srijan सृजन
Self-Reliant Initiatives through Joint Action

INRM Beginner Level Training

Session 02: Introduction to Concept of Watershed, Planning Process, Introduction to Basic Calculation, Metrics etc.

What is a Watershed?

- Watershed is a geo-hydrological unit of an area draining to a common outlet point. The undulating land area of any region forms several such units, each units of which is called watershed.

- The top of a watershed from where the slopes start is called the ridge, because it is the dividing line that partitions one watershed from another.

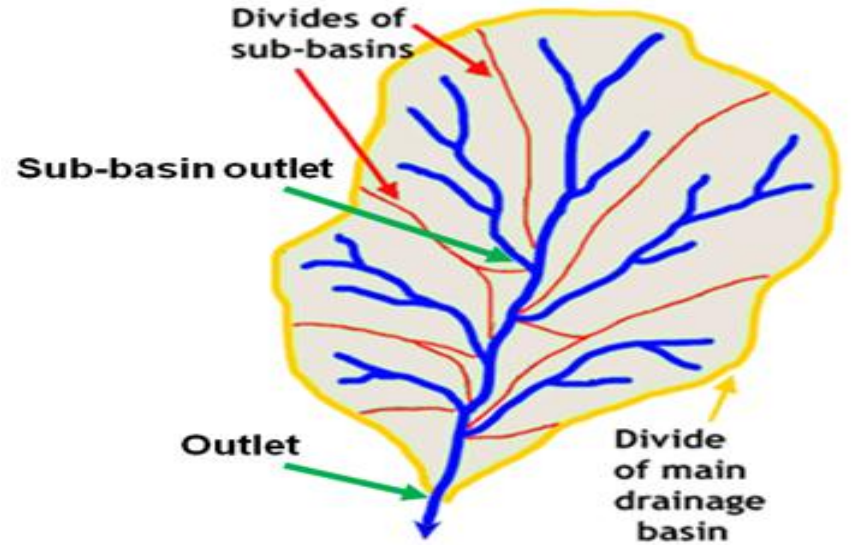
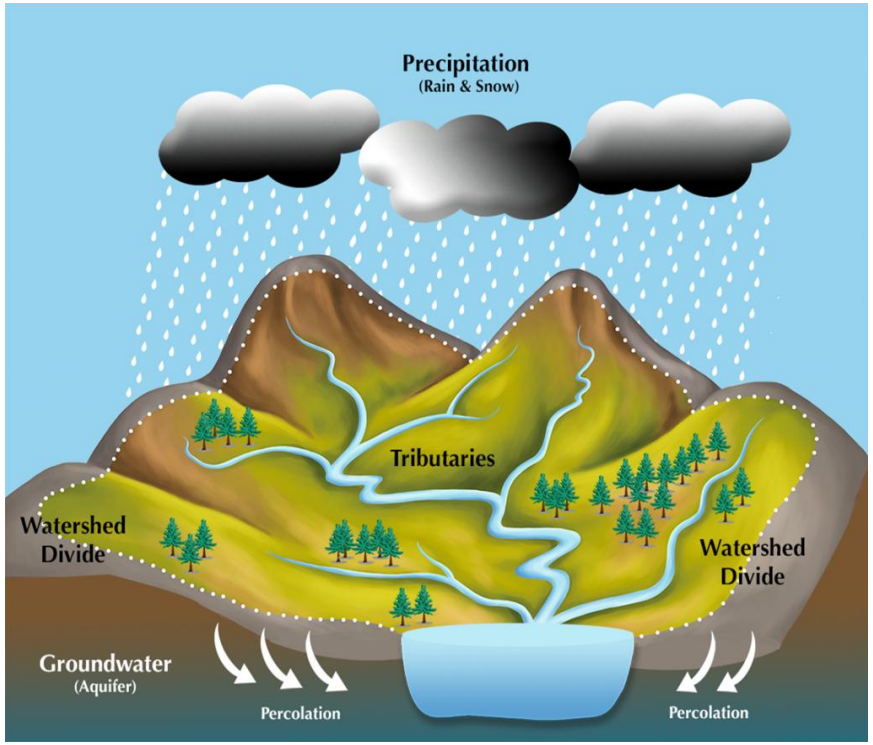


Table 2-1: System of Classification of Watersheds in India

Category	Number	Size Ranges ('ooo Ha.)
Regions	6	25,000-100,000
Basins	35	3,000-25,000
Catchments	112	1,000-3,000
Sub-Catchments	500	200-1,000
Watersheds	3,237	50-200
Sub-watersheds	12,000	10-50
Milli-watersheds	72,000	1-10
Micro-watersheds	400,000	0.5-1

(Source: Bali, 1979, p. 82)



Source: '**Samarthya**' Technical Training Manual (MGNREGA), Ministry of Rural Development, GoI

