RPSC 2024

Rajasthan Public Service Commission

Assistant Engineer

CIVIL ENGINEERING

Irrigation Engineering

CONTENTS

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WATER REQUIREMENTS OF CROPS

1

HISTORICAL BACK GROUND

- Pandit Jawaharlal Nehru used to call Dams as the Temples of modern India. Due to successful efforts of Independent India the gross area, under irrigation has come up from 19% during 1947-48 to 50% during 2000-01.

  Surface irrigation = 52%

  (a) Canal = 37%

  (b) Tanks = 15%

  Subsurface irrigation = 48%

  Mainly Wells and Tubewells.

Benefits of Irrigation

1. Increase in the food production
2. Protection from famine
3. Cultivation of cash crops
4. Increase of prosperity of people
5. Inland navigation
6. Improvement in ground water storage
7. General development of country etc.

Disadvantages of Irrigation

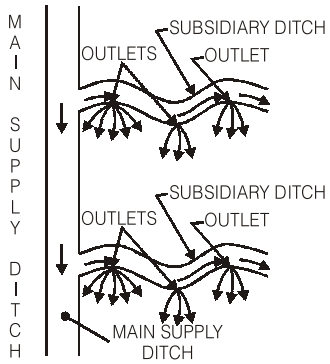
1. Water logging
2. Diseases
3. Pollution problem
4. Water losses

TECHNIQUES OF WATER DISTRIBUTION IN THE FARM

1. Free flooding
2. Border flooding
3. Check flooding
4. Basin flooding
5. Furrow irrigation method
6. Sprinkler irrigation method
7. Drip irrigation method

1. Free flooding or ordinary flooding

- Since the movement of water is not restricted, it is some times called wild flooding.
- In this method contour-ditches called subsidiary ditches are made and are generally spaced at about 20 to 50 meters apart.
- This technique is suitable for sloppy land and crops like pastures etc.
- The water application efficiency in this technique is low.

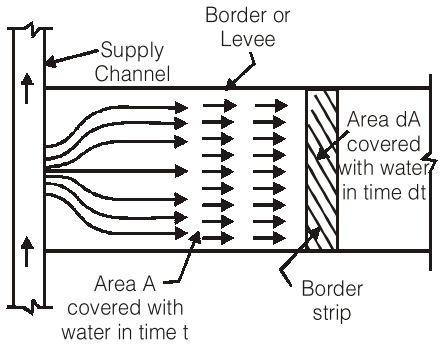


Do you know?

This method may be used on rolling land (topography irregular) where borders, checks, basins and furrows are not feasible.

2. Border flooding

- In this method land is divided in to a number of strips, separated by low levees called borders. The land area is confined between 10 to 20 m width and 100 to 400 m length of the each strip.
- Land is prepared perpendicular to the direction of flow in ditch.



- Let the discharge through supply ditch = Q
  The depth of water flowing over the strip = y
  Rate of infiltration of the soil = f
  Area of the land irrigation = A
  The Approximate time required to cover the given area is given by

$$T = 2.3\,\frac{y}{f}\,\log_{10}\left(\frac{Q}{Q - f.A}\right)$$

- The maximum area that can be irrigated with a supply ditch of discharge Q, and the soil having infiltration capacity f is given by

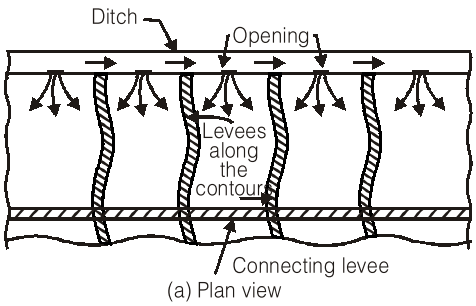
$$A_{max} = \frac{Q}{f}$$

- This method is very common in India. The shorter and narrower strips are found to be more efficient.

Do you know?
To prevent water from concentrating on either side of the border, the land should be levelled perpendicular to the flow.

3. Check flooding

- This is similar to ordinary flooding except that water is controlled by surrounding the check area with low & flat levees.
- The confined plot area generally is kept between 0.2 to 0.8 hectares.

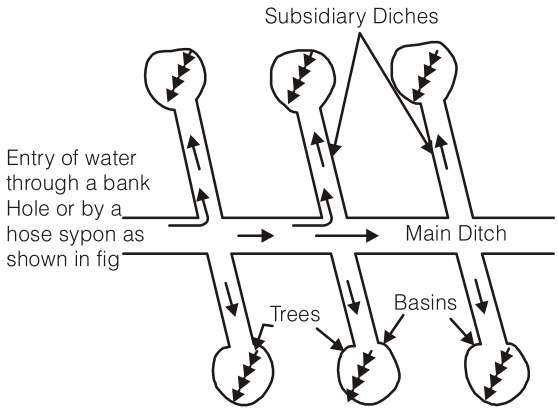


(a) Plan view

Do you know?
This method is suitable for more permeable soils as well as for less permeable soils.

