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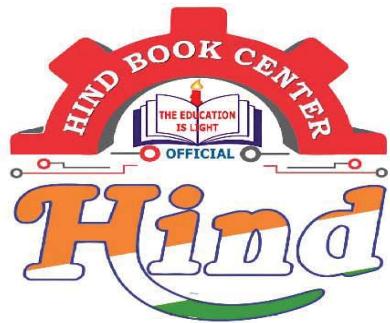
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CHAPTER 1

INTRODUCTION TO IRRIGATION & METHODS OF IRRIGATION

CONTENTS

Students should write this after chapter completion. This provides with overall view & acts as a tool for active recalling.

Introduction to Irrigation & Methods of Irrigation

Course Structure

1. Introduction to Irrigation, Methods of Irrigation.
2. Water Logging, Quality of Irrigation Water (CWCC, IARI)
3. Water Requirement for Crops.**
4. Canal design.
5. Analysis of Gravity Dams.
6. Conveyance and Regulating Structures for Canals.
7. Theories of Seepage.
8. River Training and Diversion Headworks.
9. Dams, Spillways and Energy Dissipators.

Weightage

YEAR	ESE (PRE)	GATE
2014	14 Q	1.5 M (AVG)
2015	15 Q	1.5 M (AVG)
2016	11 Q	1.5 (AVG)
2017	10 Q	2 (AVG)
2018	11 Q	1 (AVG)
2019	11 Q	1 (AVG)
2020	12 Q	3 (AVG)
2021	14 Q	3 (AVG)

Introduction to Irrigation & Methods of Irrigation

Official GATE Syllabus

Irrigation: Types of irrigation systems and methods; Crop water requirements - Duty, delta, evapo-transpiration; Gravity Dams and Spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures.

Official ESE Syllabus

2. Hydrology and Water Resources Engineering:

Hydrological cycle, Ground water hydrology, Well hydrology and related data analysis; Streams and their gauging; River morphology; Flood, drought and their management; Capacity of Reservoirs. Water Resources Engineering : Multipurpose uses of Water, River basins and their potential; Irrigation systems, water demand assessment; Resources - storages and their yields; Water logging, canal and drainage design, Gravity dams, falls, weirs, Energy dissipaters, barrage Distribution works, Cross drainage works and head-works and their design; Concepts in canal design, construction & maintenance; River training, measurement and analysis of rainfall.

Introduction to Irrigation & Methods of Irrigation

27/12/2021

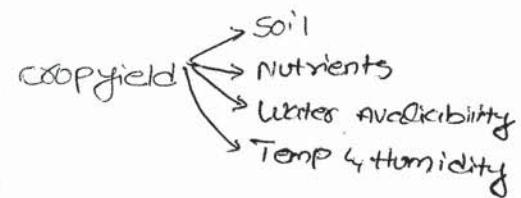
usage of water →
82% → Agriculture
6% → domestic
Municipal
need.
12% → industries.

WHAT IS IRRIGATION?

- Irrigation is the artificial application of water to soil throughout the crop period to assist in the production of crops.
- Irrigation water is supplied to supplement the water available from rainfall and ground or soil.
- In many areas of the world, the amount and timing of rainfall are not adequate to meet the moisture requirements of crops
- The pressure for survival and the need for additional food supplies are causing rapid expansion of irrigation throughout the world.

