

## Drainage System:

- ❖ Is a system by which water is drained on or in the soil to enhance agricultural production of crops.
- ❖ It may involve any combination of storm water control, erosion control, and water table control.
- ❖ Drainage can be either natural or artificial.
- ❖ Many areas have some natural drainage; this means that excess water flows from the farmers' fields to swamps or to lakes and rivers.
- ❖ A drainage system is an artificial system of land forming, surface and/or subsurface drains, related structures, and pumps (if any), by which excess water is removed from an area when
- ❖ Natural drainage is often inadequate and artificial or man-made drainage is required.

# Types of Artificial Drainage Systems

## 1. Surface Drainage and

## 2. Subsurface Drainage

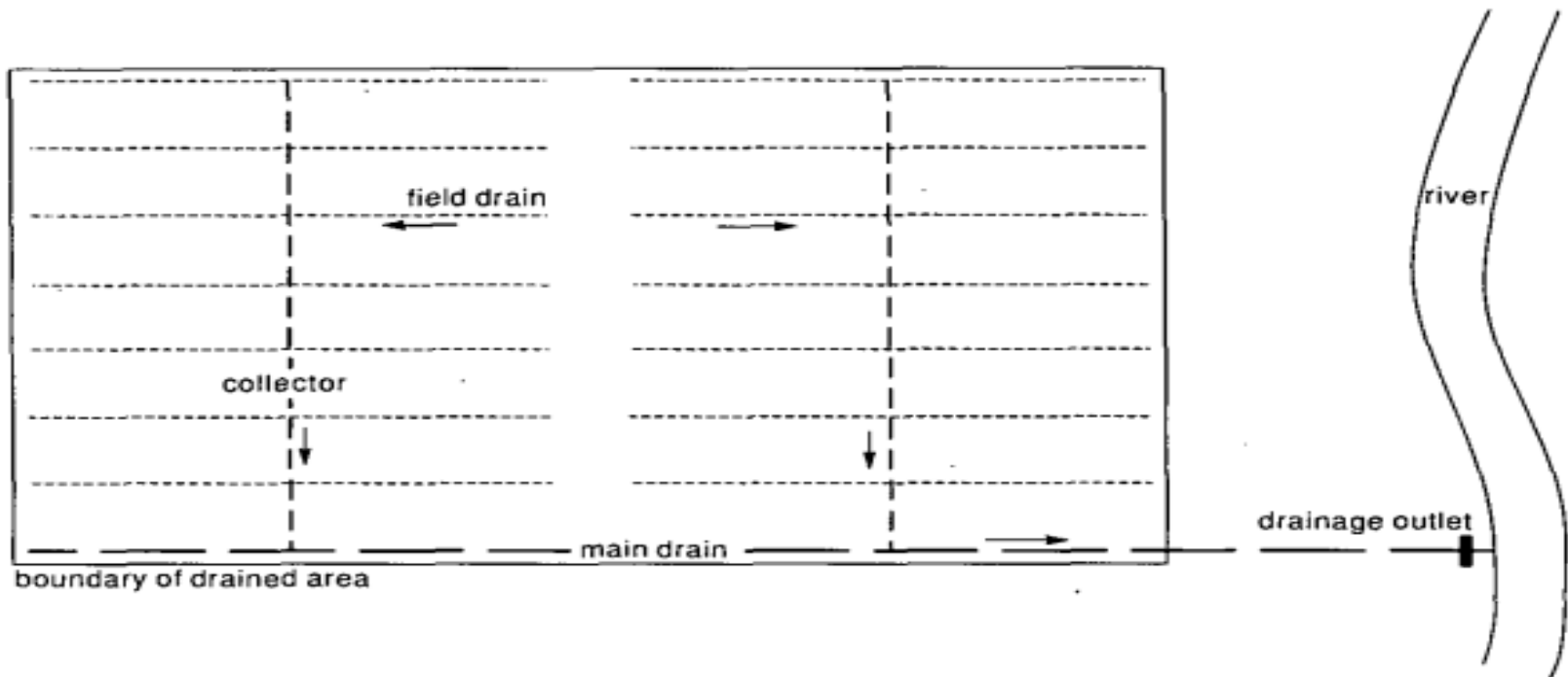
### **Surface drainage:**

- ❖ Is a system of drainage measures, such as open drains and land forming, to prevent ponding by diverting excess surface water to a collector drain.
- ❖ This is normally accomplished by shallow ditches, also called open drains.
- ❖ The shallow ditches discharge into larger and deeper collector drains.
- ❖ In order to facilitate the flow of excess water toward the drains, the field is given an artificial slope by means of land grading.

*A surface drainage system always has two components:*

1. Open field drains to collect the ponding water & divert it to the collector drain.
2. Land forming to enhance the flow of water towards the field drains.

