I DUTY

Duty- Area of the crop irrigated/ Volume of water required.

Or

It is the number of hectares of land irrigated for full growth of a given crop by a supply of 1 cumec of water continuously during the entire base period of that crop.

1.1 FACTOR AFFECTING THE DUTY

1) Soil Moisture

•In clayey soil less water is required since its retentive capacity is more.

•Pervious soil it will be more.

2) Topography

•Uniform distribution depends on topography.

•If the area is sloping the lower portion will get more water than the flat portion, & hence Water requirement is increase.

3) Nature of rainfall

•If rainfall is high over the crop period water requirement becomes less, otherwise it will be more.

4) Nature of crop irrigated

•Dry crop required less water where as wed crop required more water.

5) Method of cultivation:

•If the fields are properly ploughed it will have high retentive capacity & the number of watering are reduced.

6) Season of crop

•Less irrigation water is required for rainy season crop and the duty increased.

•If the crop grown in summer, more irrigation water is required & the duty gets decreased

7) System of Irrigation

•In perennial irrigation, continuous supply of water is given & hence water table is kept high & percolation losses is minimized

•In inundation type wastage is more by deep percolation.

8) Canal Condition

•Well maintained canal will have more duty as the losses is less.

2.2 IMPROVING DUTY

1. The water losses can be reduced by having the irrigated area nearer to the head of the canal.
2. Evaporation losses can be minimized by using the water as quickly as possible.
3. Water losses can be minimized by lining the canals.
4. The cultivators should be trained to use water economically without wasting.
5. The soil properties should be studied by establishing research stations in villages.

2.3 FACTORS ON WHICH DUTY DEPENDS

1. Type of crop
2. Climate and season
3. Useful rainfall
4. Type of soil
5. Efficiency of cultivation method

2.4 IMPORTANCE OF DUTY

•It helps us in designing an efficient canal irrigation system.

•Knowing the total available water at the head of a main canal, and the overall duty for all the crops required to be irrigated in different seasons of the year, the area which can be irrigated can be worked out.

•Inversely, if we know the crops area required to be irrigated and their duties, we can work out the discharge required for designing the channel.

2.5 MEASURES FOR IMPROVING DUTY OF WATER

The duty of canal water can certainly be improved by effecting economy in the use of water by resorting to the following precautions and practices:

(1) Proper Ploughing:

Ploughing should be done properly and deeply so that the moisture retaining capacity of soil is increased.

(2) Methods of supplying water:

The method of supplying water to the agriculture land should be decided according to the field and soil conditions.

For example,

- Furrow method for crops sown ion rows
- Contour method for hilly areas
- Basin for orchards
- Flooding for plain lands

(3) Canal Lining:

It is provided to reduce percolation loss and evaporation loss due to high velocity.

(4) Minimum idle length of irrigation Canals:

The canal should be nearest to the command area so that idle length of the canal is minimum and hence reduced transmission losses.

(5) Quality of water:

Good quality of water should be used for irrigation. Pollution en route the canal should be avoided.

(6) Crop rotation:

The principle of crop rotation should be adopted to increase the moisture retaining capacity and fertility of the soil.

II DELTA

The depth of water required every time, generally varies depending upon the type of the crop.

OR

The total water depth required for a particular crop to reach maturity conditions

- **Crop period**-the time from the instant of its sowing to the instant of harvesting.
- **Base Period**-time b/w the first supply of water to the land and the last watering before harvesting.

2.1 DUTY AND DELTA OF A CROP

- The total quantity of water required by the crop for its full growth may be expressed in hectare-meter
- Depth to which water would stand on the irrigated area if the total
- Quantity supplied were to stand above the surface without percolation or evaporation.
- This total depth of water is called delta (Δ).

Problem –1**:** If rice requires about 10 cm depth of water at an average interval of about 10 days, and the crop period for rice is 120 days, find out the delta for rice.

***Solution*:**

No. of watering required = 120/10 = 12

Total depth of water required in 120 days = 10 × 12 = 120 cm

Δ for rice = 120 cm

Problem –2**:** If wheat requires about 7.5 cm of water after every 28 days, and the base period for wheat is 140 days, find out the value of delta for wheat.

***Solution*:**

No. of watering required = 140/28 = 5

Total depth of water required in 140 days = 7.5 × 5 = 37.5 cm

Δ for wheat = 37.5 cm

2.2 RELATION BETWEEN DUTY AND DELTA

$$\Delta = 8.64B/D$$

Where,

- Δ=Delta in meter
- D = Duty in Ha/cumec
- B = Base period in days

III CROP WATER REQUIREMENTS OR MOISTURE USE OF CROP

3.1 Soil moisture

- It refers to a soil's water content when practically all pore spaces are filled with water.
- Water present in the soil may be to classified under three heads

1. Hygroscopic water
2. Capillary water
3. Gravitational water

1. Hygroscopic water

Water attached to soil particles through loose chemical bonds is termed hygroscopic water. This water can be removed by heat only. But the plant roots can use a very small fraction of this soil moisture under drought conditions.