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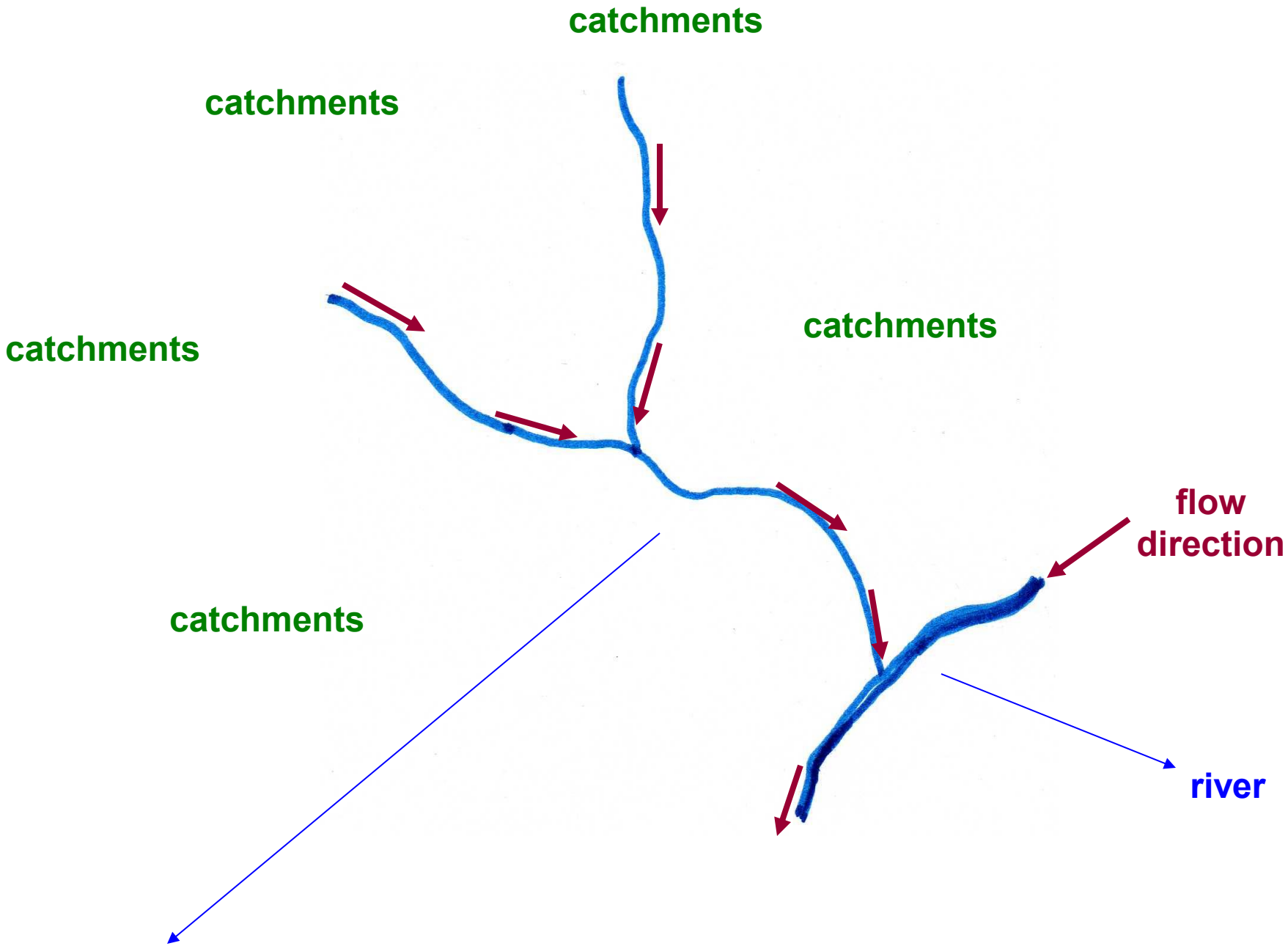
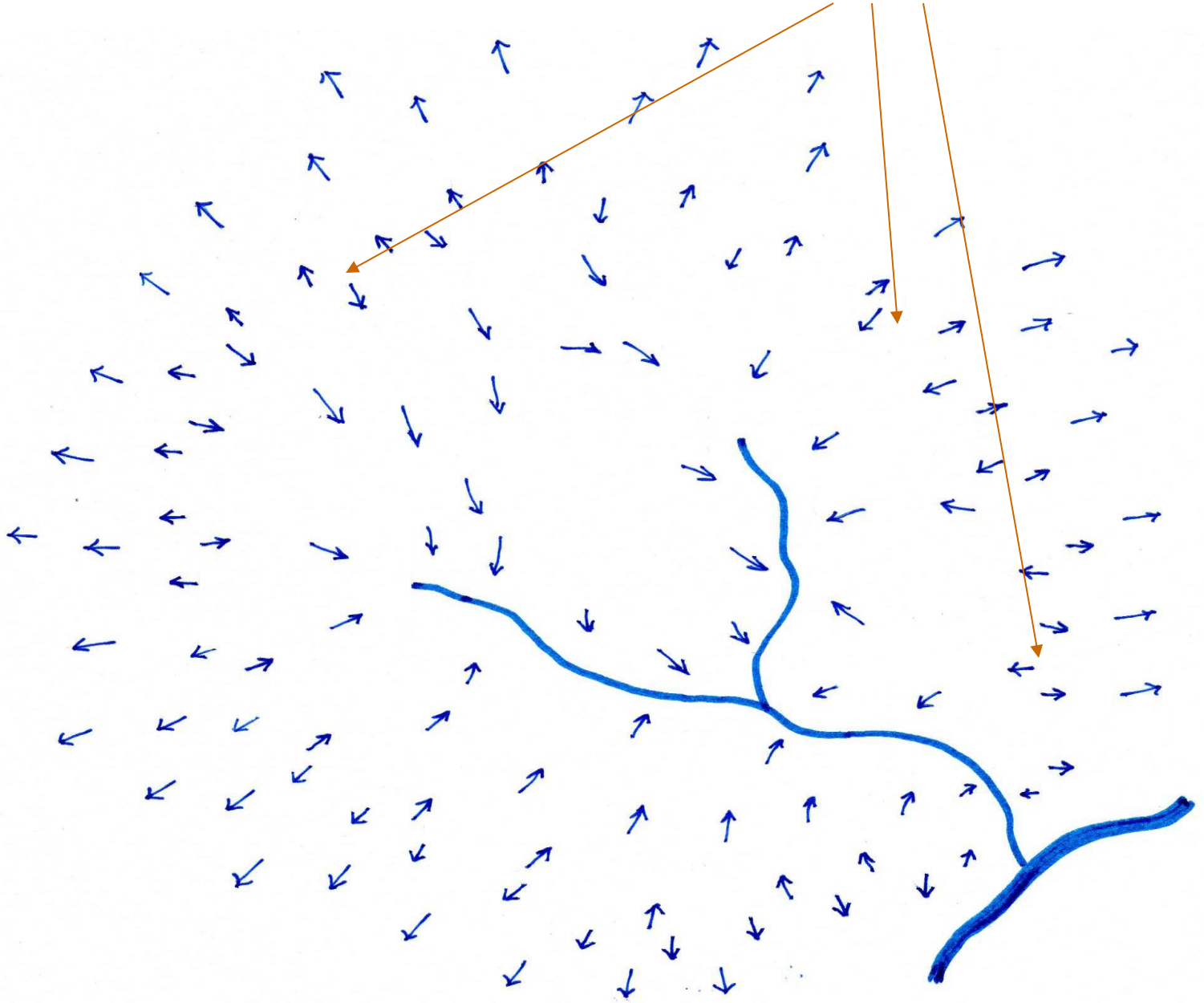
