RELIEF AND DRAINAGE BASIN MORPHOMETRY ; PART - I

E –CONTENT
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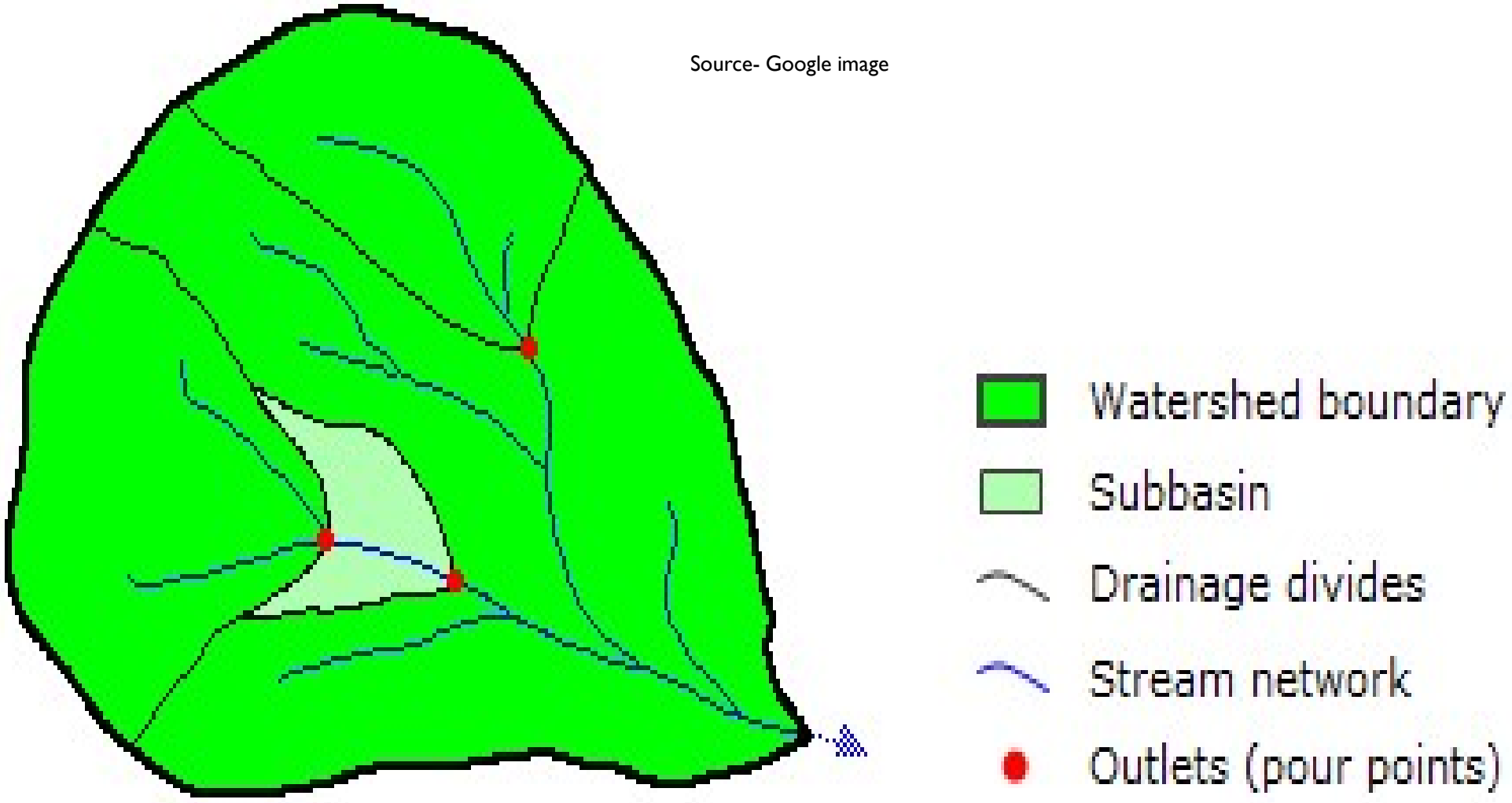
LEARNING OBJECTIVES