Advantages of Irrigation

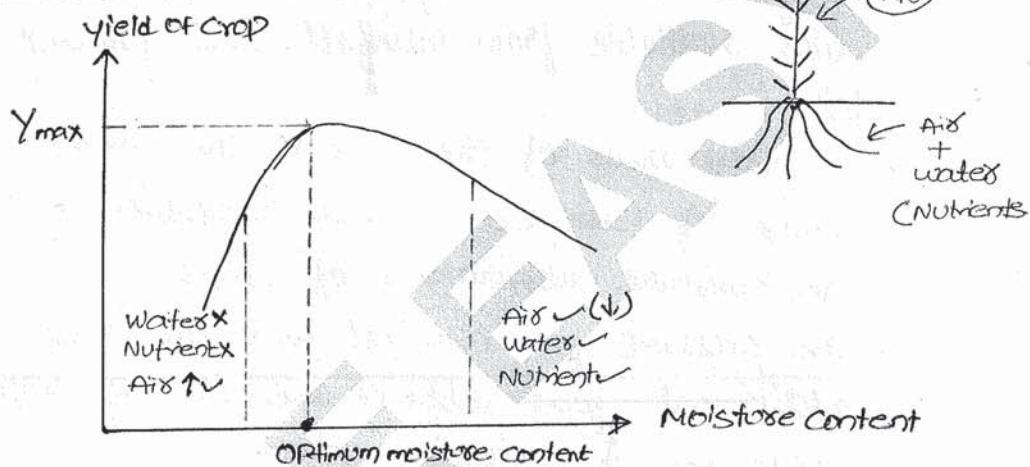
1. Increase in food production - Exact quantity required can be supplied as different crops have different water requirements and the same crop may have different water requirements at different places, depending upon the variation in climate, type of soil, method of cultivation, useful rainfall etc.



Introduction to Irrigation & Methods of Irrigation

2. Ensuring Optimum Growth in Field -

Maximum yield is obtained when just sufficient quantity is supplied and the corresponding moisture content is called as optimum moisture content.

**3. Elimination of Mixed Cropping -**

Farmers have a tendency to cultivate more than one type of crop in the same field such that even if one dies without the required water, atleast he would get the yield of the other.

- However, this reduces the overall yield from the field.
- With assured water from irrigation, farmer would cultivate only one type of crop at any time, which would increase the yield.

Introduction to Irrigation & Methods of Irrigation

Prepare Interview for

Ques: State multiple Projects (Dams) like Nagarjuna Sagar dam, Srisailam dam.

Note - Mixed Farming & Mixed Cropping are being used interchangeably in irrigation engineering. (Refer class for clarity in both definitions).

Mixed farming is a method in which multiple crops are grown in the field to utilize the space (or) land more effectively. In addition to that, it helps to prevent (or) control soil erosion.

4. Domestic & Industrial Water Supply -

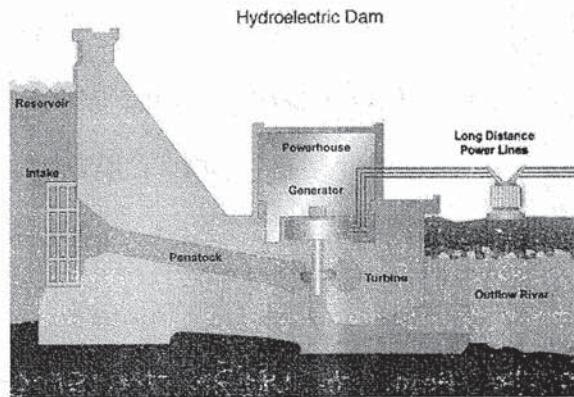
The canal system can be utilized for domestic and industrial water supply for nearby areas.

5. Flood Control - Provision of various techniques such as building of canals, flood cushioning, embankments and dykes, flood plain zoning, flood proofing etc.

6. Generation of Hydroelectric Power -

Various multipurpose projects generate hydroelectric power. It is a clean, reliable and renewable energy source. Eg → Bhakra-Nangal project, Hirakud project, Nagarjuna Sagar project, Damodar Valley Project to name a few.

Potential head \rightarrow K.E \rightarrow Mechanical head \rightarrow Electrical energy.

