



To be Continue in defining of some important terms.

1) Time Factor: is the ratio of the number of days the canal has actually run to the number of days of irrigation period.

2) Base Period (B): it is the period in days which flow is continued for a practical crop.

3) Delta (Δ): is the total depth of water required by a crop during the entire period the crop is in the field.

Example [1]:

For a specific crop that requires about 10 cm depth of water at an average interval of about 10 days, and the crop period is 120 days, find out the delta for this crop.

Solution:

Water is required at an interval of 10 days for a period of 120 days. It means that 12 times of irrigation are required, and each time, 10 cm depth of water is required. Therefore, total depth of water required:

$$\Delta = 12 \times 10 = 120 \text{ cm.}$$

Example [2]:

If a crop requires about 7.5 cm of water after every 28 days, and the base period for crop is 140 days, find out the value of delta for such crop.

Solution:

Base period = Crop period

No. of irrigations required is:

$$No. = \frac{140}{28} = 5$$

Total depth of water required in 140 days = $5 \times 7.5 \text{ cm} = 37.5 \text{ cm}$

$$\Delta = 37.5 \text{ cm.}$$



4) Duty: represents the irrigating capacity of a unit of water. It is the relation between the area of a crop irrigated and the quantity of irrigation water required during the entire period of the growth of that crop. It also may be defined as the number of hectares of land irrigated for full growth of a given crop by supply of (1m³/sec) of water continuously during the entire base period (B) of that crop.

4.1) Relation between Duty and Delta:

Let WD is the water duty in hectares/cumec,

Δ is the total depth of water supplied in meters.

B is the base period for crop in days.

The volume of water applied to irrigate such crop during B days is:

$$V = (1 \times 60 \times 60 \times 24 \times B) \text{ m}^3$$

$$V = 86400 \times B \text{ m}^3$$

Referring to definition of water duty, one cubic meter supplied for B days to irrigate WD hectares of land.

$$\text{Total depth of water applied on this land} = \Delta \quad \dots\dots(1)$$

$$\text{Total depth of water applied on this land} = \frac{\text{Volume}}{\text{Area}} \quad \dots\dots(2)$$

This quantity of water (V) will be irrigated land of 10⁴ × WD m² of area.

Sub. Eq.(2) in (1) yields:

$$\Delta = \frac{\text{Volume}}{\text{Area}} = \frac{86400B}{10^4WD}$$

$$\therefore \Delta = 8.64 \frac{B}{WD} \text{ m}$$

$$\Delta = 864 \frac{B}{WD} \text{ cm}$$



Example [3]:

Find the delta for a crop when its duty is 864 hectares/cumec on the field, the base period of this crop is 120 days.

Solution:

$$\Delta = 864 \frac{B}{WD} \text{ cm}$$
$$\therefore \Delta = 864 \times \frac{120}{864} = 120 \text{ cm}$$

4.2) Factors Affecting Duty

The water duty of canal system depends upon a variety of the factors that can be summarized as:

1. Methods and system of irrigation, and scheme of applying water to the crops,
2. Type of the crops, time and frequency of tilling,
3. Base period of the crop and climatic conditions of the area,
4. Quality of water and canal conditions,
5. Type of soil and sub-soil of the canal and the irrigation fields.

5) Root Zone Depth: is the maximum depth of soil strata in which the crop extends its root system and extracts water from the soil.

Example [4]:

A crop requires a total depth of 92 cm of water for a base period of 120 days. Find the duty of water.

Solution:

$$\therefore WD = 8.64 \frac{B}{\Delta} = \frac{8.64 \times 120}{0.92} = 1127 \text{ hectares/cumec}$$



6) Irrigation Efficiencies:

Efficiency is the ratio of the water output to the water input, and is usually expressed as percentage. The difference between input and output is the losses. Hence, efficiency is inversely proportional to the losses. Water is lost in irrigation during various processes and, therefore, there are different kinds of irrigation efficiencies.

(I) Efficiency of water conveyance (E_c): It is the ratio of the water delivered into the fields from the outlet point of the channel, to the water entering into the channel at its starting point. It takes the conveyance or transit losses into consideration.

(II) Efficiency of water application (E_a): It is the ratio of the quantity of water stored into the root zone of the crops to the quantity of water. Actually delivered into the field. It may also be called on farm efficiency, as it takes into consideration the water lost in the farm.

(III) Efficiency of water storage (E_s): It is the ratio of the water stored in the root zone during irrigation to the water needed in the root zone prior to irrigation (i.e. field capacity or existing moisture content).

(IV) Efficiency of water use (E_u): It is the ratio of the water beneficially used, including leaching water, to the quantity of water delivered.

Example [5]:

1m³/sec of water is pumped into a farm distribution system 0.8 m³/sec is delivered to 900m apart from the well. *Compute* the conveyance efficiency, conveyance losses.

Solution:

$$E_c = \frac{Q_{\text{Out}}}{Q_{\text{In}}} \times 100 = \frac{0.8}{1.0} \times 100 = 80 \%$$

$$\text{Losses} = \frac{1.0 - 0.8}{0.9} = 0.22 \text{ cumec/Km}$$