# CE432A Project

## GROUP 1 PRESENTATION


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# Acknowledgements


- We would like to express our sincere gratitude and appreciation to Prof. Bharat Lohani, Prof. Nagarajan, and Revathi mam for their invaluable teaching, as well as to our Tutor Priyanka mam for guidance throughout this project.
- We are grateful for the knowledge, skills, and experiences gained during this project.

# Introduction

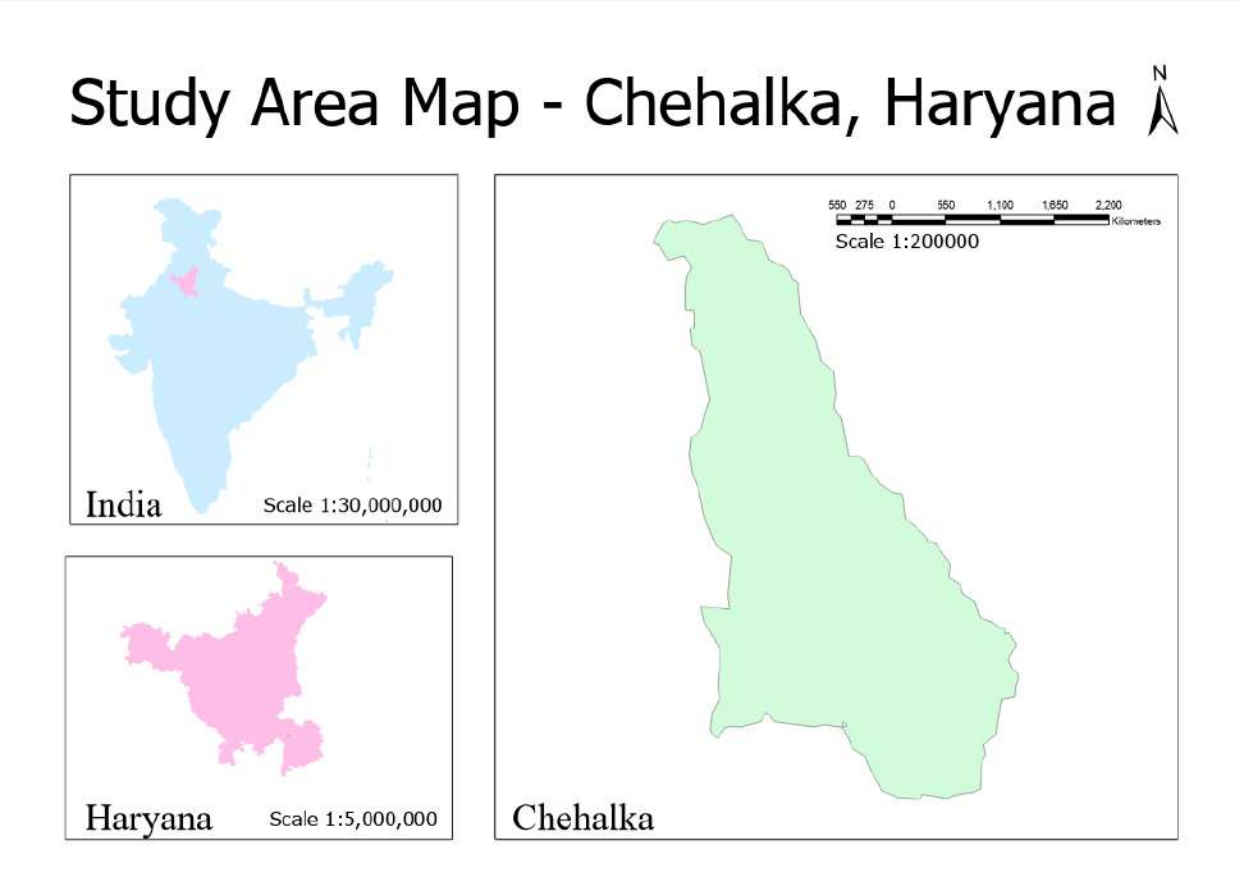
- Water conservation is a crucial element in sustaining life on earth.
- The project integrates GIS and hydrological analysis to find suitable locations for micro water conservation structures.
- The idea is to demonstrate the benefits of GIS technology in water conservation planning and simplifying hydrological analysis.
- Use of the Analytical Hierarchy Process (AHP) to decide appropriate sites for construction of check dams.

# Objective

- Objective: Identify sites for micro water conservation structures (check dams, gabions, percolation tanks).
- Approach: Use a watershed approach to consider topography, land use, and rainfall patterns.
- Purpose: Reduce erosive runoff velocity, store water, and prevent silt buildup.
- Benefits: Increase moisture regime, support vegetation growth, recharge groundwater, improve water availability, reduce soil erosion, and enhance ecological health of the area.

# Study Area

- Chehalka – A village area in Haryana.
- Approx. 5 km sq area

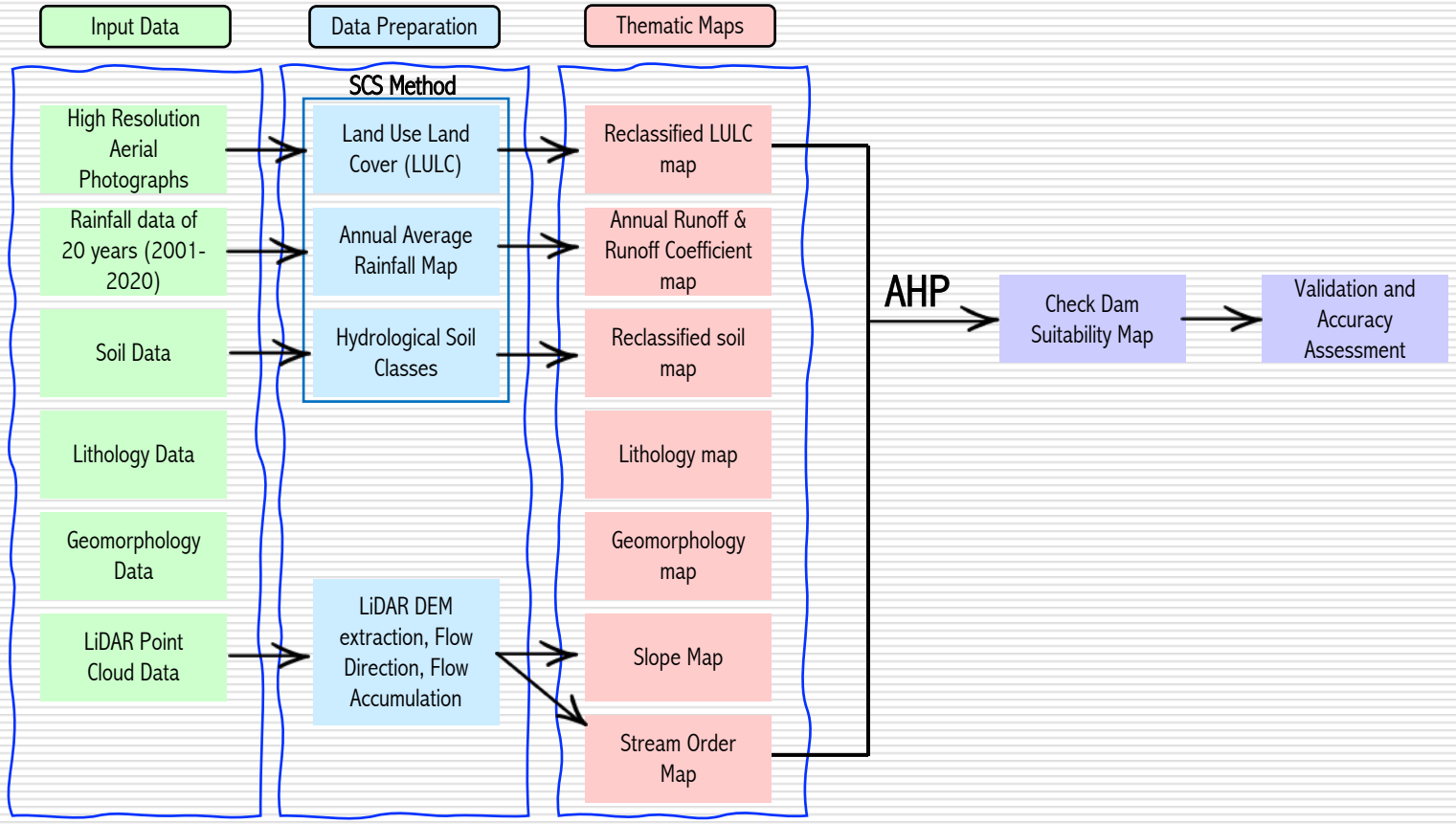


# Data

The datasets used in this project study are as follows:

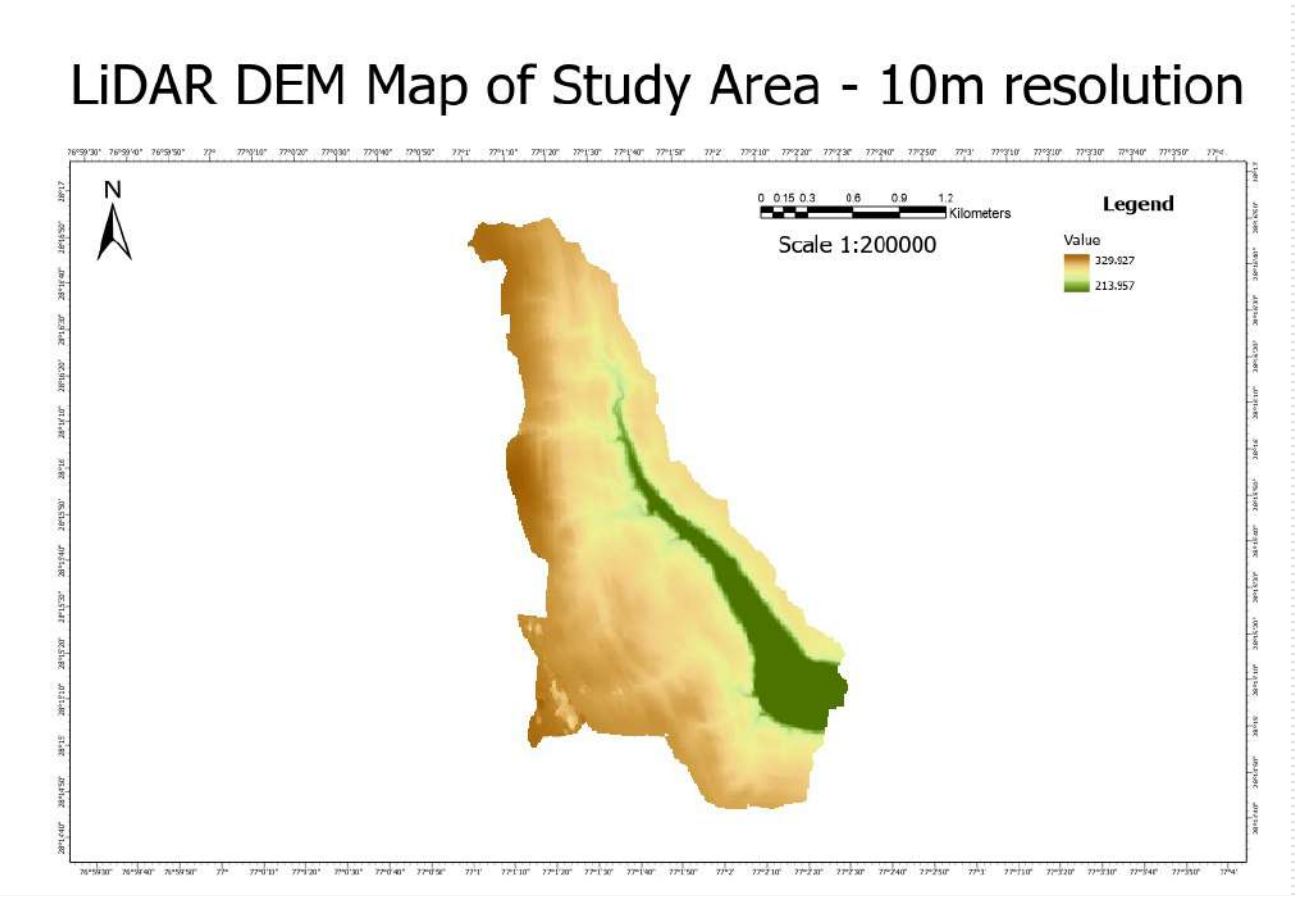
- Rainfall Data from 2001 to 2020 with a resolution of 0.25 X 0.25 degree to estimate the runoff.
- Point Cloud data - to generate a DEM.
- LiDAR DEM: LiDAR DEM of 10m resolution - to derive catchment boundaries and generate DEM derivatives such as slope map, stream order map.
- Aerial Photograph to create a high-quality Land Use and Land Cover Map.
- Land Use Land Cover Map to estimate the curve number.
- DSMW (Digital Soil Map of World) Soil Map.
- Geomorphology data at a resolution of 1:250000 scale.
- Lithology data at a resolution of 1:50000 scale.