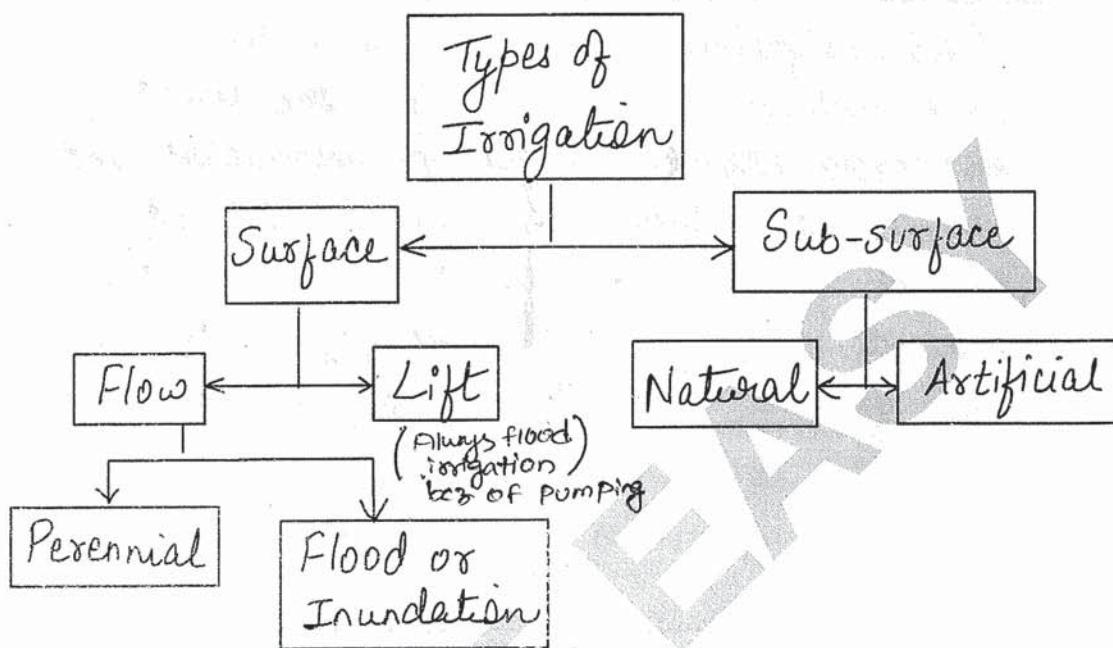
Introduction to Irrigation & Methods of Irrigation

7. Draught Control - Good irrigation practices promote soil conservation, water harvesting and development of ground water which in turn reduces draughts.

DEMERITS OF IMPROPER IRRIGATION

1. Over irrigation may cause water logging which reduces the crop yield. The roots of most crops require oxygen for respiration and hence, full saturation leads to restricted growth. However, exceptions such as rice, jute etc. which demand standing water for their growth. Rice \rightarrow close growing crop.
2. Excessive irrigation may cause leaching of pesticides, insecticides, nitrates etc. to ground water.
3. Water logging due to over irrigation leads to creation of favourable conditions for the spread of diseases like dengue and malaria.
4. Over irrigation may increase the salinity of soil (CH-2)
5. Excessive pumping out of groundwater for irrigation decreases the ground water level which increases the risk of land subsidence.
6. Needless to say, it leads to wastage of our valuable water.

Introduction to Irrigation & Methods of Irrigation

TYPES OF IRRIGATIONSurface Irrigation

It can be further classified as :-

1. Flow Irrigation - When water is available at a height such that it can be directly applied to the agricultural field by the action of gravity.

It can be further classified as :-

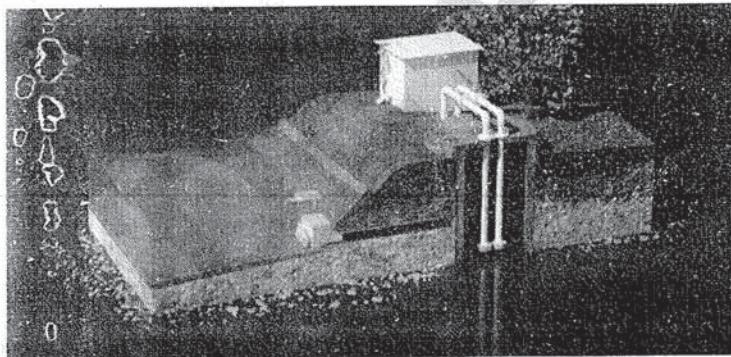
- ① Perennial Irrigation - constant and continuous water is supplied throughout the crop period.

