G.P. DHANGAR
(Fatehabad)

IRRIGATION ENGINEERING

CIVIL ENGINEERING DEPTT.

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UNIT-1

IRRIGATION:-

•It is defined as the process of artificially supplying water to the soils for raising crops.

• A crop requires a certain amount of water at some fixed interval throughout its period of growth.

• If the water requirement of crop is met by natural rainfall during the growth period, there is no need of irrigation.

Advantages of Irrigation:-

- Increase in food production
- Optimum utilization of water for optimum benefits
- General development of country
- Elimination of mixed cropping
- Generation of hydroelectric power
- Afforestation
- Domestic water supply Water for other purposes like swimming , washing ,bathing In land navigation
- Facilities for transport

Disadvantages :-

- Pollution of underground water
- Water logging of area
- Creating unhealthy conditions in cinder and damp places
- Cause breading places of mosquitoes,
- if carried out in careless way Construction cost of such projects is high so increase the expenditure of govt.
- Competition for surface water rights.
- Deep drainage (from over-irrigation) may result in rising water tables which in some instances will lead to problems of irrigation salinity requiring water table control by some form of subsurface land drainage.
- Irrigation with saline or high-sodium water may damage soil structure owing to the formation of alkaline soil.
- Depletion of underground aquifers.

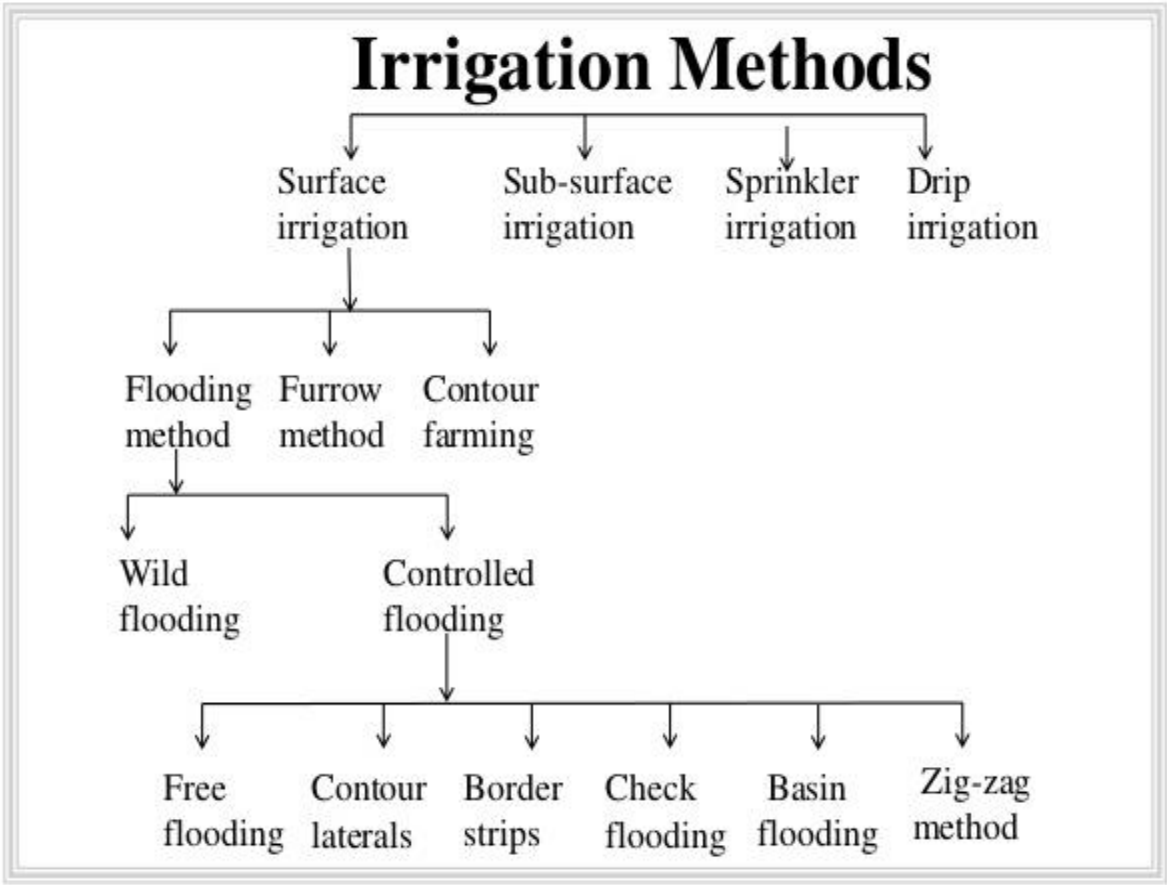
Methods of Irrigation:- There are three principle methods of irrigation viz.

