## 1. Introduction

**Irrigation engineering** is the analysis and design of systems that optimally supply the right amount of water to the soil at the right time to meet the needs of the plant system.

## 2. Necessity

1- Less Rainfall
2- Non-uniform Rainfall
3- Growing a number of crops during a year.
4- Growing Perennial crops.
5- Commercial crops with additional water.
6- Controlled water supply.

## 3. Advantage of application of water by modern methods

1- It adds water to the soil to supply the moisture essential for the plant growth.
2- It saves the crops from drying during short duration droughts.
3- It cools the soil and the atmosphere, and thus makes more favorable environment for healthy plant growth.
4- It washes out or dilutes salts in the soil.
5- It reduces the hazard of soil piping.
6- It softens the tillage pans.

## 4. Scope of irrigation science

The scope of irrigation is not limited to the application of water to the soil. It deals with all aspects and problems extending from the watershed to the agricultural farms. It deals with the design and construction of all works, such as dams, weirs, head regulators etc. in connection with the storage or diversion of water, as well as he problems of subsoil drainage, soil reclamation and water-soil-crop relationships, An irrigation engineer is also required to have the knowledge of cultivation of various crops, their maturing and protection from pests. Briefly speaking, the scope of irrigation can be divided into two heads:

### a-Engineering aspect

1- Storage, Diversion, or lifting of water
2- Conveyance of water to the Agricultural fields.
3- Application of water to Agricultural fields.
4- Drainage and relieving water-Logging.
5- Development of water power.

### b-Agricultural Aspect

the agricultural aspect deals with the thorough study of the following points.

1- Proper depth of water necessary in single application of water for various crops.
2- Distribution of water uniformly and periodically.
3- Capacities of water uniformly and periodically.
4- Reclamation of waste and alkaline lands, where this can be carried out through the agency of water.

## 5. Benefits of irrigation

1- Increase in food production.
2- Protection from famine .
3- Cultivation of cash crops.
4- Elimination of mixed cropping.
5- Addition to the wealth of the country.
6- Increase in prosperity of people.
7- Generation of Hydro-Electric power.
8- Domestic and industrial water supply.
9- Inland navigation .
10- Improvements of communication.
11- Canal plantations.
12- Improvement in the Ground water storage.
13- Aid in Civilization.
14- General Development of the country .

## 6. Basic Design Factors

1- Consumptive Use (or Evapotranspiration)

Consumptive use refers to the water needs of a crop in a specified time and is the sum of the volume of transported and evaporated water.

2- Root-zone soil water

Water serves the following useful functions in the process of plant growth:

(i) Germination of seeds
(ii) All chemical reactions,
(iii) All biological processes,
(iv) Absorption of plant nutrients through their aqueous solution,
(v) Temperature control,
(vi) Tillage operations ,and
(vii) Washing out or dilution of salts.

**Soil water can be divided into three categories:**

(i) Gravity (or gravitational or free) water,
(ii) Capillary water, and
(iii) Hygroscopic 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 void spaces.

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.

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 moisture under drought conditions.

The water remaining in the soil after the removal of gravitational water is called the field capacity. Field capacity of a soil is defined as the moisture content of a deep, permeable, and well-drained soil several days after a thorough wetting.

Permanent wilting point is defined as the soil moisture fraction, Wwp at which the plant leaves wilt (or droop) permanently and applying additional water after this stage will not relieve the wilted condition.

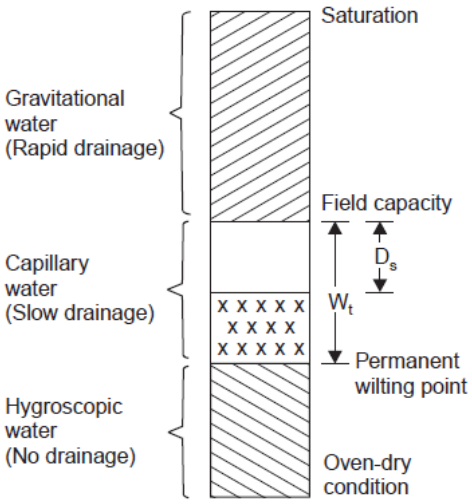


Fig 1. Different stages of soil moisture content in a soil