# Methodology



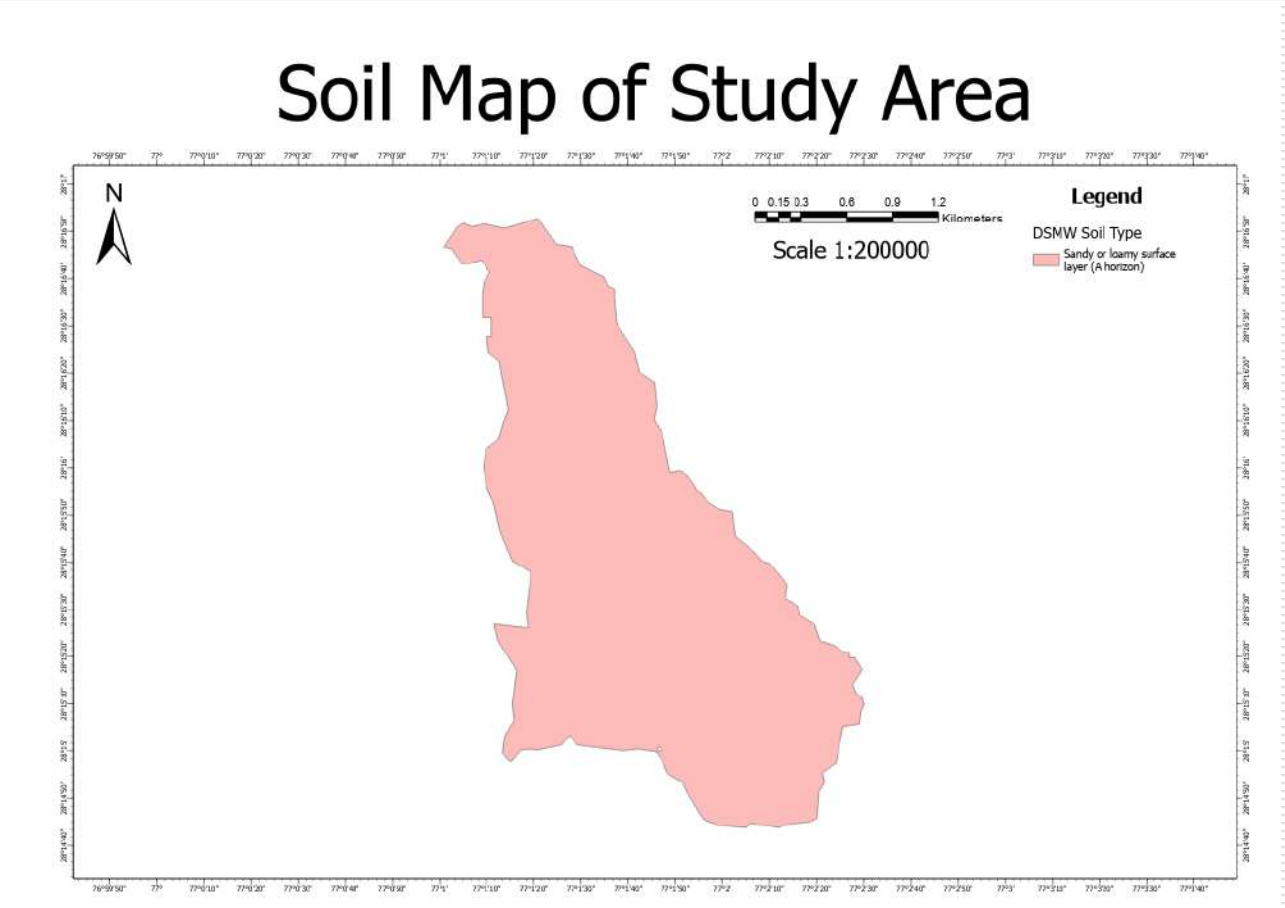
# LiDAR DEM – 10 m resolution

LiDAR Digital Elevation Model (DEM) having 10 m resolution.



# Soil Map

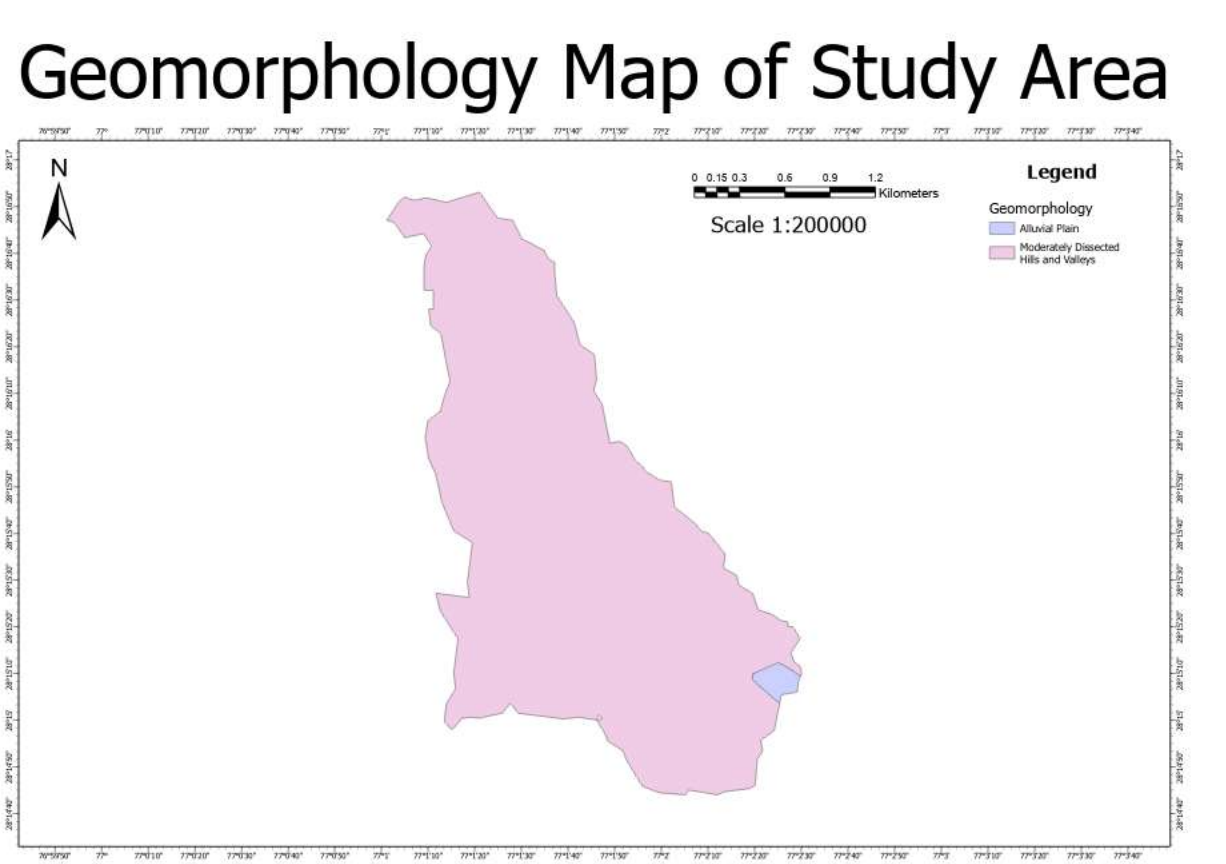
- Sandy or Loamy Surface Soil Layer as per DSMW Data
- Uniform Soil layer over entire area



# Geomorphology Map

Landform and terrain features of study area:

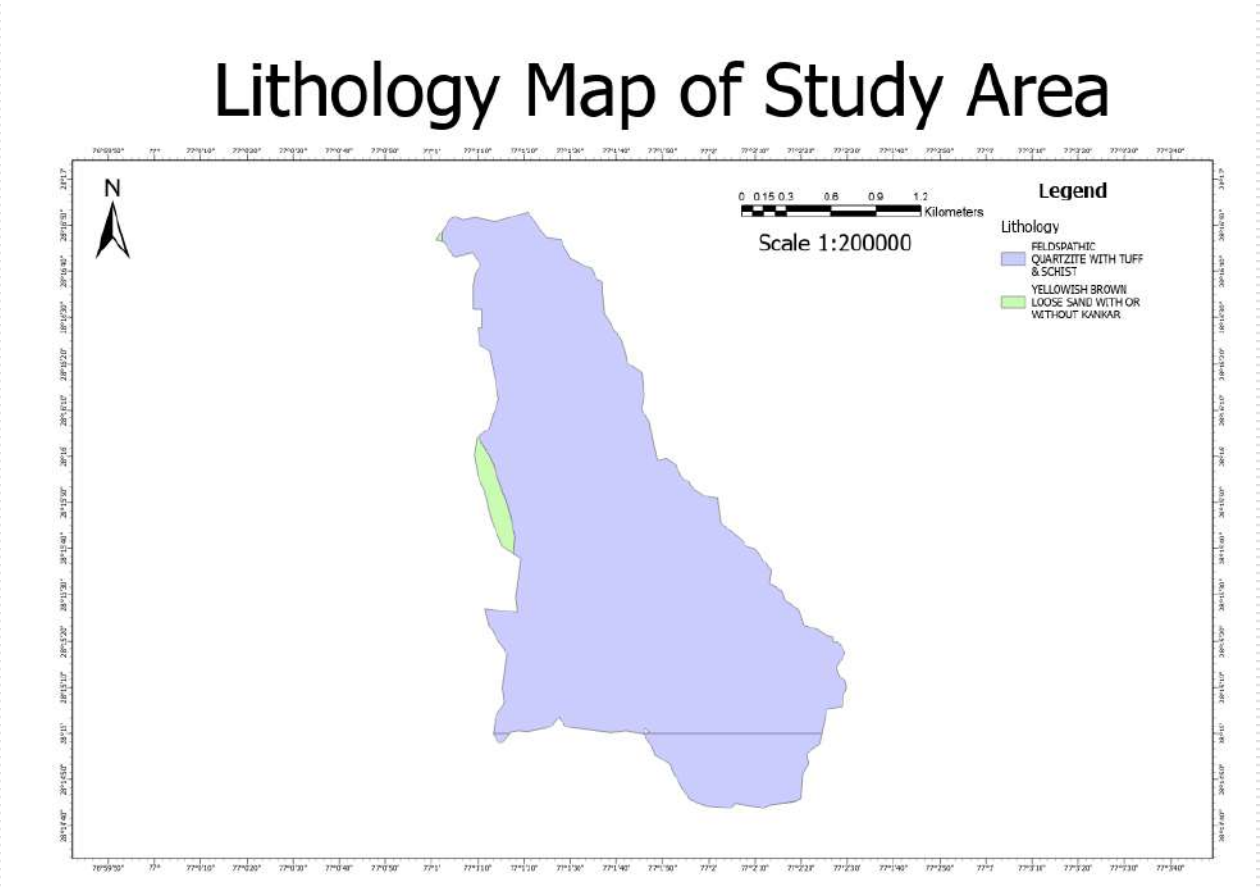
- Moderately Dissected Hills and Valleys
- Alluvial Plain



