

WATERSHED MANAGEMENT

Watershed Delineation and Characterization

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What is Watershed ?

Watershed, a hydrological unit of an area draining to a common outlet point

Recognized as an ideal unit for planning and development of land, water and vegetation resources.

Watershed concept has been extensively used because it allows accurate measurements and monitoring of components of water budgeting in hydrologic cycle, sediment, energy, heat, carbon and nutrients balances in an ecosystem.

The monitoring at the level of watersheds or sub-watersheds in a basin will help in analyzing impacts of current and future activities and accordingly plan area specific management options or alternatives based on the priorities as per the intended project objectives.

The surface runoff process

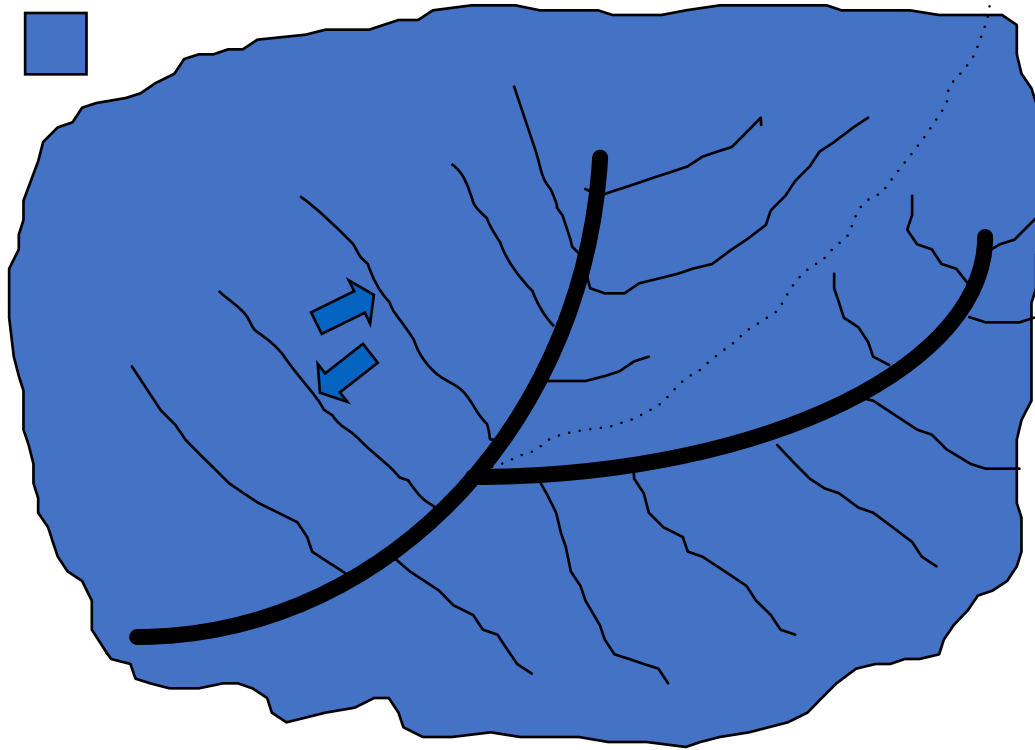
Landscape

Overland flow

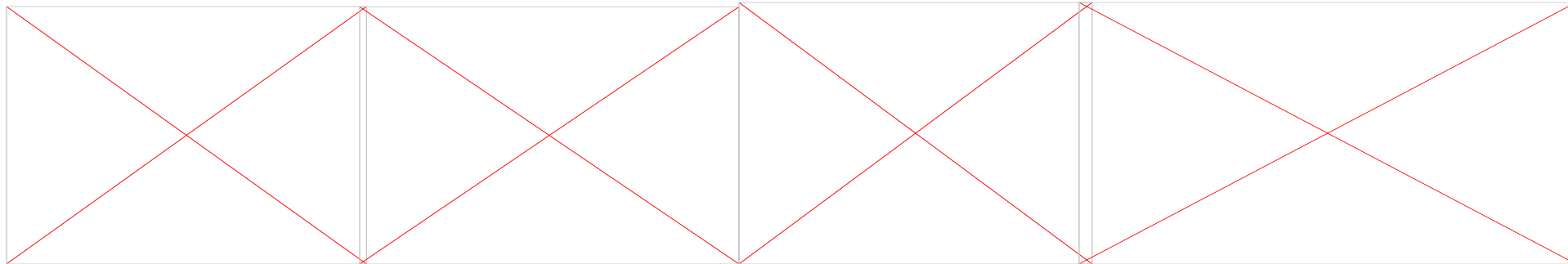
Interrill

Rill

Ephemeral
Gully
(Concentrated
flow)



