MODULE 4

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4.1.1 INTRODUCTION

Irrigation may be defined as the process of artificially supplying water to the soil for raising crops. It is a science of planning and designing an efficient low cost irrigation system to suite the natural conditions. It is the engineering of controlling and harnessing the various natural sources of water by the construction of dams and reservoirs, canals and head works finally distributing the water to the agricultural fields. Irrigation engineering includes the study and design of works connected with river control, drainage of water logged areas and generations of hydroelectric power.

- **Necessity or Importance of Irrigation**

India is basically an agricultural country and its resources on depend on the agricultural output. Prosperity of our country depends mainly upon proper development of agriculture. Even after 60 years of Independence, we have not succeeded in solving our food problems. The main reason for this miserable state of affair is that we still continue to remain at the mercy of rain and practice age old methods of cultivation. Plants usually derive water from nature through rainfall. However, the total rainfall in a particular area may be either insufficient or ill timed. In order to get the maximum yield, it is necessary to have a systematic irrigation system for supplying optimum quantity of water at correct timing.

- **Importance of irrigation can be summarized under the following four aspects:**

1. Area of less rainfall: Artificial supply of water is necessary when the total rainfall is less than the water requirement of crops in such cases, irrigation works may be constructed at a place where more water is available and conveyed to water deficit areas.

Eg: The Rajasthan canal supplies water from the river Yamuna to the arid regions of Rajasthan where annual rainfall is less than 100 to 200 mm.

2. Non-Uniform rainfall: The rainfall in a particular area may not be uniform over the entire crop period. Rainfall may be there during the early period of crops and may become scanty or unavailable at the end resulting in lesser yield or total loss of the crop. Collection of water during periods of excess rainfall and supplying the stored water during periods of scarcity may prove beneficial to the farmers. Most irrigation projects in India are based on this aspect.

3. Commercial crops with additional water: The rainfall in a particular area may be sufficient to raise the usual crops but insufficient for raising commercial and cash crops such as sugarcane and cotton. In such situations, utilizing stored water by irrigation facilities is advantageous.

4. Controlled Water Supply: Dams are normally meant for storing water during excess flow periods. But in situations of heavy rainfall, flooding can be controlled by arresting the flow in the river and excess water can be released during low flow conditions.

4.1.2 Benefits of Irrigation:

There are many direct and indirect benefits or advantages of irrigation which can be listed as follows.

1. Increase in food production: Crops need optimum quantity of water at required intervals assured and timely supply of water helps in achieving good yield and also superior crops can be grown and thus, the value of the crops increases.

2. Protection from famine: Irrigation works can be constructed during famine (drought). This helps in employment generation and people also get protection from famine. After completion of such works, continuous water supply may be available for crops and people.

3. Cultivation of Cash crops: With the availability of continuous water supply, cash crops such as sugarcane, indigo, tobacco, cotton etc. can be grown.

4. Increase in prosperity of people: Due to assured water supply people can get good yield and returned for their crops. Land value increases and this raises the standard of living of the people and hence prosperity takes place.

5. Generation of hydroelectric power: Major river valley projects are designed to provide power generation facilities also apart from irrigation needs.

6. Domestic and Industrial water supply: Water stored in reservoirs can also be used to serve other purposes like domestic water supply to towns and cities and also for industrial use. Canals can also be effectively used to serve these purposes.

7. Inland Navigation: In some cases, the canals are very large enough to be used as channels for inland navigation as water ways are the cheapest means of transportation.

8. Improvement in communication: Main canals in large irrigation projects are provided with inspection roads all along the sides. These roads can be asphalted and used as a means of communication.

9. Canal plantation: Due to continuous flow of water adjoining areas of a canal are always saturated with water. In such places, trees can be planted which increases the timber wealth of the country.

10. Improvement in ground water storage: Due to constant percolation and seepage of irrigation water, ground water table rises. The ground water may percolate and may be beneficial to other areas.

11. Aid in civilization: Due to introduction of river valley projects, tribal people can adopt agriculture as their profession which helps in improving the standards of living.

12. General development of a country: By assured water supply, farmers can expect good yield. By exporting surplus goods, Government can get revenue. The government can then come forward to improve communications facilities such as roads and railways and also social development by providing schools, hospitals etc.,

ILL-EFFECTS OF IRRIGATION

If water is used in a controlled and careful manner, there would be no ill effects of irrigation. Excess and unscientific use of irrigation of water, givers raise to the following ill effects.

1. Water logging: Excess water applied to the fields allows water to percolate below and ground water table rise. The ground water table may rise saturating the root zone of the crop and cutting of air supply to the roots of the crops. Such a phenomenon is called water logging. Under such conditions fertility of land reduced and also reduction of crop yield.

2. Breeding placed for mosquitoes: Excess application of water for irrigation leads to water logging and formation of stagnant water fools, which become breeding places for mosquitoes, thus helping spreading of malaria.

3. Unhealthy Climate: Due to intense irrigation the climate becomes damp during summer due to humidity, the climate is sultry and in winter it becomes excessively cold. The resistance of the body to diseases is reduced. In addition to the above, careless use of water leads to wastage of useful irrigation water for which any government will have incurred huge amounts.

4.1.3 TYPES OR SYSTEMS OF IRRIGATION

4.1.3.1 Lift Irrigation: It is that system of irrigation in which irrigation water is available at a level lower than that of the land to be irrigated and hence water is lifted by pumps or other mechanism (Hydraulic ram and siphon action) and then conveyed to agriculture fields by gravity flow. Irrigation through wells is an example of lift irrigation. Water from canals or any other source can also be lifted when the level of water is lower than that of the area to be irrigated.