# Lithology Map

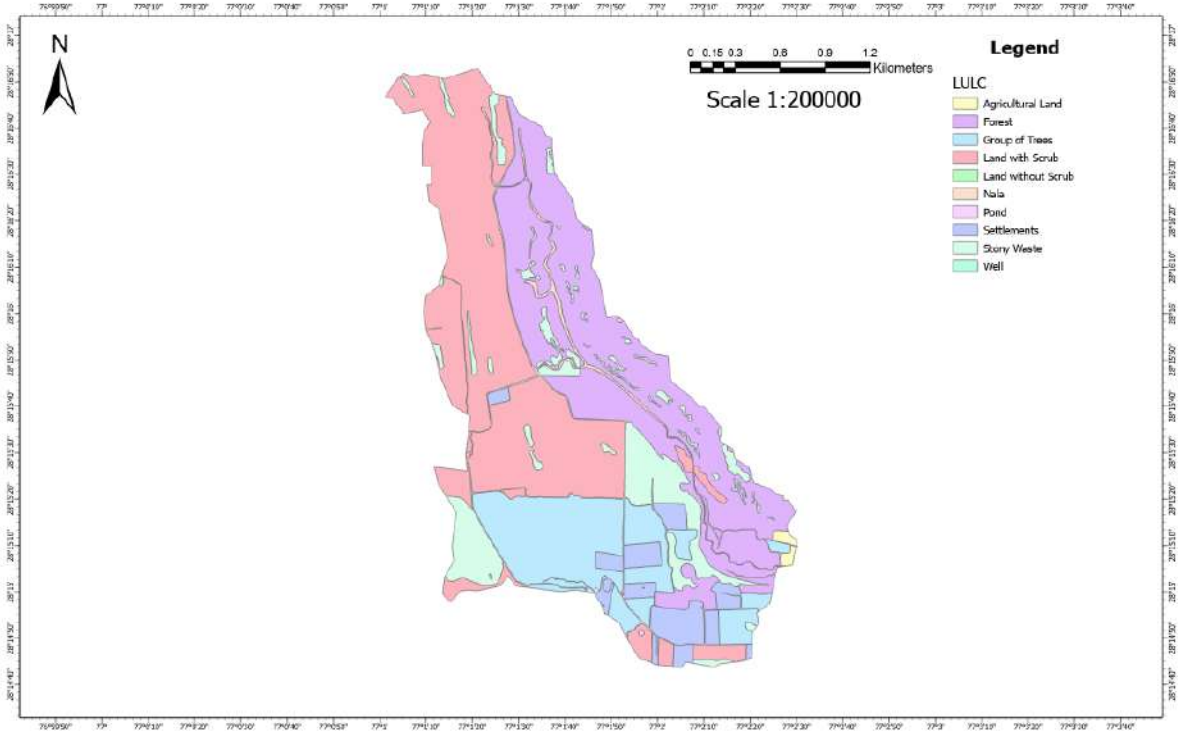
Type and distribution of rocks and sediments of study area:

- Feldspathic quartzite with tuff and schist
- Yellowish brown loose sand with or without kankar