- Flowing **water erodes landscape** and carries away sediment sculpting the topography
- Topography defines **drainage direction** on the landscape and resultant runoff and streamflow accumulation processes



Watershed Spatial Scale- Area

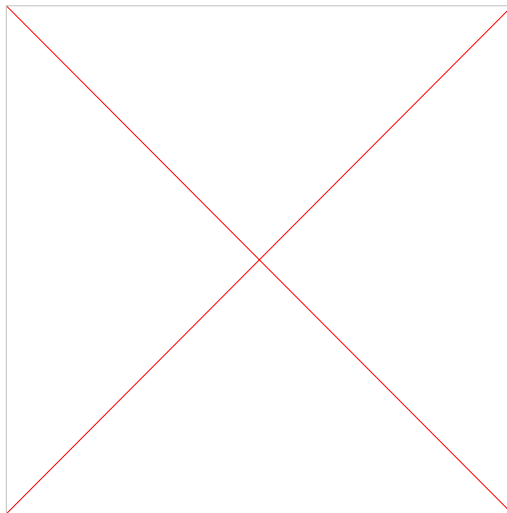
Classification of Watersheds : India		
Hydrologic Unit	Size (lakh ha)	Base map Scale
Macro-Delineation (lakh ha)		
23 Basins	60-300	1:5 M
Catchments	10-60	1:1 M
Micro-Delineation (ha)		
Sub-catchment	10,000-50,000	1:50,000
Sub-watersheds	1000-10,000	1:25,000
Micro-watersheds	100-1000	1:10,000
Mini-watersheds	< 100	1:4,000

Map Scale
1:10,000

1 cm on map =
10000cm on
ground=100 m

FPR and RVP

IWMP, NWDPR, IWDP



1. A of North Ladakh ND in Indus
2. Brahmani Baitarani
3. Cauvery
4. EFR b Godavari and Krishna
5. EFR b Krishna and Godavari
6. EFR b Krishna and Godavari
7. EFR b Krishna and Godavari
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9. EFR b Krishna and Godavari
10. EFR b Krishna and Godavari

