

## Chapter 12

### ARID, SEMI-ARID AND HUMID REGIONS

Climates can be classified on the basis of temperature, barometric pressure, humidity, sunshine, evaporation, rainfall and prevailing winds in a particular place or region. From the viewpoint of irrigation, the classification based on rainfall is reasonable, i.e., if

a.a.r. < 40 cm	—arid climate
a.a.r. = 40–75 cm	—semi-arid climate
a.a.r. > 75 cm	—humid climate

average annual rainfall (a.a.r.)

Some of the characteristic features of each type of climatic region are enumerated below:

#### ***Arid Regions***

- (i) a.a.r. < 40 cm; a drought is a normal state of affairs, and while calculating runoff each fall of rain has to be considered as a separate unit.
- (ii) A little rainfall occurs once in a while with a wide variability with respect to time and space.
- (iii) A very high temperature and hot climate; there is scarcity of water; unfit for irrigation and no regular crops can be grown.
- (iv) Evaporation losses are very high. Any slight precipitation will be lost by evaporation; water has to be applied to crops by special methods like ‘drip’ and ‘sprinkler irrigation’; salt-concentration problems occur in irrigated soils near root zones.
- (v) Rainfall is mostly during summer and is given by

$$R < (T + 14)$$

Where R = annual rainfall in cm

T = average annual temperature in °C

The arid zone of Rajasthan receives = 40 cm of rainfall per year.

- (vi) Streams carry only surface runoff and flow immediately following periods of intense rainfall; hence, they are intermittent.
- (vii) The ground water table if at all exists, is very deep and is always below the bed of the stream; most of the streams are ephemeral.
- (viii) The infiltration capacity of the soil is nearly constant throughout the year. All the infiltration may be considered as a water loss and the water once infiltrated never reaches the stream draining the basin nor the ground water storage has any significance.
- (ix) From the records of a number of intense storms and their hydrographs of surface runoff, the average infiltration capacity of a basin can be determined. This average value can be applied to each intense storm and the resulting runoff can be found.
- (x) Afforestation provides a mechanical obstacle to the free sweep of wind, reducing in the process the wind velocity, soil erosion and evaporation from soil.

- (xi) Sand dune stabilisation is considered an important work in the arid regions. The most Central Arid Zone Research Institute (CAZRI) directed their efforts towards control of desertification through afforestation and sand dune stabilisation (since wind-swept sand from deserts can bury anything coming in the way).
- (xii) Reduction in grazing land. In the arid parts, the population density is 3 per km<sup>2</sup> in most deserts of the world. Along with the rise in the human population, the livestock population too is on the increase (. 200 per ha). The result has been over use of the grazing land and depletion of natural vegetation resources. More and more marginal land is being brought under the plough, reducing the area of grazing land, trees and shrubs.

### ***Semi-Arid Regions***

- (i) The a.a.r. = 40 to 75 cm; a semi-arid region usually receives precipitation during winter and spring.
- (ii) Rainfall occurs during a particular season of the year and it may be virtually non-existent in other parts of the year.
- (iii) Only during the rainy season, the stream flow is continuous; during the dry season the stream becomes dry most of the time and carries water intermittently after an occasional heavy storm. The stream flows are usually of too short duration to develop a stable channel section and occasional high flood flows may change the cross-section radically.
- (iv) Moderate precipitation and temperature higher than normal. Average elevation-precipitation curves from precipitation data will be more useful for semiarid regions.

$$R \text{ lies between } (T + 14) \text{ and } 2(T + 14)$$

where R = annual rainfall in cm

T = annual average temperature in °C

- (v) Major loss of water is by evapotranspiration and the evapotranspiration losses range from 40 cm/year for barren rocky areas to 90 cm/year for heavy forest areas.
- (vi) The ground water table occurs at moderate depth.
- (vii) Wide variability of hydrologic factors with respect to time and space are a characteristic feature; for example, vegetative cover may vary radically across a basin—thick vegetation in higher altitudes and barren land in lower reaches.
- viii) Probability and duration studies (flow duration, drought duration) are essential to determine the available flow or drought period in a long term climatological cycle (or swing).
- (ix) A drought occurs at least once in a year except in abnormal years,
- (x) Even in a single river basin, the hydrological processes in semi-arid regions differ from area to area.
- (xi) Silting. While sheet erosion is dominant in regions of moderate rainfall, gullying and stream channel erosion are characteristic of arid and semi-arid regions. Sediment deposits in the upper end of reservoirs generally become covered by vegetation resulting in heavy evapotranspiration loss of the available water, which is more critical in arid regions.

### ***Humid Regions***

- (i) High intensity of rainfall (a.a.r. > 75 cm) with not much variability with respect to time and space.
- (ii) High precipitation, low temperature and minimum loss of water. Transpiration is the major water loss amounting upto 80%.
- (iii) Flow in streams is continuous and the ground water table is always above the bed level of the stream, *i.e.*, the streams are mostly perennial.
- (iv) The ground water table is usually at very high elevation and the ground water contributes to streamflow. The change in ground water storage becomes significant.
- (v) Average annual yield can be satisfactorily determined from a comparatively short period of records.
- (vi) Best suited for irrigation and agriculture. Crops can be grown throughout the year due to availability of water supply throughout.
- (vii) A drought does not occur in ordinary years.