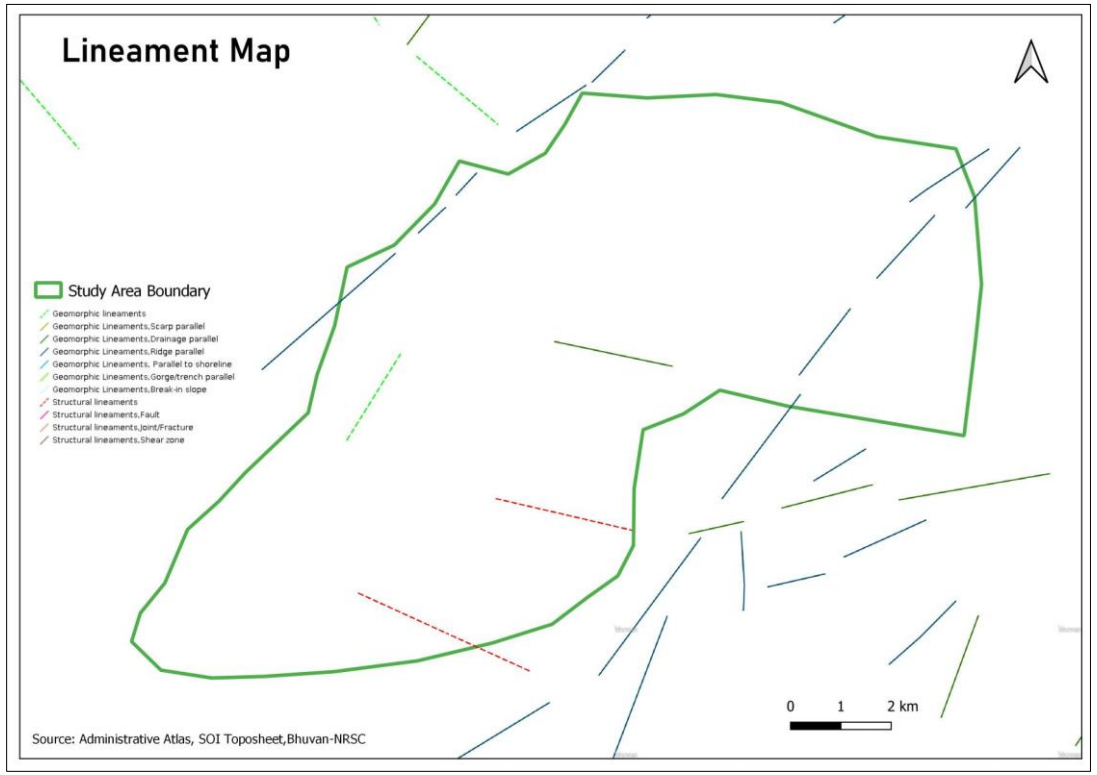
- **Use in Recharge Zone Identification-** Analyzing drainage patterns helps in identifying areas where water collects and potential recharge zones.

- **Source** – Bhuvan Geo Portal
  https://bhuvan-app1.nrsc.gov.in/bhuvan2d2.0/



Lineament Map

A lineament is an underground formation such as a fracture, fold or fault in the geological structures of an area. A lineament map indicates a zone in a watershed or village where there is a possibility of groundwater recharge or discharge.



- **Use in Recharge Zone Identification-** Lineaments often represent zones of weakness in the Earth's crust, such as fractures and faults.