4.1.3.2 Inundation Irrigation: It is that system of irrigation in which large quantity of water flowing in a river is allowed to flood or inundate the fields to be cultivated. The land becomes thoroughly saturated. Excess water is drained off and the land is prepared for cultivation. Moisture stored in the soil is sufficient to bring the crop to maturity. Inundation irrigation is

commonly practiced in delta region of rivers. Canals may be also employed to inundate the fields when water is available in plenty.

4.1.3.3 Perennial Irrigation: It is that system of irrigation in which irrigation water is supplied as per the crop requirements at regular intervals throughout the crop period. The source of irrigation water may be a perennial river, stored water in reservoirs or ground water drawn from open wells or bore wells. This is the most commonly adopted irrigation system.

4.1.3.4 Direct Irrigation: It is a type of flow irrigation in which water from rivers and streams are conveyed directly to agricultural fields through a network of canals, without making any attempt to store water this is practiced in areas where the rivers and streams are perennial. Small diversion dams or barrages may be constructed areas the rivers to raise the water level and then divert the water into canals.

4.1.3.5 Storage Irrigation: Dams are constructed across rivers which are non- perennial. The discharge in such rivers may be very high during rainy season and may become less during dry stream. By constructing dams across such rivers water can be stored as reservoir during excess flow and can be utilized or diverted to agriculture fields through canals as and when required. Such a system is known as storage irrigation.

4.1.4 BANDHARA IRRIGATION

It is a special irrigation scheme adopted across small perennial rivers. This system lies somewhere between inundation type and permanent type of irrigation. A Bandhara is a low masonry weir (obstruction) of height 1.2m to 4.5m constructed across the stream to divert water into a small canal. The canal usually takes off from one side and the flow into the canal is controlled by a head regulator.

The length of the main canal is usually restricted to about 8km. A series of Bandharas may be constructed one below the other on the same stream so that water spilling over from one Bandhara is checked by another Bandhara. The irrigation capacity of each Bandhara is may be about 400 hectares. Bandharas are adopted across small streams having isolated catchments which are considered to be non feasible or uneconomical to be included under a large irrigation scheme.

This method of irrigation is followed in Central Maharashtra and is commonly known there as the ‘Phad’ system.

<u>Advantages of Bandharas:</u>

1. Small quantity of flow in streams can be fully utilized or otherwise might have gone as a waste.

2. As the length of the canal is short, seepage and evaporation losses are less.

3. Intensive irrigation with high duty may be achieved and the area to be irrigated is close to the source

4. The initial investment and maintenance cost of the system is low.

Disadvantages of Bandharas:

1. The supply of water is unreliable when the flow in streams becomes lesser.

2. Excess water available cannot be utilized as area for cultivation below each Bandhara is fixed.

3. In dry seasons, people living on the downstream side of Bandharas may be deprived of water for domestic made also.

4.2 WATER REQUIREMENT OF A CROP

It is the total quantity of water required by the crop from the time it is sown to the time it is harvested. Different crops require different quantities of water. Since the growing crops use water continuously, it is essential to maintain the quantity of readily available moisture in the soil by irrigation. As such the total quantity of water required by a crop is so distributed that a part of it is applied each time at a more or less fixed interval throughout the period of growth. The quantity of water applied at each irrigation should be such that water sufficient to meet the needs of the crop for a period between two successive irrigations is stored in the soil. Therefore in addition to the total quantity of water required by a crop, it is also essential to determine the frequency of irrigation as well as the quantitv ofwater required to be applied during each application.

4.2.1 DEFINITIONS

Duty of Water:

Duty represents the irrigating capacity of a unit of water.

It is usually defined as the area of land in hectares which can be irrigated to grow a crop of the cumec of water is continuously supplied for the entire period of the crop.

Delta:

It is the total depth of water required by a crop during the entire crop period and is denoted as ‘Δ’

4.3 IMPORTANT QUESTIONS

- Define irrigation? What is the necessity of irrigation?
- Discuss in brief the benefit and ill effects of irrigation.
- With a neat sketch explain Bhandhara irrigation scheme.
- Explain irrigation efficiencies.
- Define duty? What are the factors affecting duty of water? Explain.
- Explain consumptive use of water. List the factors affecting consumptive use of water.
- Explain irrigation requirements of crops.
- Explain the following:

  (a) Base period (b) crop period (c) Time factor

  (d) Gross command area (e) Culturable command area
- The base period, Intensity of Irrigation and duty of water for various crops under a canal system are given the table below. Determine the reservoir capacity if the culturable commanded area is 40,000 hectares, canal loses are 20% and reservoir loses are 10%.

Crop	Base period (In days)	Duty of water at the field (hectares/cumec)	Intensity of Irrigation (%)
Wheat	120	1800	20
Sugarcane	360	1700	20
Cotton	180	1400	10
Rice	120	800	15
Vegetables	120	700	15

- A water course has a culturable command area of 1200 hectares. The intensity of irrigation for crop A is 40 % and for B is 35%, both the crops being rabi crops. Crop A has a kor period of 20 days and crop B has kor period is 15 days. Calculate the discharge of the water course if the kor depth for crop A is 10cm and for it is 16cm.
- The gross commanded area for a distributory is 20000 hectares, 75% of which can be irrigated. The intensity of irrigation for Rabi season is 40% that for Kharif season is 10%. If kor period is 4 weeks for rabi and 2.5 weeks for Kharif, determine the outlet discharge. Outlet factors for rabi and Kharif may be assumed as 1800 hectares/ cumec and 775 hectares/ cumec. Also calculate delta for each crop.

4.4 OUTCOMES

- Understand the concept of hydrograph and runoff

4.5 FURTHER READING

https://nptel.ac.in/courses/105101002/9

https://nptel.ac.in/courses/105101002/7