### *1. Open field drains*



## 2. Land forming

- ❖ It is the change of surface of the land to meet the requirements of surface drainage or irrigation.
- ❖ There are three land-forming systems:
  - *bedding*,
  - *land grading and*
  - *land planning*.
- **Bedding:** is a surface drainage method achieved by ploughing land to form a series of low beds, separated by parallel field drains.
- **Land grading:** Land grading for surface drainage consists of forming the land surface by:
  - cutting, filling and smoothing it to predetermined grades so that each row or surface slopes to a field drain.
- **Land planning:** Land planning is the process of smoothing the land surface to eliminate minor depressions and irregularities, but without changing the general topography

# Surface Drainage System

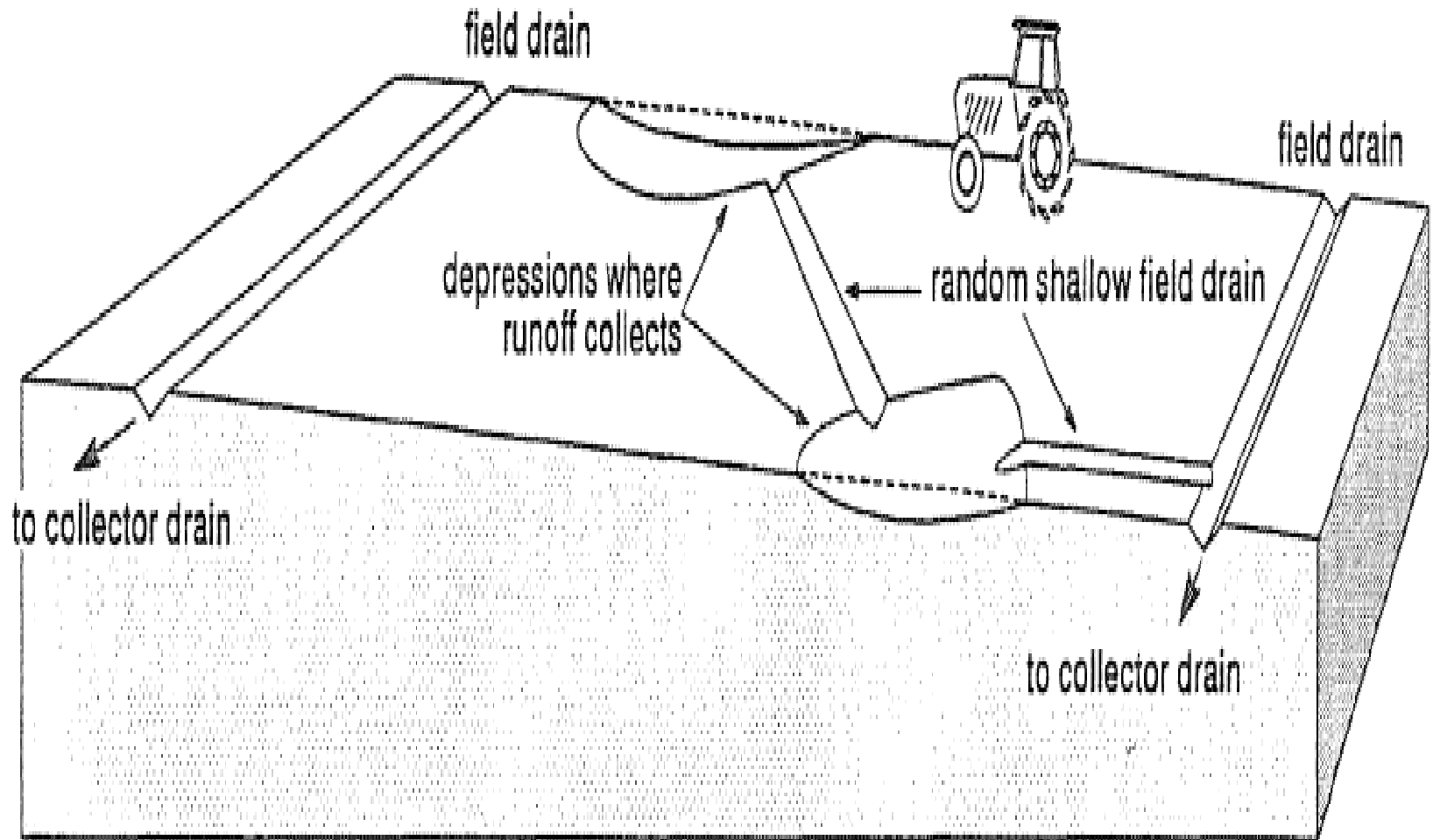
surface drainage systems have two different layouts:

- ❑ **The random field drainage system and**
- ❑ **The parallel field drainage system**

## ➤ *Random Field Drainage System*

- ❖ This type system is adapted to drainage systems on undulating land where only scattered wet areas require drainage.
- ❖ Applied where there are a number of large but shallow depressions in a field.
- ❖ Connects the depressions by means of a field drain and evacuates the water into a collector drain.
- ❖ The system is often applied on land which does not require intensive farming operations.