Ex - Bhakra Scheme.

Introduction to Irrigation & Methods of Irrigation

(ii) Flood / Inundation / Uncontrolled Irrigation -
When water is available, fields are flooded so as to cause thorough saturation of the field

2. Lift Irrigation - Usually, groundwater is lifted up by some mechanical or manual action and then, it is supplied to the fields.



Sub Surface Irrigation

Water doesn't wet the surface and is applied to the root zone by the action of capillarity.

Introduction to Irrigation & Methods of Irrigation

- i) Natural Sub-Surface Irrigation - When underground irrigation is simply achieved naturally without any additional efforts, it is called natural sub-surface irrigation.
Ex → water from ground water table through capillary action.
- ii) Artificial Sub-Surface Irrigation - When a system of open jointed drains is artificially laid below the soil so as to supply water to the crops, it is called as artificial sub-surface irrigation.
Ex → Drip Irrigation

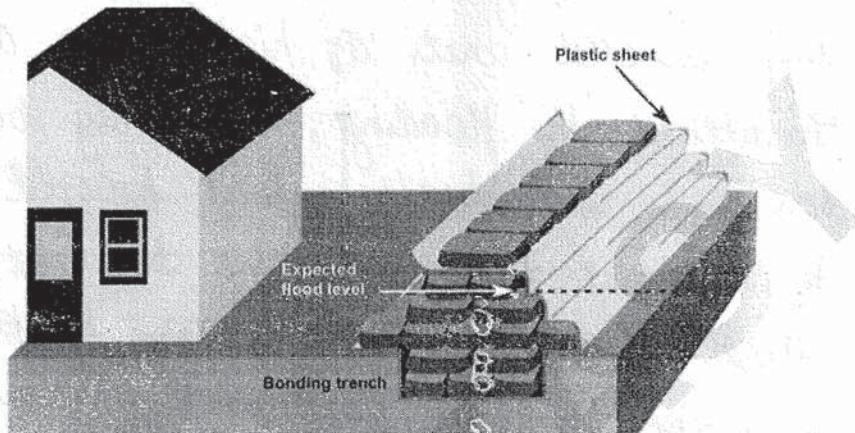
Some Related Terms

- 1) Flood Cushioning - The reservoirs created behind dams may be emptied to some extent, depending on the forecast of impending flood, so that as and when the flood arrives, some of the water gets stored in the reservoir, thus reducing the severity of the flood.

Introduction to Irrigation & Methods of Irrigation

- 2) Flood Proofing - In instances where only isolated units of high value are threatened by flooding, they may be sometimes individually flood proofed.
- An industrial plant comprising buildings, storage yards, roads etc., may be protected by a ring levee or flood wall. Levee wars - youtube video
 - Individual buildings sufficiently strong to resist the dynamic forces of the flood water are sometimes protected by building the lower stories (below the expected high-water mark) without windows and providing some means of watertight closure for the doors.
 - Thus, even though the building may be surrounded by water, the property within it, is protected from damage and many normal functions may be carried on.

Example of Flood Proofing



3. Check Dams or Low Head Dams

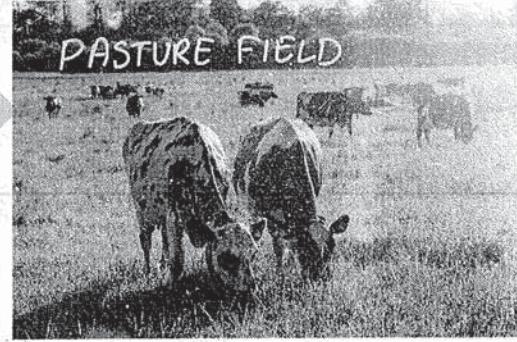
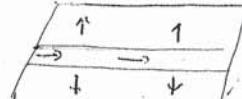
- These are small barriers built across the direction of water flow on shallow rivers and streams for the purpose of water harvesting.
- Pressure created in the catchment area helps force the impounded water into the ground.
- The major environmental benefit is the replenishment of nearby groundwater reserves and wells.

