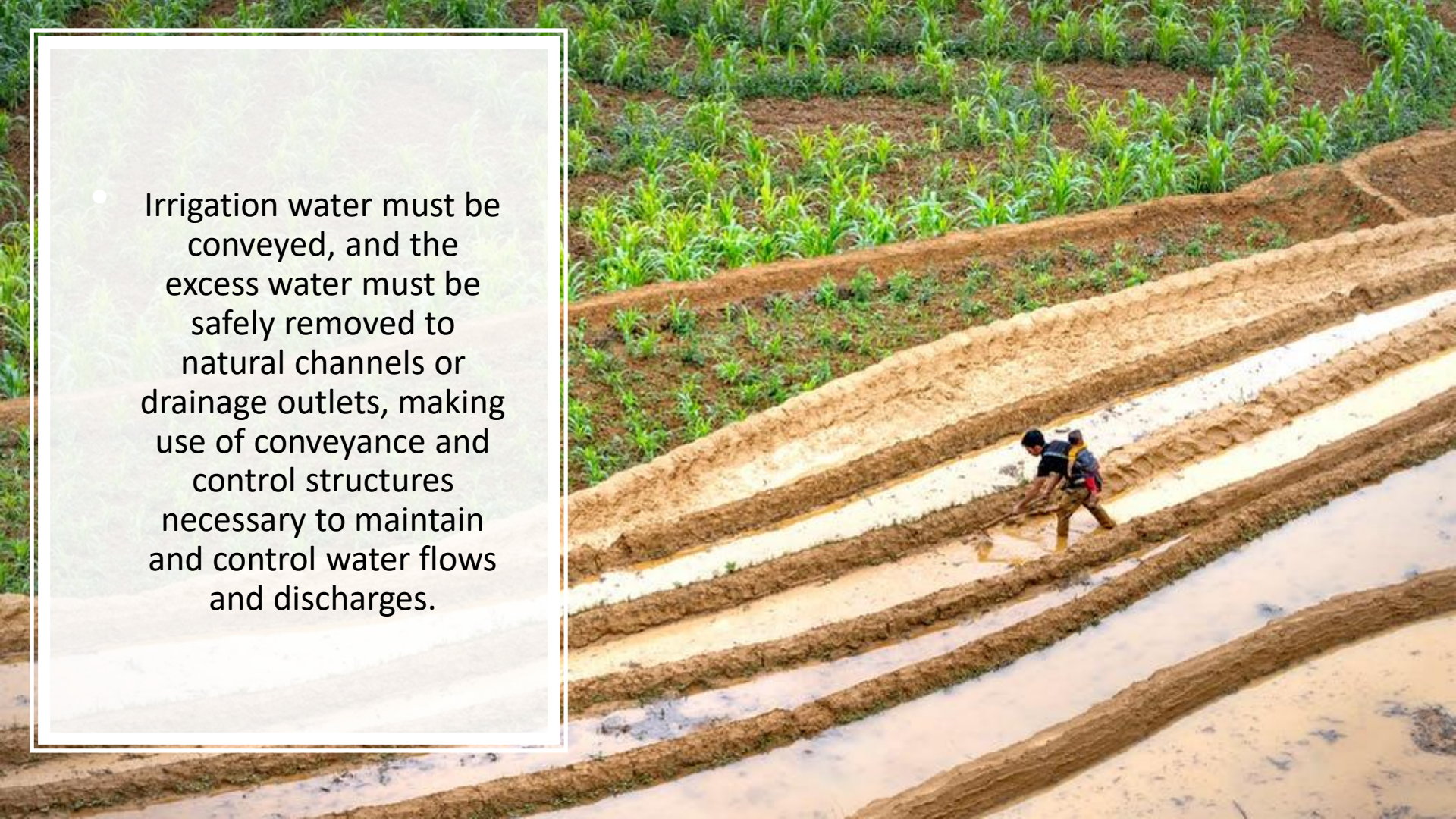
IRRIGATION AND DRAINAGE STRUCTURES



- Irrigation water must be conveyed, and the excess water must be safely removed to natural channels or drainage outlets, making use of conveyance and control structures necessary to maintain and control water flows and discharges.