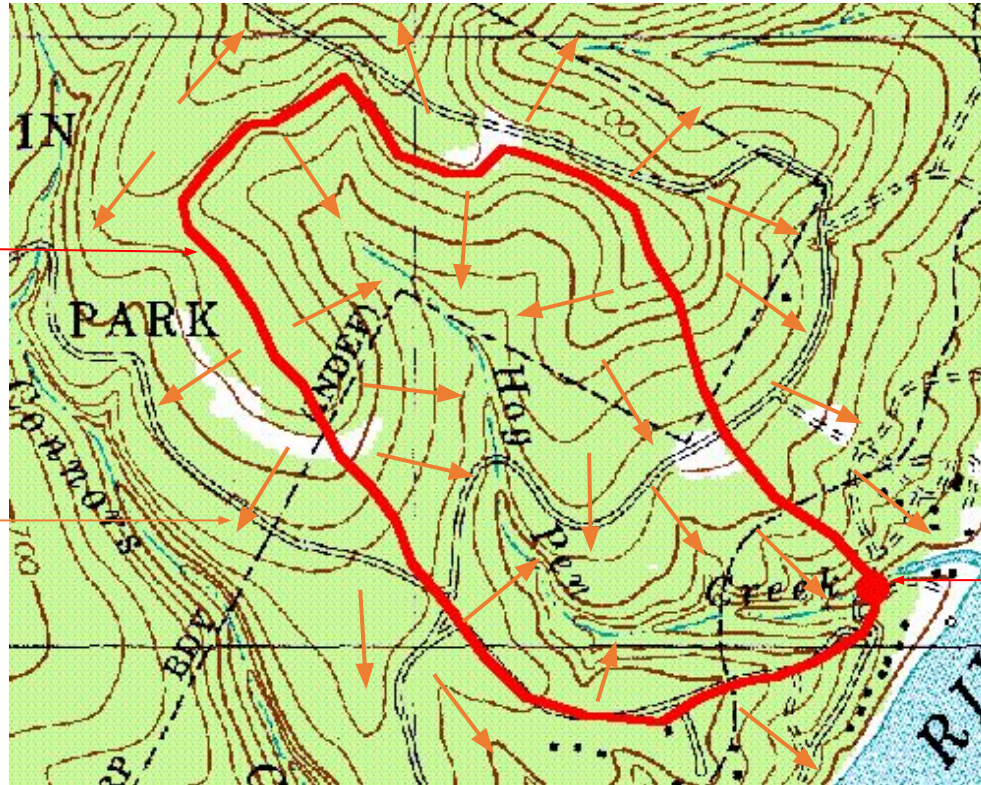
Water Balance

Water-budget component	Annual rate, in mm	Percentage of annual precipitation
Precipitation	834	100
Evapotranspiration	540	65
Total discharge to oceans	294	35
Discharge to oceans from surface runoff	204	24
Discharge to oceans from base flow	90	11
Infiltration of precipitation	630	76

Integrated Watershed Management Programme in India

- **Out of 4000 Bm³ of rainfall in our country, ~60% or 2400 Bm³ available as overland runoff/soil storage is the core objective of integrated watershed development**
- **There is an increased need to demonstrate the outcomes of development projects and programs**
- **Measures such as area of watershed treated or the increase in yield are being replaced by performance measures of the environmental and economic benefit obtained from the practice**

Watershed Delineation



Watershed divide

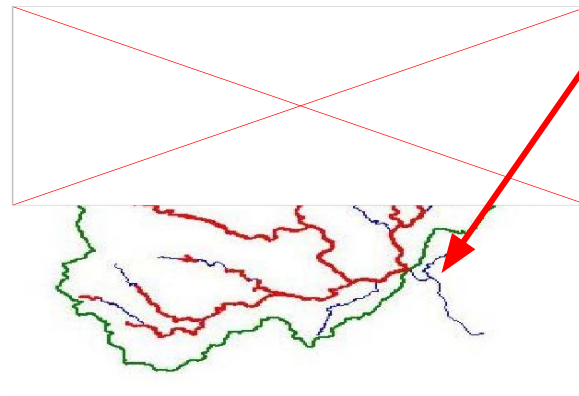
Drainage direction

Outlet

- **Watershed delineation is the process of identifying the drainage area of a point.**

