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Czech University of Life Sciences – Series of Guest Lectures, 3-7 December 2011

Need for Drainage

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  - Water ponding, waterlogging and Salinisation

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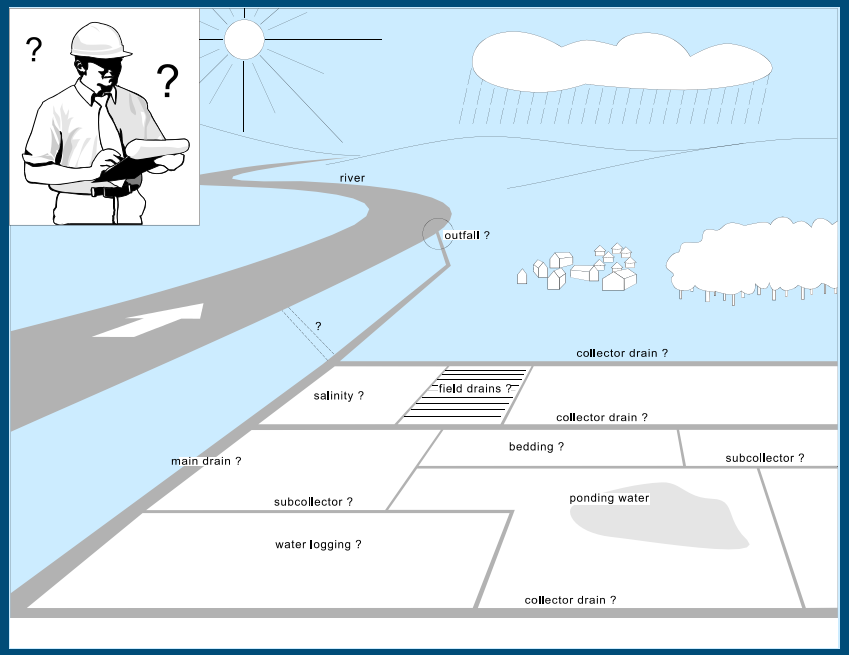
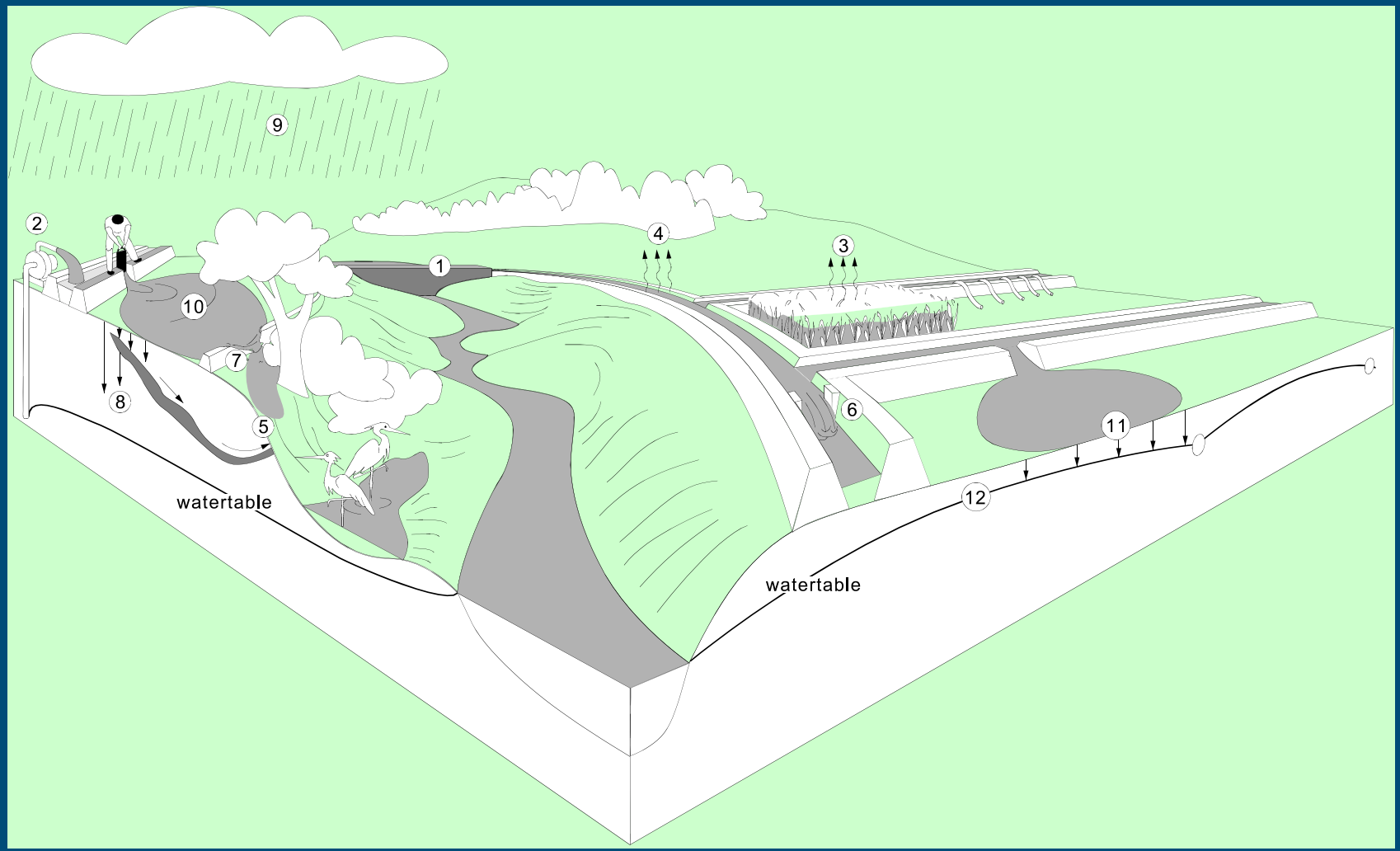
  - Temperate, arid & semi-arid and humid tropics



Irrigation & Drainage = manipulation of the water balance



Drainage for Agriculture: Need for Drainage

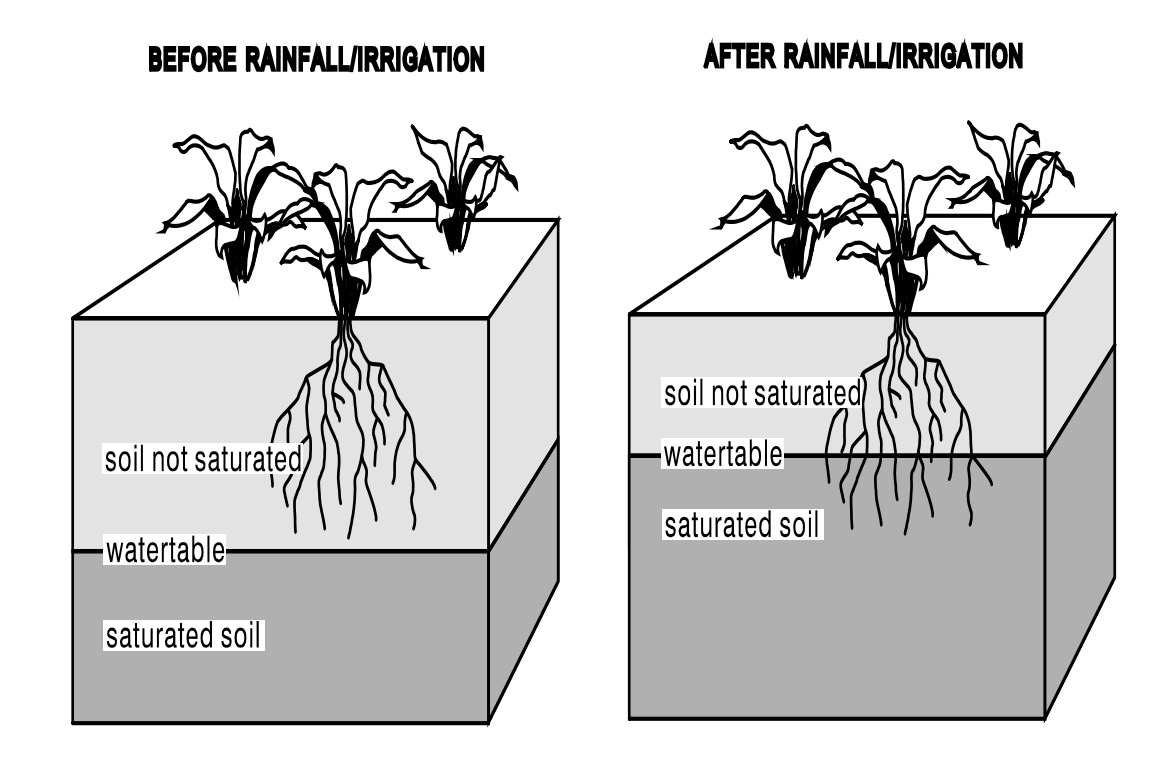
Drainage:

