1. PRECIPITATION AND GENERAL ASPECTS OF HYDROLOGY

INDEX OF WETNESS

- $\text{Index of wetness} = \dfrac{\text{rainfall in a given year at a given place}}{\text{average annual rainfall of that place}} \times 100$
- % Rain deficiency = 100 – % Index of wetness

ARIDITY INDEX

$$A.I = \frac{PET - AET}{PET} \times 100$$

where, A.I. = Aridity Index
PET = Potential Evapo-transpiration
AET = Actual Evapotranspiration

(a) $AI \le 0 \rightarrow$ Non arid (b) $1 \le A.I \le 25 \rightarrow$ Mild Arid
(c) $26 \le A.I \le 50 \rightarrow$ Moderate Arid (d) $A.I > 50 \rightarrow$ Severe Arid.

Remember: In this AI calculation, AET is calculated according to Thornthwaite's water balance technique.

OPTIMUM NUMBER OF RAIN GAUGE : (N)

$$N = \left(\frac{C_v}{\epsilon}\right)^2 \qquad C_v = \frac{\sigma}{\bar{x}} \times 100 \qquad \sigma = \sqrt{\frac{\Sigma (x - \bar{x})^2}{(n-1)}} \qquad \bar{x} = \frac{\Sigma x}{n}$$

where, C_v = Coefficient of variation, ϵ = Allowable % Error,
σ = Standard deviation of the data, n = Number of stations
$\bar{x}$ = Mean of rainfall value

ESTIMATION OF MISSING RAINFALL DATA

(a) $$P_x = \frac{P_1 + P_2 + \ldots + P_n}{(n-1)}$$ If $N_1, N_2 \ldots N_n < 10\%$ of N_x

where, $N_1, N_2, \ldots N_x \ldots N_n$ are normal annual precipitation of 1, 2, ... x ... n respectively.
$P_1, P_2 \ldots P_n$ are rainfall at station 1, 2, ... n respectively.
and P_x is the rainfall of station x.

Case : A minimum number of three stations closed to station 'x'

$$P_x = \frac{P_1 + P_2 + P_3}{3}$$

(b) $$P_x = \frac{N_x}{n-1}\left[\frac{P_1}{N_1} + \frac{P_2}{N_2} + \ldots + \frac{P_n}{N_n}\right]$$ If any of $N_1, N_2, N_3 \ldots$ $N_n > 10\%$ of N_x

MEAN RAINFALL DATA

To convert the point rainfall values at various stations into an average value over a catchment the following three methods are in use

(i) **Arithmetic Avg Method:** When the rainfall measured at various stations in a catchment show little variation, the average precipitation over the catchment area is taken as the arithmetic mean of the station values.

$$P_{avg} = \frac{P_1 + P_2 + \ldots + P_n}{n}$$

where, $P_1, P_2 \ldots P_n$ are rainfall values of station 1, 2, ... n respectively.

In practice this method is used very rarely.

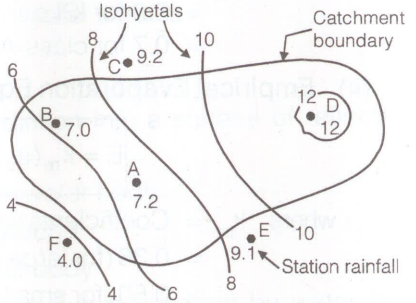
(ii) **Thiessen Polygon Method:** In this method the rainfall recorded at each station is given a weightage on thebasis of an area closest to the station.

$$P_{avg} = \frac{P_1A_1 + P_2A_2 + \ldots + P_nA_n}{A_1 + A_2 + \ldots + A_n}$$

where, $P_1, P_2, \ldots P_n$ are the rainfall data of areas $A_1, A_2 \ldots A_n$.

The Thiessen-polygon method of calculating the average percipitation over an area is superior to the arithmetic average method.

(iii) **Isohyetal Method:** An isohyet is a line joining points of equal rainfall magnitude. The recorded values for which areal average P is to be determined are then marked on the plot at appropriate stations. Neighbouring stations outside the catchment are also considered.



$$P_{avg} = \frac{A_1\dfrac{(P_1 + P_2)}{2} + A_2\dfrac{(P_2 + P_3)}{2} + \ldots A_{n-1}\dfrac{(P_{n-1} + P_n)}{2}}{A_1 + A_2 + \ldots + A_{n-1}}$$

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