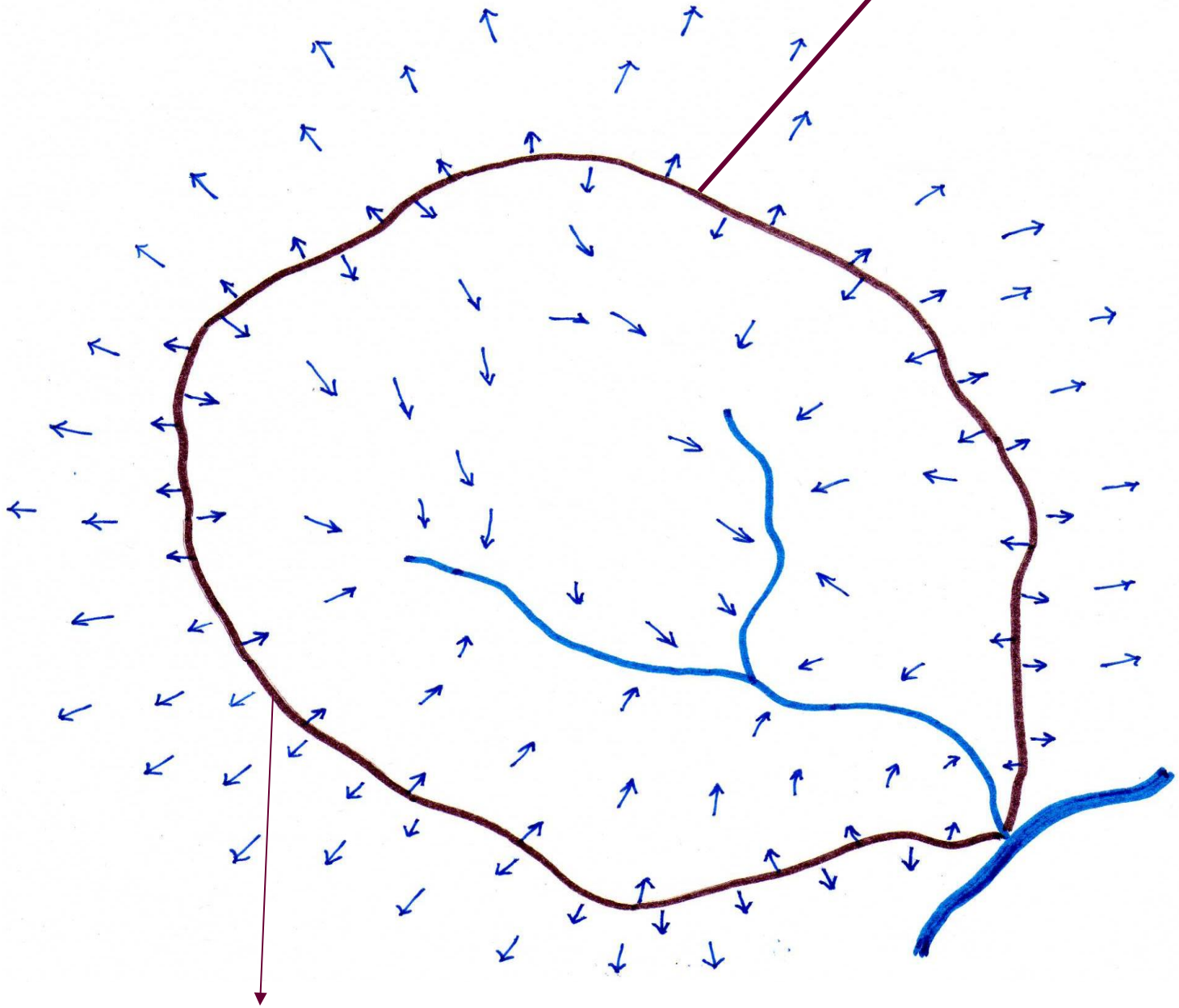
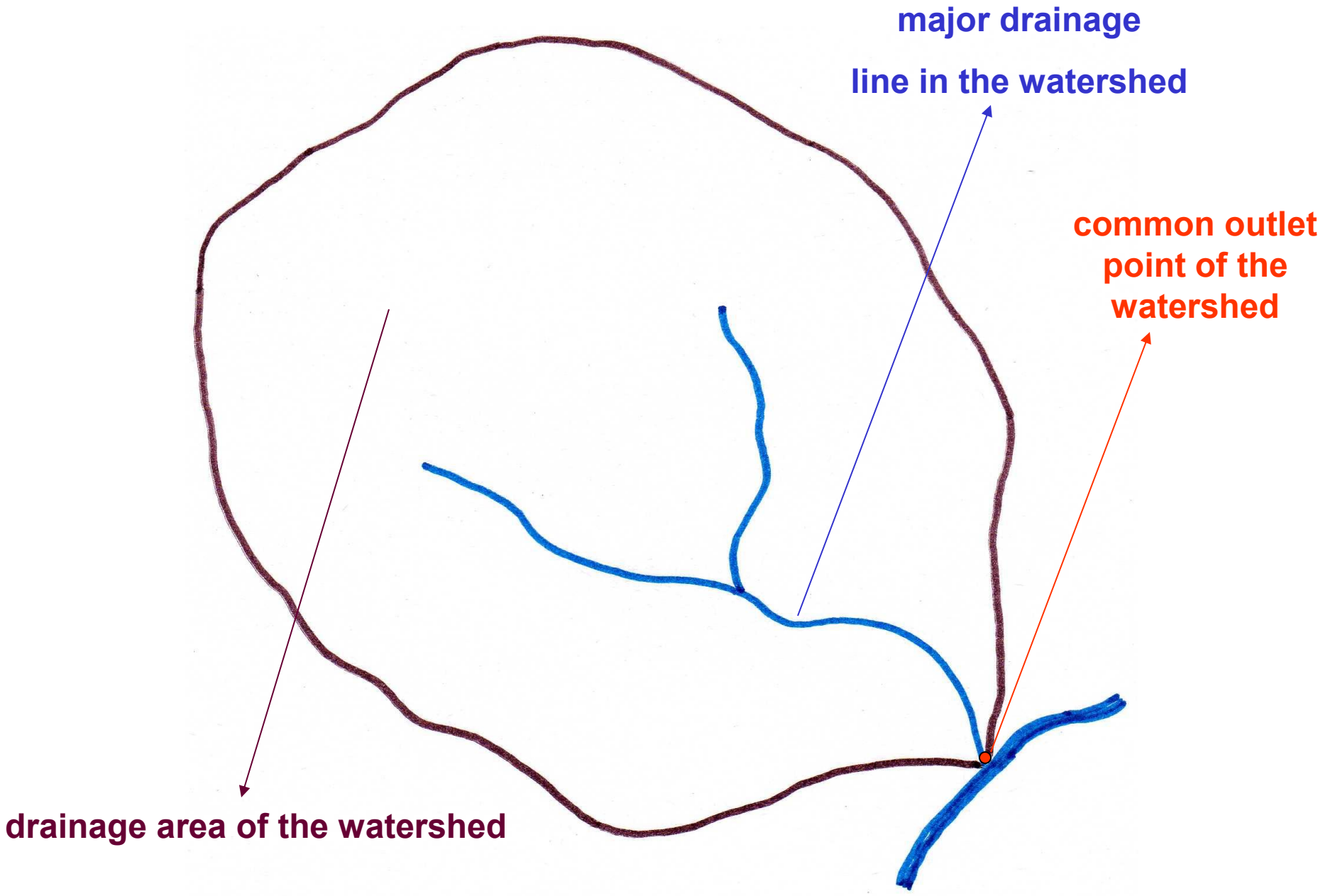

