# 7. Irrigation Management

**Can you recall?**

(1) What are the basic needs of plant for their survival?
(2) What is the difference between water and irrigation?
(3) About Soil, water and plant relationship.

For successful crop production water must be supplied to plant as required by them through irrigation. Plant receives water required for their growth from soil moisture. The soil moisture can be replenished whenever it gets depleted. Irrigation helps to maintain soil water balance during stress period.

**Do you know ?**

- What is the main source of irrigation in India?
- What efforts are made to distribute water uniformly ?

## 7.1 Definition of irrigation

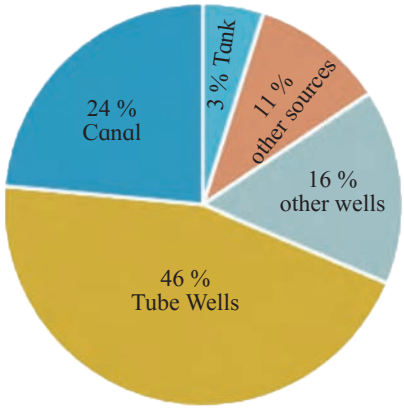
The artificial application of water for supplying moisture essential to plant growth is known as irrigation.

It is the artificial provision of water to supplement rainfall for crop production. Irrigation provides favourable environment for higher crop growth and yield. Effective irrigation is the controlled and uniform application of water to crop land in the required amount at the required time, with minimum cost to produce optimum yields without wastage of water and any adverse effect.

## 7.2 Advantages and adverse effects of irrigation

### 7.2.1 Advantages of irrigation

(1) Irrigation provides insurance against short duration drought during crop season.




Different sources of irrigation

**Remember this**

Largest Dams in Maharashtra
1. Koyana, Satara
2. Jayakwadi, Aurangabad
3. Ujjani, Solapur
4. Isapur, Nanded
5. Totladoh, Nagpur

(2) Yield of crop is increased and it maintains soil temperature.

(3) It maintains soil water balance completely and plant water balance partly.

(4) Irrigation is necessary for raising winter and summer season crops.

(5) It improves the ground water storage.

(6) Water supplies two essential elements, hydrogen and oxygen to the crops.

(7) It is necessary for the absorption of mineral nutrients by the plants from the soil.

(8) It brings biological equilibrium and enrichment of soil.

(9) Irrigation ensures choice of efficient valuable crop and increases efficiency of inputs.

### 7.2.2 Adverse effects of irrigation

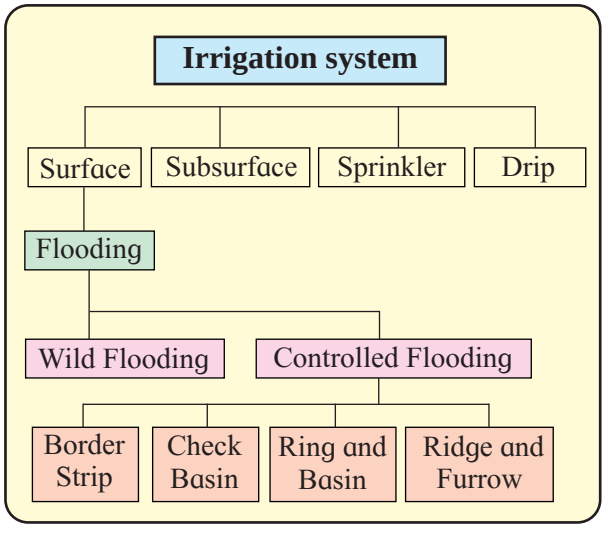
- The indiscriminate use of water leads to the problem of waterlogging and salt imbalance making the agricultural land unproductive.

- The root growth is restricted in irrigated soil and therefore nutrients that leach downward are not extracted by the crops.
- Irrigated soil becomes more compact on drying and thus tillage requirements are high.
- Erosion of soil and loss of plant nutrients and wastage of water in sloppy land.
- In deep clay soils a huge quantity of water is lost in filling up cracks before it reaches at saturation level.
- Preparation of boundary bunds, plot bunds, channels for irrigation and drainage reduce effective sowing area.
- The requirements of costly inputs such as fertilizer and tillage are considerable in irrigated agriculture.
- Irrigation water is often acidic or alkaline and contains injurious salts, impurities and weed seeds that affect crop production.
- Incidence of insects, pest, pathogens, parasite and weed are high in irrigated areas.