1) Surface
2) Sub surface
3) sprinkler irrigation.

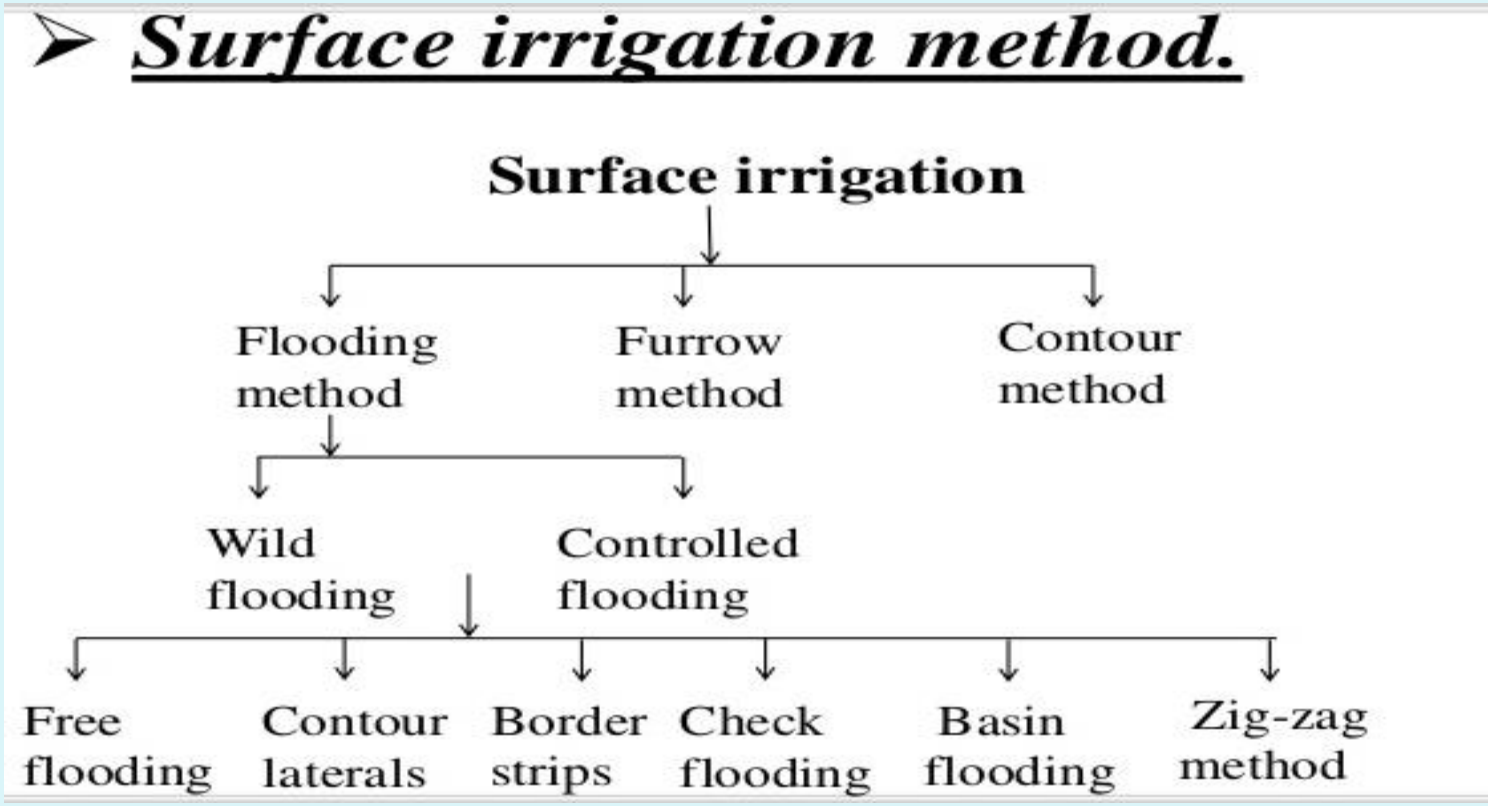
Surface irrigation:-There are 4 types under this method viz.

(1) Wild flooding.
(2) Free Flooding
(3) Check Flooding
(4) Border Strip Method
(5) Zig-Zag Method
(6) Basin method
(7) Furrow method

Method of Irrigation



Surface Method of Irrigation



1. Wild Flood Irrigation Method:- This method is suitable where large quantity of water is available. Water is allowed to cover large areas during high floods so that area is completely saturated.