- **Source -** National geoscience data repository (NGDR)- https://geodataindia.Gov.In/
- Bhuvan Geo Portal - https://bhuvan-app1.nrsc.gov.in/state/RJ

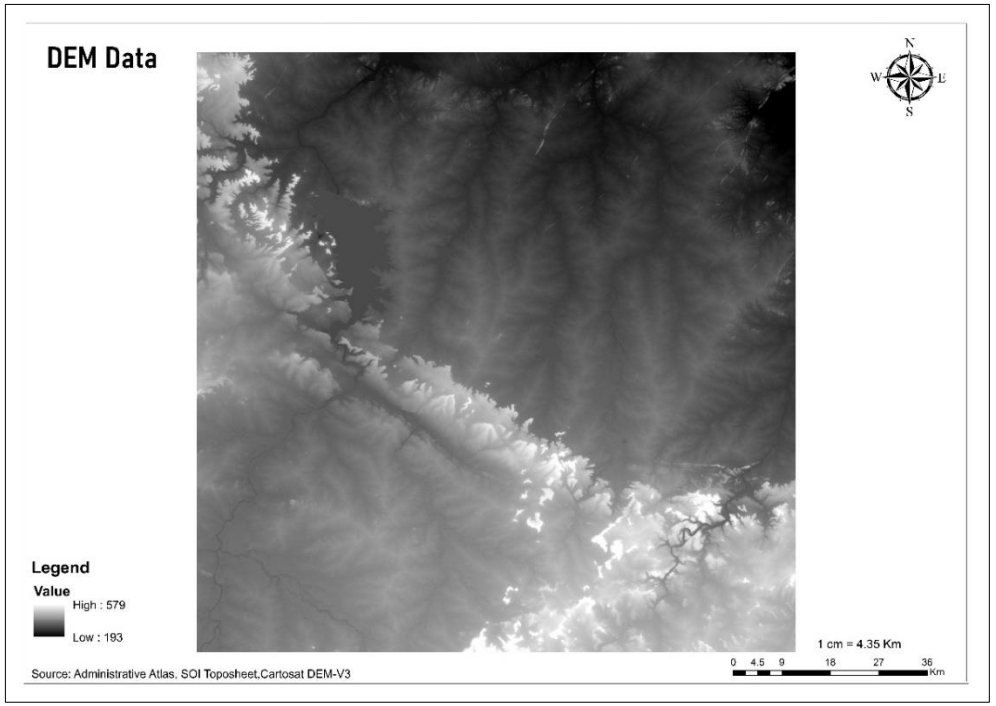
✓ **These zones can enhance groundwater recharge because they provide pathways for water to infiltrate deeper into the subsurface. Water can move more easily through these fractured zones, increasing the recharge rate.**

Digital Elevation Model (DEM) Map

A DEM is a raster file, which contains elevation data in the form of a grid with elevation values. The grids can be of smaller or larger sizes, depending upon the resolution of the sensor capturing the elevation data. A higher resolution DEM will give better analysis and help in accurate analysis of the selected area. The DEMs are used to create an elevation profile of the watershed and to generate the drainage pattern. The different colors in the maps show ridges, mountains, depressions and valleys .

- **Use in Recharge Zone Identification-** It will helps in understanding these features helps in identifying natural depressions and low-lying areas where water is likely to collect and infiltrate into the ground.
- **Source-** CARTOSAT DEM **(**Bhuvan Geo Portal **)**

