Title: Watershed Delineation Using Digital Elevation Model (DEM) in ArcGIS

Introduction:

A watershed is a natural hydrological unit that drains rainfall and surface runoff to a common outlet such as a stream, river, or reservoir. It plays a critical role in the management of water resources, soil conservation, groundwater recharge, and ecological sustainability. The study of watersheds is important for understanding surface water dynamics, planning water harvesting structures, and mitigating floods and droughts.

With the advent of Remote Sensing and GIS techniques, watershed delineation has become more accurate and efficient. Digital Elevation Models (DEMs) are widely used in ArcGIS to identify watershed boundaries, drainage patterns, and stream orders, which provide valuable insights for integrated watershed management.

Objective:

The main objectives of this study are:

1. To delineate the watershed boundary using DEM (Digital Elevation Model) data in ArcGIS.
2. To identify drainage networks and stream orders within the watershed.
3. To calculate the watershed area.
4. To calculate drainage density.

Study Area:

The study area is Bhubaneswar, located in Khurda district, Odisha, India, lying between 20°12′–20°26′ N latitude and 85°44′–85°55′ E longitude.

Methodology:

The watershed delineation process was carried out in ArcGIS using DEM data. The steps involved are as follows:

- Filling the DEM
- Generating Flow Direction from Filled DEM
- Generating Flow Accumulation from Flow Direction
- Creating Feature Pour Point Data (Outlet)
- Delineating Watershed

- Defining the streams of the Watershed
- Conversion to Vector (both Watershed and streams)
- Extracting Stream from Watershed
- Calculating Watershed Area
- And finally generating stream order

Result:

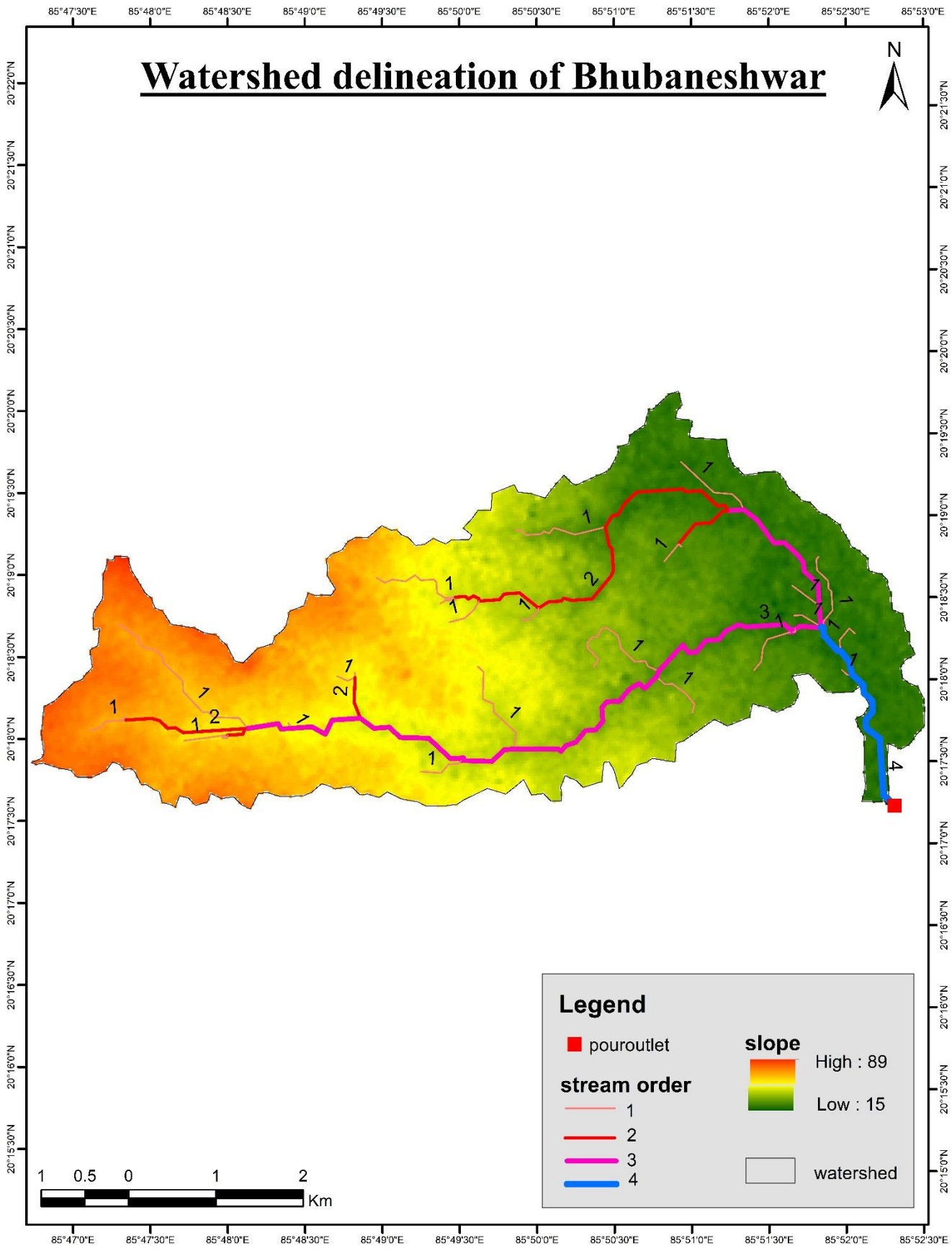
The watershed was successfully delineated, and the drainage network was extracted along with stream orders. And the drainage pattern was dendritic drainage pattern.

- Total Watershed Area: 26,032,317.2247 m^2 (26.03 km^2)
- Total length of stream: 34,781.585098 m (34.7816km)
- Drainage density= (total length of stream/ Area)

  =0.001336m/m2 (1.34km/km2)

Conclusion:

The watershed boundary for was effectively delineated using DEM data in ArcGIS. Flow direction and flow accumulation analysis helped in defining the drainage network and stream orders. The calculated watershed area of 26.03 km^2 and total length of stream is 34.7816km. As 1.34 km/km^2 = Low Drainage Density that means watershed (Bhubaneswar) likely has: Permeable soils/subsurface (good infiltration). Gentle slope (not very steep). Higher potential for groundwater recharge compared to runoff.


Watershed delineation of Bhubaneshwar
N
85°47'30"E
85°48'0"E
85°48'30"E
85°49'0"E
85°49'30"E
85°50'0"E
85°50'30"E
85°51'0"E
85°51'30"E
85°52'0"E
85°52'30"E
85°53'0"E
20°22'0"N
20°21'30"N
20°21'0"N
20°20'30"N
20°20'0"N
20°19'30"N
20°19'0"N
20°18'30"N
20°18'0"N
20°17'30"N
20°17'0"N
20°16'30"N
20°16'0"N
20°15'30"N
20°15'0"N
1 0.5 0 1 2
Km
Legend
pouroutlet
stream order
1
2
3
4
slope
High : 89
Low : 15
watershed