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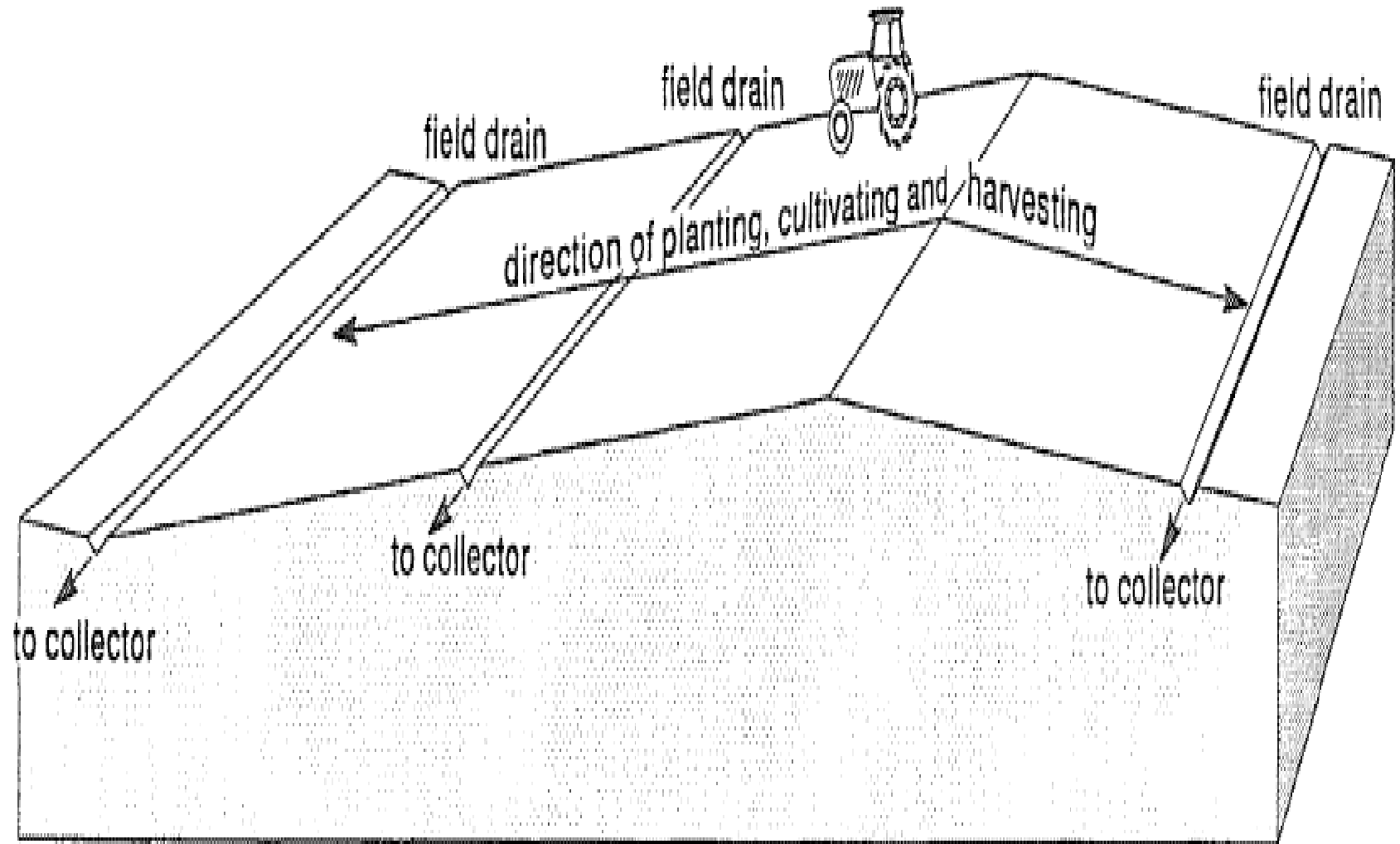


**Random field drainage systems**

## ➤ **Parallel field drainage system**

- ❖ This type system is applicable to land where the topography is flat and regular and where uniform drainage is needed.
- ❖ The parallel field drainage system in combination with proper land forming, is the most effective method of surface drainage.
- ❖ The parallel field drains collect the surface runoff and discharge it into the collector drain.
- ❖ The ditches are established parallel but not necessarily equidistant.
- ❖ The system is suitable in flat areas with an irregular micro-topography.

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The parallel field drainage system



# Subsurface Drainage

- ❖ Removal of excess water and dissolved salts from the soil
- ❖ It is accomplished by deep open drains or buried pipe drains.