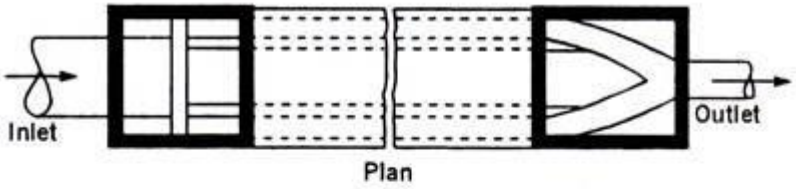
CONVEYANCE STRUCTURES

1. Inverted Siphon
2. Road Crossing
3. Drops
4. Chutes
5. Flumes
6. Culverts

INVERTED SIPHON

A structure for carrying water under pressure by gravity beneath roads, railroads, rivers or streams, various types of drainage channels, and depression.

INVERTED SIPHON



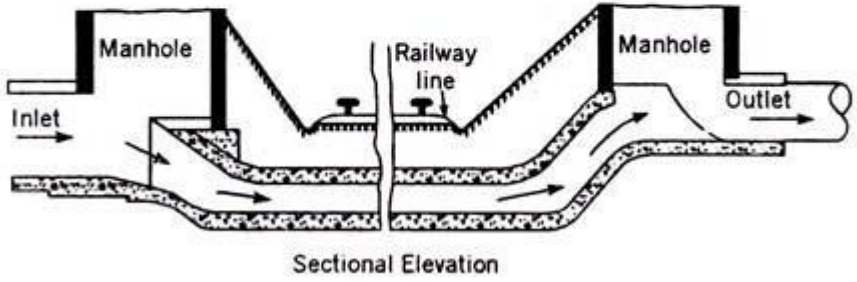


Fig. 7.11. Inverted Siphon.

ROAD CROSSING

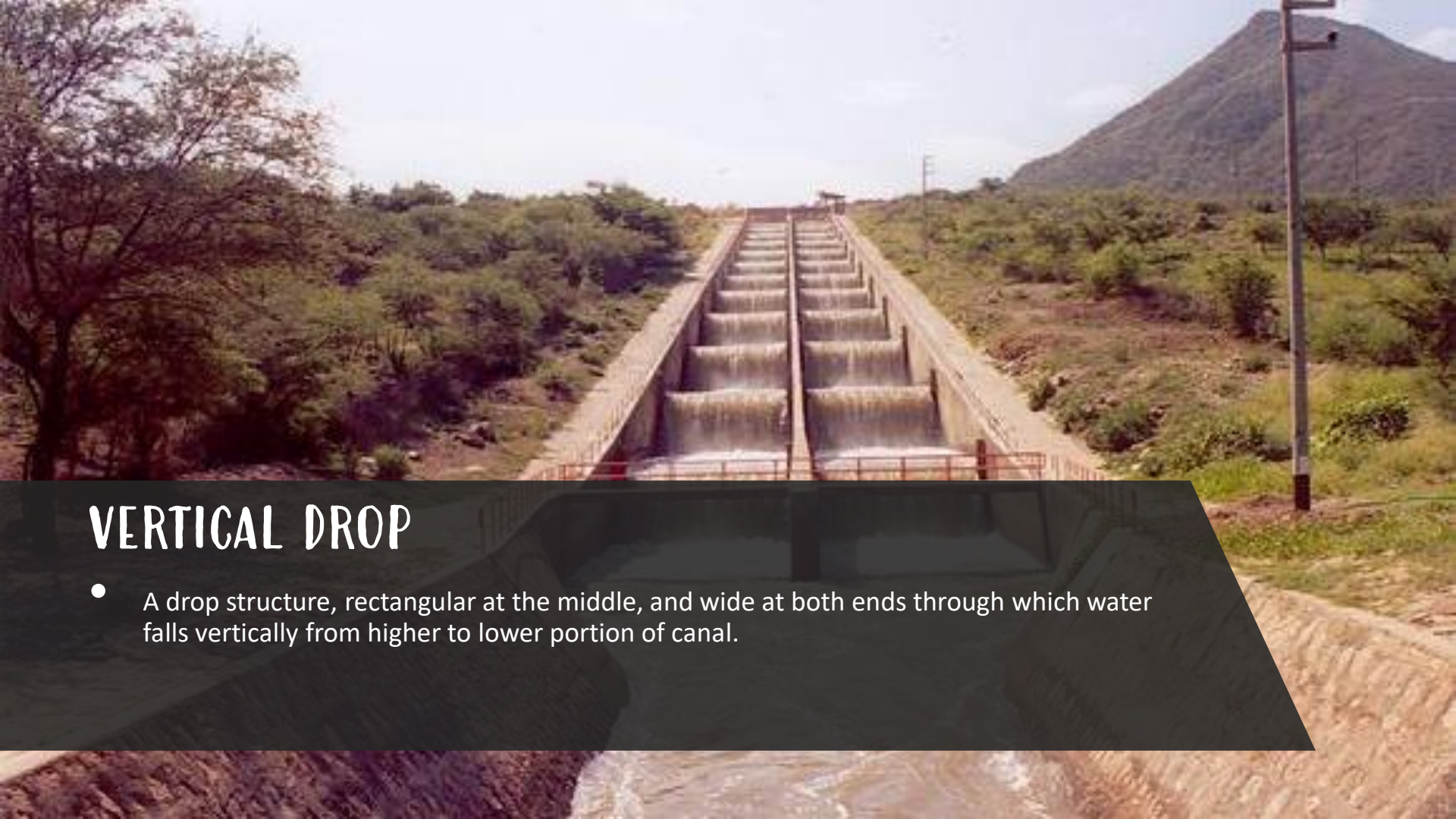
Structures used to carry water under roads or railroads. Concrete pipes are generally used for small flows. Some road crossings are built with other structures such as check structures.