- To prevent or reduce waterlogging and/or water ponding
- To control salinity
- To reclaim
- To sustain

Need for drainage: Water ponding

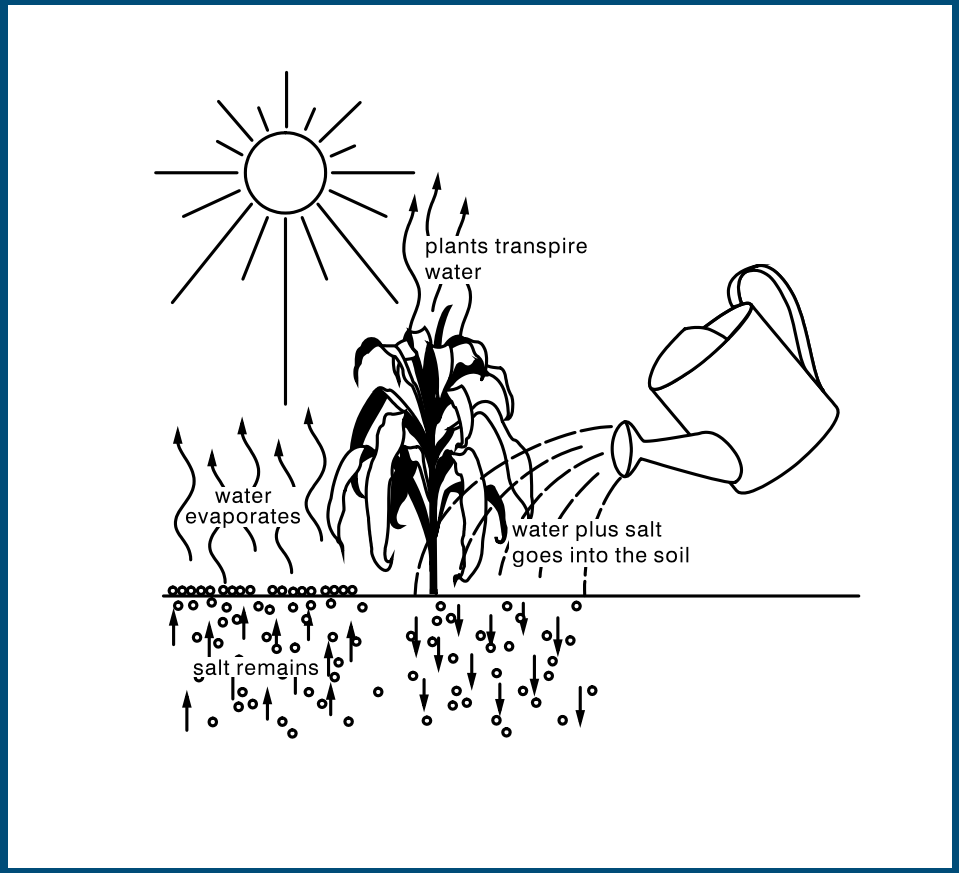
Water ponding is the accumulation of excess water on the soil surface

Need for drainage: Waterlogging



Waterlogging is the accumulation of excess water in the root zone of the soil.

Need for drainage: Salinization



Salinization is the accumulation of soluble salts at the surface, or at some point below the surface of the soil profile, to levels at which they have negative effects on plant growth and/or soils.

Question: how much salt is brought into the soil profile by irrigation?

Example – Leaching in the Nile Delta, Egypt

Irrigation based on crop water requirements:

V_i = 1200 mm/yr = 1200 x 10^{-3} x 10^4 m^3/ha/yr

= 12 x 10^3 m^3/ha/yr

Salinity of irrigation water:

EC_i = 0.3 dS/m = 0.3 x 640 ppm

= 0.3 x 640 mg/l = 200 mg/l

= 2 x 10-4 ton/m3

Total salts brought into the soil:

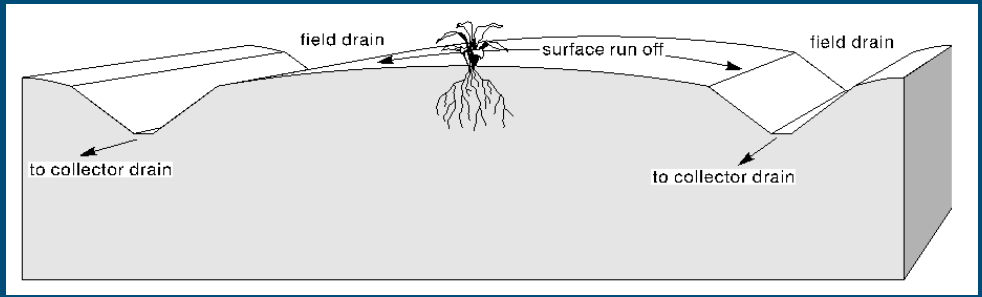
$S = V_i \times EC_i$

= 12 x 103 m3/ha/yr x 2 x 10-4 ton/m3

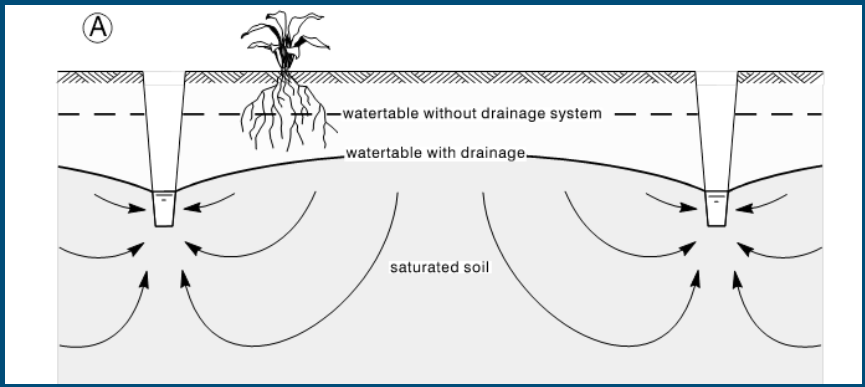
= 2.4 ton/ha/yr

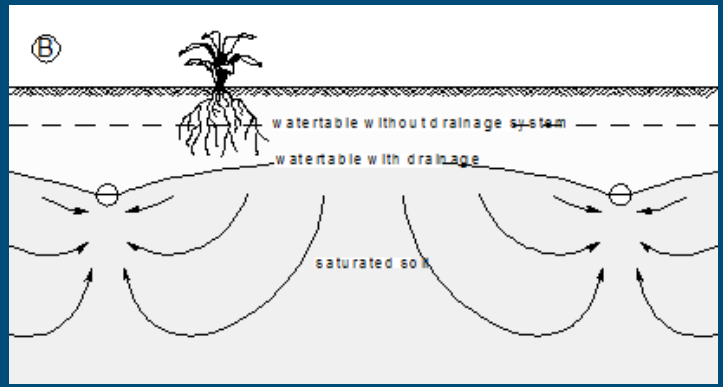
Types of Drainage

- Surface drainage

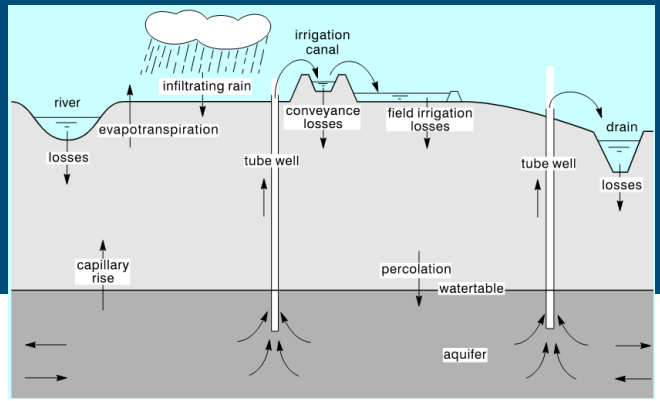


- Subsurface drainage

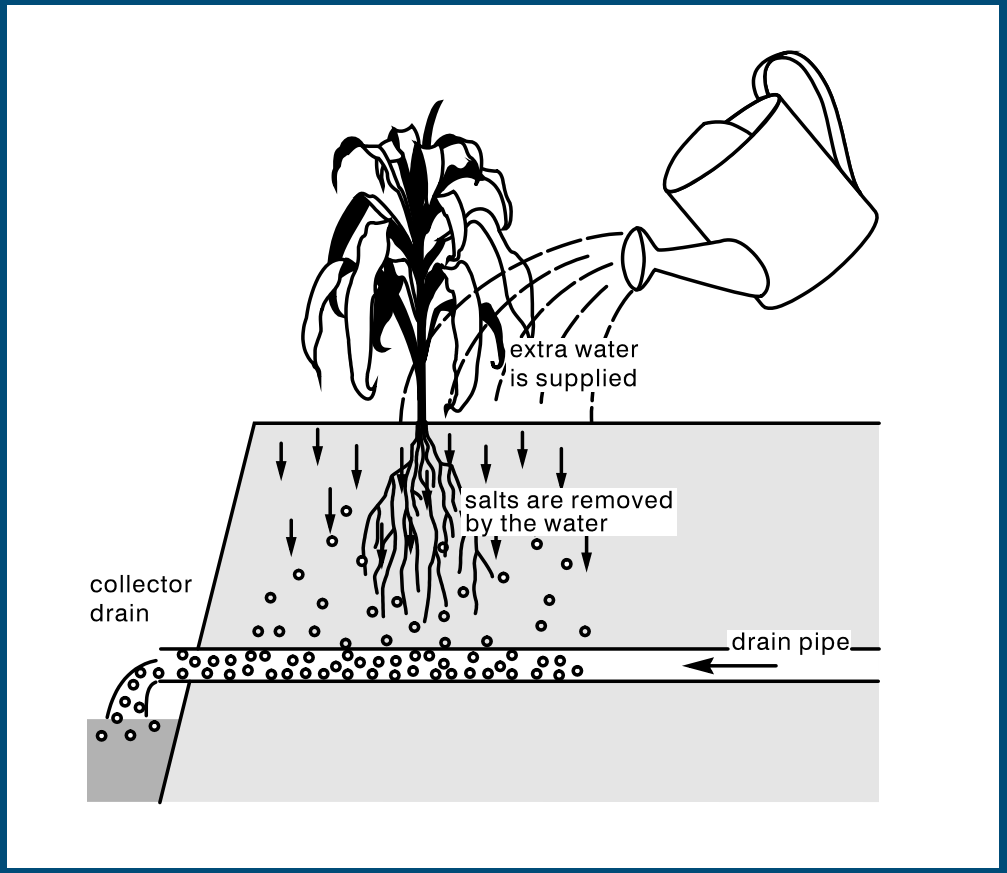




- Tubewell drainage



Leaching: combination of irrigation and drainage



the removal of soluble salts by the passage of water through soil.