## 7.3 Systems of irrigation

Different systems are used to apply irrigation water to the crop depending upon

(a) Topography (present condition of land)
(b) Soil type
(c) Crop water resources
(d) Climatic condition
(e) Cost




**Do you know ?**

Why irrigation is indispensable in India?
- Uncertain monsoon rain.
- Spatial variation in rainfall.
- Low winter rain.
- Low retaining capacity of soil.
- Cultivation of high yielding variety.
- Multiple cropping

These systems are as follows :

### 7.3.1 Surface irrigation system :

In this system water is applied and distributed over the soil surface by gravity. It is often referred as flood irrigation in which applied water moves over the land surface freely and also infiltrate into the soil.

The various methods of surface irrigation systems are

**Flooding** : It includes (a) Wild flooding (b) Controlled flooding

**(a) Wild flooding :** In this method water from channel is allowed to flood in the entire field in an uncontrolled way. This practice is followed where water is abundant and inexpensive. It is followed on smooth lands like wet land of rice and close growing crops like leafy vegetables and fodder crops.

| Advantages | Disadvantages |
|---|---|
| 1. It is less expensive and does not require any skill | 1. The main drawback of this method is loss of huge quantity of water. |
| 2. Except land levelling and boundary bund preparation, no other field layout is necessary | 2. It is the most inefficient method in which high lying patches remain dry and low lying once are submerged in water |
| 3. Supervision of water application may not be required | 3. All types of field management practice are very poor i. e. nutrient management |

**(b) Controlled flooding**

**(i) Border strip method**

In this method the field is divided into long, narrow strips with small parallel ridges on the sides. Length of the strip ranges from 30 to 150 meters long and 6 to 8 meters wide, which depend upon field condition and crop type. The borders are laid out along the general slope.

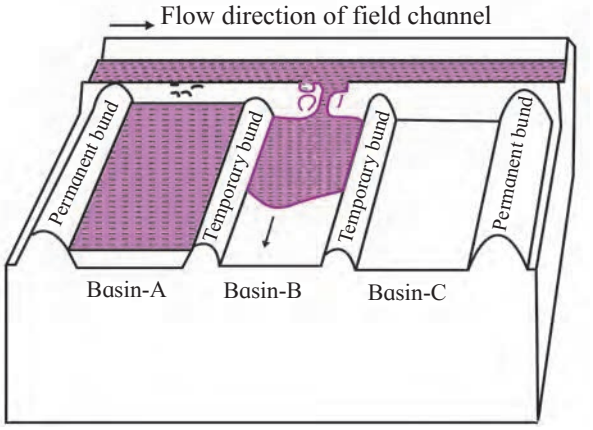



**Fig 7.1 (a) : Border strip method**

**Fig 7.1 (b) : Border strip method**

This method is suitable for close growing crops like wheat, legume, fodder crops etc. in medium to heavy textured soil. Intercultivation is possible. Labour requirement is less for field layout, large irrigation streams can be efficiently used, It is not suitable in coarse texture soil. Repairing and supervision during irrigation is needed.

**(ii) Check basin method**

It is the most common method among surface methods of irrigation.

In this method field is divided into small plots surrounded by bunds at all the four sides. The size of check basin ranges from 4 × 3 m to 6 × 5 m. The shape may be rectangular or square depending upon topography and soil texture. It is suitable for crops like groundnut, wheat, finger millets, etc. In this method water can be applied uniformly but more labour is required to prepare layout. Land is wasted under channels and bunds. Intercultivation by implement is difficult.

**Fig 7.2 : Check Basin method**

**(iii) Ring and Basin method**

This method is suitable for orchard and other high value crops. The basin may be square, rectangular or circular in shape.

**Basin method** - A small bund of 15 to 22 cm high is formed around the stump of the tree at a distance of about 30 to 60 cm depending upon water quantity to be supplied. In this method water is applied in controlled way, to the restricted area around the stem.

**Fig 7.3 : Basin method**

**Ring method** - These are circular beds. Heap of soil around plant trunk is made to avoid direct contact of water to the plant trunk. This helps in avoiding water borne diseases.

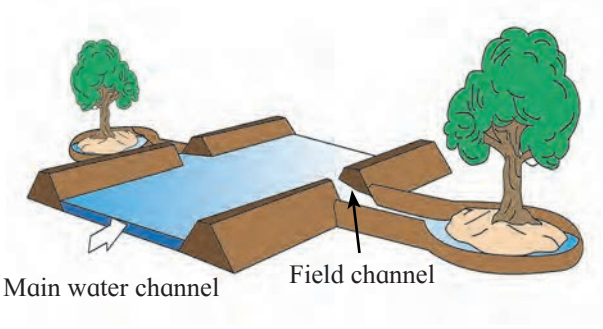



**Fig 7.3 : Ring method**

**(iv) Ridges and furrow method**

Furrows are small parallel channels made to carry water in small streams between the rows of crops grown on ridges or furrow sides. This method is suitable for crops like sugarcane, cotton, tobacco, sorghum, maize, vegetables, etc. The size and shape of the furrow depends upon spacing adopted for the crop, soil type and slope. The length ranges from 30 m to 300 m. In this method uniform application of water is possible. Cost of furrow preparation is more. Furrow can be open using ridger or by manual operation.