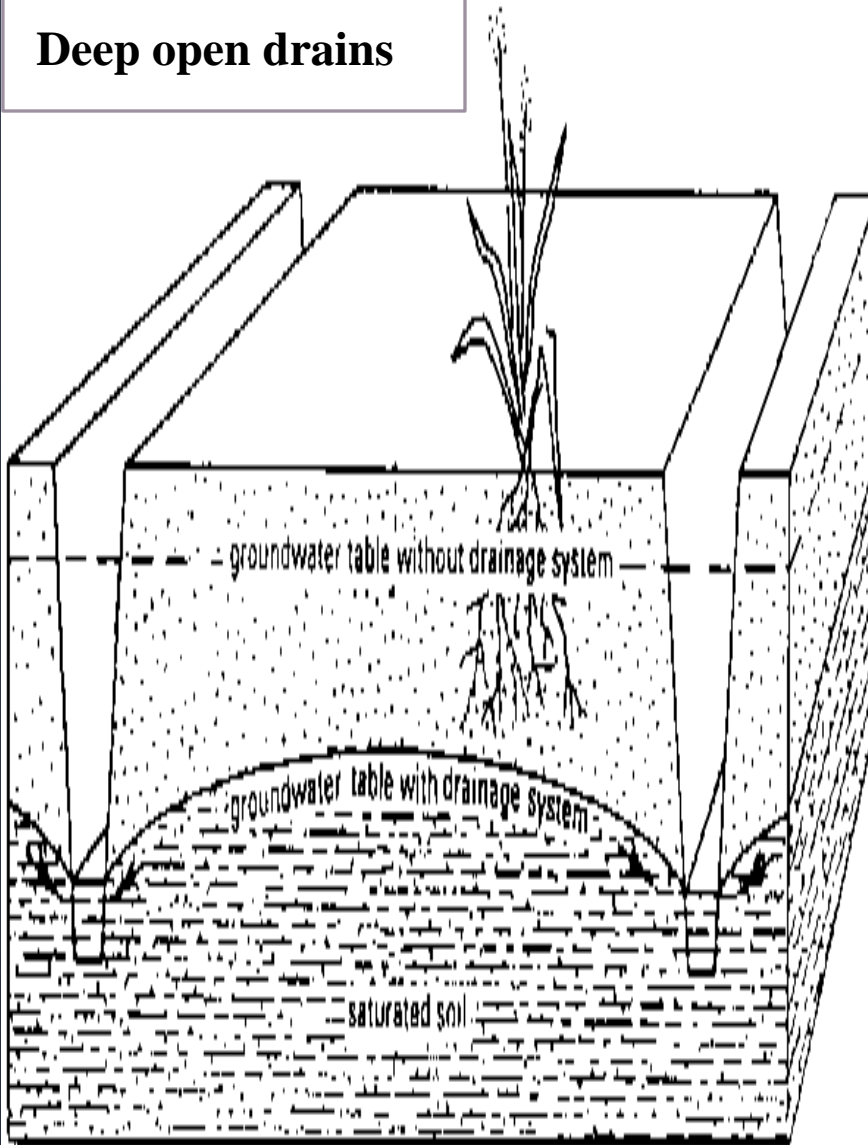
## **Deep open drains**

- ❖ The excess water from the root zone flows into the open drains.
- ❖ The disadvantage of this type of subsurface drainage is that it makes the use of machinery difficult (not easily avail).