2. Capillary water

The capillary water is held within soil pores due to the surface tension forces (against gravity) which act at the liquid-vapour (or water-air) interface.

3. Gravitational water

Gravity water is that water which drains away under the influence of gravity. Soon after irrigation (or rainfall), this water remains in the soil and saturates the soil, thus, preventing circulation of air in the void spaces.

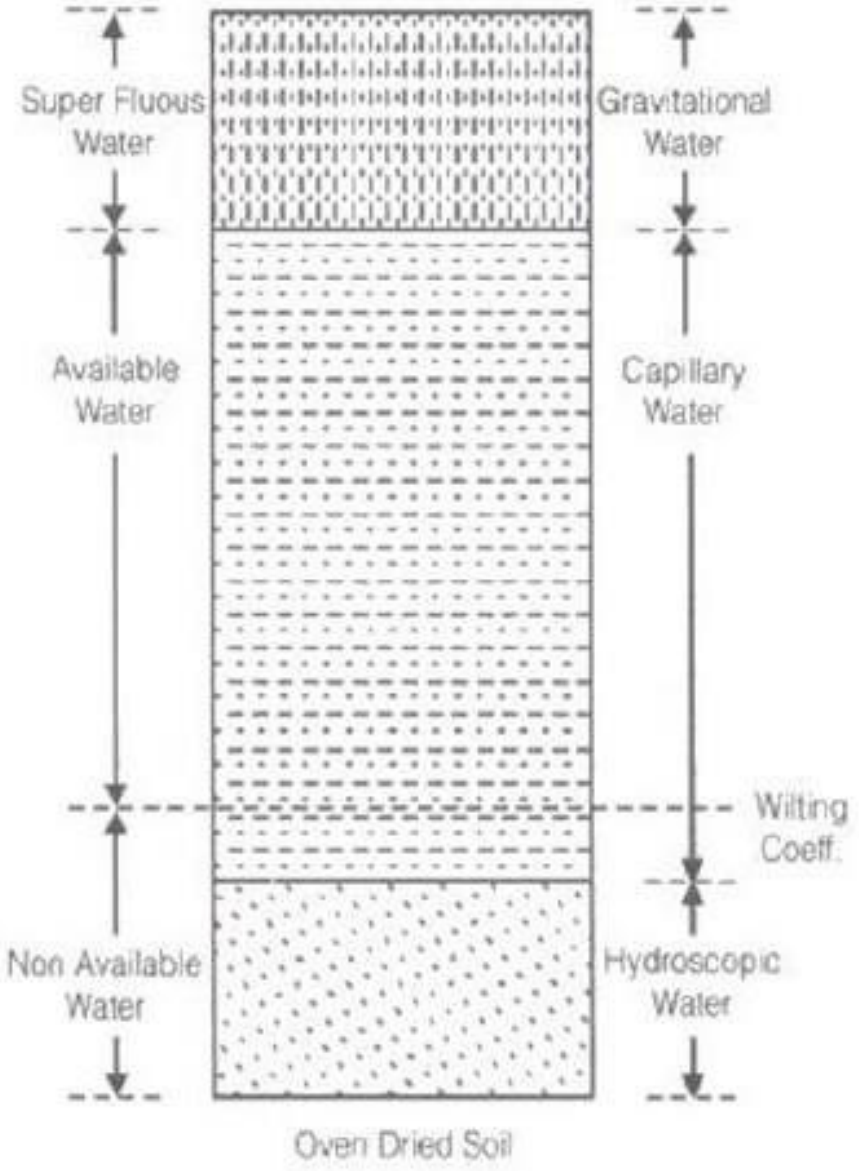
(1) Available moisture for the plant=Fc-Ǿ

(2) Readily available moisture for the plant = FC - Mo

Here FC= field capacity

φ = wilting point or wilting coefficient below plant can't survive.

Mo= Readily available moisture content


Super Fluous Water
Gravitational Water
Available Water
Capillary Water
Wilting Coeff.
Non Available Water
Hydroscopic Water
Oven Dried Soil

(3) Frequency of Irrigation $= \dfrac{weight\ /\ readily\ available\ moisture\ depth}{consumptive\ use\ rate}$

(4) $F_C = \dfrac{weight\ of\ water\ stored\ in\ soil\ of\ unit\ area}{weight\ of\ same\ soil\ of\ unit\ area}$

where, weight of water stored in soil of unit area $= \gamma_w \cdot d_w \cdot 1 \cdot$