**Fig 7.4 : Ridges and furrow method**

- How do you reduce water loss by evaporation?
- Do you know modern methods of irrigation?

### 7.3.2 Subsurface irrigation system

In this system water is applied into a series of field ditches or through under ground perforated pipes deep down to impervious layer. The depth of ditches varies from 30 cm to 1m and 15 to 30 cm apart. Water through ditches or perforated pipes gradually saturates the root zone through capillary movement. This system is practiced in sandy soil for coconut garden in Kerala and for vegetables in Kashmir. In artificial sub irrigation water passes through underground perforated pipe in the root zone. This system avoids water loss through evaporation and reduce weed problem. It may causes heavy loss of water through deep percolation. Maintenance is required and it causes interference in cultivation.

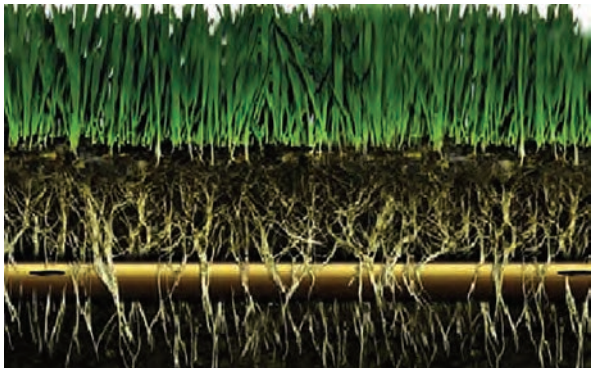


**Fig 7.5: Subsurface Irrigation system**

### 7.3.3 Sprinkler irrigation system

This is a method of applying irrigation water under controlled manner as like natural rainfall. It is also called as overhead irrigation. It acts as spray.

**Fig 7.5: Sprinkler Irrigation system**

The important components of a sprinkler irrigation system are the pump, pressure gauge, control valves, main pipeline, lateral line, T-coupling, bend, end plug, riser pipe and sprinkler head. The height of riser pipe depends on the height of the crop. Sprinkler heads of rotation type are fixed on the riser pipe. Sprinkler heads generally have two nozzles, one to apply water at long distance and other for short distance.

**Advantages**

(1) It is used for almost all crops and for all types of soil.

(2) Water can be applied at a controlled rate with uniform distribution and high efficiency.

(3) Land levelling is not essential.

(4) Run off and soil erosion is less.

(5) Soluble fertilizers, herbicides, insecticides and fungicides can be applied through this method.

(6) Saving of water about 30 - 40 per cent.

(7) Accurate and easy measurement of distributed water.

**Disadvantages**

(1) Sprinkler irrigation does not work well under high wind velocity.

(2) High initial equipment cost.

(3) It is not suitable where water contains large amount of salt, sand and debris.

**Remember this**

**Rain gun –** It is high pressure, high volume, large diameter sprinkler irrigation. It covers more area for irrigation .There are semi – permanent and permanent rain guns. These sprinklers have radius of discharge throw from 24 m to 36 m. This can be used for various agronomic crops, vegetables, flowers, etc. It is available in portable and fixed form.

**Fig 7.6 : Rain gun**

### 7.3.4 Drip irrigation system

Drip irrigation is a method of controlled irrigation in which water is slowly delivered drop by drop to the root system of multiple plants. The water is applied to the soil from the emitters. The emitters which are attached to laterals distribute water for irrigation. The number of emitters on laterals depends on plant spacing of the crop, soil characteristics, root development and discharge of emitter. The main components of drip system are–pump set, pressure gauge, control valve, pressure regulator, primary filter, secondary filter, main line, lateral line, multi outlet distributor, end plug and emitters. This method is most suitable for arid and semi-arid region with limited availability of water. It is best suited for wide spaced fruit crops, vegetables, sugarcane, cotton, etc.

**Advantages**

(1) Saves water upto 70% and labour also.

(2) Water losses due to percolation, runoff and evaporation are quite minimum.

(3) Weed population is less due to limited surface wetting.

(4) No land levelling is necessary and can be followed in hilly terrain areas.

(5) Fertilizes can be applied along with water.

(6) Plant growth is better and higher yield can be obtained.

(7) Less incidence of disease.

**Disadvantages**

(1) High initial cost.

(2) It requires specific skill.

(3) Need regular maintenance and high repair cost

(4) Damage to lateral system by rodents, clogging of emitters and accumulation of salt near plant are the limitations.