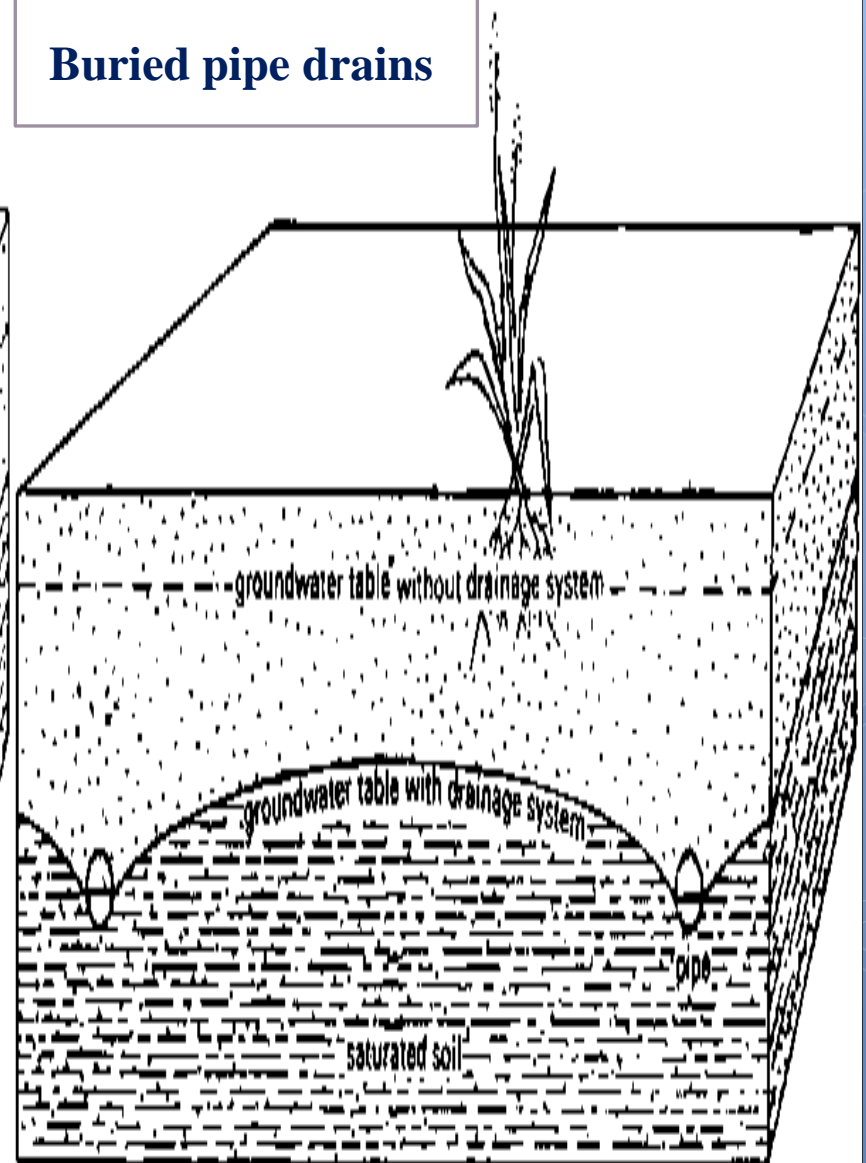
## **Buried pipe drains**

- ❖ Buried pipes with openings through which the soil water can enter
- ❖ The pipes convey the water to a collector drain