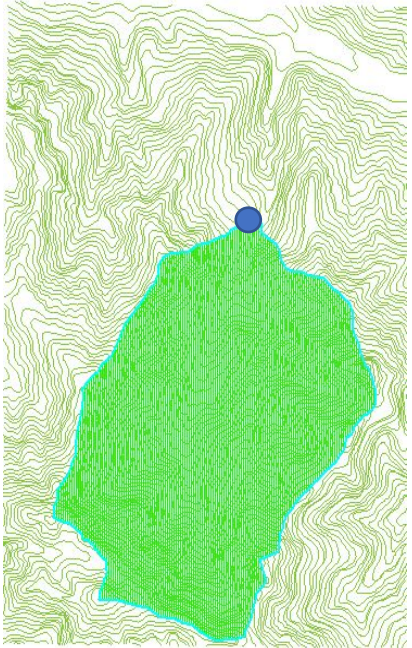
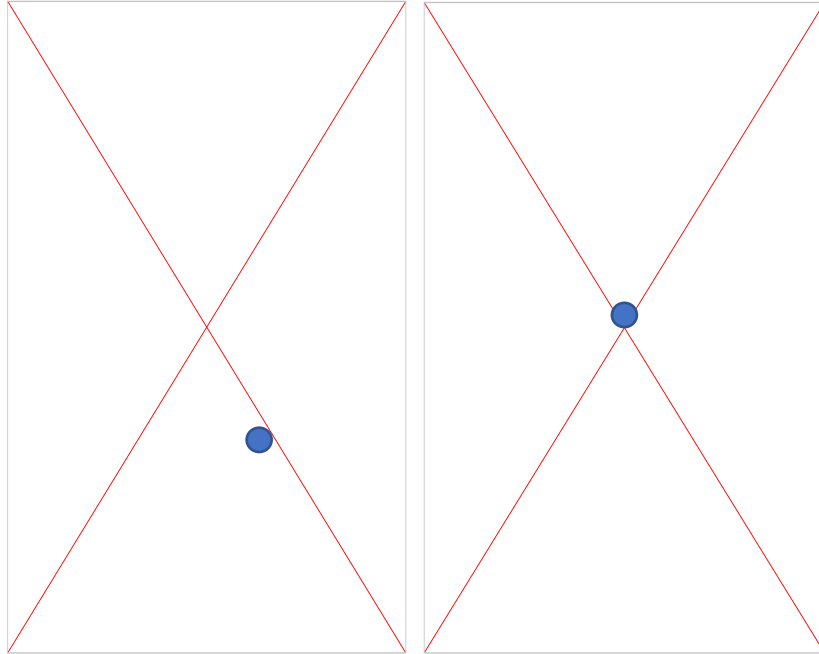
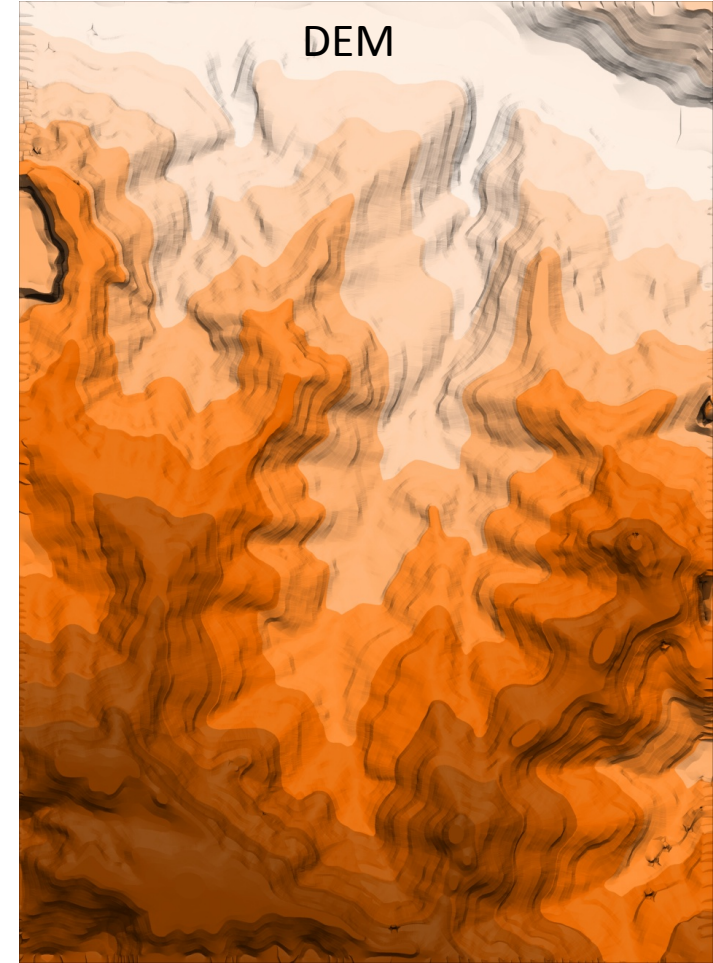
Landscape Map- Toposheet
2-D Map

- X,Y Coordinates
- Longitude, Latitude
- Contour- represent height



AUTO DELINEATION OF WATERSHED In GIS using DEM

Outlet



Watershed Analysis Procedure

- Step 1. Characterize the watershed
- Step 2. Identify issues and key questions
- Step 3. Describe current conditions
- Step 4. Describe desirable conditions
- Step 5. Synthesize and interpret results
- Step 6. Develop recommendations

Modules

- Erosion processes
- Hydrology (Water resources)
- Vegetation
- Stream channel
- Water quality
- Species and habitats (aquatic and terrestrial)
- Human uses

Watershed Characterization

1. General description- Location, latitude, longitude, area
2. Climate- Rainfall, temperature, sunshine hours
3. Topographic features- contours, slope, aspect, drainage
4. Geology- rock types
5. Soil- soil types, land capability classification
6. Ground water aquifers, springs
7. Present land use- rainfed: area, crops, varieties and productivity, rotation, management practices
 - Irrigated: area, crops, varieties and productivity, rotation, management practices
 - Forest
 - Pasture/grazing land
 - Horticulture
 - Miscellaneous