DROPS

Structures used to conduct water from a higher to a lower elevation and to diffuse the force of the falling water. The inlet of the structure also serves as a control to regulate the water depth in the canal upstream.

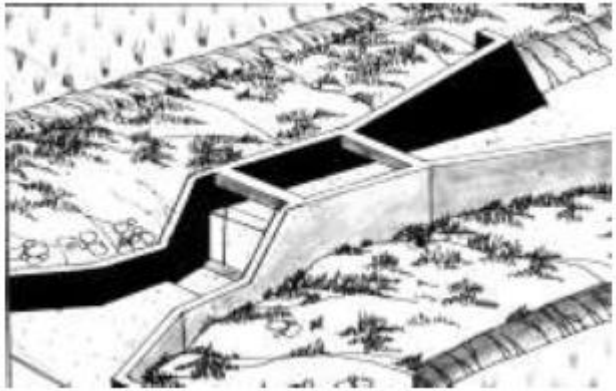
RECTANGULAR INCLINED DROP

- A rectangular shaped structure with an inclined concrete chute that conveys water from a higher to a lower part of a canal system.



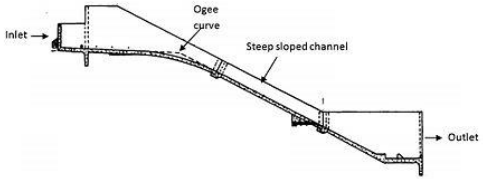
VERTICAL DROP

- A drop structure, rectangular at the middle, and wide at both ends through which water falls vertically from higher to lower portion of canal.



CHUTES

Structures used to carry water from a higher elevation to a lower elevation like inclined drops but they carry water over longer distances over flatter slopes and through several changes in grade.



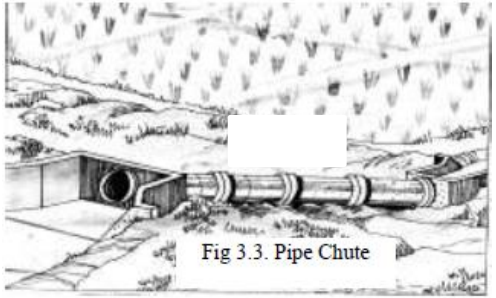


Fig 3.3. Pipe Chute

FLUMES

Structures used for crossing natural depressions or narrow canyon, and for conveying water along steep sidehills, drainage creeks, roadways, and lower irrigation canals.