**Deep open drains**

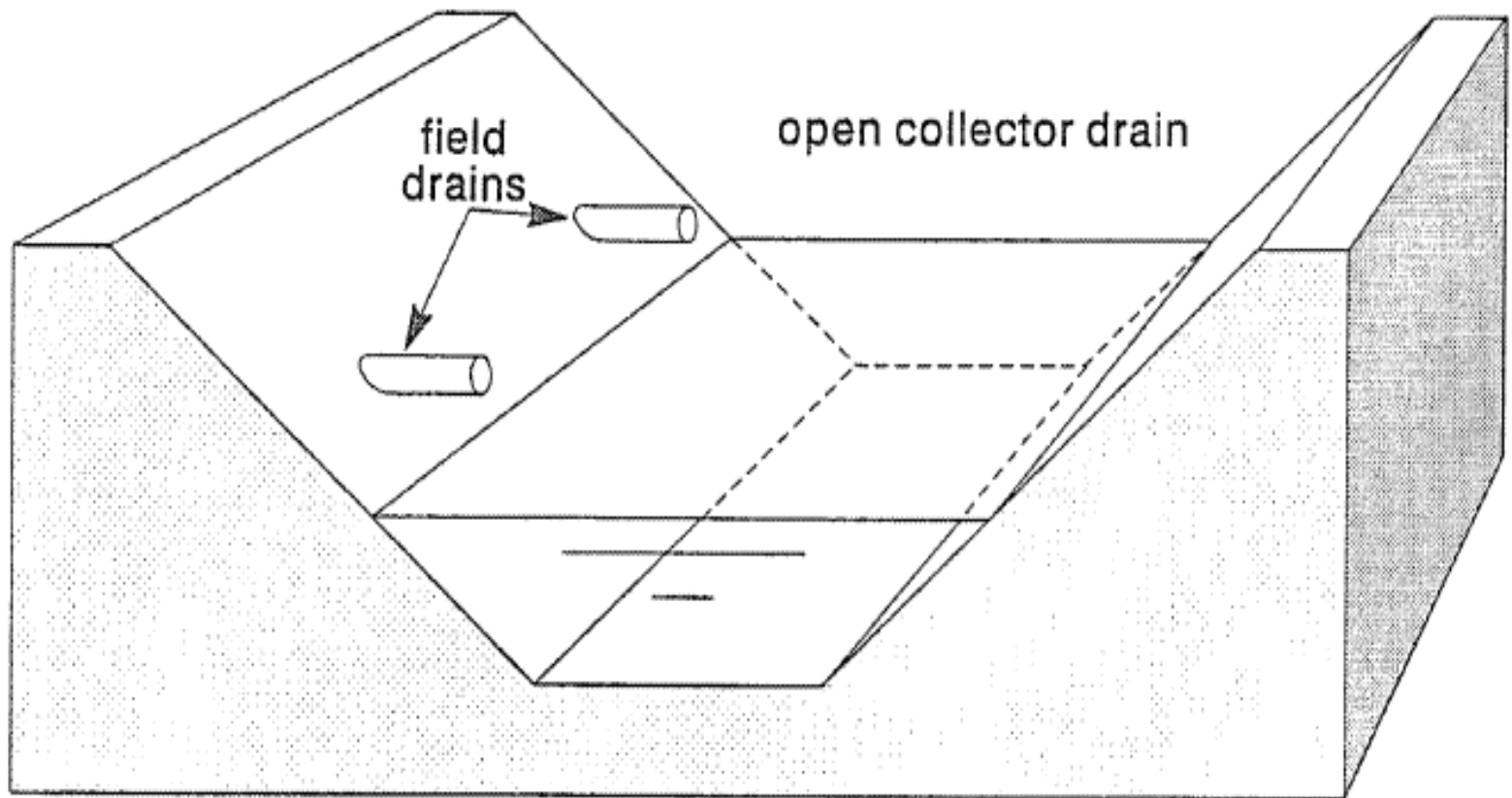


**Buried pipe drains**



- ❖ The choice between open drains or pipe drains has to be made at two levels:
  - For field drains and
  - For collector drains.
- ❖ If the field drains are to be pipes, there are still two options for the collectors:
  - *open drains*, so that there is a singular pipe drainage system.
  - *Pipe drains*, so that there is a composite pipe drainage system.
- ❖ In a singular pipe drainage system, each field pipe drain discharges into an open collector drain

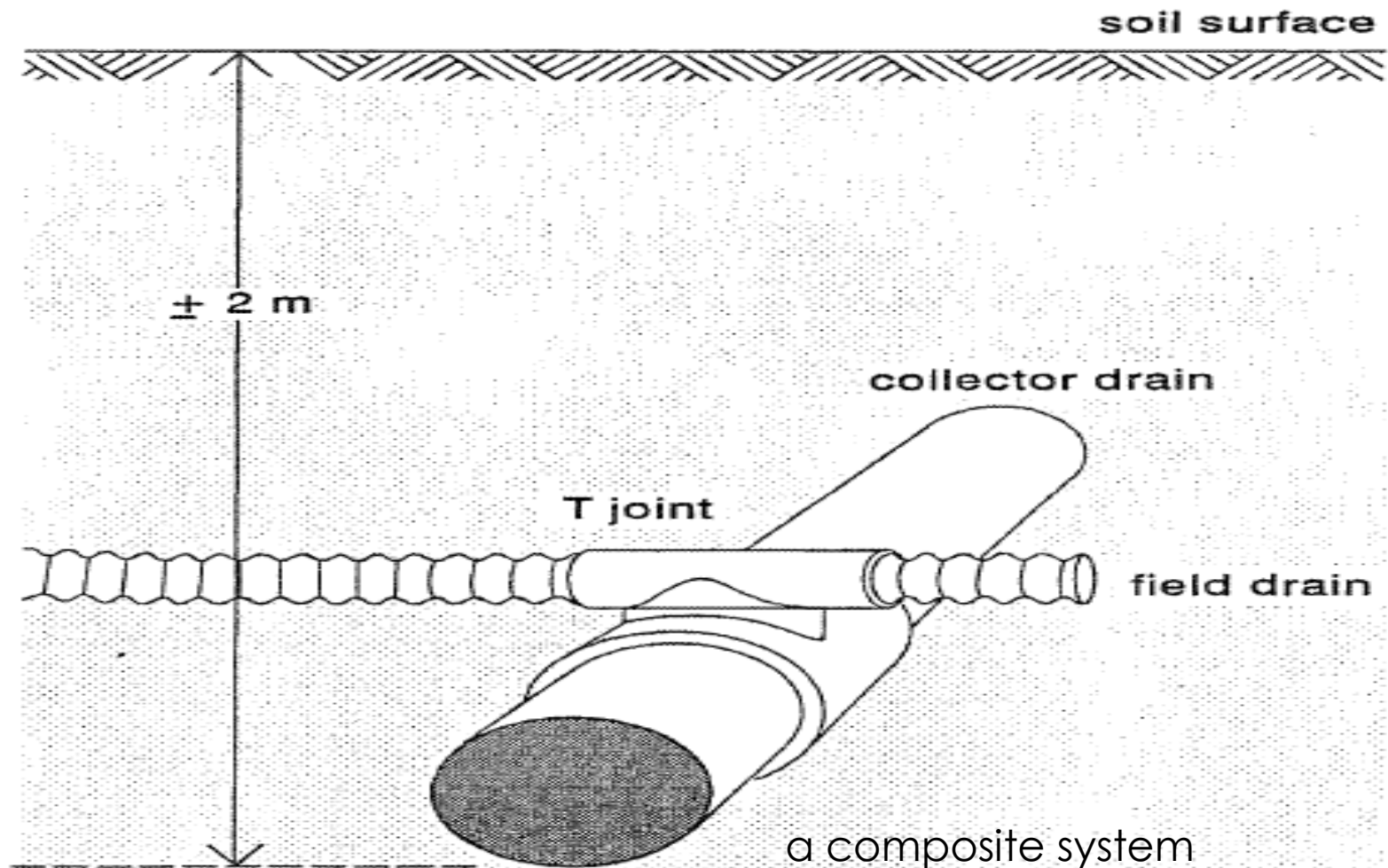
- ❖ A **singular drainage system**: A drainage system in which the field drains are buried pipes and all field drains discharge into open collector drains.