https://bhuvan-app3.nrsc.gov.in/data/download/index.php



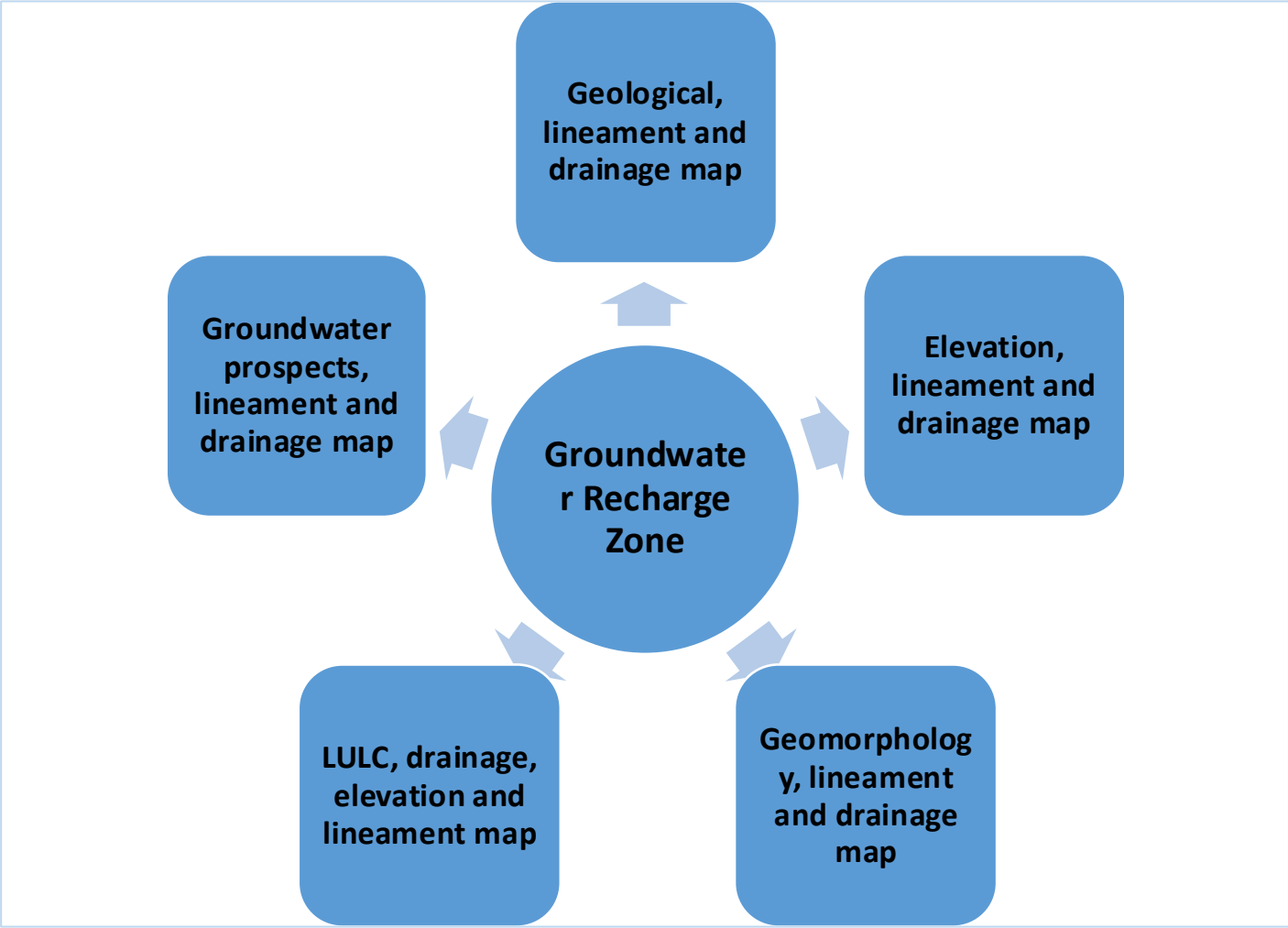
- ✓ The generation of thematic maps through GIS software's is not enough to understand the location of groundwater recharge structures. Superimposition of generated thematic maps is important to identify potential groundwater recharge zones.

- ✓ Superimposition, also known as map overlay analysis, involves layering multiple maps in a GIS to analyze spatial relationships and identify areas of interest, such as potential recharge zones.