Problem ← → Types of Drainage

Water ponding

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surface drainage

Waterlogging & Salinisation

↓

subsurface drainage

Waterlogging & Salinisation

↓

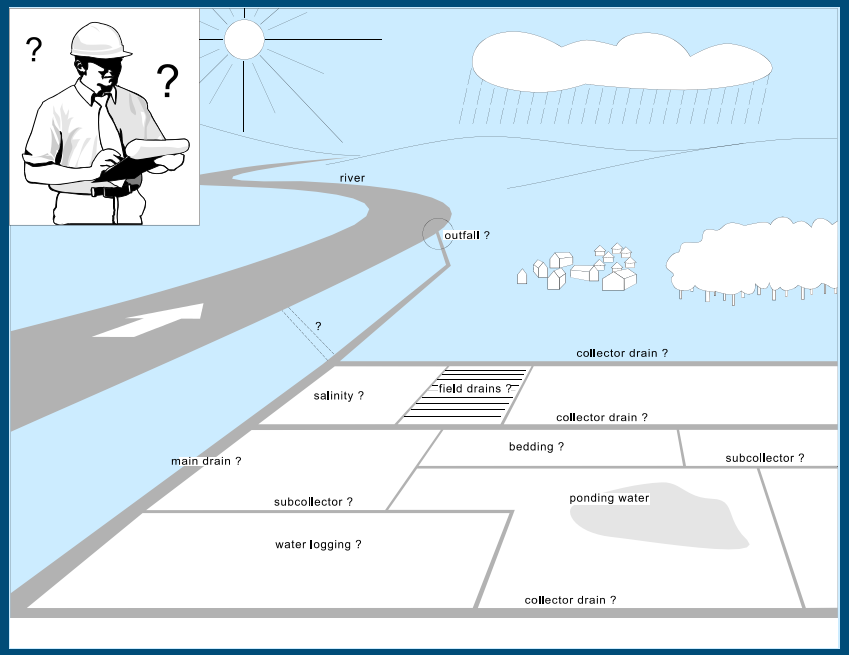
tubewell drainage

Subjects

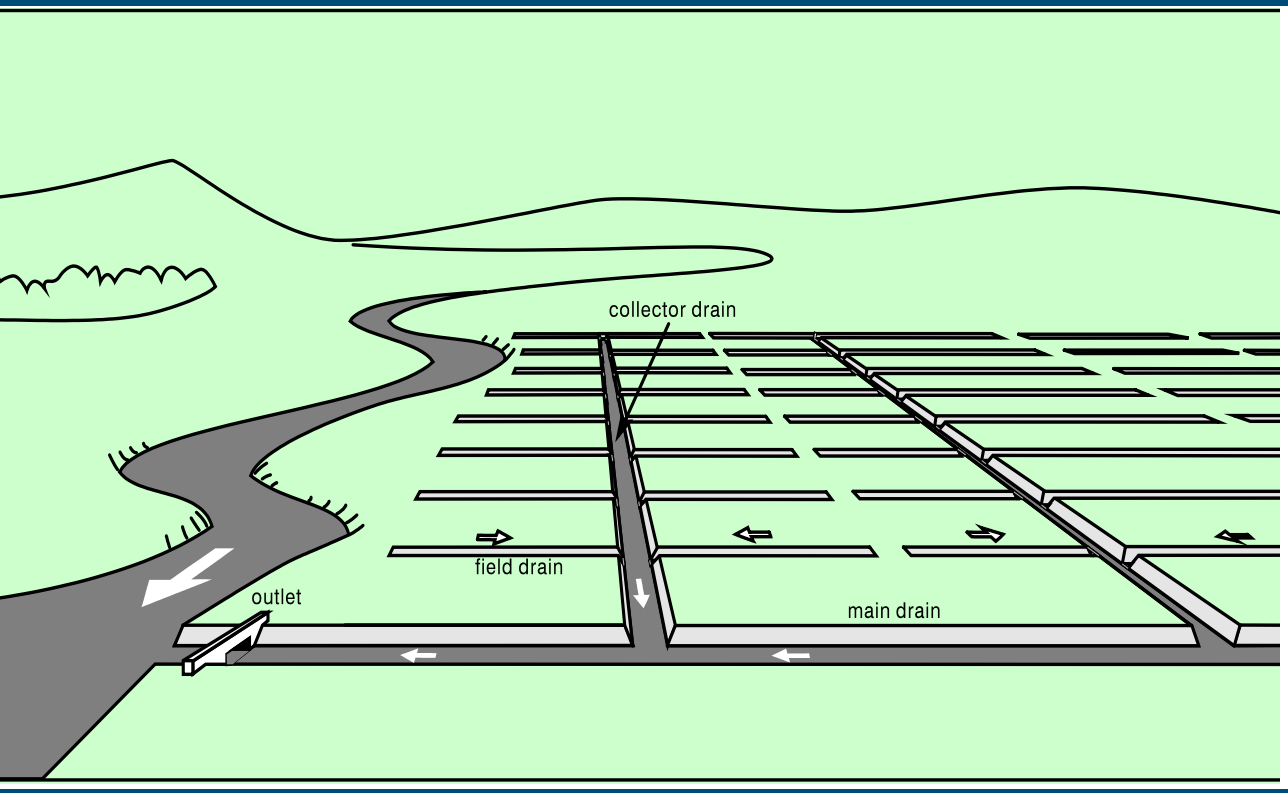
- **Need for drainage**
  - Drainage for Agriculture
  - Water ponding, waterlogging and Salinisation

- **Drainage Systems**
  - Outlet
  - Main drainage system
  - Field drainage system

- **Examples of drainage systems**
  - Temperate, arid & semi-arid and humid tropics



Components of a Drainage System



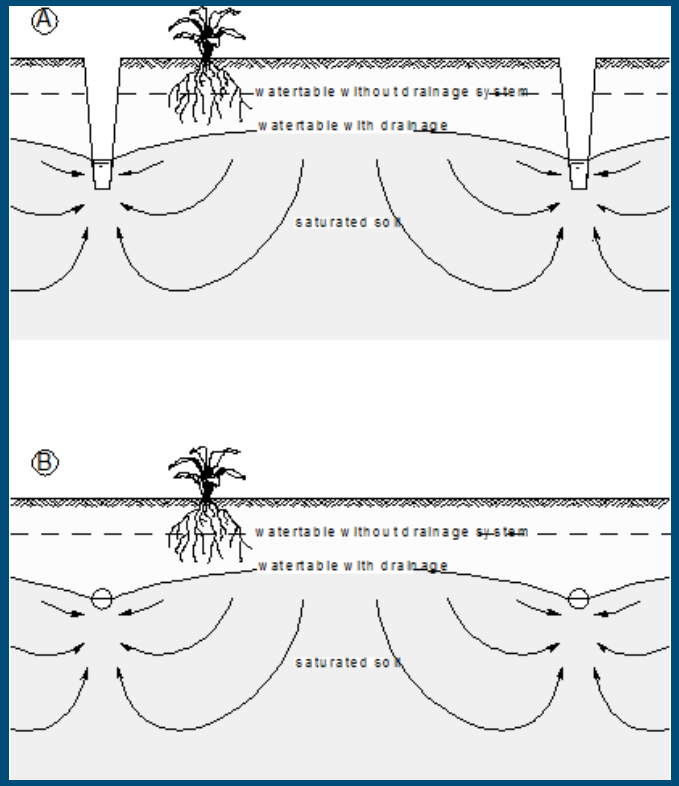
- Field drainage system: control
- Main drainage system: conveyance
- Outlet: disposal

Field Drainage System

a network that gathers the excess water from the land by means of field drains, possibly supplemented by measures to promote the flow of excess water to these drains

Two functions:

1. Control of the watertable
2. Removal of excess rainfall/irrigation



Main Drainage System

a water conveyance system that receives water from the field drainage systems, surface runoff, and groundwater flow, and transports it to the outlet point

Two functions:

1. Water transport
2. Water level control

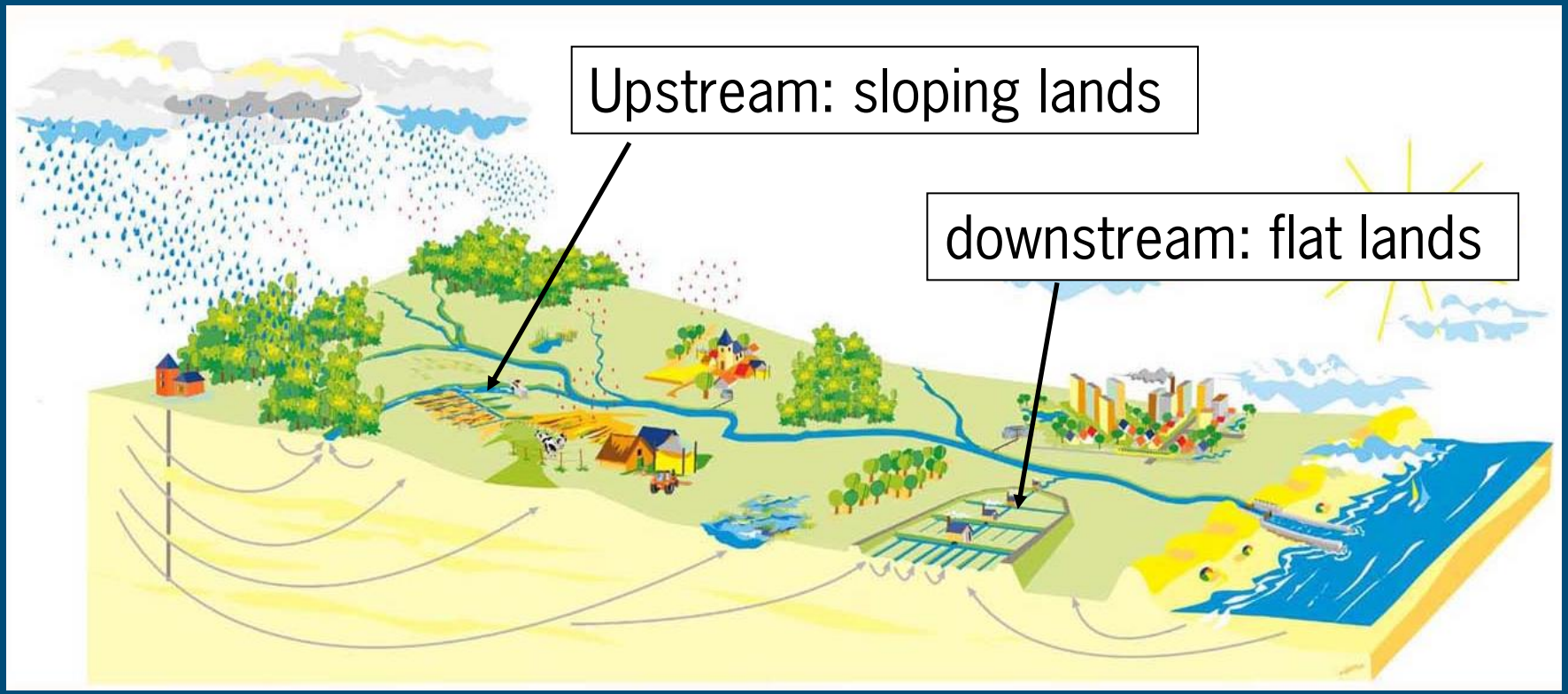
Outlet

is the terminal point of the entire drainage system, from where it discharges into a river, lake, or sea