catchments
catchments
catchments
catchments
catchments
flow direction
river

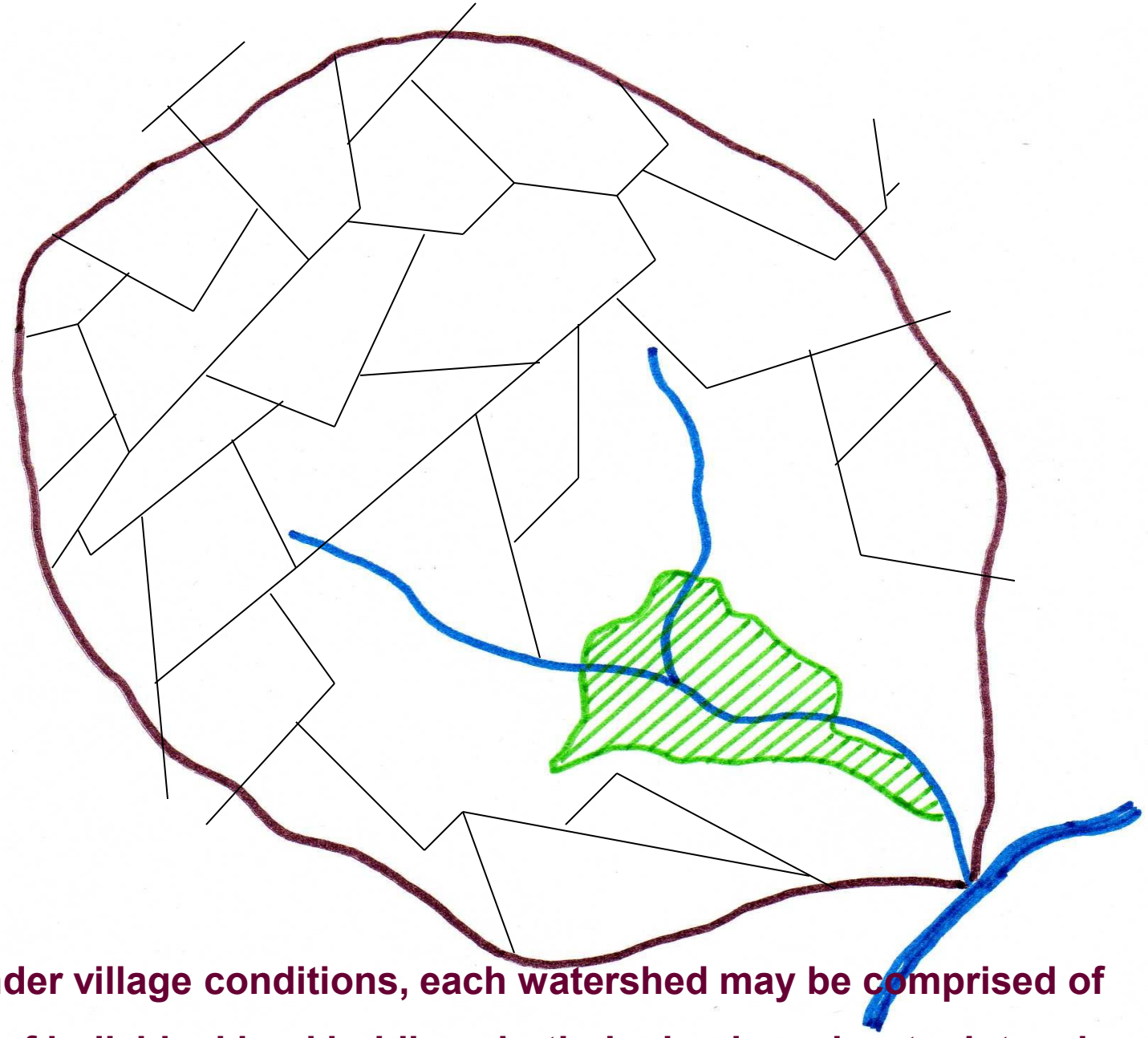
an imaginary line dividing the flow directions is passing through these points