ELEVATED FLUMES

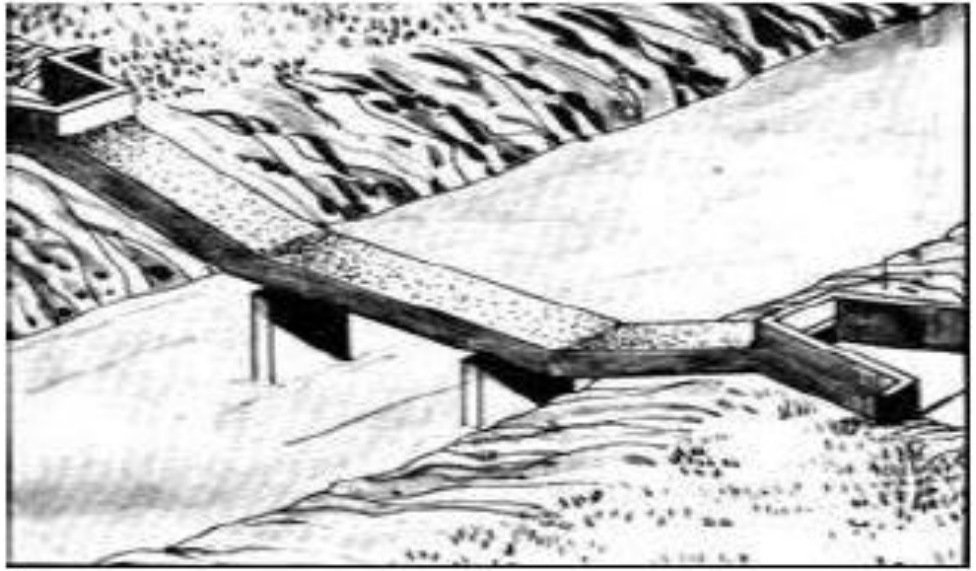
- A structure that often serves as an elevated siphon crossing a depression, stream, drainage canal, or other manmade channels. It is a concrete rectangular structure with a hollow trough through which water flows to the other side. The structure is supported above the ground by reinforced concrete, structural steel or timber.

BENCH FLUME

- Usually, a rectangular reinforced concrete trough supported on a bench excavated into a hillside and through which water flows into an adjoining canal. In steep hillside terrains, bench flumes are more practical and cost considerably less to construct than canals or pipelines.

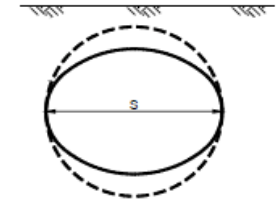
SI-FLUME

- A combination of siphon and flume that conveys water across a depression, drainage canal or stream usually from a higher to a lower opposite bank. It is usually a closed rectangular reinforced concrete conduit supported above the ground by columns or piers.

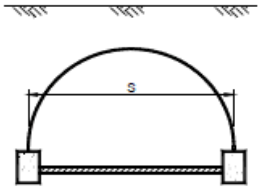


CULVERTS

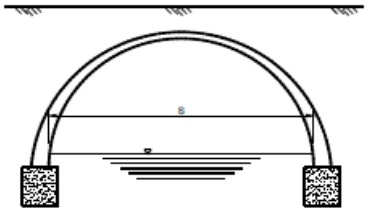
Closed conduits usually circular, square, or rectangular in cross sections. They are used for conveying water across and under an elevated roadway, embankment or dike.