Two functions:

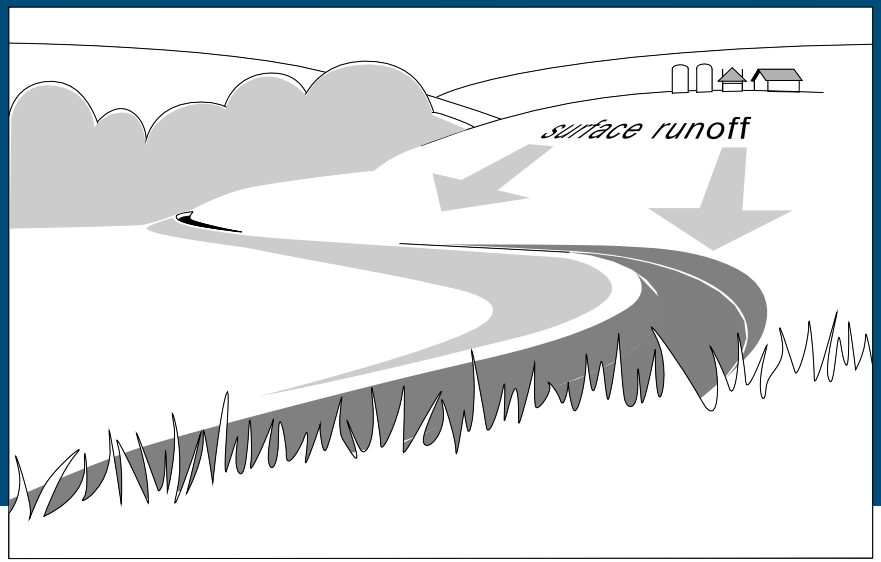
1. Controlled disposal
2. (in site) Water level control

Design options for drainage



Challenges for sloping lands

- Steep (hydraulic) gradients
- Control erosion (also during off-season when land is fallow)
- High peak discharges



Challenges related to drainage in coastal plains

- Gentle hydraulic gradients
- Tidal levels in the river near the sea
- Salt water intrusion
- Complicated network of river branches
- Rapid changes in channel configuration after floods
- Low elevation with respect to level in the rivers or sea

Subjects

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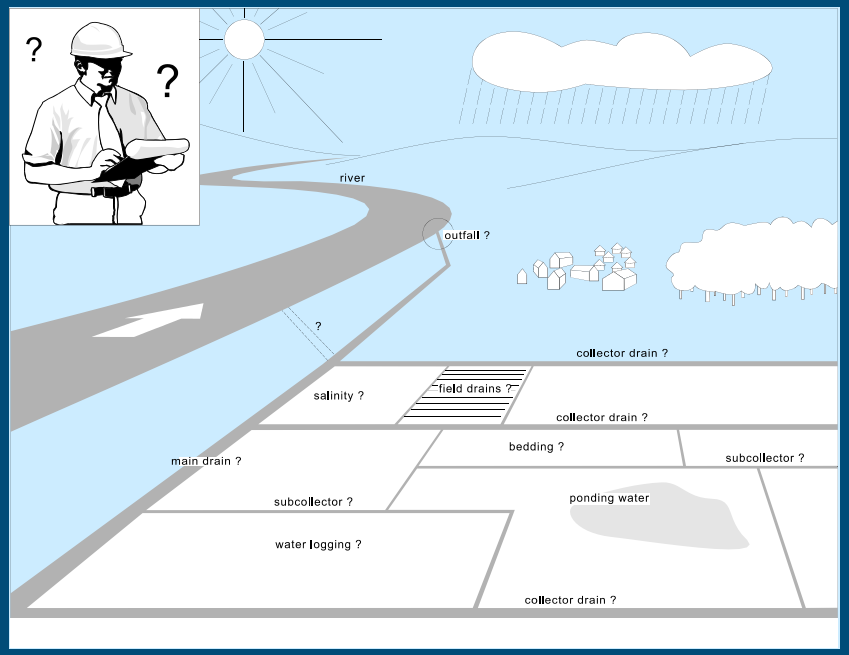
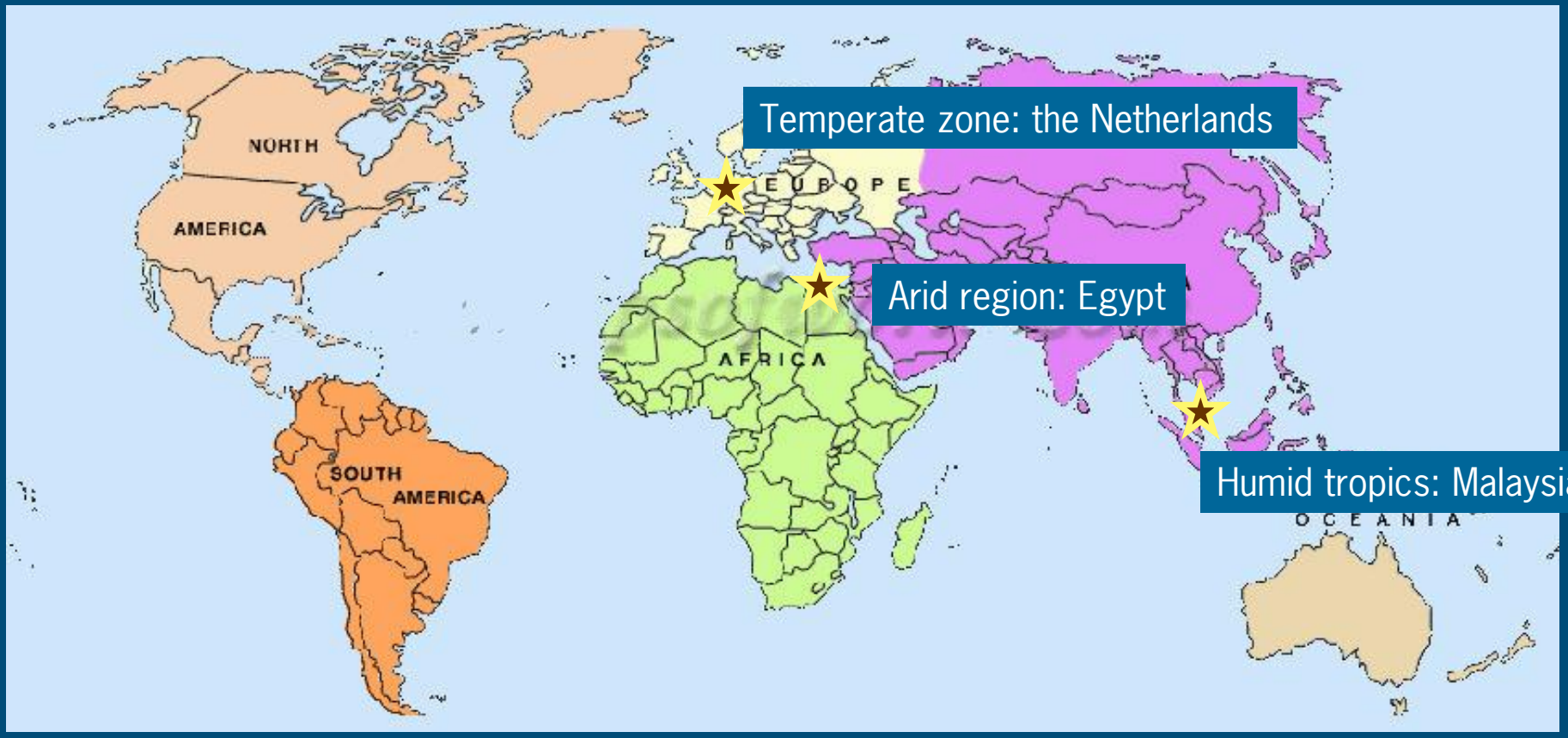
  - Field drainage system