Introduction to Irrigation & Methods of Irrigation

(II) TECHNIQUES / METHODS OF IRRIGATION

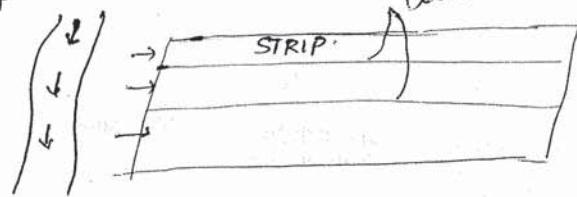
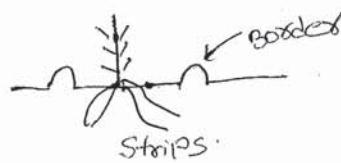
1. Free or Ordinary or Uncontrolled Flooding

- Ditches are excavated in the field and the water from these ditches flows across the field.
- Adopted in those fields where control on flow required is less.
- It is also called as Wild Flooding as the movement of water is not restricted.
- Suited for close growing crops such as rice, pastures etc.



2. Border Strip Irrigation

- A large piece of land is divided into a no. of strips separated by low earthen levees which are called as borders.
- Suited to all the crops which are not damaged by inundation for short periods like cotton, spinach, Broad beans.

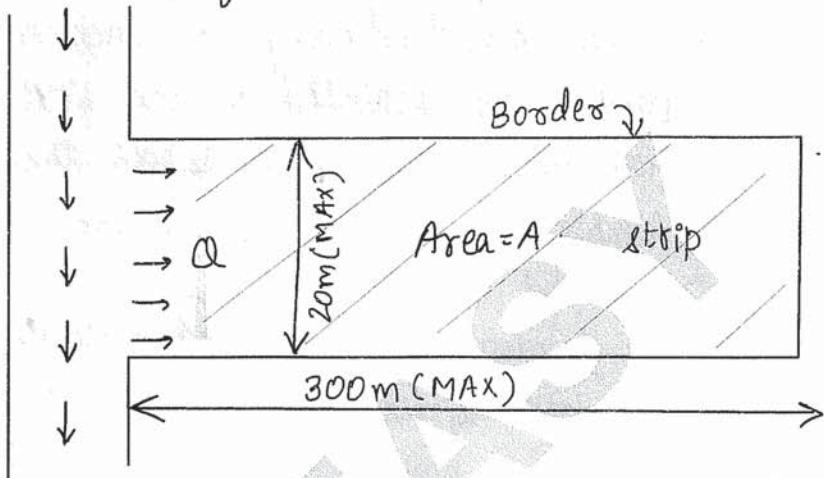


Introduction to Irrigation & Methods of Irrigation

This method is used for Length and width are not in equal proportions.

Usual Dimensions:-

main supply ditch



Expression :-

The time required to irrigate a strip of area 'A' with a continuous discharge 'Q' is given by :-

$$t = \frac{y}{f} \ln \left(\frac{Q}{Q - Af} \right)$$

f → infiltration rate

y → average depth of flow of water over the strip

Maximum area that can be irrigated :-

$$A_{\max} = \frac{Q}{f} \rightarrow Q = A_{\max} \times f$$

Units: $\rightarrow m^2 \times m/h \Rightarrow m^3/h$

Logic :- If $t \rightarrow \infty$, $\Rightarrow Q - Af \rightarrow 0$ If area increases then discharge also increases due to infiltration increase.

$$Q - A_{\max} f = 0$$

Infiltration is more.