Weight of some soil of unit area $= \gamma \cdot d \cdot l$

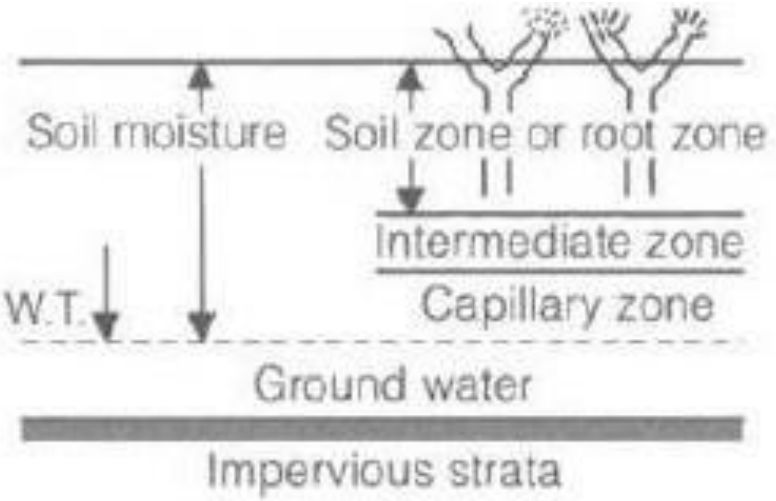
dw= depth of water stored in root zone.

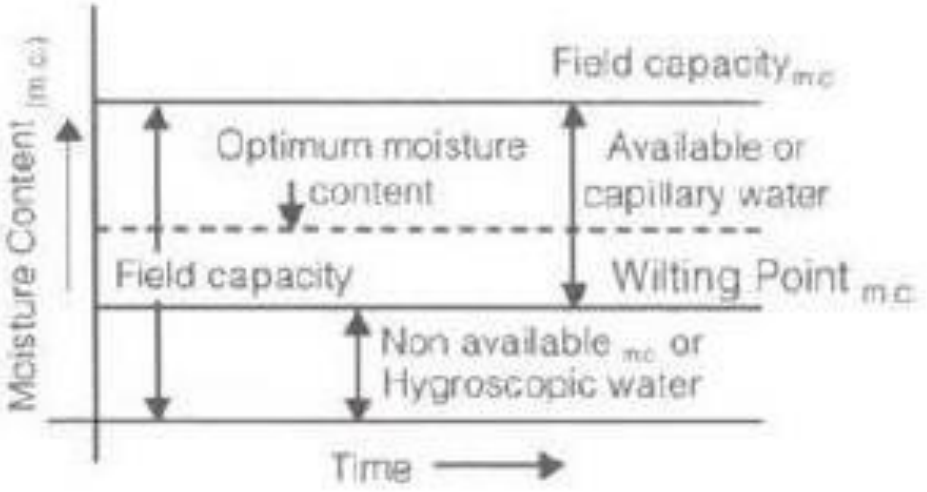
(5) $d_w = \dfrac{\gamma \cdot d}{\gamma_w} \cdot F_C$ $\gamma \rightarrow$ dry unit wt. of soil

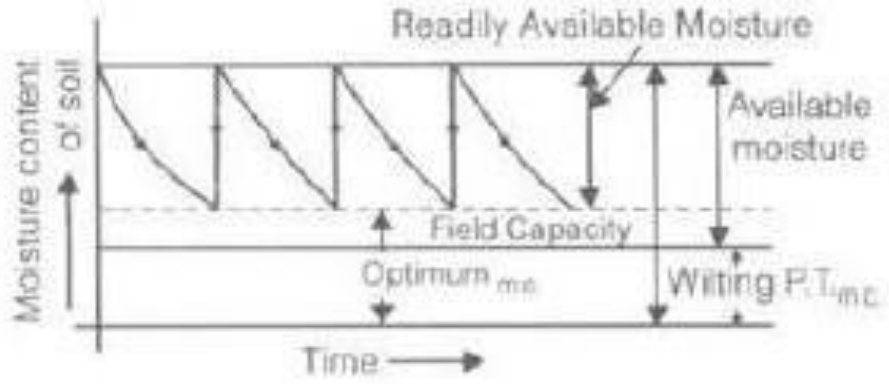
(6) Available moisture depth to plant $d_w' = \dfrac{\gamma . d}{\gamma_w}(F_C - \phi)$

(7) Readily available moisture depth to plant $d_w' = \dfrac{\gamma . d}{\gamma_w}(F_C - m_o)$

(8) $F_C = n / G$ where, G = specific gravity and n = porosity


Soil moisture
Soil zone or root zone
Intermediate zone
Capillary zone
W.T.
Ground water
Impervious strata


Moisture Content (m.c.)
Field capacity m.c
Optimum moisture content
Available or capillary water
Field capacity
Wilting Point m.c
Non available m.c or Hygroscopic water
Time


Moisture content of soil
Readily Available Moisture
Available moisture
Field Capacity
Optimum m.c
Wilting P.T m.c
Time

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