2.Free Flood Irrigation Method:- This method is quite popular in our country. The area to be irrigated is divided in to number of compartments. Water enters at the upper reach and flowa towards the lower areas.

3. Check Flood Irrigation Method:- This method of irrigation is popular in Punjab where it is known as Khal-Kiari system Water from the source is fed in to a ditch from where it is fed in to a number of small compartments (kiari).

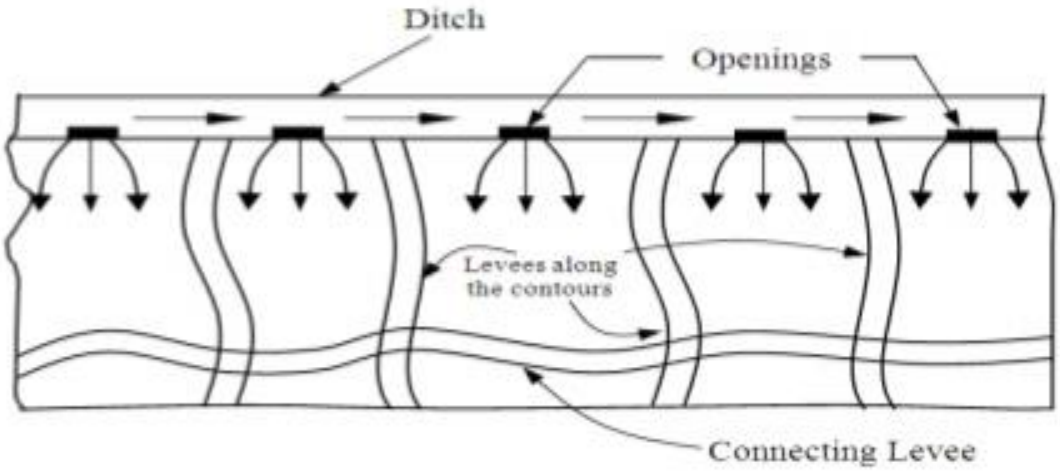
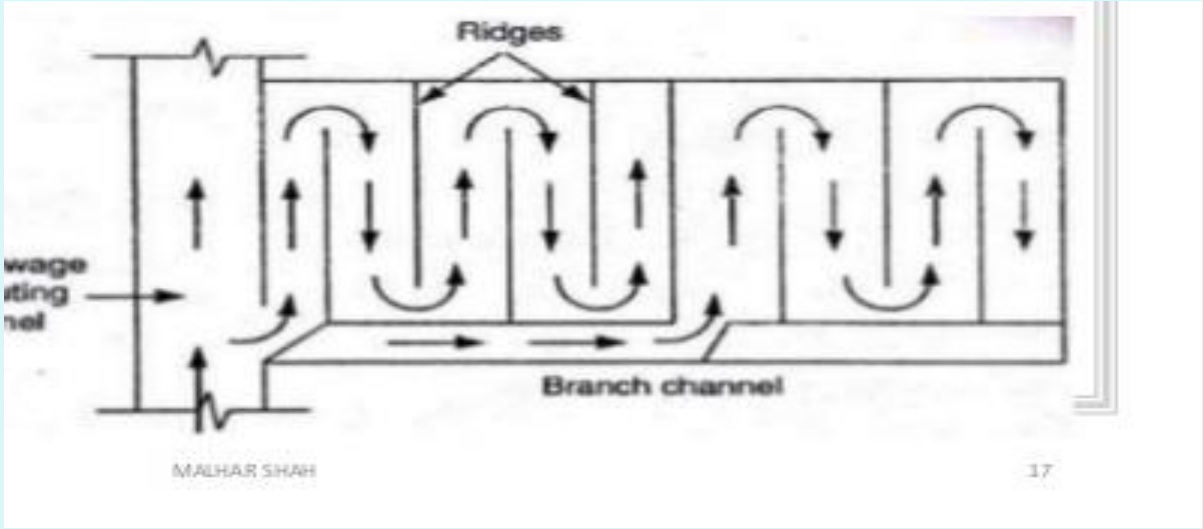


Fig: Check flooding (Plan view)