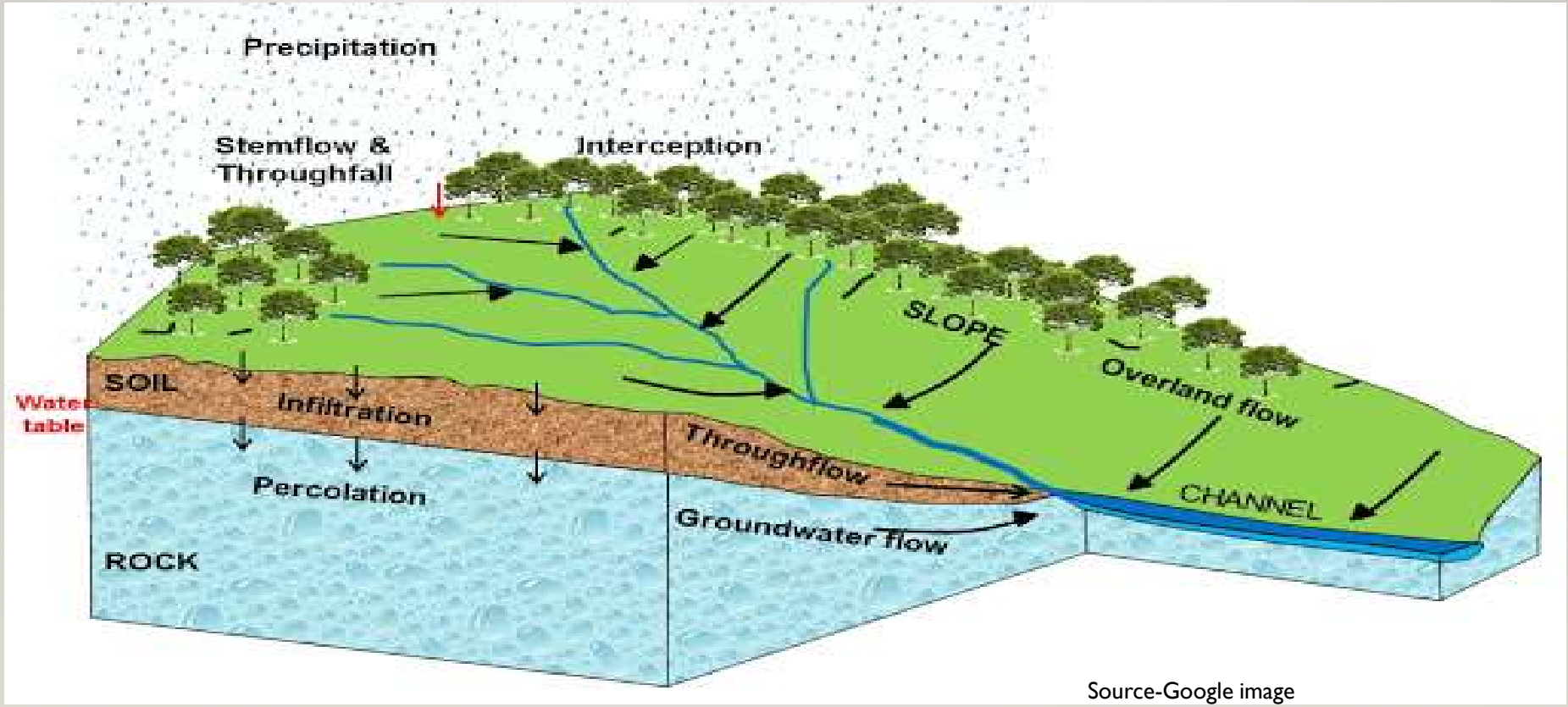
- Drainage basin as a system unit.
- Variables defining the characteristics of river basin .
- Brief history on Morphometry.

RIVER BASIN AS A SYSTEM UNIT

- RIVER BASIN- A river or drainage basin is the entire area drained by a stream or system of connecting streams such that all the streamflow originating in the area is discharged through the single outlet.
- The river basin are delineated by uplands or ridge lines which are called water divides

Source- Google image





Source-Google image

- The evolution of any landscape on our planet, and hence of any drainage basin, is the result of interactions between the flows of matter and energy entering and moving within its limits and the resistance of the topographical surface .In the normal conditions , precipitation is the major source of matter and solar radiation is the major source of energy . The resistance of the topographical surface is determined by its altitude, the resistance to erosion of the constituent rocks the percentage of plant cover, the presence of a layer of soil, etc. The inter- relationships between these factors and their distributions in time and space govern to a great extent the evolution and present state of drainage-basin topography.

. INPUTS OF MATTER AND ENERGY.

- a drainage basin can be described as an open system which permanently exchanges matter and energy with its surroundings.
- **Precipitation. -The most important form of matter entering a drainage basin is provided by precipitation.**
- **Underground inputs-Sometimes, an underground flow of water from other basins may appear on the flank of a syncline or anticline.**
- **Inputs due to wind-matter carried by the wind may also penetrate into a drainage basin. This may be liquid precipitation carried over a drainage divide by strong winds ; snow, which can also be moved easily by strong winds from one basin into another.**
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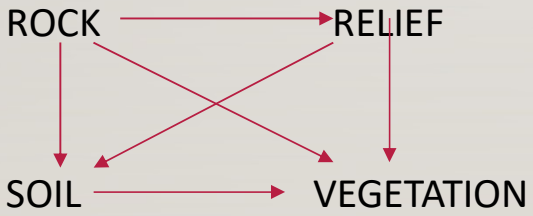
- **solar radiation)-the major source of energy for a drainage basin is solar radiation, which at the upper limit of the atmosphere is of the order of 2 cal /cm/min, a value known as the solar constant. More than one-half of this energy returns into outer space following certain processes that occur in the atmosphere and at the Earth's surface ; approximately 9 % is returned by diffuse reflection and 25% by diffusion from clouds and the ground ; approximately 19 % is absorbed by the atmosphere and clouds. Hence, leaving these losses (totalling 53 %) aside, the remaining 47 % reaches the Earth's surface either directly through the atmosphere (41%) or through diffuse sky radiation (6%) (Strahler and Strahler, 1973)**