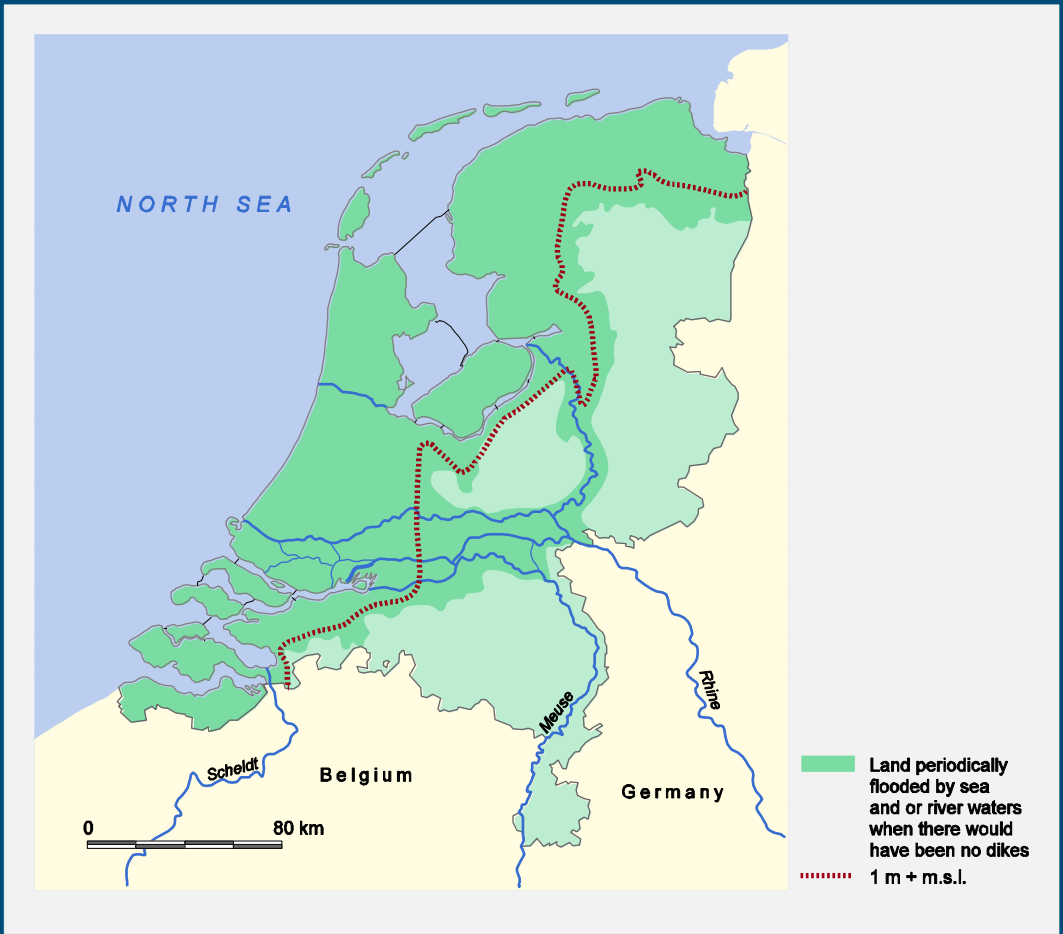
- **Examples of drainage systems**
  - Temperate, arid & semi-arid and humid tropics



Three examples: temperate, arid and humid climates



Example from a temperate humid region: The Netherlands



- 25 % of the land below mean sea level
- 65% protected by dikes against flooding

Question: has it always be like this?

Subsidence: a never-ending process !!