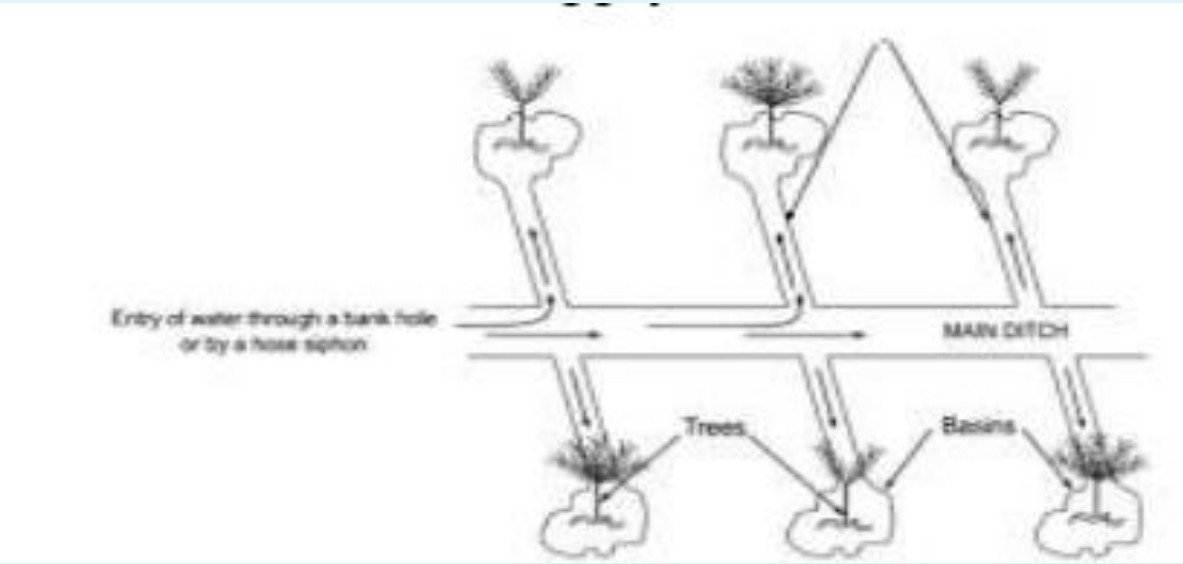
2.Border Strip method :- The area to be irrigated is converted in to a number of smaller plots or strips which may be of 10*100m to 20*300m. Water is fed in to each strip in turn.

1. Zig-Zag Irrigation Method:- The area is divided in to a number of rectangular square plots. Each plot is subdivided with the help of bunds and water takes a circuitous route before it reaches the dead end. The system is suitable for irrigating level plots.



3. BASIN IRRIGATION:

1) This method is suitable for Orchids 0r Fruit crop and other high value crops where the size of the plot to be irrigated is very small. One basin is constructed around each plant.Water is fed in to these basins from the field ditch referred to under check flooding method.
2) The basin may be square, rectangular or circular shape.



4) Furrow method (Ridges and Furrow, Broad ridges, Counter furrow):-

1) Row crops such as potatoes, cotton, sugarcane, vegetable etc. can be irrigated by furrow method.

2) Water is allowed to flow in furrow opened in crop rows. It is suitable for sloppy lands where the furrows are made along contours.

3) The length of furrow is determined mostly by soil permeability. It varies from 3 to 6 meters. In sandy and clay loams, the length is shorter than in clay and clay loams.

B. SUBSURFACE IRRIGATION :-

Subsurface irrigation or sub-irrigation may be natural or artificial. Natural sub surface irrigation is possible where an impervious layer or loose surface exists below the root. In artificial sub surface irrigation, perforated or porous pipes are laid out underground below the root zone and water is led into the pipes by suitable means. The method involves initial high cost, but maintaince is very cheap. It is very efficient in the use of water as evaporation is cut off almost completely. This method is adopted in the Israel country.

Duty (d):- the area irrigated by an average discharge of 1cumec for a specified number of days is called duty of water .

Base period (B):- The time between first watering of crop at the time of sowing and the last watering before harvesting is called the base period.

Crop period:- The time period that elapses from the instant of its sowing to the instant of its harvesting is called crop period

Delta:- The depth of water required per hectare for the full growth of the crop is called delta

Crop Seasons: Rabi season: November to March Kharif: June – October

Cash Crop: The crops which are grown by farmer for selling in the market to meet his financial requirements.