the divide line of a drainage area

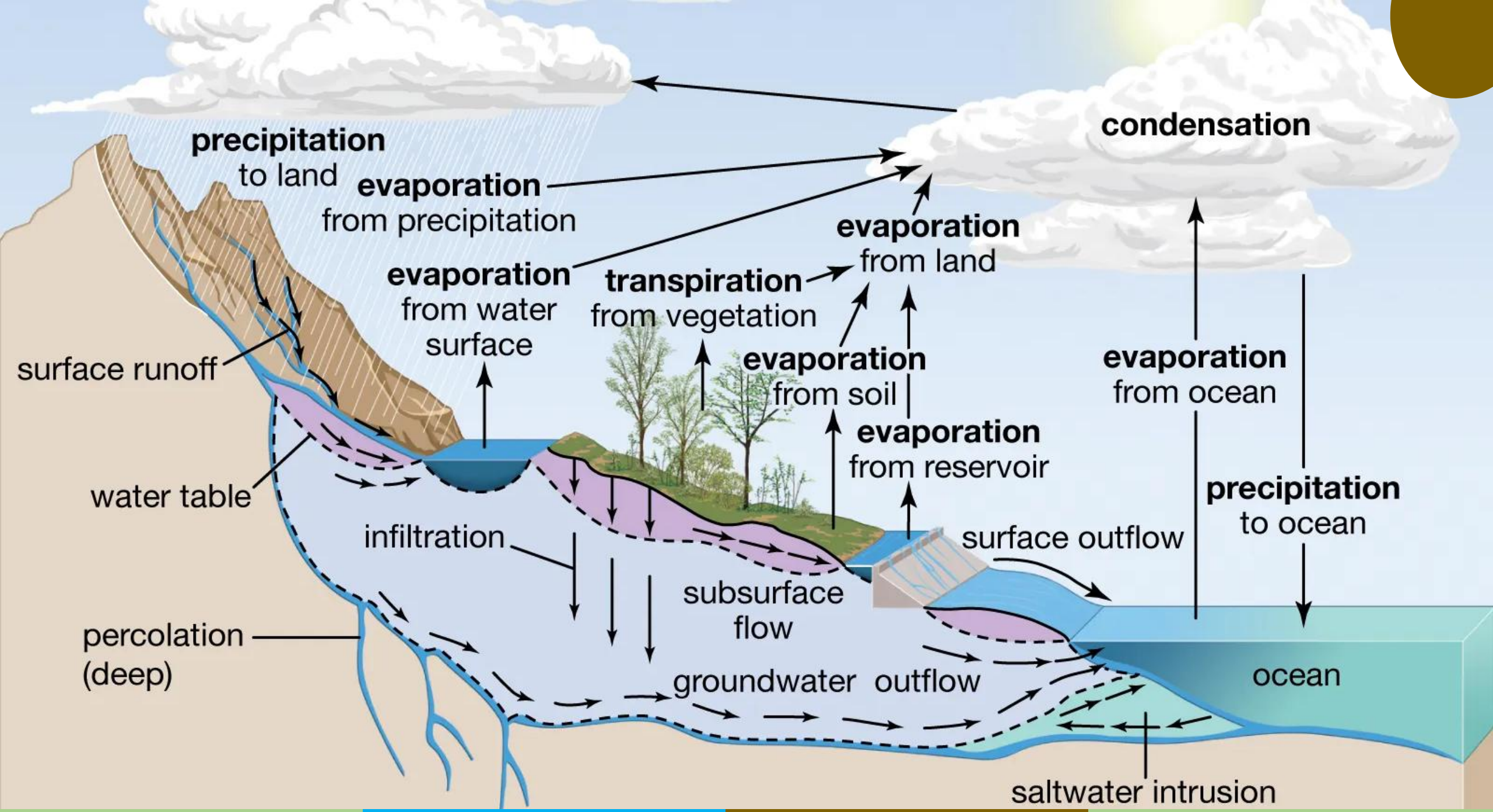



major drainage
line in the watershed
common outlet
point of the
watershed
drainage area of the watershed



under village conditions, each watershed may be comprised of

hundreds of individual land holdings both dry lands and water intensive crops


condensation
precipitation
to land
evaporation
from precipitation
evaporation
from water
surface
transpiration
from vegetation
evaporation
from land
evaporation
from soil
evaporation
from reservoir
evaporation
from ocean
precipitation
to ocean
surface runoff
water table
infiltration
surface outflow
subsurface
flow
percolation
(deep)
groundwater outflow
ocean
saltwater intrusion

What is a Slope?

- Slope is essentially the change in height over the change in horizontal distance and is often referred to as rise over run.
- Slope = $\frac{\Delta Y}{\Delta X}$
- Or Slope = Change in Height/ Change in Horizontal Distance

Formula for Slope

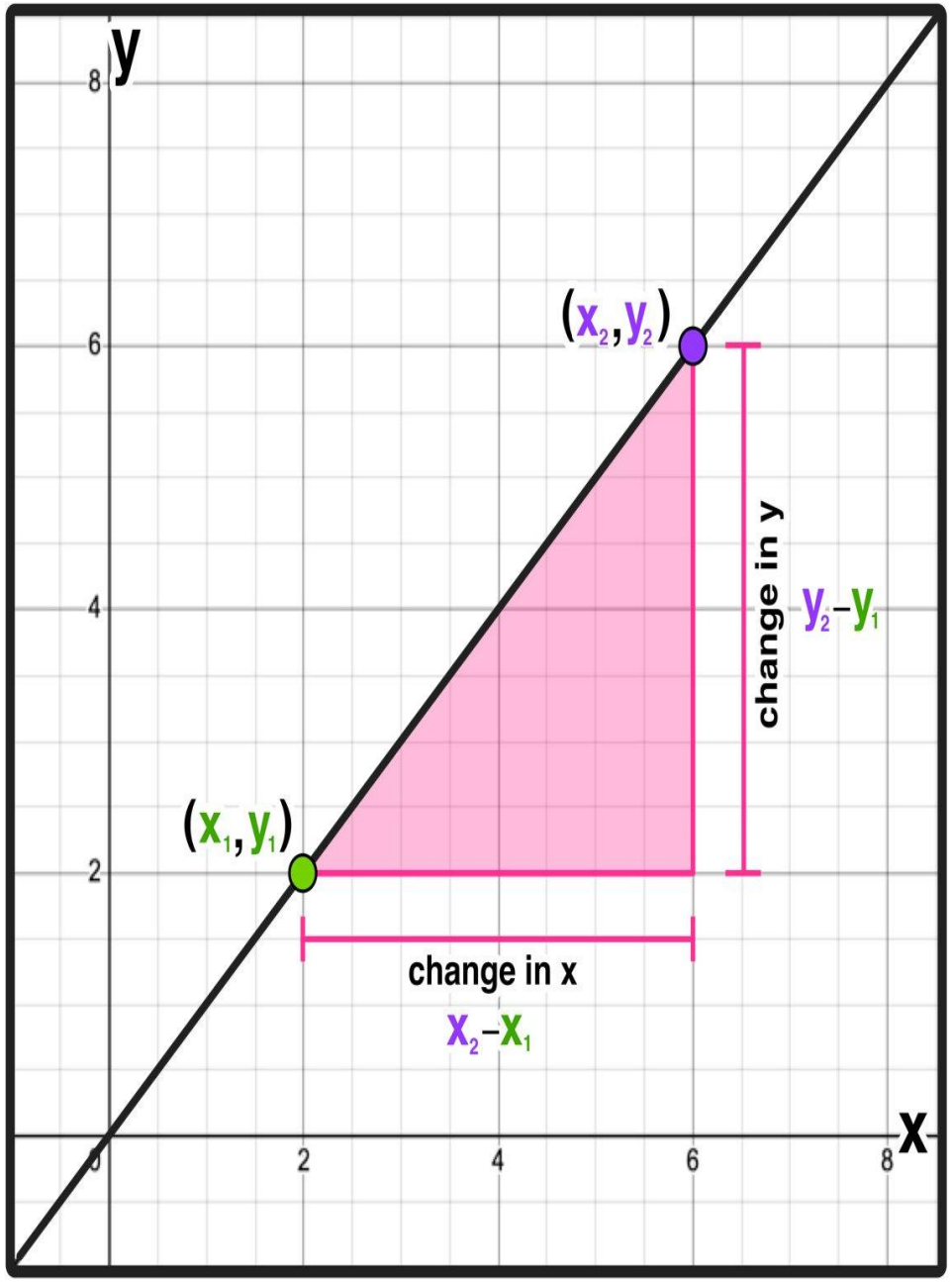
Given two points with coordinates:

(x_1, y_1) ← The 1st point has the 1 subscript

(x_2, y_2) ← The 2nd point has the 2 subscript

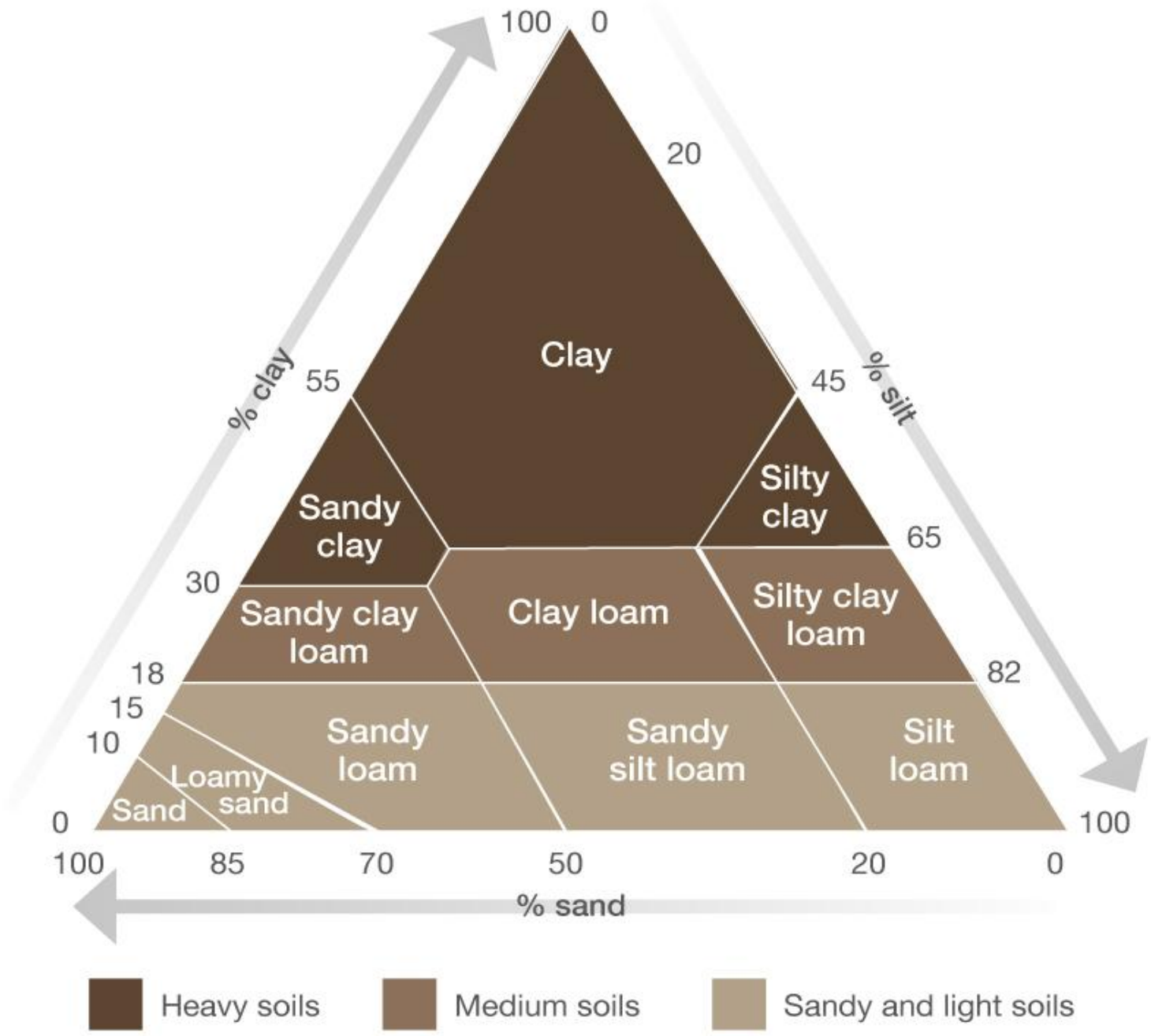
The slope, m, of the line that passes through them is equal to:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