a singular pipe drainage system

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- ❖ A **composite drainage system**: A drainage system in which all field drains and all collector drains are buried pipes



# Components of a Drainage System

■ *A drainage system has three components:*

❖ *Field drainage system*

❖ *Main drainage system*

❖ *An outlet*

## **The field drainage system**

- ❖ is a network that gathers the excess water from the land by means of field drains, possibly supplemented by measures to promote the flow of water to these drains.
- ❖ The *field drains* (or *laterals*) discharge their water into the collector or main system either by *gravity* or by *pumping*.
- ❖ The field drainage system is the most important component for the farmers.

# Main Drainage System

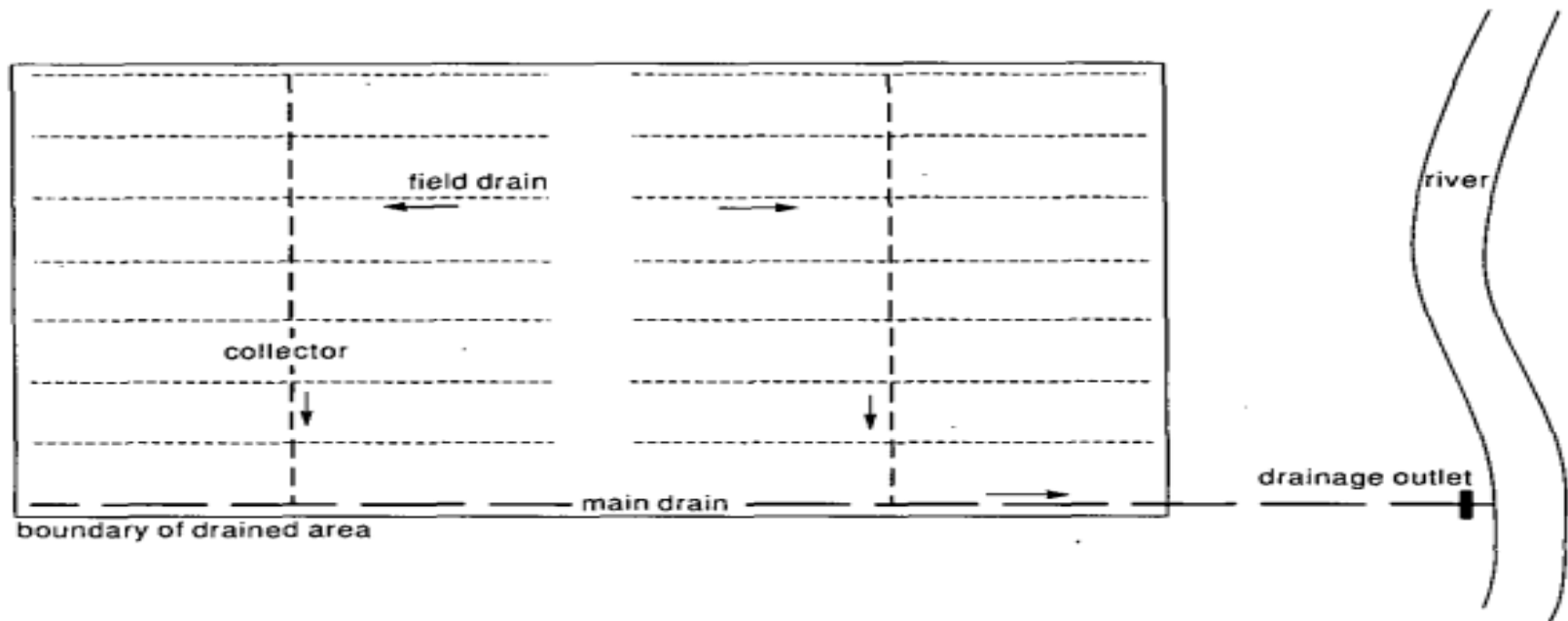
- ❖ **It** is a water-conveyance system that receives water from the field drainage systems; surface runoff and groundwater flow, and transports it to the outlet point.
- ❖ A collector drain collects water from the field drains and carries it to the main drain for disposal.
- ❖ The main drainage system consists of some collector drains and a main drainage canal.
- ❖ Collector drains can be either open drains or pipe drains.
- ❖ The main drain is the principal drain of an area.