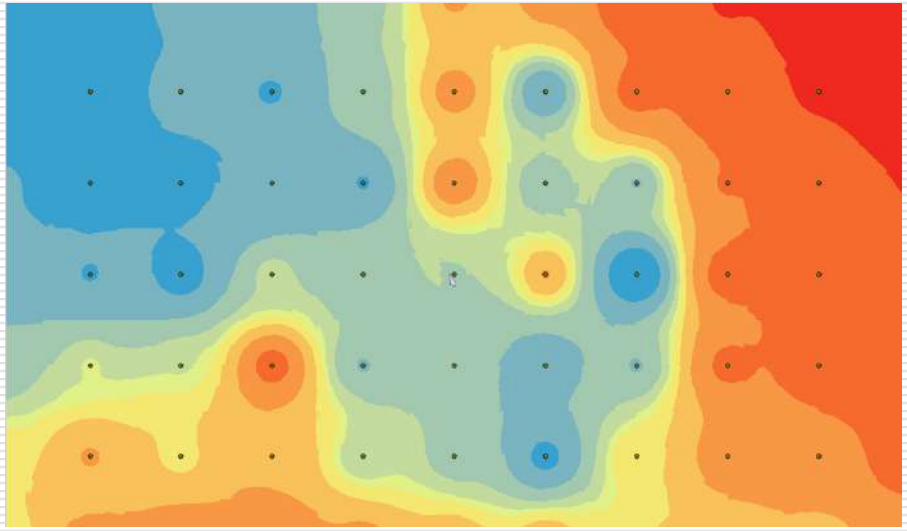
# LULC Map

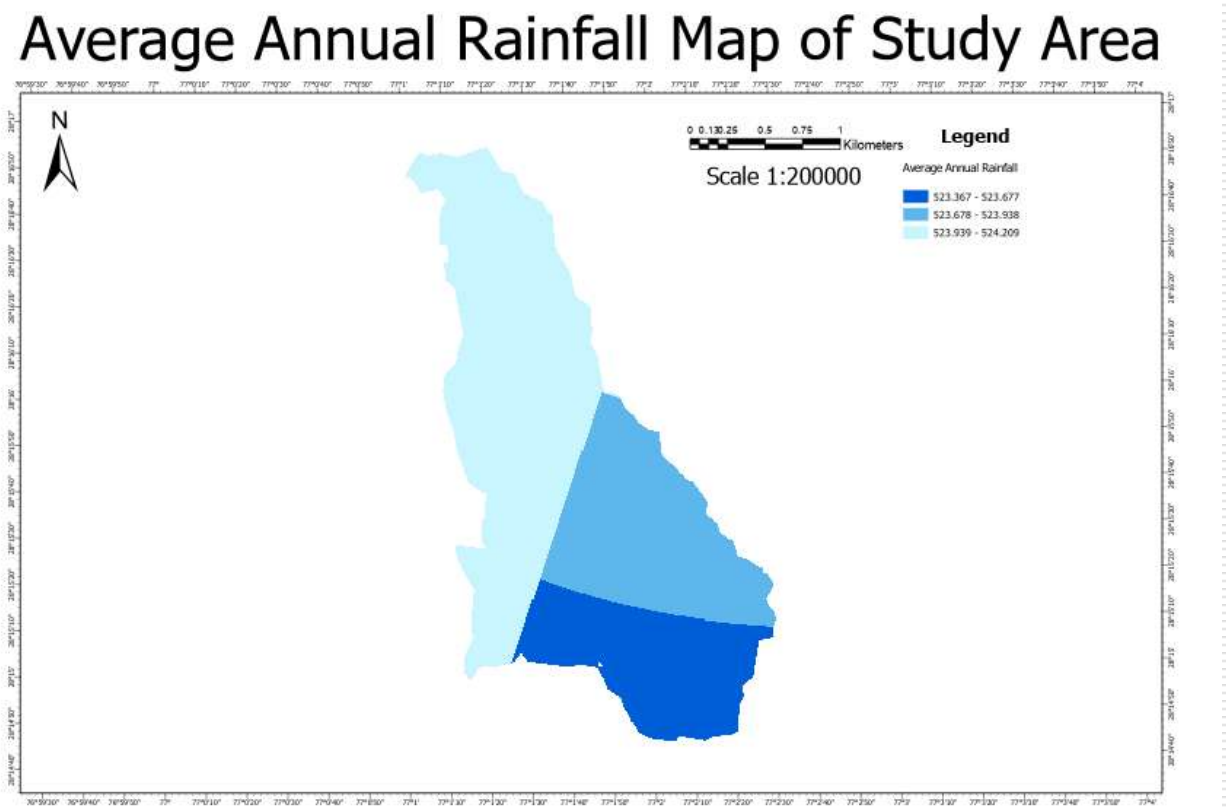
LULC map for information about the land use and land cover characteristics of the study area.



# Average Annual Rainfall Map

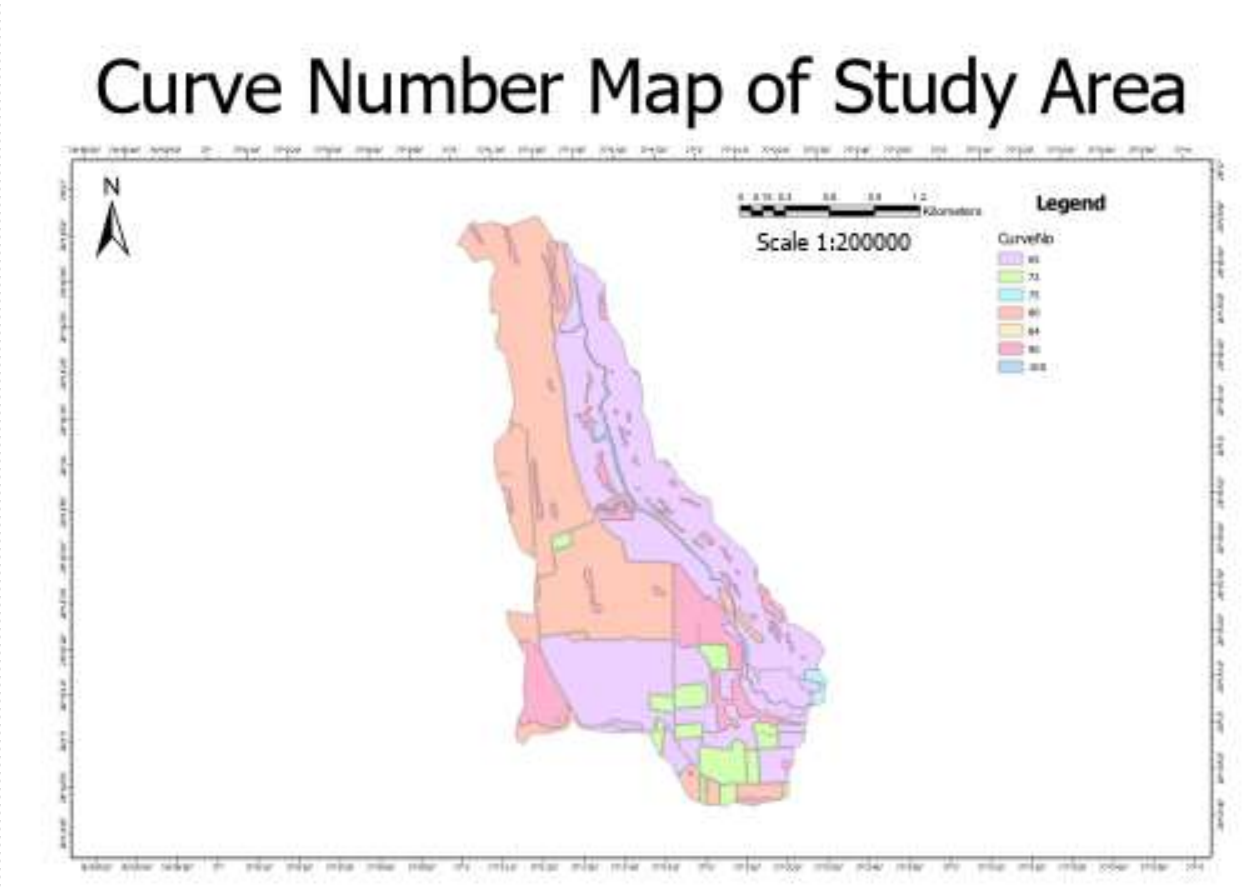
The annual average rainfall map of study area over a 20-year period, from 2001 to 2020.





# Curve Number Map

Curve No. to represent how easily water can infiltrate (penetrate) the soil in the study area.



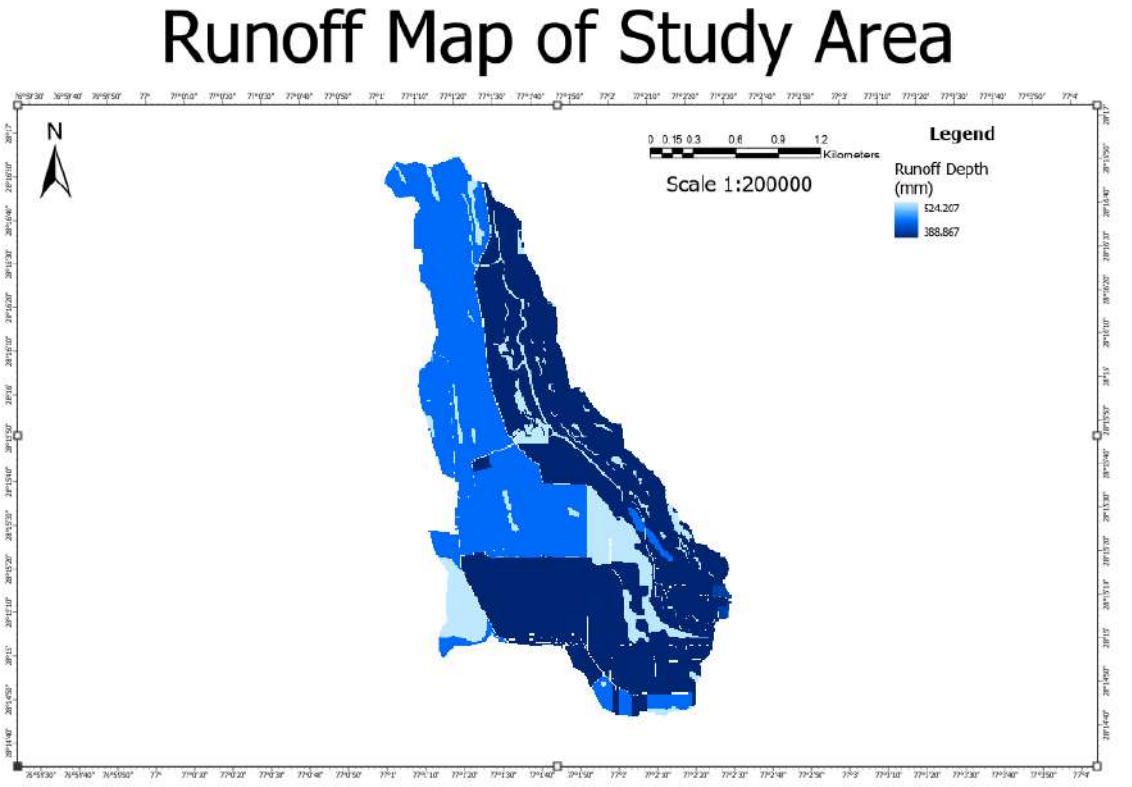
# Runoff Map

Runoff calculated as

$$Runoff = \frac{(P - I_a)^2}{(P - I_a + S)}$$

where P = average annual rainfall, Ia = 0.2S and S is potential retention which is calculated using curve number as