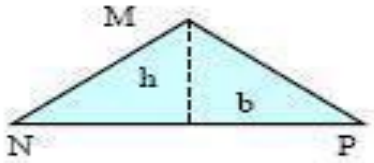
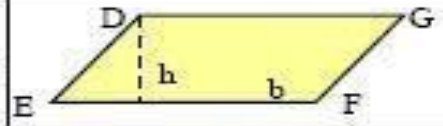
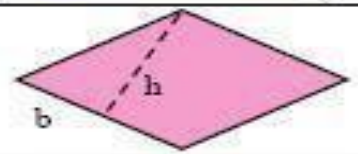
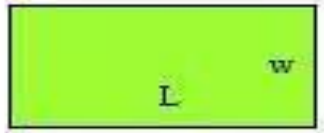
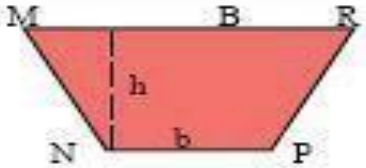
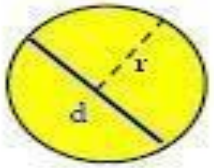
Soil Types (ISSCS)

- Clay < 75 micron but having considerable strength.
- Silt < 75 micron
- Sand – 4.75 mm to 75 micron
- Gravel – 80mm to 4.75 mm



General Formulas

- 1 Hectare = 10,000 square Meters
- 1 Hectare = 2.50 acre
- 1 meters = 3.28 feet
- 1 meters = 1000 millimeters
- 1 meters = 100 centimeters
- 1 Acre= 4000 square meters
- 1 cubic meter= 1000 liters

NAME	FIGURE	AREA	PERIMETER CIRCUMFERENCE
TRIANGLE		$A = \frac{b \times h}{2}$	$P=MN+NP+PM$
PARALLELOGRAM		$A = b \times h$	$P=DE+EF+FG+GD$
RHOMBUS		$A = b \times h$	$P = b+b+b+b$ $P = 4b$
RECTANGLE		$A = L \times w$	$P = L+w+L+w$ $P = 2L+2w$
SQUARE		$A = l^2$	$P = l+l+l+l$ $P = 4l$
TRAPEZOID		$A = \frac{(B+b) \times h}{2}$	$P=MN+NP+PR+RM$
CIRCLE		$A = \pi r^2$	$C = 2\pi r = \pi d$

Water Budgeting And Planning in Watershed Development

- Water budgeting is the process of assessing the volume of additional rainwater to be harvested in the watershed area and to plan harvesting structures accordingly. It also involves calculating the volume of water required for human, livestock, agriculture and for maintaining the ecological balance sustainably.

- Steps for the calculation of the amount of water to be harvested are:

    1. Calculation of total annual volume of runoff with respect to **catchment area**, **rainfall**, **runoff coefficient** (Qt).
    2. Existing storage capacity of the area (B).
    3. Water Requirement by human life including agriculture purposes, livestock and to maintain ecology keeping 20 years projection in mind (C).
    4. Runoff available for harvesting (D) = Qt – B
    5. Generally, maximum 75% of balance available run off (E) = 0.75x (D) is to be harvested and rest 25% runoff water allowed to flow in the drainage line.
    6. Check whether (E) => (C), if not than make alternative plans like **reducing water demand, mobilizing from neighboring water sufficient area etc.**

Source: '**Samarthya**' Technical Training Manual (MGNREGA), Ministry of Rural Development, GoI

Calculation of total annual volume of runoff in a watershed (surface water yield)

$$Qt = C * R * A$$

Where,

Qt = Annual Volume or Quantum of Surface Run-Off (In Cubic Meters)/ Surface Water Yield of a Watershed.

C = is the co-efficient of run off

R = is the annual rainfall (in meters)

A = is the area on which the rain falls (in square meters)

Source: '**Samarthya**' Technical Training Manual (MGNREGA), Ministry of Rural Development, GoI

Table 2-2: Coefficient for Estimating Run-off

Land Use & Slope	Sandy Loams	Clay/Silty Loams	Silty Clay
Cultivated Land			
0- 5%	0.30	0.50	0.60
5- 10%	0.40	0.60	0.70
10 - 30%	0.52	0.72	0.82
Pasture Land			
0- 5%	0.10	0.30	0.40
5- 10%	0.16	0.36	0.55
10 - 30%	0.22	0.42	0.60
Forest Land			
0- 5%	0.10	0.30	0.40
5- 10%	0.25	0.35	0.50
10 -30%	0.30	0.50	0.60

(Source: Dhruvnarayana, 1993)

Source: '**Samarthya**' Technical Training Manual (MGNREGA), Ministry of Rural Development, GoI

Toposheet (Survey of India)

Google Earth Pro (Open GIS source)

Resource Map, Transect Walk, Seasonal calendar, Timeline

Understanding the village-Area

Thank You!

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