OUTPUT OF MATTER AND ENERGY

- **Runoff.-This is the amount of water which enters a stream net- work via overland flow and leaves the respective basin through its mouth. It is estimated as volume per unit time (m3/s) .**
- **Evapotranspiration-**
- **The amount of water leaving a basin area through evapo-transpiration depends on a number of general and local factors. One quantitative general factor determining this phenomenon is the amount of insolation the drainage basin receives, which depends on its location on the globe. Local factors include plant cover, and the nature and type of superficial deposits. A well-vegetated basin not only retains a greater amount of water which evaporates easily, but large amounts of water are also released into the atmosphere through transpiration. In contrast, soil poorly protected by plant cover allows greater amount of runoff, which carries a proportional quantity of mineral matter away from the basin area.**
- **Outputs due to man's action- The construction of domestic and industrial water supplies, or of canals linking various waterways of the same system or of adjoining basins, transferring variable amounts of water, cannot but influence the flow and transfer of matter within a drainage basin**
- Energy output- through evaporation. Hence, huge amounts of energy may leave a basin through latent heat of evaporation.

VARIABLES DEFINING THE CHARACTERISTICS OF A BASIN

- The present surface of any drainage basin is the result of a long process of evolution, in the course of which dynamic equilibrium has been achieved between the general flows of matter and energy and the variables which define the behaviour of the basin towards these flows.



- **Rock-** is a very important element, both as a support for other elements and in forming the morphometrical features of drainage basins. The relief of a basin depends to a great extent on the degree of resistance of the rocks making up its surface. The main physical properties of rocks are porosity, specific weight, compactness, permeability and solubility, while the main mechanical properties are cohesiveness, resistance to mechanical stress and perforation, and especially hardness and resistance to wear, and to com- pression, traction, shearing and bending which dircly and indirectly influences the geology and structure of the river basin. The type of rock also influences the soil layer and vegetation.

- **Relief** is the totality of land forms in a given drainage basin. The current aspects and characteristics are the result of a long process of evolution and interaction between internal and external factors.
- **Soil** is another component which depends on the type of rock, on vegetation, on the spatial position of a basin, and hence on climatic factors. texture is one of the most important characteristics.
- **Vegetation** is another element of the basin surface which depends on the soil, rocks, relief and location of a basin. Through its influence on climatic conditions and hydrological proeesses, vegetation affects the circulation, spatial distribution and annual regime of energy and matter within a basin.

BRIEF HISTORY ON MORPHOMETRY

- **Morphometry** – Measurement of external forms / detailed evaluation of landforms through mathematical measurement.
- Stared by Egyptians, reconstitute the boundaries separating estates which were wiped away by each flood of the Nile.
- science of land measurement developed into a branch of mathematics are generally known. Since the etymology of the word geometry (geometrein, to measure the land).
- the term **Geomorphormetry** as used by Morisawa (1962) has been adopted as denoting the science dealing with measurements of the form of the Earth's crust

- During the Renaissance, Leonardo da Vinci in the 16th century and Galileo Galilei in the 17th established the qualitative observation that the longitudinal profiles of rivers take the form of a concave curve.
- The expansion of trade and the increasing number of voyages and geographical expeditions in the 16th century resulting in the achievement of the first world map by Mercator.
- Carl Ritter, who related the areas of the continents to the squares of their perimeters or to the areas of the smallest circumscribed circles, thereby obtaining a circularity index.(1826).

- The principle of the hypsometric curve .was established in 1854 by Carl Koritska. In 1888 John Murray applied the method to ocean floors, and in 1894 Albrecht Penck corrected it to the form used subsequently for continents, islands, mountain ranges, etc
- The last decades of the 19th century saw the first use of morphometrical elements in hydrology.

SUGGESTED READINGS

- Thornbury ,W.D.(1960):"*Principles of Geomorphology*",CBS publishers and distributors pvt ltd.
- A. N. Strahler,"Quantitative geomorphology of drainage basin and channel networks," in *Handbook of Applied Hydrology*, V. T. Chow, Ed., McGraw Hill, New York, NY, USA, 1964.
- Singh, savindra ,(2018):"*Geomorphology*", Prayag pustak bhawan,Allahabad.