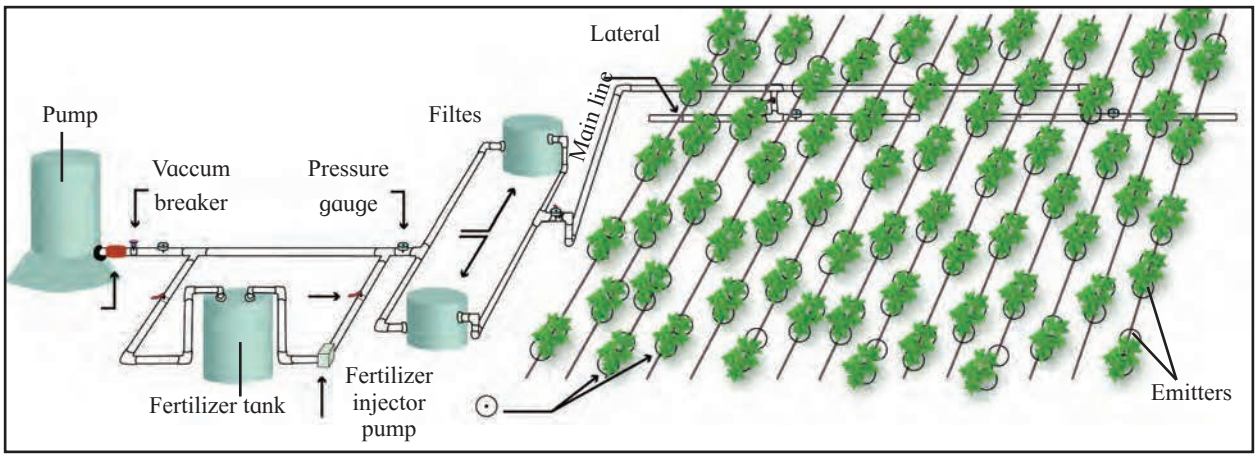
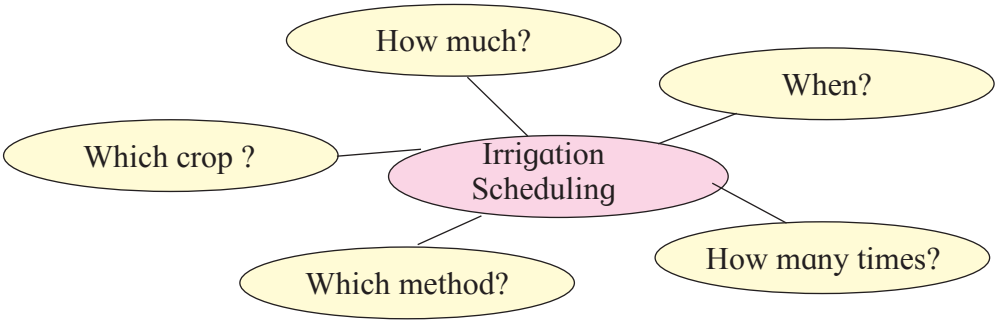
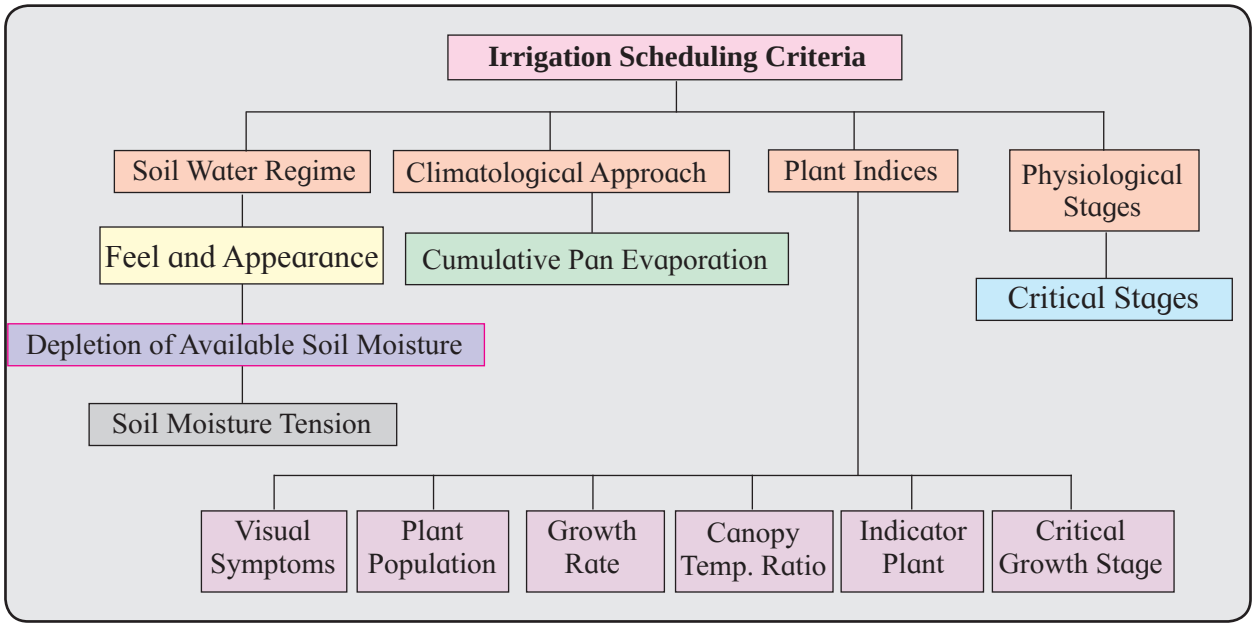