4. Basin flooding

- This method is a special type of check flooding.



(a) Plan view

Do you know?
This method is adopted specially for orchard trees.

5. Furrow Irrigation

- In furrow irrigation method only 1/5 to 1/2 of the land area is wetted by water.
- In this method evaporation losses are less and less pudding of soil is required.

Do you know?
Furrows vary from 8 to 30 cm deep, and may be as much as 400 meters long.

6. Sprinkler Irrigation

- Water is sprayed through a network of pipes and pumps. This method gives uniform distribution of water.
- This method is suitable when
  1. Topography is irregular.
  2. When soil is excessive permeable or highly impermeable.
  3. When water table is high.
  4. When water is scarce.

6. Consumptive Use Efficiency (η_{cu})

It is given by

$$\eta_{cu} = \frac{W_{cu}}{W_d} \times 100$$

Where,

W_{cu} or C_u = normal consumptive use of water

W_d = net amount of water depleted from root zone soil.

Determination of Irrigation Requirements of Crops

In order to determine the irrigation requirements of certain crop, during its base period, the following terms are required.

1. Effective Rainfall (R_e)

Effective rainfall is that part of the precipitation falling during the growing period of the crop that is available to meet the evapotranspiration needs of the crop.

2. Consumptive Irrigation Requirements (CIR)

Consumptive irrigation requirement is defined as the amount of irrigation water that is required to meet the evapotranspiration needs of the crop during its full growth. Therefore, CIR = $C_u - R_e$

where C_u is the consumptive use of water.

3. Net Irrigation Requirements (NIR)

Net irrigation requirement is defined as the amount of irrigation water required at the plot to meet the evapotranspiration needs of water as well as other needs such as leaching etc. Thus NIR = $C_u - R$ + water lost in deep percolation for the purpose of leaching etc.

4. Field Irrigation Requirement (FIR)

$$FIR = \frac{NIR}{\eta_a}$$

5. Gross Irrigation Requirement (GIR)

Gross irrigation requirement is the sum of water required to satisfy the field irrigation requirement and the water lost as conveyance losses in distributaries up to the field. If η_c is the water conveyance efficiency, we have

$$GIR = \frac{FIR}{\eta_c}$$

Practice Questions : Level-1

Q.1 The relation between duty D is hectares/cumec, depth of water Δ in metres and base period B in days is given by

(a) $\Delta = \frac{1.98B}{D}$ (b) $\Delta = \frac{8.64B}{D}$

(c) $\Delta = \frac{5.68B}{D}$ (d) $\Delta = \frac{864B}{D}$

Q.2 Sodium Absorption Ratio (SAR) is defined as

(a) $\frac{Na^+}{\sqrt{Ca^{++} + Mg^{++}}}$

(b) $\frac{Na^+}{2\sqrt{Ca^{++} + Mg^{++}}}$

(c) $\frac{Na^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$

(d) $\frac{2Na^+}{\sqrt{Ca^{++} + Mg^{++}}}$

Q.3 The "outlet discharge factor" is the duty at the head of

(a) main canal (b) branch canal

(c) watercourse (d) distributary

Q.4 The Gross Irrigation Requirement (GIR) of water is equal to

(a) NIR + η_a

(b) NIR ÷ $\eta_a.\eta_c$

(c) NIR ÷ $\frac{\eta_a}{\eta_c}$

(d) None of these

Q.5 The ratio of the water stored in the root zone of a crop, to the water actually delivered to the crop in the field, is known as

(a) water conveyance efficiency

(b) water application efficiency

(c) water use efficiency
(d) None of these

Practice Questions : Level-2

Q.6 Available moisture for a crop is equal to
(a) field capacity moisture content—Wilting point moisture content
(b) field capacity moisture content—Hygroscopic moisture content
(c) Both (a) and (b)
(d) None of these

Q.7 A soil has a field capacity of 25%, permanent wilting point of 15%, and specific weight of 14.7 kN/m^3. If the root zone depth of the grown crop is 90 cm, then its available moisture holding capacity is
(a) 10 cm (b) 13.5 cm
(c) 16.67 cm (d) 20 cm

Q.8 The efficiency of water application does not depend upon
(a) climatic conditions
(b) type of the soil
(c) method of application
(d) geometry of the conveyance system

Q.9 The moisture held by a well drained soil against gravity drainage, by the force of surface tension between the soil grains and water drops is called
(a) field capacity water
(b) hygroscopic water
(c) capillary water
(d) water of adhesion

Q.10 The efficiency of water conveyance does not depend upon
(a) climatic conditions
(b) geometry of the conveyance system
(c) nature of the boundary of the conveyance system
(d) method of application of water

ANSWERS

1. (b)	2. (c)	3. (c)	4. (b)	5. (b)
6. (c)	7. (b)	8. (d)	9. (c)	10. (d)

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