Crop Rotation:

Crop Rotation Growing different crops in rotation, one after the other, in the same field is called crop rotation. Same crop is grown again and again in the same field, the fertility of land gets reduced as the soil becomes deficient in plant foods favorable to that particular crop. To enhance the fertility of land and to make the soil to regain its original structure, it is necessary to give rest to the soil. Allow the land to lie fallow without any cultivation for some time or to grow crops which do not mainly require these salts or foods which are mainly required by earlier grown crop. Wheat – Juar- Gram Rice – Gram Cotton – Wheat – Gram Cotton – Juar - Gram

RELATIONSHIP BETWEEN DUTY, DELTA AND BASE PERIOD :-

Let Δ be the depth of irrigation water required by a crop in cm

B be the base period in days d be the duty of water in ha/ cumec

Then, The volume of water required per ha of cropped field = Δ x 10000 = 100 Δ m 100

The base period = B days = B x 24 x 3600 = 86400 B seconds

The term duty explains that to irrigate d ha of land water is to be supplied at the rate of 1 cumec.

Therefore, To irrigate one ha the rate of flow required = 1/d cumec.

The volume of water supplied @ 1/d cumec over B days = 86400 B/d m 3

Equating the volume required and supplied.

we get, 100 Δ = 86400 B d i.e., Δ = 864 B cm d

Paleo: First watering of soil before crop is swon.

Kor watering: First watering which is given to the crop

WATER REQUIREMENTS FOR DIFFERENT CROPS:- The term water requirements of a crop means the total quantity of all water and the way in which a crop requires water, from the time it is sown to the time it is harvested. The water requirement of crop varies with the crop as well as with the place. The same crop may have different water requirements at different places of the same country; depending upon the climate, type of soil, method of cultivation and useful rainfall. For better .understanding of crop water requirement, it is prudent to have knowledge of functions of irrigation water.

Factors affecting water requirement :

(a) Type of soil

(b) Temperature and wind

(c) Rainfall and wind.

(d) Crop

(e) Method of cultivation.

(f) Water management.

Sprinkler irrigation:- Sprinkler irrigation is a method of applying irrigation water which is similar to natural rainfall. Water is distributed through a system of pipes usually by pumping. It is then sprayed into the air through sprinklers so that it breaks up into small water drops which fall to the ground. The pump supply system, sprinklers and operating conditions must be designed to enable a uniform application of water Components of sprinkler System Pressure generating unit (Pumps and booster pumps) Water carrier unit (Main and lateral pipe lines) Water delivery unit

Advantages of sprinkler irrigation:-

•System losses (runoff, seepage) substantially reduced

• Over irrigation is completely eliminated and uniformity of application is high.

• Irrigation water requirement reduced as compared to other methods.

• No land leveling required in the field and land use for productive purposes can be maximized. Fertilizer can be injected in the irrigation water to reach the root zone directly

•The system allows better weed control

Limitations of sprinkler irrigation:-

• Poor uniformity and application efficiency in high wind regimes and / or dry and hot conditions.

• Capital cost is high with greater operational costs due to higher energy requirements.

•Not suitable for paddy crops Crops prone to diseases due to moist environment. Water with impurities and sediments may damage the system.

Drip irrigation system :- Drip irrigation , also known as trickle irrigation or micro irrigation , is an irrigation method which saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters.

Advantages of drip irrigation:-

• Minimized fertilizer/nutrient loss due to localized application and reduced leaching.

•High water application efficiency.

• Leveling of the field not necessary. Ability to irrigate irregular shaped fields.

•Allows safe use of recycled water.

•Moisture within the root zone can be maintained at field capacity.

Highly uniform distribution of water i.e., controlled by output of each nozzle.

• Lower labour cost.

•Variation in supply can be regulated by regulating the valves and drippers. Fertigation can easily be included with minimal waste of fertilizers.

• Foliage remains dry thus reducing the risk of disease.

• Usually operated at lower pressure than other types of pressurized irrigation, reducing energy costs.

•**Limitations of drip irrigation:-**

•Expense. Initial cost can be more than overhead systems. Waste.

•The sun can affect the tubes used for drip irrigation, shortening their usable life. Longevity is variable.

•Clogging. If the water is not properly filtered and the equipment not properly maintained, it can result in clogging.

• Drip irrigation might be unsatisfactory if herbicides or top dressed fertilizers need sprinkler irrigation for activation.

• Drip tape causes extra cleanup costs after harvest. You'll need to plan for drip tape winding, disposal, recycling or reuse.

•Waste of water, time & harvest, if not installed properly.

•These systems requires careful study of all the relevant factors like land topography, soil, water, crop and agro-climatic conditions, and suitability of drip irrigation system and its components.

• Salinity. Most drip systems are designed for high efficiency, meaning little or no leaching fraction. Without sufficient leaching, salts applied with the irrigation water may build up in the root zone, usually at the edge of the wetting pattern.

•On the other hand, drip irrigation avoids the high capillary potential of traditional surface-applied irrigation, which can draw salt deposits up from deposits below