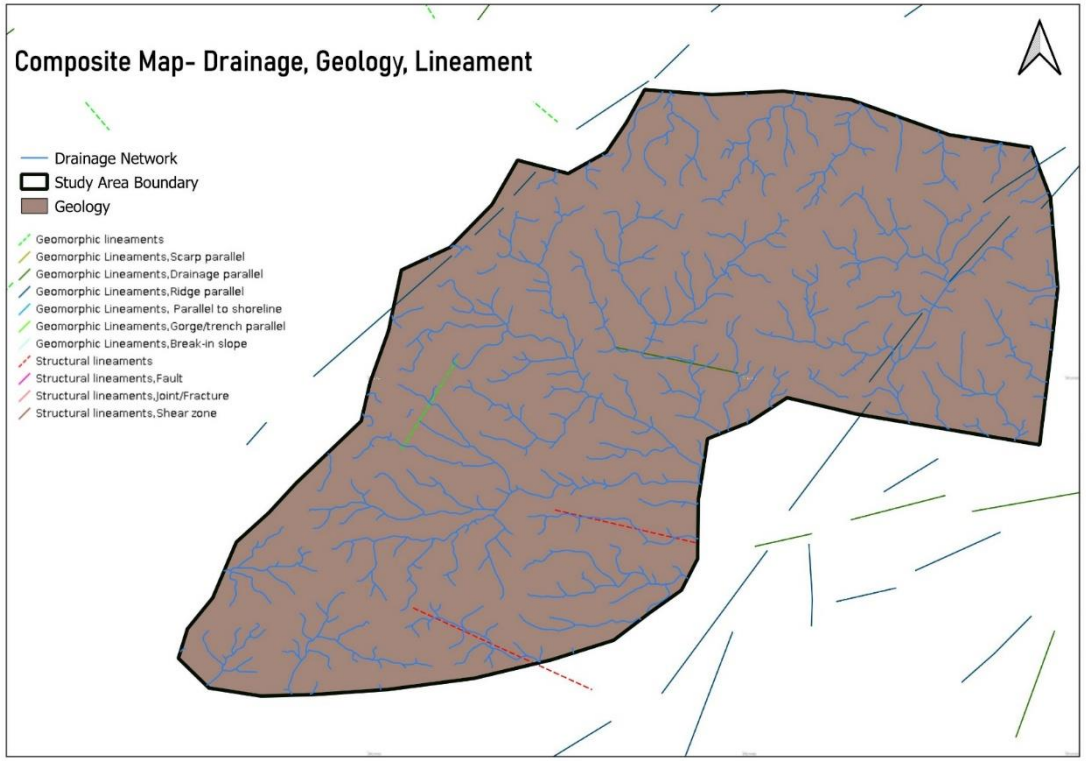
- ✓ **Software Used – Google Earth Pro and QGIS**

Map overlay/ Superimposition

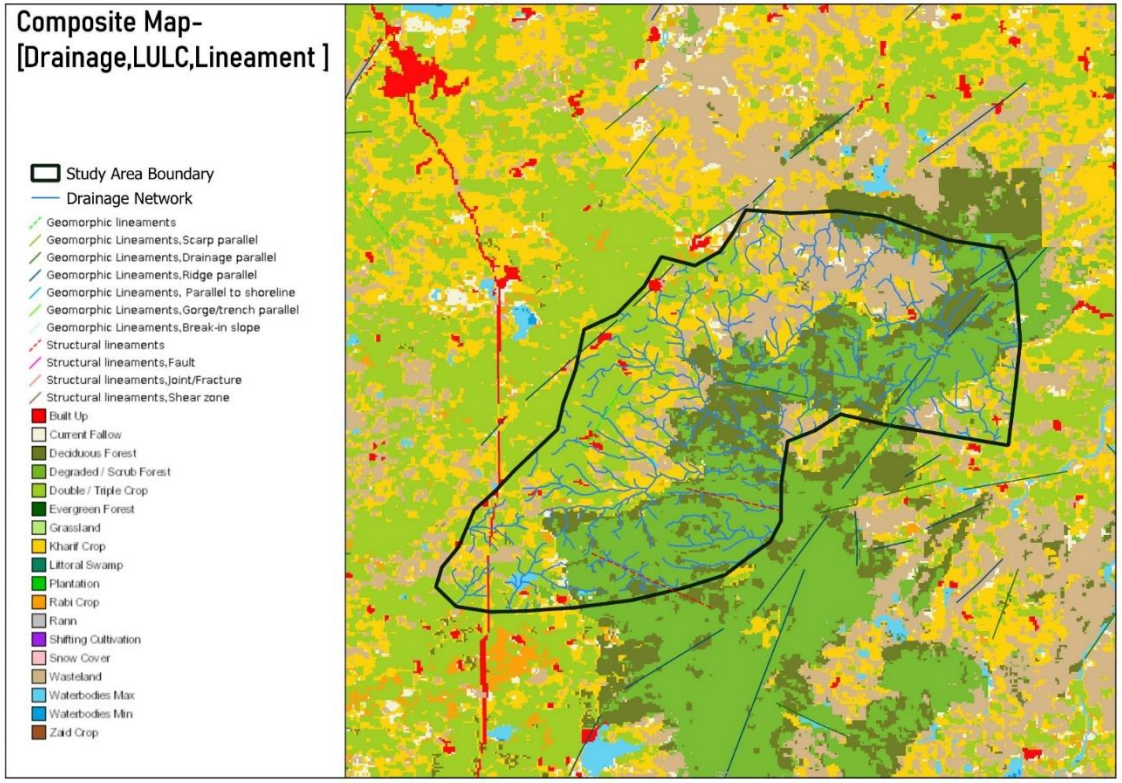
- Geological, Lineament and drainage map
- Elevation, lineament and drainage map
- Geomorphology, lineament and drainage map
- LULC, drainage, elevation and lineament map
- Groundwater prospects, lineament and drainage map