Watershed Characterization

Watershed Analysis

- Identification of erosion prone areas
- Sedimentation and prioritization of watershed
- Water balance studies and water availability estimation
- watershed physiography measurements
- Conservation planning in watershed
 - soil and water conservation structures require
 - drainage area and stream network
 - physiography and relief, slope
 - soil and erosion prone areas
 - land use and land cover
 - rainfall intensity, duration, return periods
 - water utilization potential
- Monitoring of watershed

Watershed Characterization

Hydrologic Analysis

Rainfall Data analysis- Water Resources, Drought, Water requirements

Runoff – Rainfall derived parameter surface and subsurface

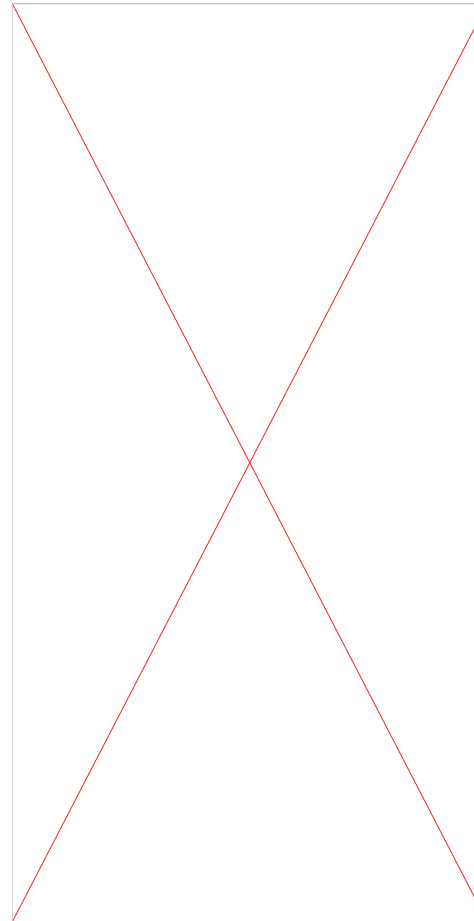
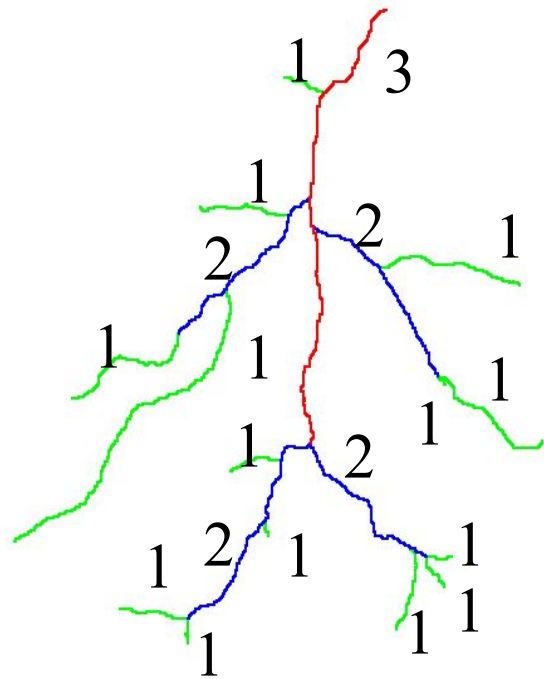
Soil loss – erosion estimates, severity indices