**Fig 7.7 : Drip Irrigation system**

## 7.4 Criteria for scheduling of irrigation



There are several approaches of scheduling irrigation based on soil, crops, climate and plant – water relationship.

(1) **Soil water regime (depletion)** - In this method soil moisture content is estimated to know the deficit in available soil moisture at which it is proposed to irrigate at particular level. It can be measured either by direct gravimetric method or indirect measurement such as tensiometer and resistance block method.

(2) **Climatological approach** - Evapo transpiration (ET) mainly depends upon climate. The amount of water lost by evapo-transpiration is estimated from climatological data and when ET reaches at particular level, irrigation is given.

(3) **Plant indices** - Any plant character, related directly or indirectly to plant water deficit which responds readily to integrated influence of soil water, plant evaporative demand of the atmosphere, may serve as criteria for timing of irrigation. Visual sign of plant wilting can be used to schedule irrigation to crops. Farmer frequently use dropping, curling and rolling of leaves as visual signs.

(4) **Physiological stages** - The critical growth stages of some important field crops at which irrigations are given after considering the rainfall are used for scheduling irrigation.

**Critical stages of different crops:**

| Crop | Critical stages | No. of irrigation |
|---|---|---|
| **Rice** | Early tillering, panicle initiation, flowering | 3 |
| **Wheat** | Crown root initiation, tillering, flowering, grain development, dough stage | 5 |
| **Sorghum** | seedling, flag leaf, flowering | 3 |
| **Groundnut** | Germination, pegging, flowering, pod development | 4 |
| **Redgram** | Flowering, pod formation | 2 |

**Basic unit of water measurement (motion)**

(1) **Cusec**- cubic feet per second,
1 cubic feet =7.4805 gallons

(2) **Acre inch**- Quantity of water that will cover one acre of surface and one inch deep soil

(3) **Duty**- Denotes the number of acres covered by 1 cusec of water flowing continuously throughout the growing season of crop.

(4) **Delta**- It is total depth of water required for a crop during entire period of the crop.

**Do you know ?**

- Which irrigation method is mostly used in India?

## 7.5 Drainage

**Can you recall?**

Why water is stored in the field?

How will you remove stagnated water in the field?

### 7.5.1 Meaning of drainage

Excess soil moisture or water logging occurs due to heavy and continuous rains or due to faulty irrigation practices. Water logging causes several changes in the soil and plant resulting in reduced growth and in some cases, death of the plants.

Drainage is the removal of excess gravitational water from the soil by artificial means to enhance crop production.

**Fig 7.8 : Drainage channel**

Drainage is the provision of suitable method for removal of excess irrigation or rainfall water from the field to facilitate favourable moisture condition for the growth of plants.

The removal of excess water (free or gravitational/standing or stagnant water) from the surface of soil or below the surface of the soil so as to create favorable soil conditions for plant growth is known as drainage.

Surface drainage means removal of excess water from the surface of soil.

Subsurface or internal drainage means removal of excess water from-within the soil surface (mainly from saturated soil pores).

### 7.5.2 Importance of drainage

For healthy growth of most of the crops and for getting higher yield soil should not only be fertile but it should be well drained also.

The various advantages of good drainage are as follows.

(1) The field will not get waterlogged and the crop can get sufficient water and air.

(2) The soil comes in proper tilth earlier after rainfall and it is possible to carry out agricultural operations properly and in time.

(3) Good drainage helps to improve physical structure of soil.

(4) Proper drainage prevents salt accumulation and degradation of irrigated lands.

(5) There should be good balance among moisture, air and temperature at root zone.

(6) Microbial activity is induced and resulted in accelerated organic matter decomposition.

(7) Desirable chemical reactions take place and nutrients become available to the plant easily.