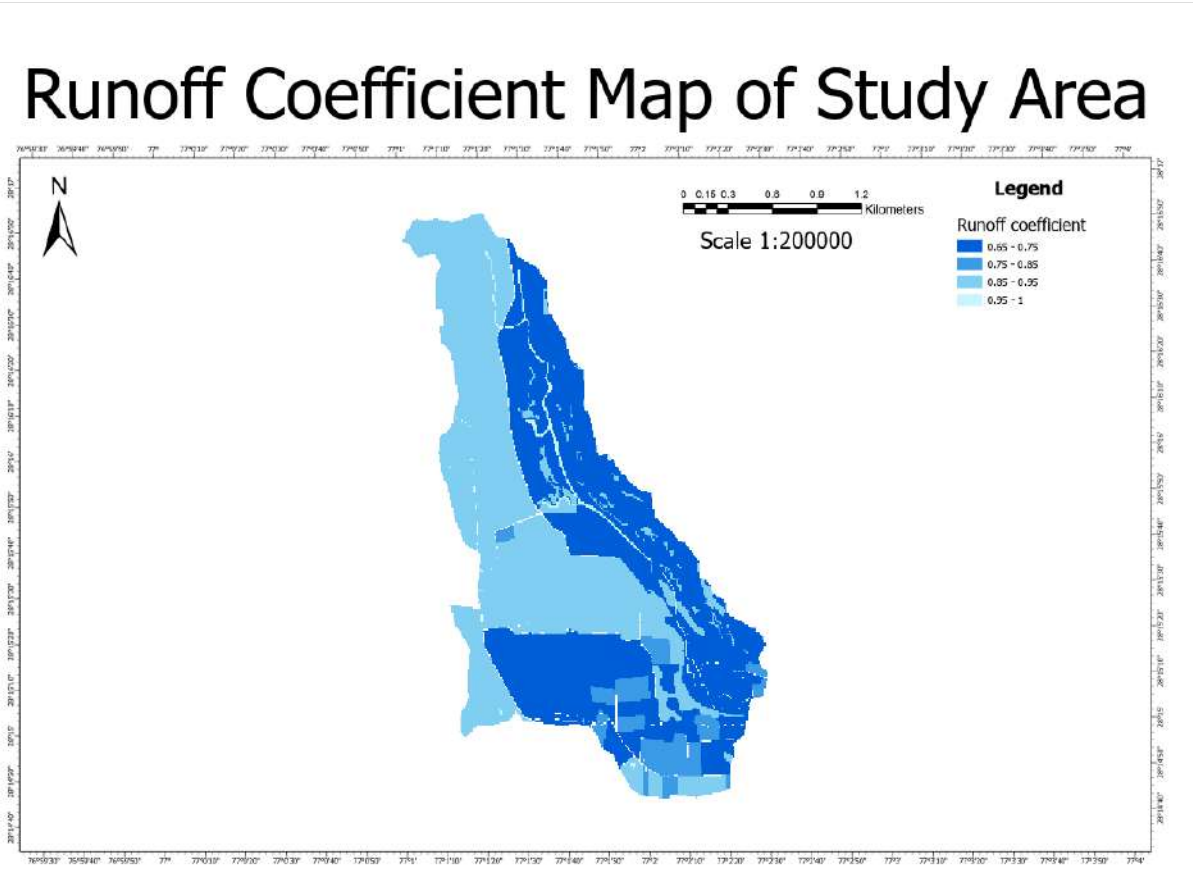
$$S = \frac{25400}{CN} - 254$$



# Runoff Coefficient Map

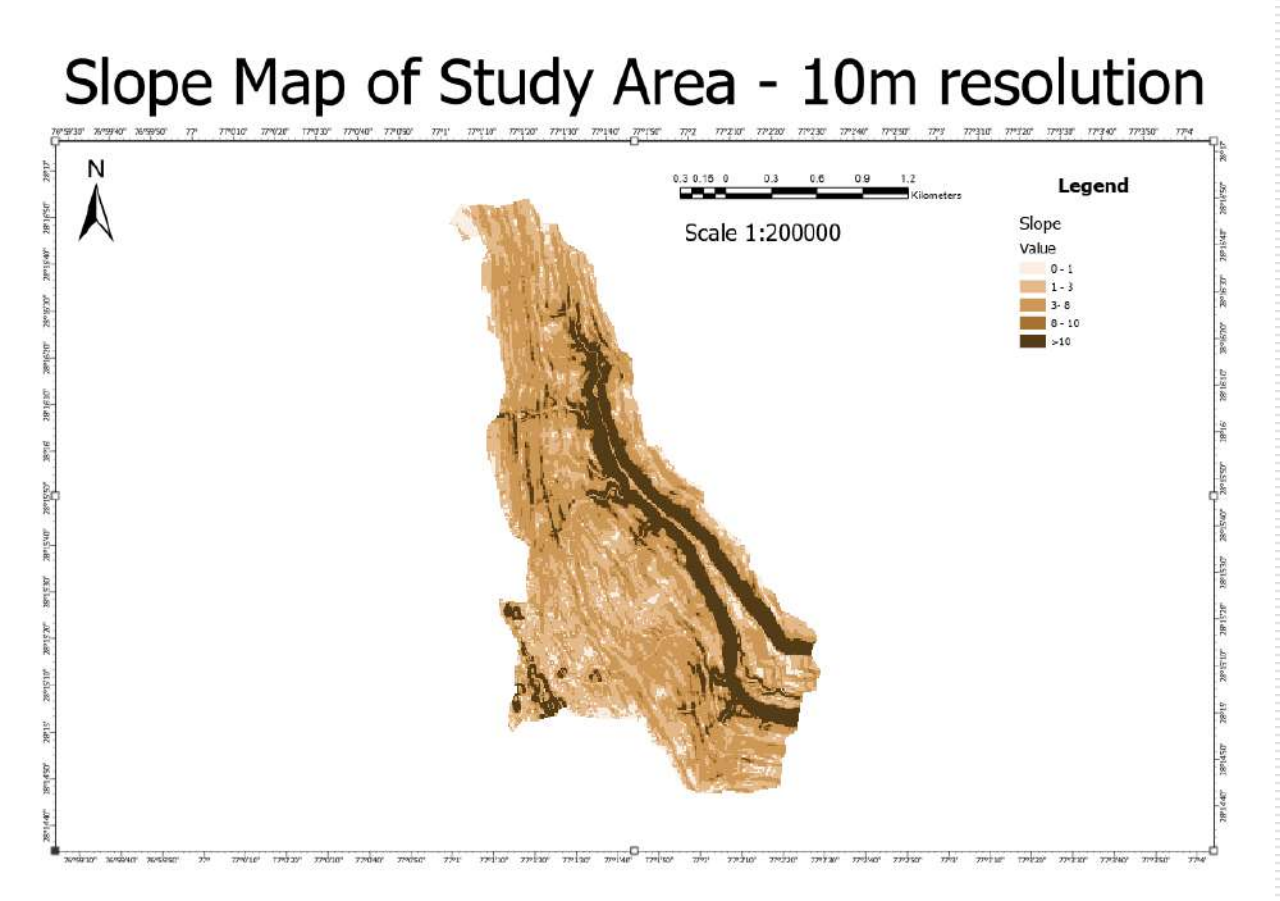
Runoff Coefficient calculated as:

$$Runoff\ Coefficient = \frac{Annual\ Runoff\ Depth}{Annual\ Average\ Rainfall}$$