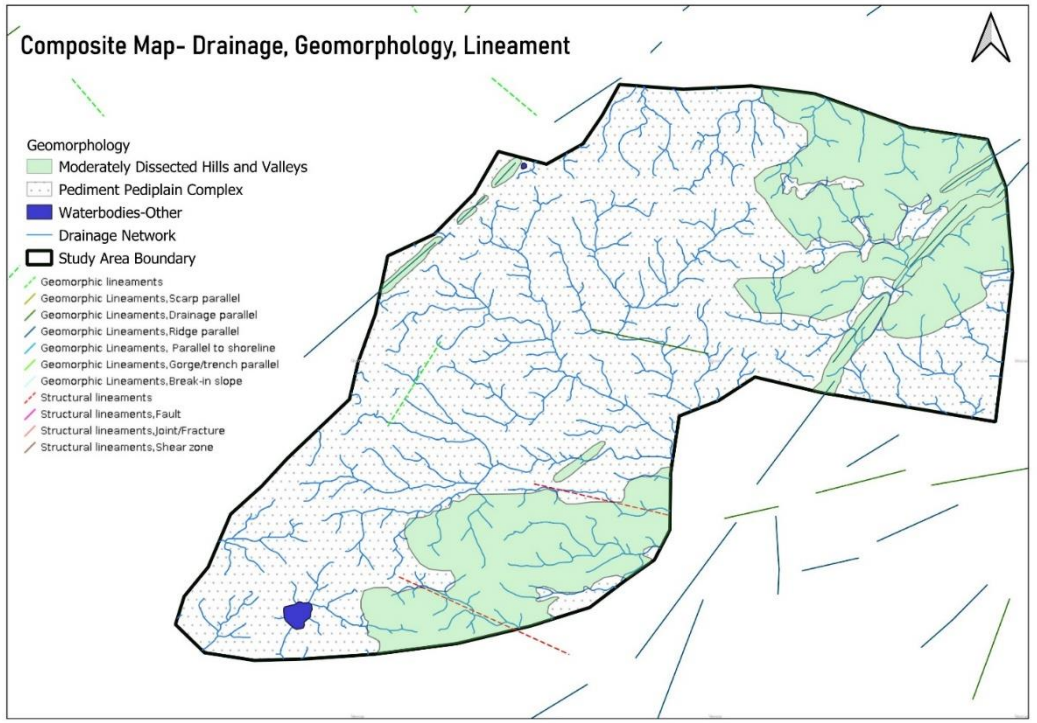
- A geological map represents the presence of type of rocks in the area while a lineament map represents the presence of folds, faults or fractures. The superimposition of drainage maps with these two layers will help to identify suitable locations where the stream flows along or across the lineament in a certain type of geology.