(8) There is proper root development and absorption of nutrients is increased.

(9) Seed germinates faster and a better stand of the crop is obtained.

(10) Interculturing operations can be done at proper time.

(11) There is healthy growth of plants and plant resists the attack of pest and diseases.

(12) Roots can draw moisture from greater depth and withstand against drought condition.

### 7.5.3 Causes of improper drainage

If the soil is not well drained then there is water logging or stagnation of water takes place which affects, growth and yield of crop. The causes of such bad or improper drainage are as follows.

(1) If soil is fine textured such as clay with poor permeability the water cannot move downward fast enough and accumulates on the surface in a thin layer obstructing aeration.

(2) The water table may be high and additional gravitational water accumulates and chokes the airspaces and saturates the surface and sub- soil.

**Fig 7.9 : Water logging**

(3) There may be hard pan which affects seepage of water to lower strata.

(4) There may be salts affecting water absorption by roots.

(5) Due to low lying area excess rain water cannot be carried away as surface runoff rapidly into the drain.

(6) Faulty use of irrigation water leads to creation of water logged condition and raising of ground water table.

(7) Humid regions with continuous and heavy rainfall raises water table and saturates the pore spaces.

(8) The area under saline and alkali soils with poor permeability.

### 7.5.4 The remedies for drainage improvement

**Surface drainage**

Surface drainage is the simplest and the common method in India. In this method large outlet channels or field ditches are formed on the surface to remove the excess water due to heavy rainfall or over irrigation. Irrigation channels also serve as drainage channels. These drains cause hindrance to field preparation and intercultivation. They are subjected to silting and weeds growths which are to be removed regularly. Open drains are damaged by rodent and farm animals. Different methods of surface drainage are adopted depending on topography of the land, soil characteristics and crops grown.

(1) Random field ditches
Field ditches of shallow depth are formed randomly over the field. The depressions are connected by means of shallow channels or ditches and these are led into an outlet.

(2) Land smoothing
In this method, the elevated area is cutoff and the excess soil is spread over low areas so that the surface will be even with uniform slope. Excess surface runoff is collected and conveyed into the field ditches provided at the lower end of the field.

(3) Bedding
Small furrows are formed at known interval parallel to the slope for draining out water. These furrows are known as dead furrows and land between these furrows is known as beds. Small ridges or bunds are made at the center of the bed with gradual slope to drain water into the dead furrows.

**Tell us**

What is difference between surface and subsurface drainage?

(4) Parallel field ditches
It is similar to bedding system but the parallel ditches of greater capacity are formed instead of dead furrows. This system is suitable for flat lands with number of small impressions.

### 7.3.5 Sub surface drainage or underground drainage:

A subsurface drainage will remove excess water as it percolates into themselves, just like open drain. It avoids wastage of land and do not interfere with farm operation.

Sub surfaced systems are

**(1) Tile drain:** It consists of digging a narrow trench, placing short section of tiles at bottom and covering the tiles with earth.

**Fig 7.10 : Subsurface drainage**

**Fig 7.11 : Tile drainage**

(2) **Rubble drains:** It is made by cutting narrow 'V' shaped drains or rectangular section, as for box drains, filling them up with rough stone (large and small) and covering the whole up with soil level with surface field soil. Depth may be 90 cm.

(3) **Perforated pipe drains:** In this a perforated pipe is designed to allow water to enter or exit through small holes along the pipe.

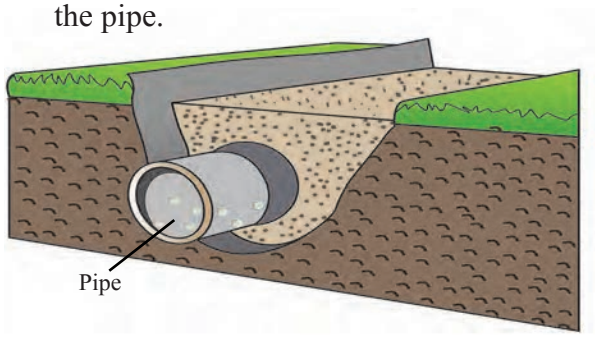



**Fig 7.12 : Perforated pipe drainage**

## 7.6 Watershed Management

**Can you recall?**

(1) What is flooding and reason for flooding?
(2) What kind of damages take place in flooding?
(3) Why Maharashtra always suffers from drought condition?
(4) What kind of measure will you suggest to overcome the drought condition?

### 7.6.1 Definition of watershed and watershed management

Watershed is the area of land that drains of shed water into specific receiving water body such as lake or river. It is the drainage area on the earth surface from which runoff resulting from precipitation flows or passed through a single point to a large stream, a river, a lake or an ocean.

