SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution Coimbatore – 35

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DEPARTMENT OF AGRICULTURAL ENGINEERING

19AGE308
WATERSHED PLANNING AND MANAGEMENT

Watershed Characteristics: Physical and Geomorphologic Characteristics associated with Watersheds

- **Areal aspects:**

Watershed Area (Aw):

•Drainage area, basin area and catchment area are the synonyms of watershed area.
•It is the area surrounded by the ridge line / divide of that watershed.
•It can be expressed in m^2 , hectares or Km^2 .
• It is an important morphological feature as the amount of runoff is influenced by it.
Watershed area is having two components stream area and inter basin area (Fig. 8).

Areal aspects:

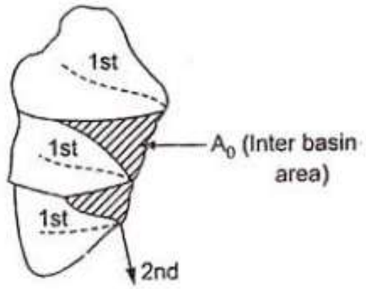


Fig. 27.7. View of inter-basin area

Fig. 8. Stream areas & inter basin areas

The stream area discharges its runoff to stream order number 1 but inter basin area discharge its runoff directly to the stream order higher than 1.

Watershed Shape:

•Watershed may have several shapes. Broadly we may consider fan shaped (circular) and fern shaped (elliptical) watershed.

•Shape is closely related to contribution of runoff to outlet.

•In fan shaped watershed the runoff from various parts accumulate to outlet at almost same time thus magnitude of peak runoff is high.

•In fern shaped watershed the runoff from various parts reach gradually to outlet thus magnitude of runoff is lower as compare to fan shaped watershed.

•The watershed shape is reflected by number of parameters like form factor, shape factor, circulatory ratio, elongation ratio and compactness coefficient

- **Form Factor (Rf)**

•It is defined as the ratio between watershed area (Aw)and the square of watershed length (Lw).

•It is a dimensionless number and will always be less than 1.

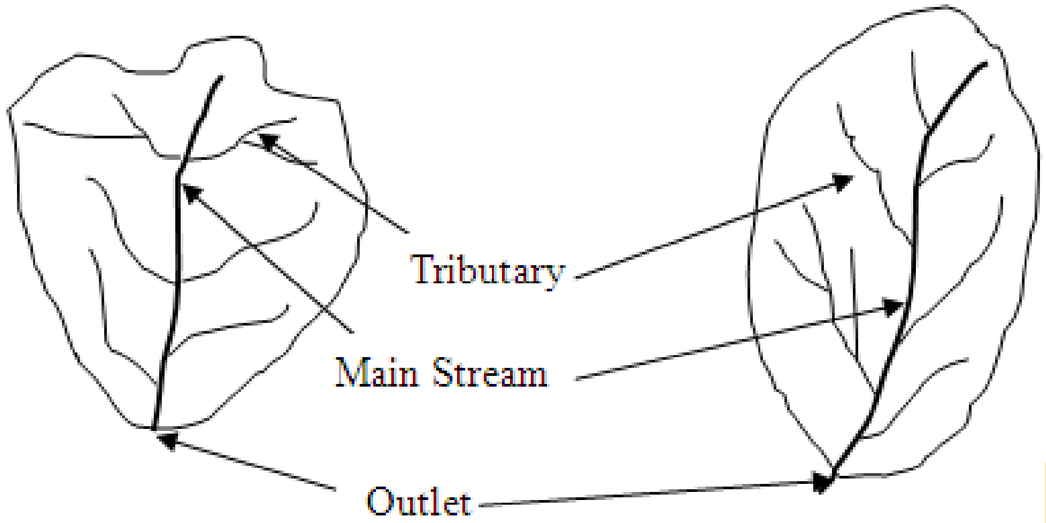
•For a perfectly fan shaped (circular) watershed the numerical value of form factor will be 0.786.

•Fern shaped watershed has value smaller than 0.786.

• Smaller numerical value of form factor indicates the more elongation of watershed.

watershed.

Form Factor $R_f = A_w / (L_w)^2$



- **Shape Factor**

It is defined as the ratio between watershed area (Aw) and the square of main flow path. It is a dimensionless number and will always be less than 1.

Elongation Ratio (Re):

•Elongation ratio is defined as the ratio of diameter of a circle of the same area as the watershed to the maximum watershed length.

• The numerical value varies from 0 (in highly elongated shape) to 1 (in circular shape). These values can be grouped as,

Elongation ratio	Shape of watershed
< 0.7	Elongated
0.8-0.7	Less elongated
0.9-0.8	Oval
> 0.9	Circular

- **Circularity Ratio (Rc)**

•Circulatory ratio is defined as the ratio of watershed area to the area of the circle having the same perimeter as the watershed perimeter.

•The numeric value may vary in between 0 (in line)and1 (in a circle).

• In general most of the watersheds have values from 0.2 to 0.8.

Compactness Coefficient :

Compactness coefficient is defined as the ratio of the watershed perimeter to the circumference of equivalent circular area.

Stream Frequency (Fs):

Stream frequency is defined as the number of stream segments per unit area

Drainage Density (Dd):

Drainage density is defined as total length of all streams per unit area of watershed.

- Relief aspects

Watershed Slope (Sw):

•It is very important property as it affects the velocity, momentum of runoff and erosion potential of watershed.

• It also affects the ground water recharge. It is the rate of elevation difference along the principal flow path.

• It is calculated as the elevation difference between the two end points of the main flow path divided by its length.

$$S_w = h_f / L_f$$

Where S_w is the slope of watershed in m/m, h_f is the elevation difference between upper and lower points of main flow path in m, and L_f is the length of main flow path in m.

- Watershed Relief (H):

Watershed relief is the elevation difference between highest and lowest points of valley floor.

Relief Ratio (Rh):

•Relief ratio is defined as the ratio between watershed relief and the longest dimension of the watershed parallel to the main flow path.

•High numeric value of relief ratio indicates the steep slope and vice-versa.

Parameter (author)	Definition	Formula	Value
Form factor (Horton, 1932)	$\frac{\text{Watershed area}}{(\text{Watershed length})^2}$	$\frac{A}{L^2}$	<1
Shape factor, B_s (U.S. Army Corps of Engineers, 1954)	$\frac{(\text{Watershed length})^2}{\text{Watershed area}}$	$\frac{L^2}{A}$	>1
Elongation ratio (Schumm, 1956)	$\frac{\text{Diameter or circle of watershed area}}{\text{Watershed length}}$	$\frac{1.128A^{0.5}}{L}$	≤1
Circularity ratio (Miller, 1959)	$\frac{\text{Watershed area}}{\text{Area of circle of watershed perimeter}}$	$\frac{12.57A}{P_s^2}$	≤1
Compactness coefficient (Strahler, 1964)	$\frac{\text{Watershed perimeter}}{\text{Perimeter of circle of watershed area}}$	$\frac{0.2821P_s}{A^{0.5}}$	≥1

* A = watershed area, L = watershed length, and P_s = perimeter.