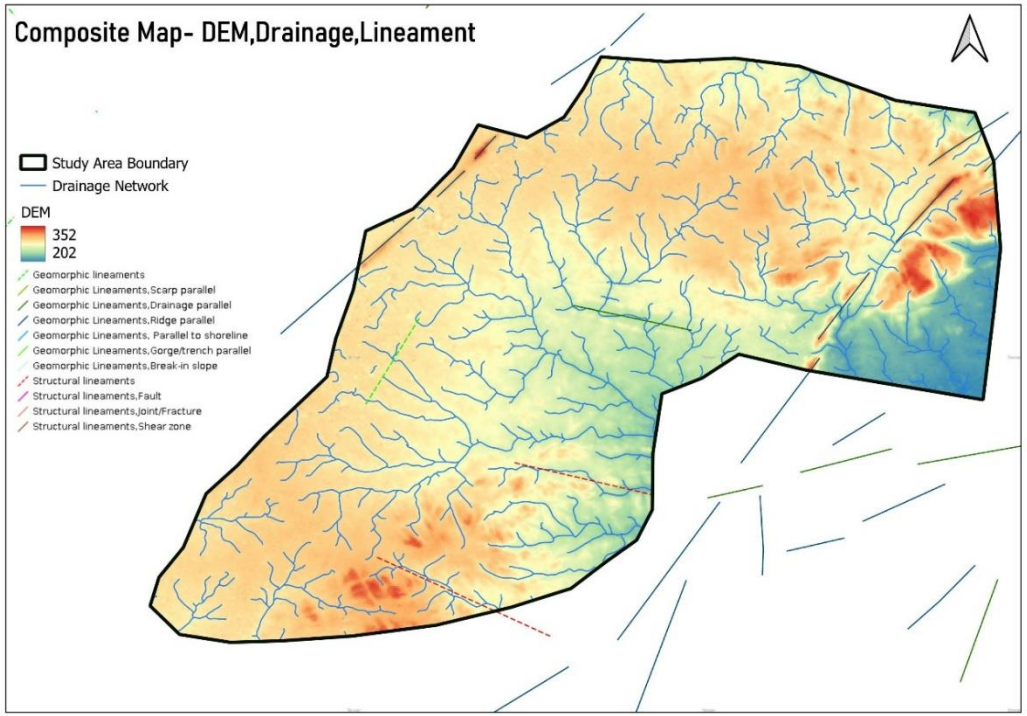
- Superimposing drainage, LULC, and lineament maps provides a powerful method for identifying and managing potential groundwater recharge zones, offering a comprehensive approach to understanding and leveraging natural recharge process how different land cover types (e.g., urban areas, forests, agricultural fields) influence surface runoff and infiltration.