It is the area of land that drains water, sediment and dissolved material through a common outlet to a some point along the stream. In another word watershed is natural hydrological unit.

**Fig 7.13 : Typical watershed**

Watershed management is an adaptive, comprehensive, integrated multi-resource management planning process that seeks to balance healthy, ecological, economic, and social conditions within watershed.

Watershed management serves to integrate planning for land and water. It takes into account both ground and surface water flow recognizing and planning for the interaction of water, plants, animals and human land use found, within the physical boundaries of watershed.

### 7.6.2 Types of watershed?

Watershed area is classified in to different categories based on size, drainage, and shape and land use pattern

(1) On the basis of area.

| Sr. No. | Types of watershed | Area covered |
|---|---|---|
| 1. | Mini watershed | 1 to 100 ha |
| 2. | Micro watershed | 100 to 1000 ha |
| 3. | Mili watershed | 1000 to 10000 ha |
| 4. | Sub watershed | 10000 to 50000 ha |
| 5. | Macro watershed | More than 50000 ha |

(2) On the basis of shape

| Sr No. | Shape |
|---|---|
| A | Square |
| B | Triangular |
| C | Rectangular |
| D | Oval |
| E | Fern leaf shaped |
| F | Palm shaped |
| G | Polygon shaped |
| H | Circular Sector Shaped |

### 7.6.3 Objectives of watershed management

(1) To control damaging run off and degradation and thereby conservation of soil and water.

(2) To promote sustainable farming and stabilize crop yield by adopting suitable cropping and crop management system.

(3) To check soil erosion and increase water infiltration rate.

(4) To cover non- aerable area effectively through afforestation and pasture land

(5) To restore ecological balance

(6) To enhance the income of the individuals by adopting alternate enterprises

(7) To minimize the risk of flood, drought and land slide.

(8) Supply and securing of clean and sufficient drinking water.

### 7.6.4 Components of watershed mangement

(1) There are four important components of watershed management.

| |
|---|
| (I) Soil and water conservation |
| (II) Water Harvesting |
| (III) Crop management |
| (IV) Alternate land use system |

**(I) Soil and water conservation**

The main object of soil and water conservation is to check soil erosion and to increase availability of ground water. This can be achieved by three ways,

(a) Temporary (b) Moderate method (c) Permanent

**(a) Temporary method:** In this method simple measures like cultivation practices across the slope. It requires time to time renovation of measures.

**(b) Moderate method:** It includes levelling of land having breadth of 4 to 5 m , growing grass on bunds to slowdown the speed of water flow (for every 4-5 year).

**(c) Permanent method:** This method helps to stop soil erosion and slow down speed at water flow by constructing check dam, percolation pond, etc.

**(II) Water harvesting**

It is nothing but accumulation and storage of rainwater for reuse on site, rather than allowing it to run off. Water is collected in farm pond , percolation tank, Nala bund and deep tank for domestic and agricultural use.

**Try this**

**Experiment** - How much rain water quantity will be collected from 10 mm rainfall that received on your roof ?

- Which cropping system is useful on sloppy land?

**(III) Crop management**

This component is related with increasing crop production and to give sustainability by using different cropping patterns. It involves monocropping, inter cropping, strip cropping, mixed cropping, crop rotation, cultivation practiced against slope, etc.

**(IV) Alternate land use system**

Land not useful for growing agronomic crop can be brought under cultivation by using advance techniques e.g. agro forestry, pasture land, fiber crop, furniture wood, agri - horticultural land use, etc. This can improve economical status of farmer.

### 7.6.5 The steps in watershed management?

Watershed management involves determination of alternative land treatment measures for which information about problems of land, soil, water and vegetation in the watershed is essential.

**(1) Recognition phase**

It involves following steps

(a) Recognition of the problem

(b) Analysis of the cause of the problem and its effect

(c) Development of alternative solution of problem

**(2) Restoration phase**

It includes two main steps

(a) Selection of best solution to identified problem.

(b) Application of the solution to the problem of the land.

**Can you tell?**

(1) What do you do when low rainfall is received in your area?

(2) Do you store water received from rainfall?

(3) What kinds of containers are used to store rain water?

**(3) Protection phase**

This phase takes care of the general health of the watershed and ensures normal functioning.

**(4) Improvement phase**

This phase deals with overall improvement in the watershed and all land is covered.

### 7.6.6 Water harvesting

**Concept :** It is based on the concept of depriving part of the land of its share of precipitation, giving it to another part to increase the amount of water available to the gutter part and bring this amount closer to crop water requirement so that an economical agricultural production can be achieved. Such concentration of precipitation in a smaller area is called water harvesting (WH).