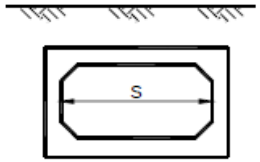
i – Soil Steel (Any Shape)



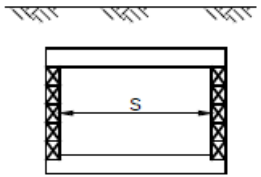
ii – Soil Steel Arch



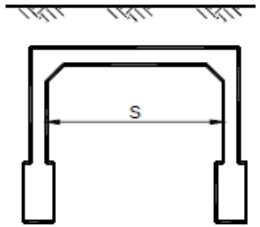
iii – Concrete Barrel Arch



iv – Concrete Box



v – Timber



vi – Concrete Open Footing

WATER CONTROL STRUCTURES

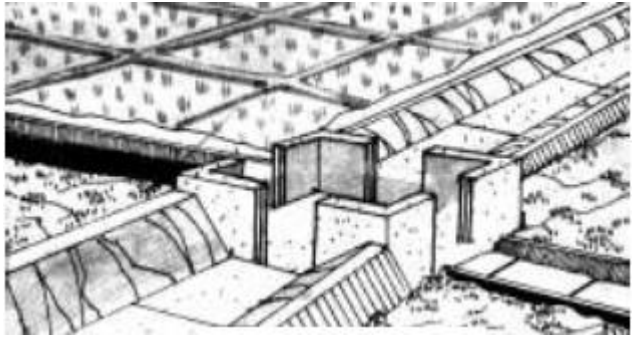
1. Checks
2. Division Box
3. Paddy Drain
4. Turnouts

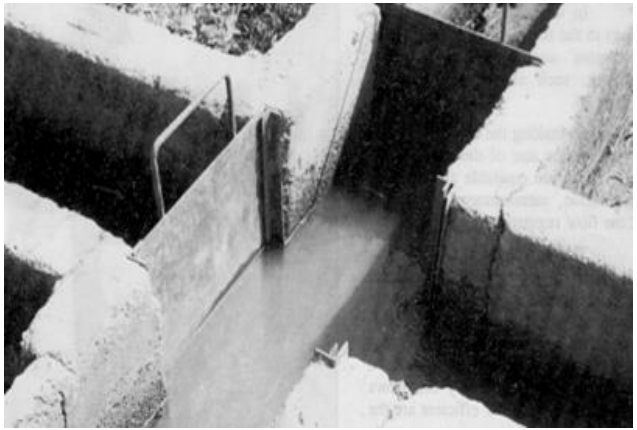
CHECKS

Check structures are used to regulate the canal water upstream of the structure and to control the downstream flow. These are built primarily to maintain the water surface elevation required by upstream water delivery systems servicing nearby farms.

DIVISION BOX

Usually consists of gate structures at the end each canal, so that flow in each branch can be regulated. The division box is used to divide the flow of water in a channel into two or more directions of approximately equal amounts without actual measurements.





PADDY DRAIN

a drainage built to convey excess water away from the paddy fields to a drainage canal or reservoir. It is a concrete structure cutting through the embankment or bank separating the rice fields and the drainage or reservoir.

TURNOUTS

- There are small outlet gates along a supply canal used for delivering water directly to rise paddies for farm ditches.

IRRIGATION METHODS

4 General Methods of Applying Water to Land:

1. Surface Irrigation
2. Subsurface Irrigation
3. Localized Irrigation
   - Sprinkler Irrigation
   - Drip/Trickle Irrigation
4. Manual Irrigation

SURFACE IRRIGATION

Most common method of applying irrigation water.

a. UNCONTROLLED OR "WILD" FLOODING

Water is applied from ditches without any levees to guide its flow or restrict its movement.

Usually practiced in areas where there is abundant supply of irrigation water.

Advantages:

- No land levelling & land shaping required
- Low labour and land preparation costs
- Less skill required by irrigator

Disadvantages:

- Applied water is lost by deep percolation & surface runoff
- Low irrigation application efficiency

b. CONTROLLED FLOODING

Water is applied from field ditches with levees to guide its flow.

b.1. BASIN

The field to be irrigated is divided into level rectangular areas bounded by dikes and ridges.

Water is turned in at one more points until the desired volume had been applied to the area.