# outlet

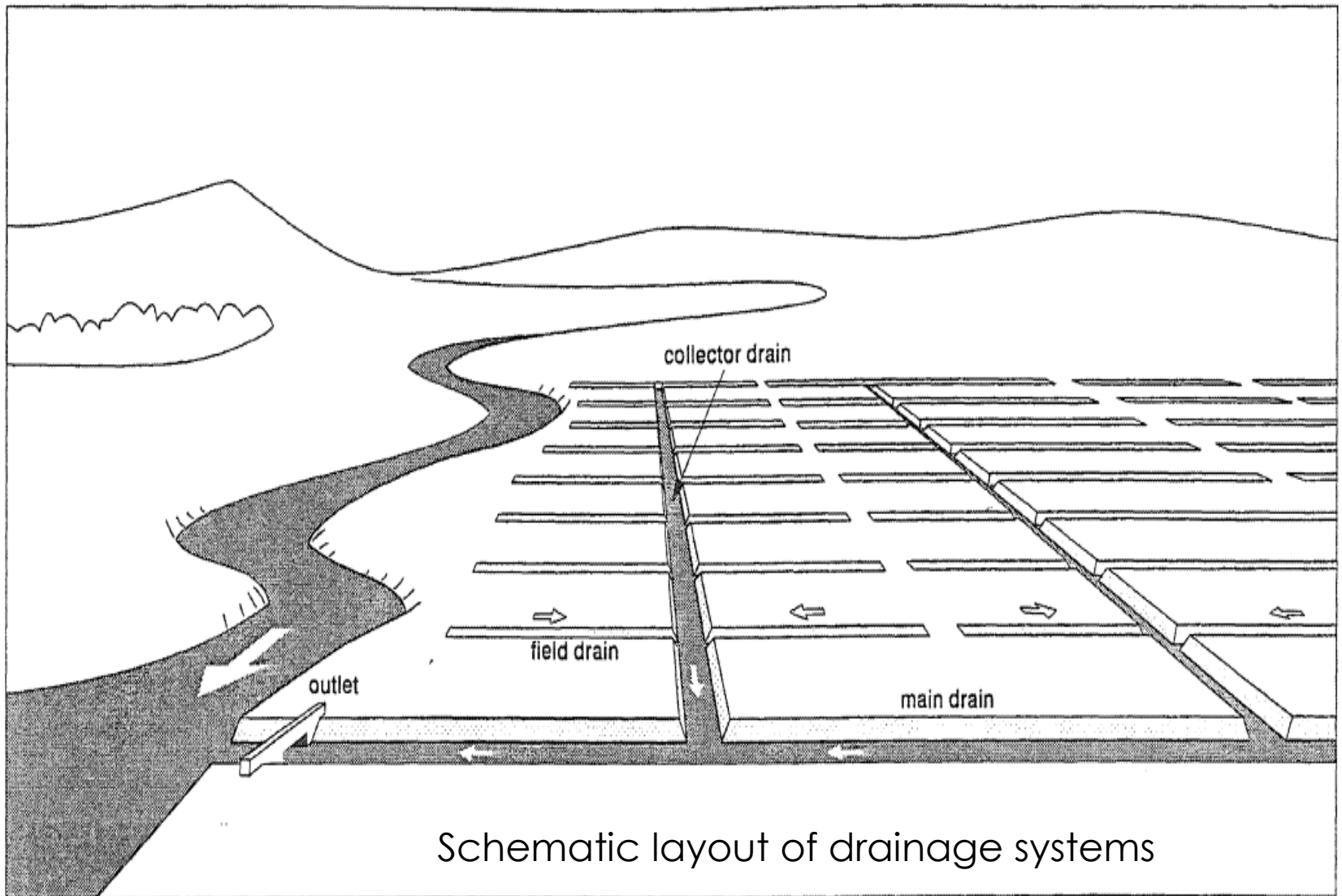
- ❖ It is the terminal point of the entire drainage system, from where the drainage water is discharged into a river, a lake, or a sea.
- ❖ It can be one of two kinds: a gravity outlet or a pumping station.
- ❖ A gravity outlet is a drainage structure in an area which has outside water levels that rise and fall.
- ❖ The drainage water can flow out when the outside water levels are low.



- ❖ A pumping station is needed in areas where the water levels in the drainage system are lower than the water level of the river, lake or sea.



*Components of a Drainage System*



Schematic layout of drainage systems

# Compound Drainage Systems

- Sometimes, combined surface and subsurface drainage systems are used.

Whether this is needed or not depends on a combination of factors:

- ❖ The intensity and duration of the rainfall
  - ❖ Surface storage
  - ❖ The infiltration rate
  - ❖ The hydraulic conductivity and
  - ❖ The groundwater conditions.
- Sub-surface drainage is needed to control salinity for the dry-foot crops (e.g. maize and cotton), whereas surface drainage is needed to evacuate the standing water from the rice fields (e.g. before harvest).

- Areas with occasional high-intensity rainfall, which causes water to pond at the soil surface, even when a subsurface drainage system has been installed.

***Rice is cultivated alongside “dry-foot” crops***