**Definition**

- The process of collecting natural precipitation from prepared watershed for beneficial use.
- Collecting and concentrating various forms of runoff from precipitation for various purposes.
- Simply water harvesting is defined as collection of runoff for its productive use.

**Types of water harvesting**

(1) Rainwater harvesting : It is one of the most effective method of water management and water conservation.

It is the term used to indicate the collection and storage of rainwater used for human, animals and plant needs. It involves collection and storage of rainwater on surface or in subsurface before it is lost as surface runoff.

(2) Ground water harvesting : Artificial recharge to groundwater is a process by which the groundwater reservoir is augmented at a rate exceeding that under natural conditions of replenishment. Ground water is recharged and eventually flows to the surface naturally.

Fig 7.14 : Water harvesting

(3) Roof water harvesting: It is the technique through which rainwater is captured from the roof catchment and stored in reservoir. It can be stored in sub-surface ground water by adopting artificial recharge techniques. It helps in self sufficiency of water supply and reduces cost of pumping, provides high quality water. i.e. soft and low in minerals, less expensive.

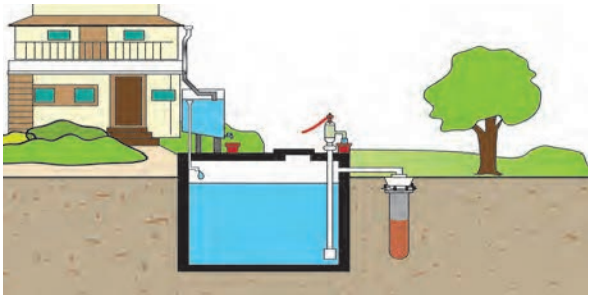


Fig 7.15 : Roof water harvesting

# Exercise

## Q1. A. Fill in the blanks

1. Ring method of irrigation is suitable for ---------- crops.
2. Tensiometer instrument is used to measure soil ----------.
3. Water harvesting is a component of ----------.
4. Sprinkler irrigation method saves ---------- % water.
5. Emitters are the main components of ---------- irrigation system.

## B. Make the pairs

| | A | B |
|---|---|---|
| 1. | Riser pipe | a. Drainage |
| 2. | Perforated pipe | b. Rain gun |
| 3. | Tensiometer | c. Sprinkler irrigation |
| | | d. Surface drainage |
| | | e. Soil moisture |

## C. State true or false

1. Water supplies only oxygen to the plant.
2. Drip irrigation method saves more than 50 % water.
3. Furrow method of irrigation is suitable for crops like jowar, wheat and paddy.
4. Removal of excess water from the field is known as irrigation.
5. Micro watershed covers the area from 1 to 100 hectares.

## Q. 2 Answer in brief

1. Write note on a ridge and furrow method.
2. Give components of watershed.
3. Write difference between surface and sub surface irrigation methods.
4. Complete the chart.

| Surface Method | | Check basin | |
|---|---|---|---|
| Irrigation scheduling criteria | Soil water regime | | Plant indices |
| Surface drainage | Random field ditches | | Bedding |

## Q. 3 Answer the following questions.

1. Describe drip irrigation method.
2. Explain the adverse effects of irrigation.
3. Give the advantages of irrigation.
4. Suggest remedies for poor drainage.
5. Read the following paragraph and answer the questions given below.

Farm pond is a dug out structure with definite shape and size having proper inlet and outlet structures for collecting the surface runoff flowing from the farm area. It is one of the most important rain water harvesting structures constructed at lowest portion of the farm area. The stored water must be used for irrigation only.

There are three types of excavated farm ponds – Square, Rectangular and Circular. Circular ponds have high water storage capacity. The problem associated with farm pond in red soils is high seepage losses. This can be reduced by lining walls. Some of the traditional methods for seepage control are the use of bentonite, soil dispersants and soil- cement mixture. Bentonite has excellent sealing properties if kept continuously wet,

but crack develops when dried. Soil cement mixture can be used. A soil – cement lining of 100 mm thickness reduces seepage losses up to 100 per cent. The other alternative sealant. Alfisols is a mixture of red soil and black soil in the ratio of 1:2.

(a) What is farm pond?

(b) What are the types of farm pond?

(c) ------- type farm pond have high water storage capacity.

(d) How seepage water losses are controlled in farm pond?

(e) What is the thickness of soil – cement lining in farm pond?

**Q. 4 Answer in detail.**

(1) Write in detail about sprinkler method with its advantages and disadvantages.

(2) Write in detail about objectives of watershed management.

(3) Write importance of water harvesting.

(4) Write importance of drainage.

(5) Describe controlled flooding method.

**Activity :**

1. Practice different surface irrigation methods in the field.
2. Collect information about WALMI and write the work details in table given below.

| Photograph and information | Information (work details) |
|---|---|
| | |