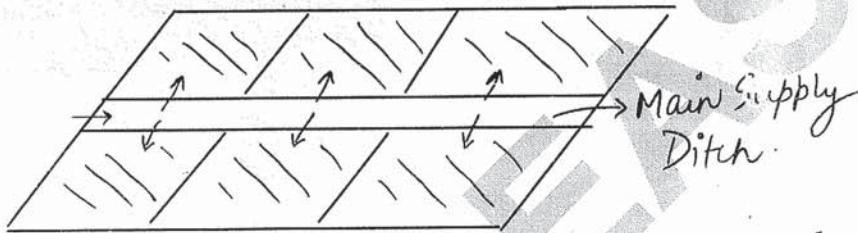
Discharge should be more.

$$A_{\max} = \frac{Q}{f}$$

Introduction to Irrigation & Methods of Irrigation

3. Check Basin Method

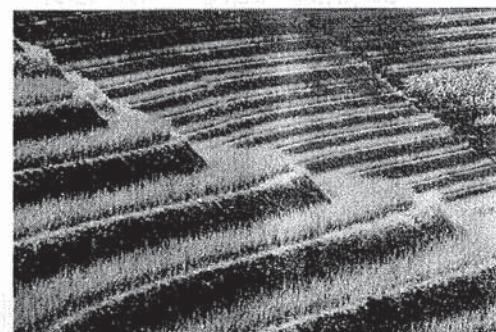
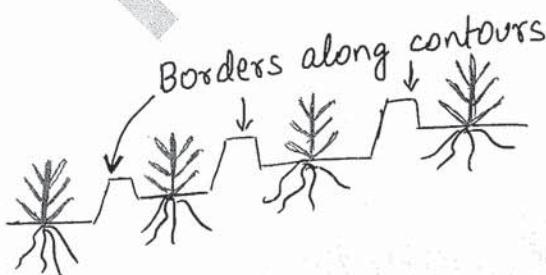
- A main supply ditch runs through the field and the area is divided into suitable squares or rectangles.
- It is a modified form of free flooding in which flow is systematically ensured in every basin.



- It may be used for fine soils to obtain desired penetration.

4. Contour Border Method

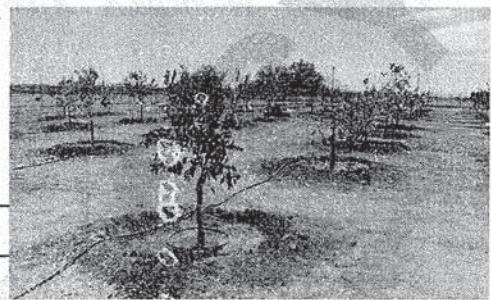
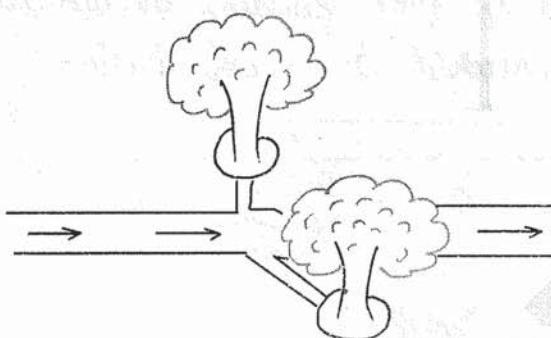
- In this method, levees are constructed along the contours in hilly areas.
- This helps in reducing the runoff losses significantly.



Introduction to Irrigation & Methods of Irrigation

5. Ring Basin Method

- It is specifically adopted for orchard trees and mango trees
- Small basins are made around the stem of the tree and the water is allowed to stand till the desired percolation is obtained.

**6. Furrow Irrigation**

- Furrows are narrow ditches which are excavated between rows of plants and carry irrigation water through them.
- In this method, only 20-50% of the field area is wetted and thus, evaporation losses are considerably reduced as compared to some other methods.
- It is usually adopted for crops such as cotton, potato, leafy vegetables, sugarcane etc.



- It is used for small delicate crops