The Western part of the Netherlands consists of peat lands = organic soil

In its natural state peatlands are waterlogged

Drainage needed for cultivation => subsidence

Rate of subsidence: ? **1-2 cm/year**

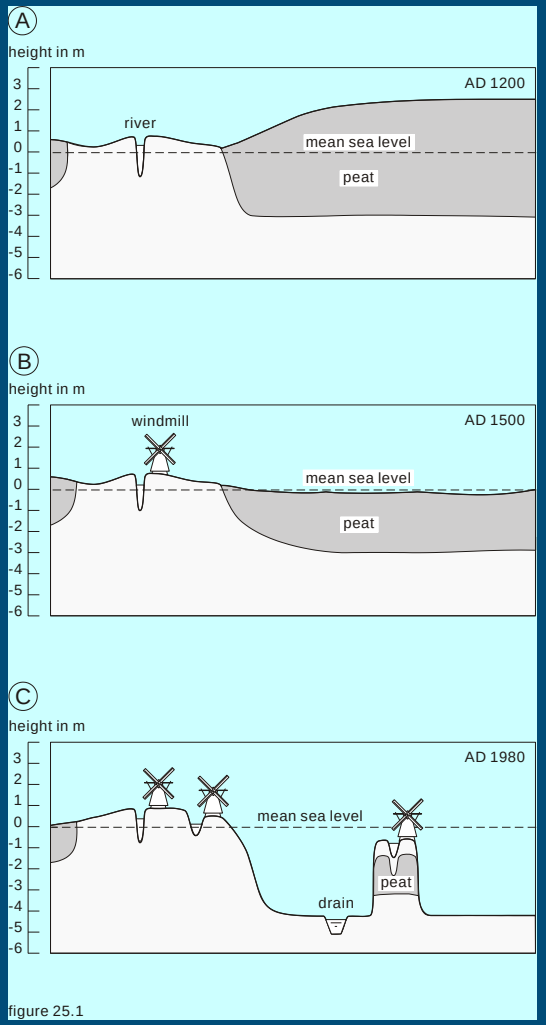


figure 25.1

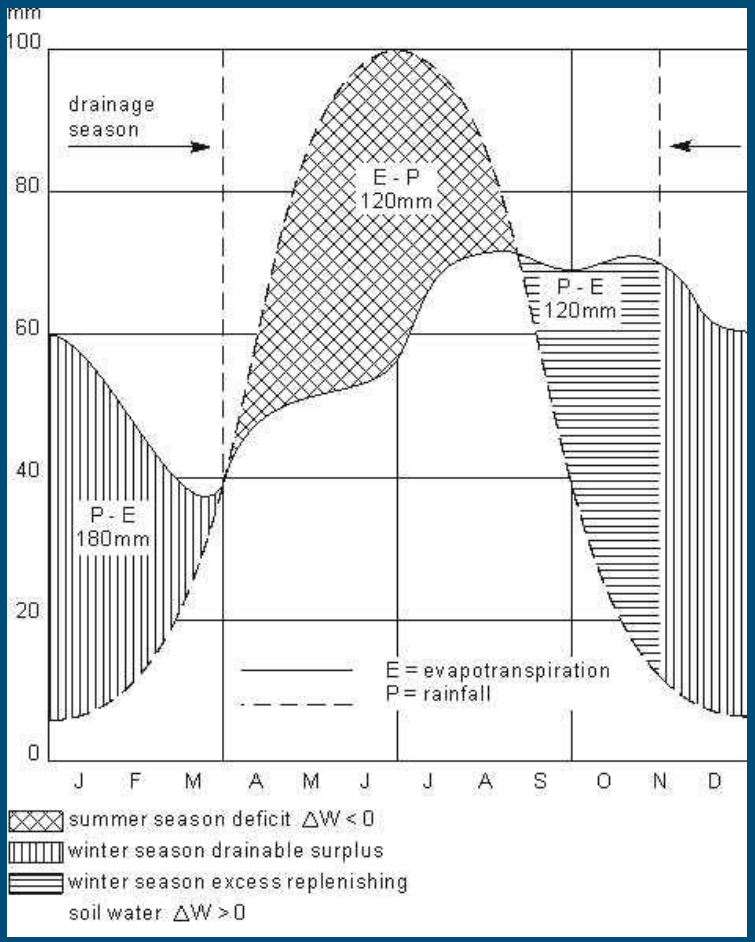
Climate in the Netherlands

Average rainfall : 725 mm
Average evaporation: 475 mm
Drainage surplus: 250 mm

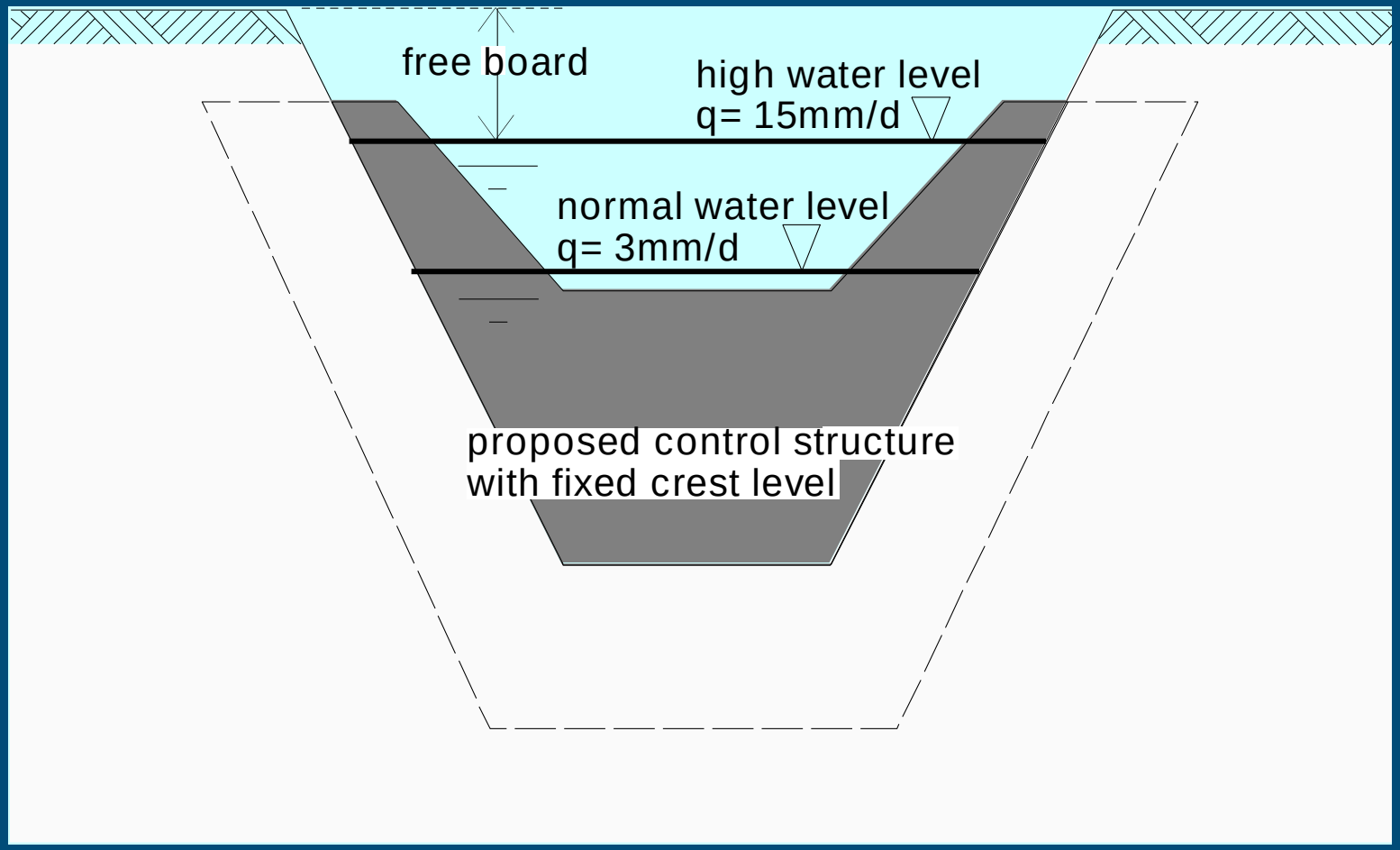
In summer: deficit: 120 mm
In winter: excess rainfall: 180 mm

Drainage system has two functions:

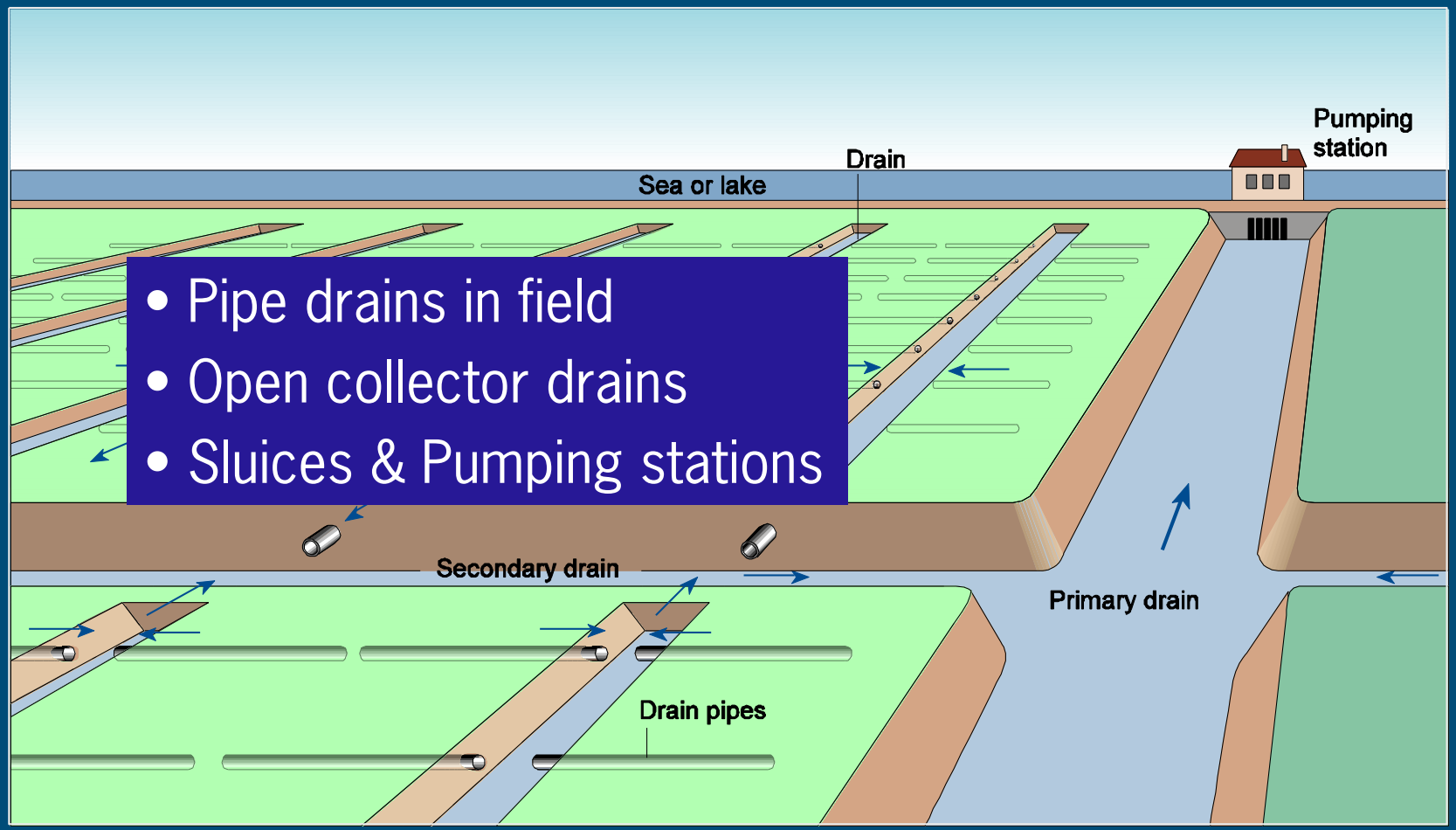
1. Control of the watertable in summer
2. Removal of excess rainfall in winter