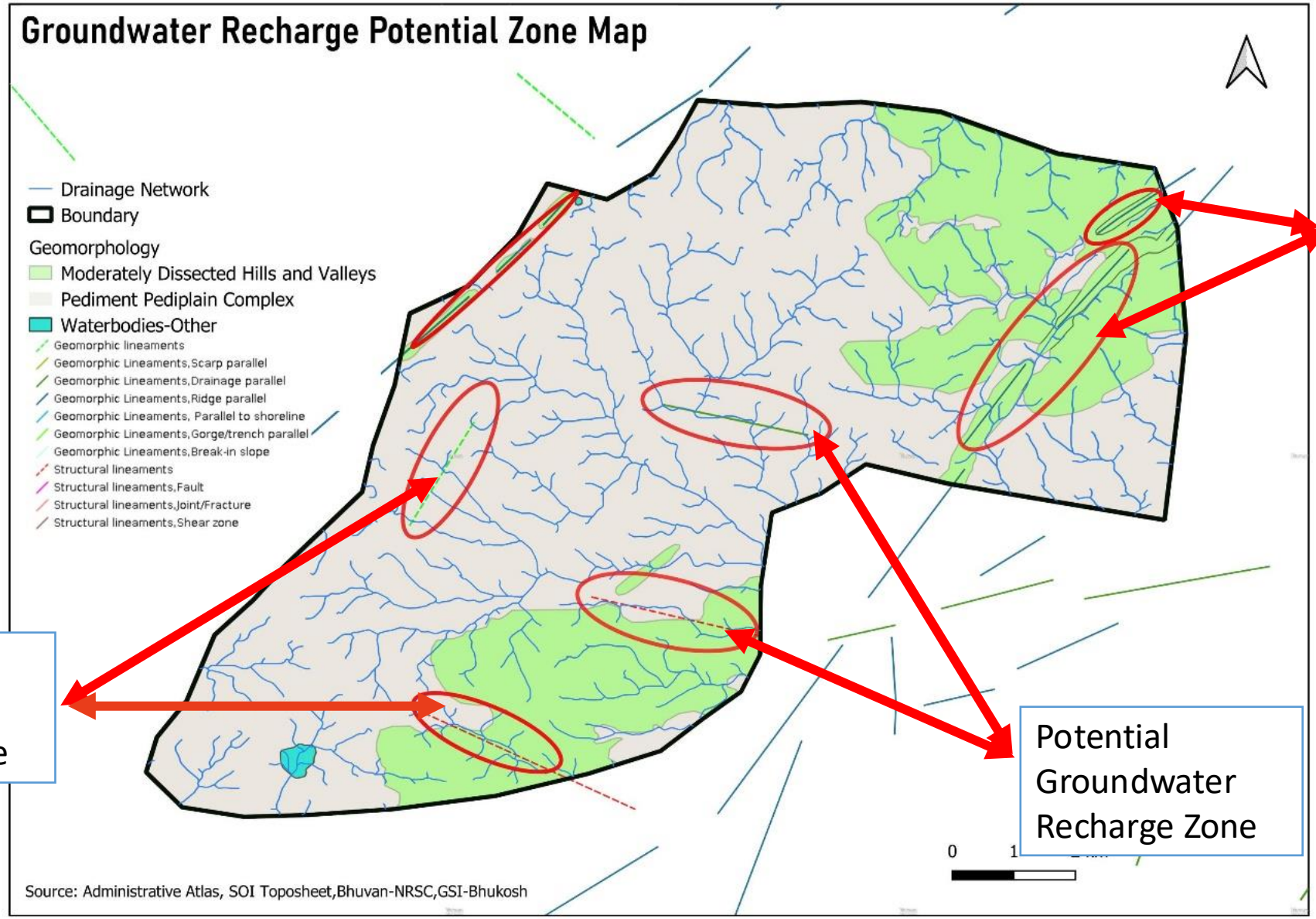


- The superimposition of drainage, geomorphology and lineament maps helps us to understands about how drainage systems interact with geological structures, as lineaments can enhance groundwater movement and create preferential pathways for recharge. It will also help us in site selection where drainage patterns, landforms, and lineaments collectively indicate high recharge potential, ensuring the effectiveness of recharge structures.



- Superimposing Digital Elevation Model (DEM), drainage, and lineament maps involves layering these maps to analyze spatial relationships and identify potential groundwater recharge zones. This method integrates information about terrain elevation, surface water flow, and geological structures to enhance the accuracy of recharge zone identification. It also help us to get how elevation and terrain features influence surface water flow. Identify areas where water is likely to accumulate, such as valleys and depressions, which are potential recharge zones.





Potential Groundwater Recharge Zone

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- **For a step-by-step guide, refer to the CSE toolkit on Managing Groundwater Sustainably in Rural Areas.**

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THANK YOU