-Peak rate of runoff q_p

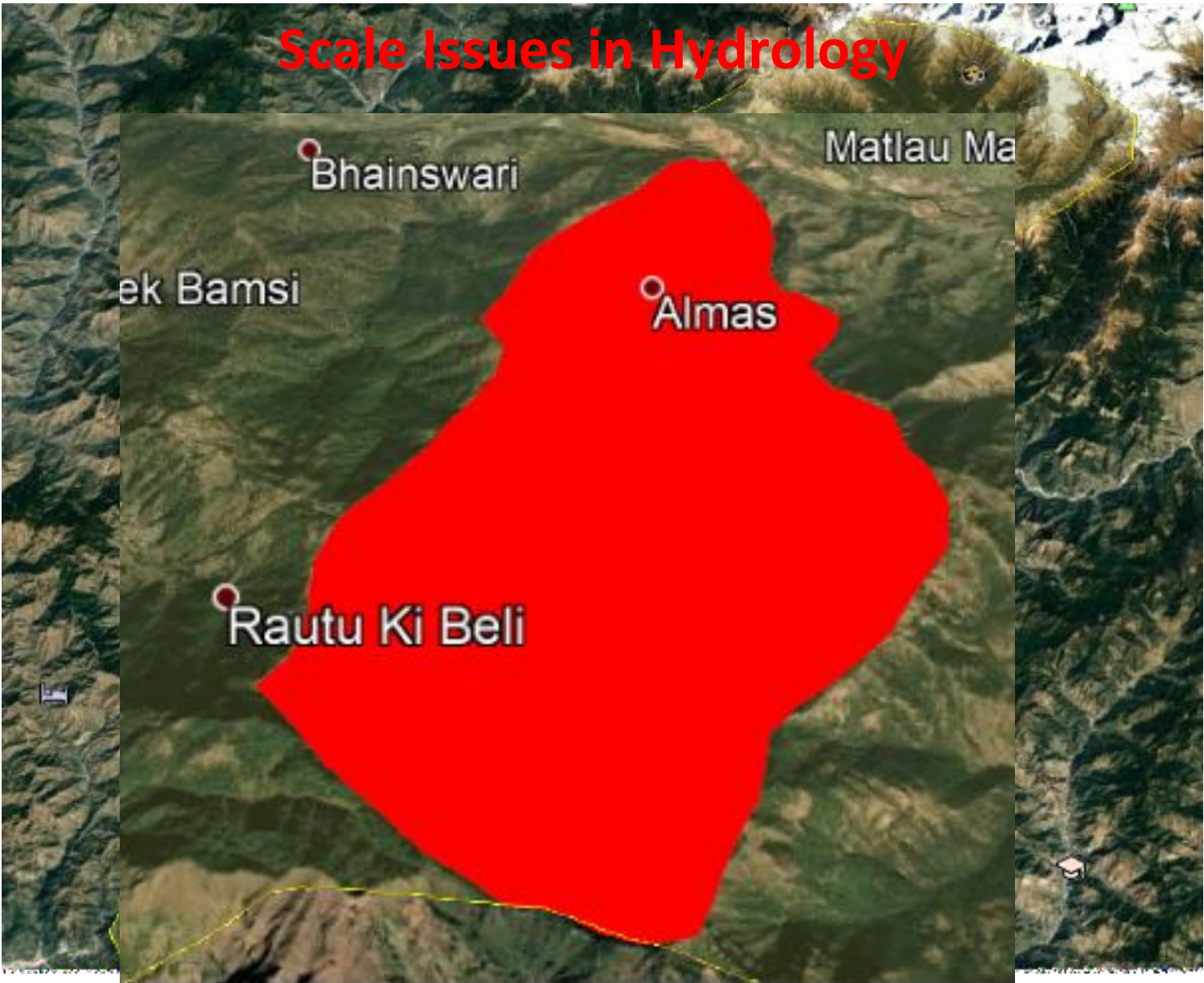
- Volume of runoff or the yield of a watershed

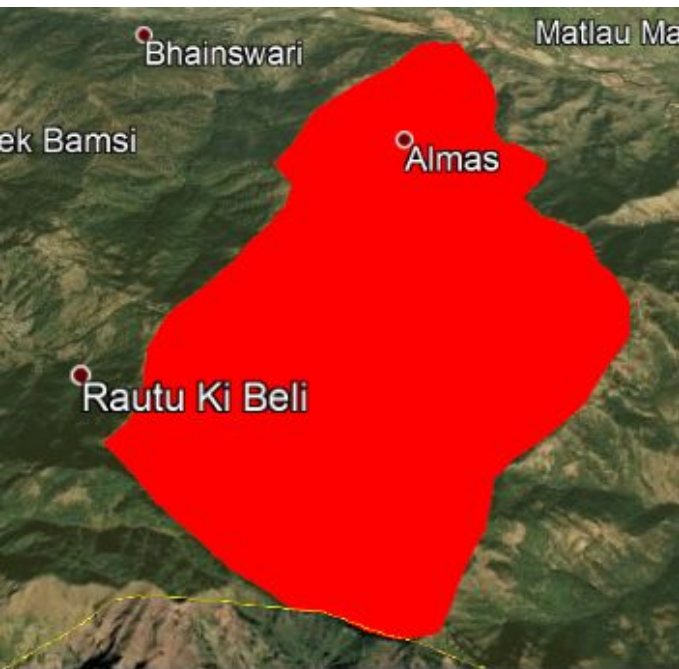
Lets look at some geomorphology.