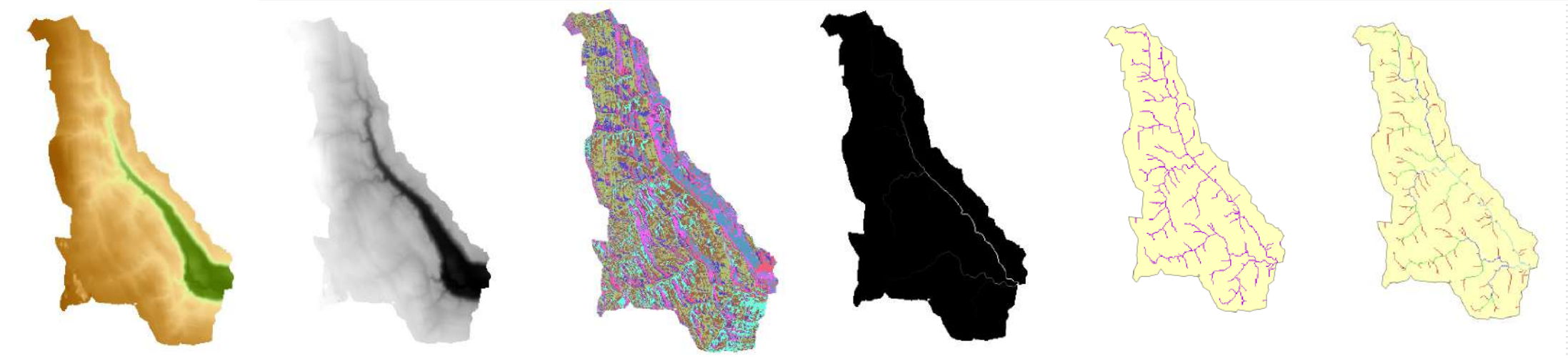


# Slope Map – 10 m resolution

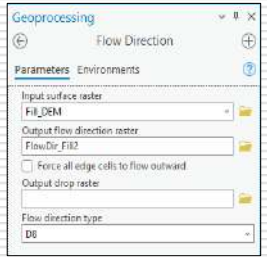
Slope map derived from LiDAR DEM to depict the slope of the land surface

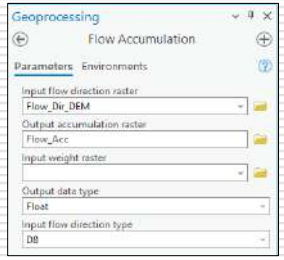


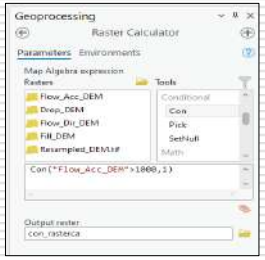
# DEM Processing to make Stream Order



DEM → Fill Sink → Flow Direction → Flow Accumulation → Drainage Network → Stream Ordering

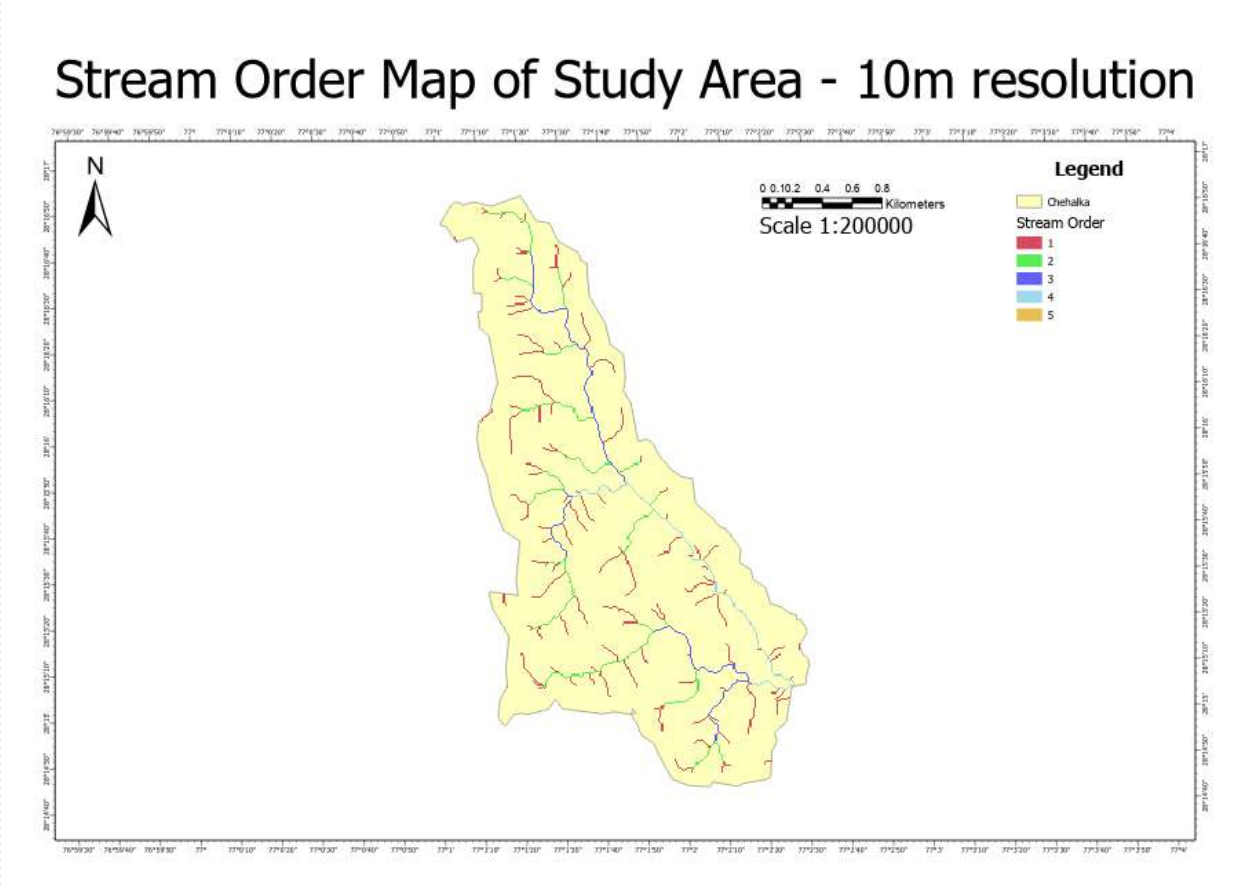




# Stream Order – 10 m resolution

Different stream order within watershed of the study area.