Advantages:

- Water can be applied uniformly.
- Even small streams can be used for irrigation of crops efficiently.
- Simple and cheap when equipment is used for constructing bunds

Disadvantages:

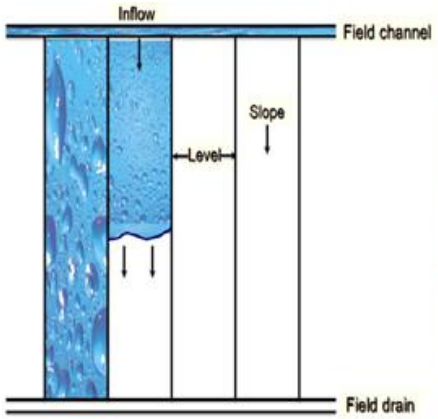
- Unless the land is levelled, distribution of water in plot is uneven.
- Considerable area is lost under field channels and bunds i.e. nearly 30% of area.
- Bunds interfere in working of inter-cultivation equipment
- More labour is required for field layout and irrigation

b.2. BORDER

The field to be irrigated is divided into graded strips by parallel dikes or border ridges.

The ends of the strips are usually not closed.

Water is turned in the upper ends and flows as a sheet down the strip.



Advantages:

- Large water streams can be used safely
- Provides uniform wetting of soil profile
- Low labour requirement

Disadvantages:

- Requires relatively large water streams for quick advance of water to minimize deep percolation losses at the upper end of the border strip.
- Wastage of water by deep percolation in coarse textured soils.

b.3. FURROW

- Small, evenly spaced channels installed down or across the slope of the field to e irrigated.
- Water is turned in at the high end and conveyed in the small channels to the vicinity of plants growing in or on beds between channels.

Advantages:

- Fairly high irrigation application efficiency among surface irrigation methods
- Furrows serve as field drains in areas of heavy rainfall
- Low evaporation losses

Disadvantages:

- Not suitable in coarse textured soils with high infiltration rates
- Possibility of intra-furrow soil erosion
- Labour intensive

SUBSURFACE IRRIGATION

Water is applied below the surface of the soil.

Advantages:

- High degree of control over water application with the potential for high uniformity of application
- Evaporation is reduced
- The amount of water can be fine-tuned. This avoids water loss caused by run off or evaporation
- Frequent irrigation allows for optimum soil moisture content in the root zone
- Great performance in windy and arid locations
- If pre-treated wastewater is used for irrigation, the risk of direct contact with crops and laborers is reduced

Disadvantages:

- Not suitable in coarse textured soils with high infiltration rates
- Possibility of intra-furrow soil erosion
- Labour intensive

OVERHEAD OR SPRINKLER IRRIGATION

Application of water to the surface of the soil in the form of spray, simulating that of rain.

Advantages:

- Affordable and easy to set up.
- Water measurement is easier than surface irrigation system.
- Less interference with cultivation and less land loss.
- High and frequent application can be effectively accomplished.
- Easy mechanization and automation.

Disadvantages:

- High operating cost.
- Water will drift when there is a lot of wind.
- A stable water supply is needed.
- Saline water may cause problem.
- Water must be free from sand, debris and large amount of salt.

DRIP OR TRICKLE IRRIGATION

- Method of applying water directly to the soil near the plant through a number of flow rate outlets (emitters) generally placed at short intervals along small tubing.
- May apply water to individual plant or to a row of plants.

Advantages:

- Reduced Water Usage
- Healthier Foliage
- Prevents Fungus
- Prevents Soil Erosion
- Reduces Weeds
- Nutrient Runoff Minimized
- Doesn’t Require Lot Leveling and Drainage
- Works With Low Pressure

Disadvantages:

- Clogging
- Requires Installation
- Requires Maintenance and Oversight

MANUAL IRRIGATION

Using buckets or hand sprinkler

ADVANTAGES:

- Improved water-use efficiency (reduced loss through evaporation)
- Well directed, selective and targeted irrigation
- Ensures constant water supply in the crucial phase of germination
- Higher yields, better quality, higher germination rate, lower incidence of pest attack
- Facilitates pre-monsoon sowing
- Can be constructed with locally available material
- Low investment costs

Disadvantages:

- Labour intensive
- User need a basic training to install and use the correct most of the method
- If the water is not properly filtered and the equipment not properly maintained, it can result in clogging