- Stream order
- Drainage Density
- Slope
- **Maximum Relief:** Elevation difference between highest and lowest point



Scale Issues in Hydrology



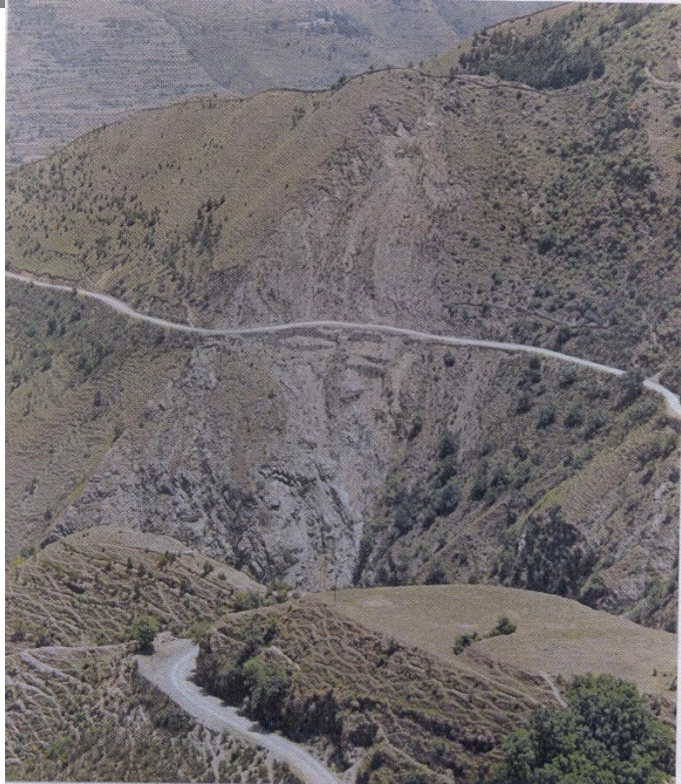
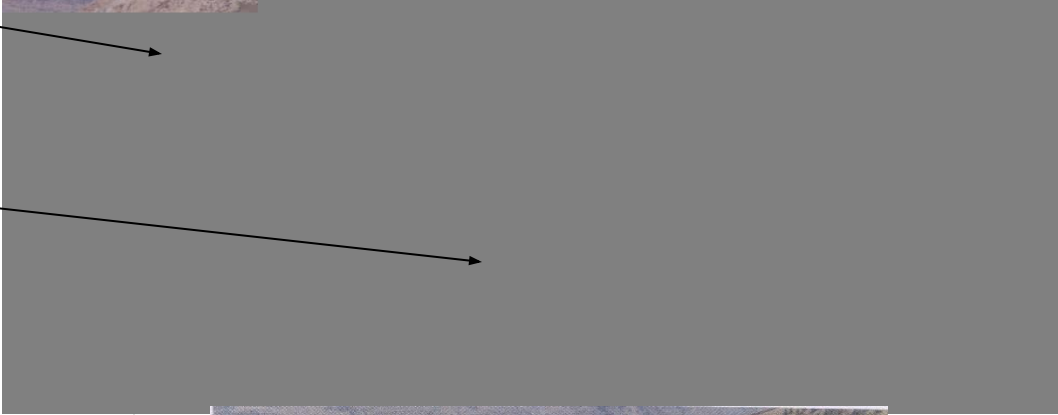
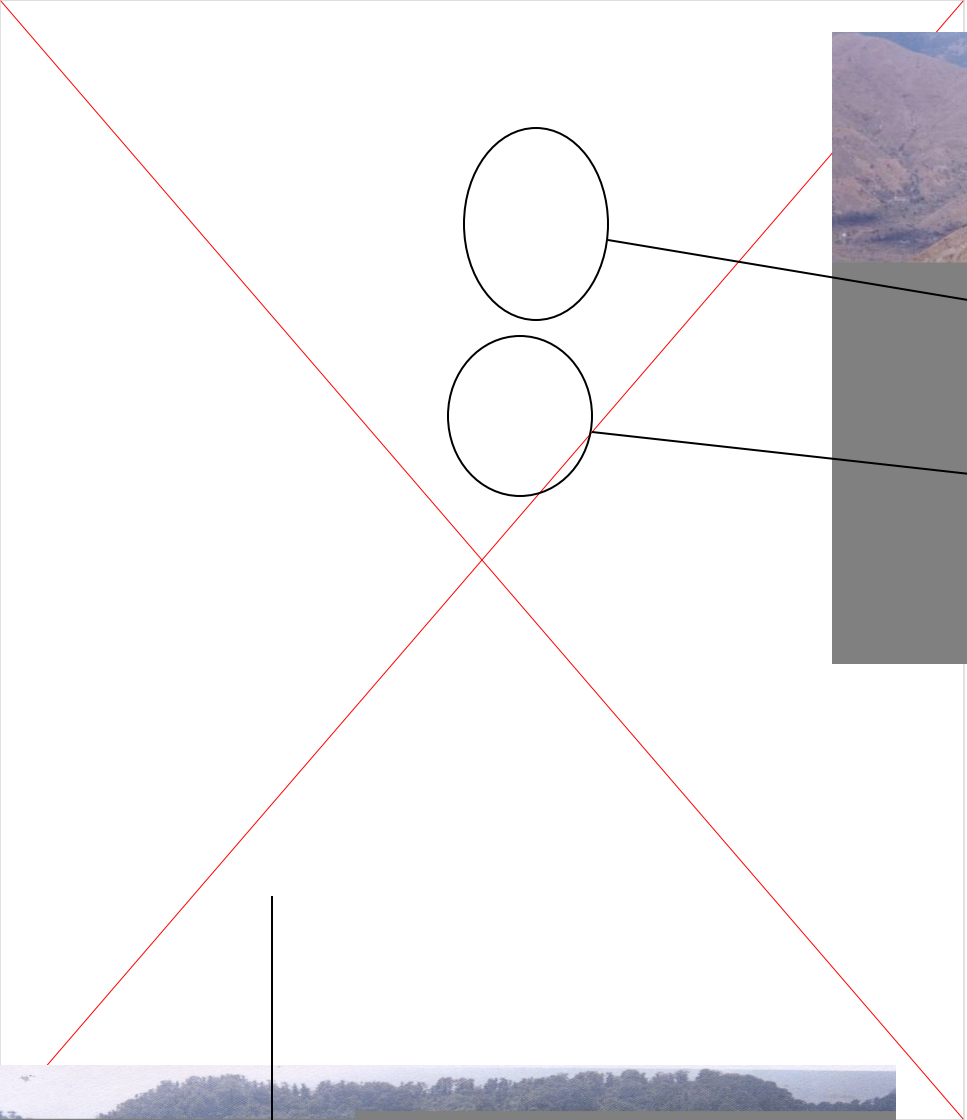