# AHP Analysis

| Judgement Matrix | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Slope | LULC | Runoff Coeff | Stream Order | Soil | Geomorphology | Lithology |
| Slope | 1 | 2 | 1/2 | 2 | 2 | 2 | 2 |
| LULC | 1/2 | 1 | 1/3 | 1/3 | 2 | 2 | 2 |
| Runoff Coeff | 2 | 3 | 1 | 3 | 3 | 3 | 3 |
| Stream Order | 1/2 | 3 | 1/3 | 1 | 2 | 2 | 2 |
| Soil | 1/2 | 1/2 | 1/3 | 1/2 | 1 | 2 | 2 |
| Geomorphology | 1/2 | 1/2 | 1/3 | 1/2 | 1/2 | 1 | 1 |
| Lithology | 1/2 | 1/2 | 1/3 | 1/2 | 1/2 | 1 | 1 |

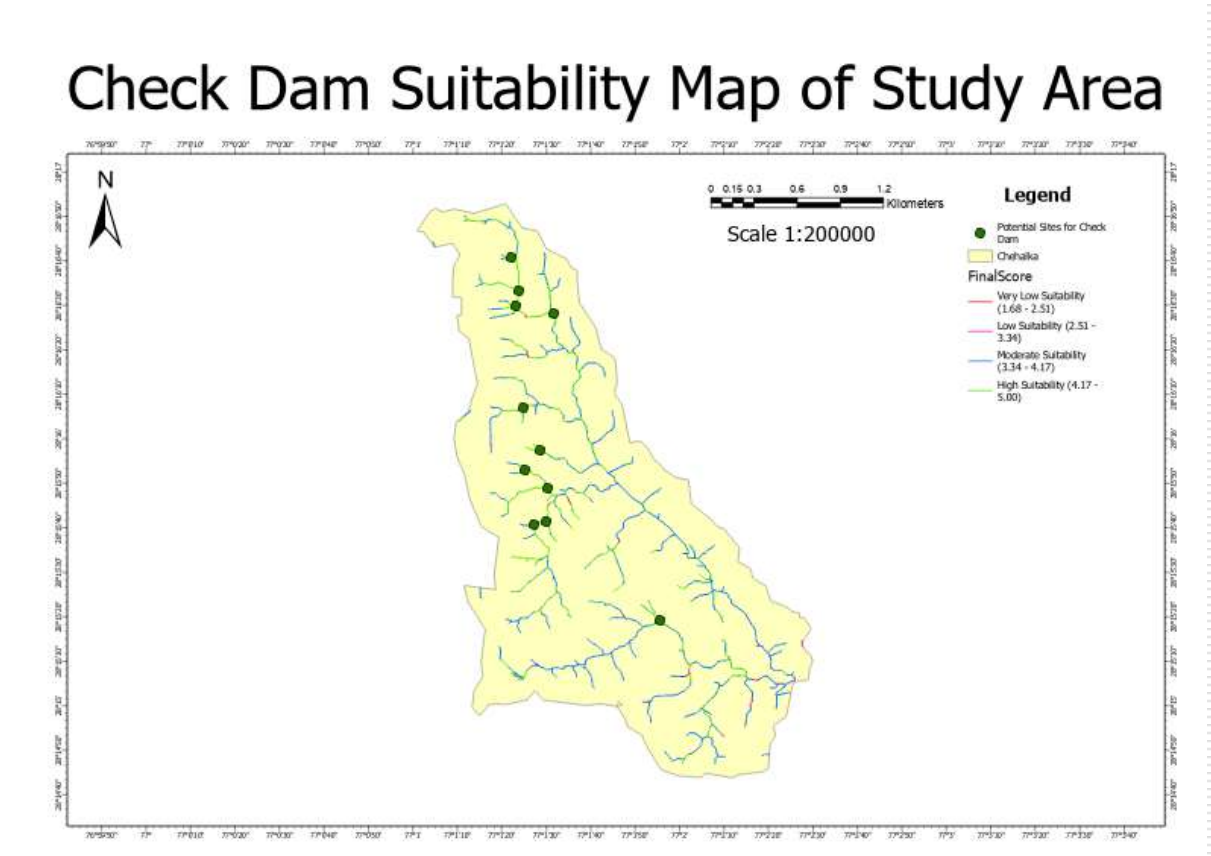
| Calculation of Weightage Matrix | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Slope | LULC | Runoff Coeff | Stream Order | Soil | Geomorphology | Lithology | GM | A2 | A3 | A4 | Final Weight |
| Slope | 1 | 2 | 1/2 | 2 | 2 | 2 | 2 | 1.486 | 0.19 | 1.36 | 7.24 | 19 |
| LULC | 1/2 | 1 | 1/3 | 1/3 | 2 | 2 | 2 | 0.891 | 0.11 | 0.84 | 7.52 | 11 |
| Runoff Coeff | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 2.420 | 0.30 | 2.20 | 7.23 | 30 |
| Stream Order | 1/2 | 3 | 1/3 | 1 | 2 | 2 | 2 | 1.219 | 0.15 | 1.17 | 7.62 | 15 |
| Soil | 1/2 | 1/2 | 1/3 | 1/2 | 1 | 2 | 2 | 0.774 | 0.10 | 0.72 | 7.34 | 10 |
| Geomorphology | 1/2 | 1/2 | 1/3 | 1/2 | 1/2 | 1 | 1 | 0.575 | 0.07 | 0.52 | 7.20 | 7 |
| Lithology | 1/2 | 1/2 | 1/3 | 1/2 | 1/2 | 1 | 1 | 0.575 | 0.07 | 0.52 | 7.20 | 7 |

# AHP Analysis

| Criteria | Class | Range | Rank | Weights | Rank*Weight |
|---|---|---|---|---|---|
| Slope (degree) | 0 to 1 | Moderate | 3 | 0.187 | 0.56 |
| | 1 to 3 | Very High | 5 | | 0.94 |
| | 3 to 8 | High | 4 | | 0.75 |
| | 8 to 10 | Low | 2 | | 0.37 |
| | >10 | Very Low | 1 | | 0.19 |
| Land Use Land Cover | Land with Scrub | Low | 2 | 0.112 | 0.22 |
| | Land without Scrub | Moderate | 3 | | 0.34 |
| | Lake, Pond, Water, Tank, well | High | 4 | | 0.45 |
| | Nala | Very High | 5 | | 0.56 |
| | Forest | Moderate | 3 | | 0.34 |
| | Agriculture Land | Low | 1 | | 0.11 |
| | Settlements | Low | 1 | | 0.11 |
| | Group of Tress | Low | 1 | | 0.11 |
| | Stony Waste | Moderate | 3 | | 0.34 |
| Stream Order | 1 to 2 | Moderate | 3 | 0.154 | 0.46 |
| | 2 to 3 | High | 4 | | 0.61 |
| | 3 to 4 | Very High | 5 | | 0.77 |
| | 4 to 6 | Low | 2 | | 0.31 |
| | >6 | Very Low | 1 | | 0.15 |
| Soil Texture | Sandy Loam | Very High | 5 | 0.098 | 0.49 |
| Lithology | Yellowish Brown loose sand | High | 4 | 0.072 | 0.29 |
| | Phylite Quarzite | Very High | 5 | | 0.36 |
| Geomorphology | Highly dissected hills and valleys | Very High | 5 | 0.072 | 0.36 |
| | Alluvial Plain | Moderate | 3 | | 0.22 |
| Runoff Coefficient | 0.3 - 0.45 | Low | 1 | 0.305 | 0.30 |
| | 0.45 - 0.53 | Very Low | 2 | | 0.61 |
| | 0.53 - 0.63 | Moderate | 3 | | 0.91 |
| | 0.63 - 0.85 | High | 4 | | 1.22 |
| | 0.85 - 0.98 | Very High | 5 | | 1.52 |

# Check Dam Suitability Map

The final check dam suitability map depicting suitable area for siting check dam which is done using AHP approach and overlap option in ArcGIS Pro.

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