~600 ha



~200,000 ha

~85,000,000 ha



REHABILITATION ON MINESPOILED WATERSHED AT SAHASTRADHARA, UTTARAKHAND HILLS

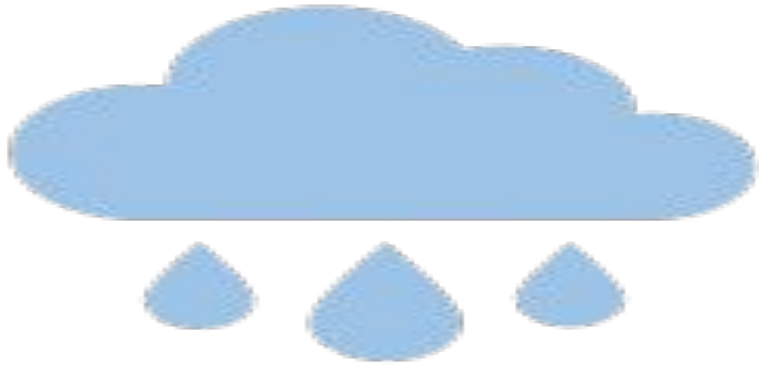
Indicators	Before treatment (1983)	After treatment (1996)
Debris outflow, t/ha/yr	550	6
Monsoon runoff, %	57	37
Water quality	Not potable	Potable
Lean period flow, days	60	240
Vegetation cover, %	<10	>90



Mined watershed before treatment



Mined watershed after treatment



Thank You