Design criteria for open collector drains in the Netherlands



Commonly used drainage system



Traditional pumping “stations”

Example from an arid region: Egypt

Rainfall: 5 – 200 mm/yr

Evaporation: 1500 - 2400 mm/yr

Irrigation from River Nile

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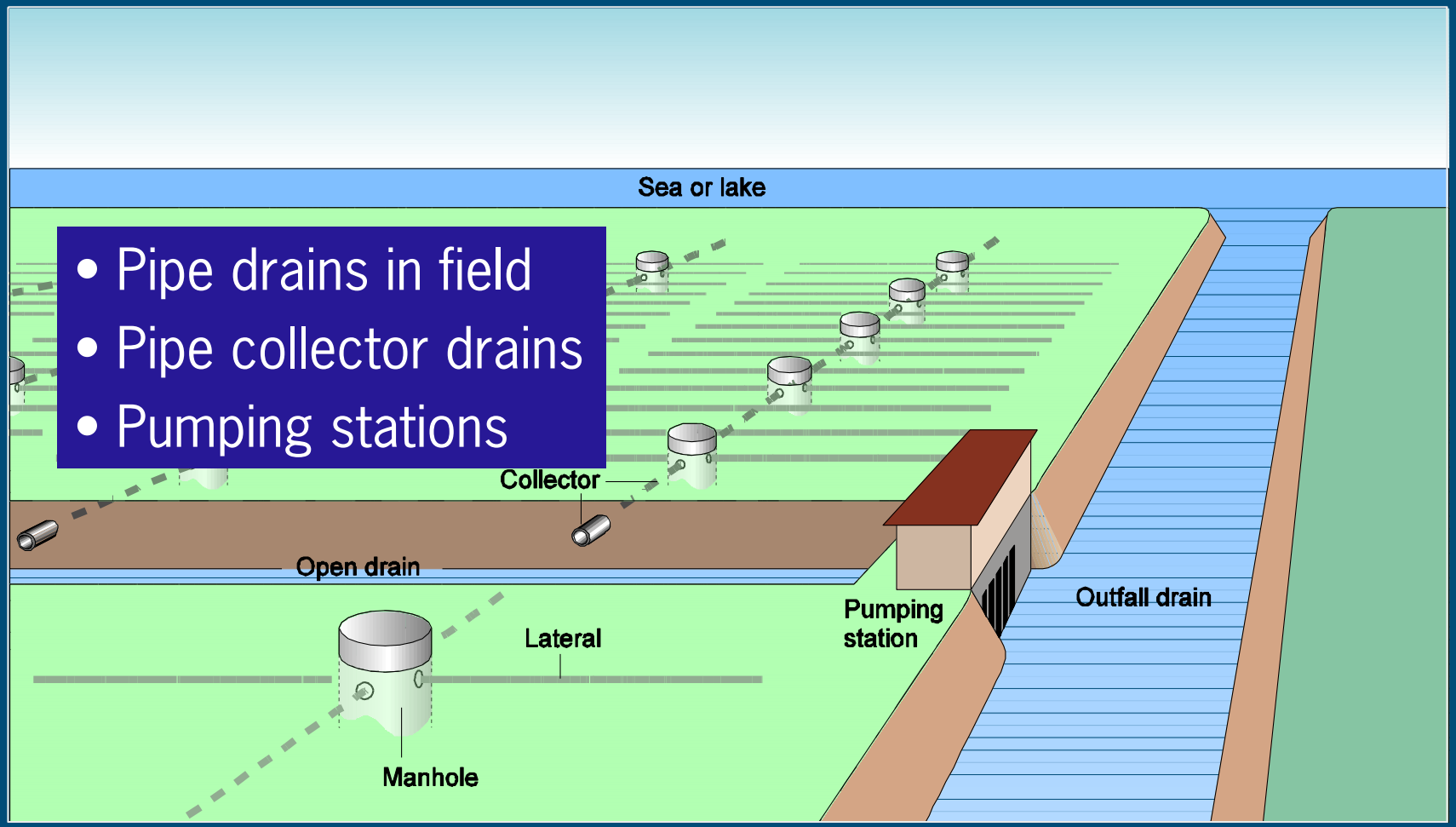
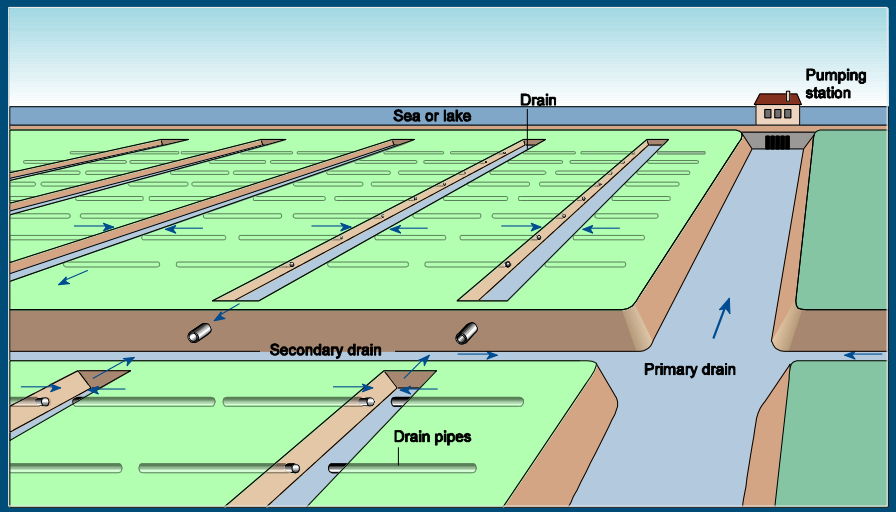
Drainage for salinity control (based on leaching requirement)

Commonly used drainage system

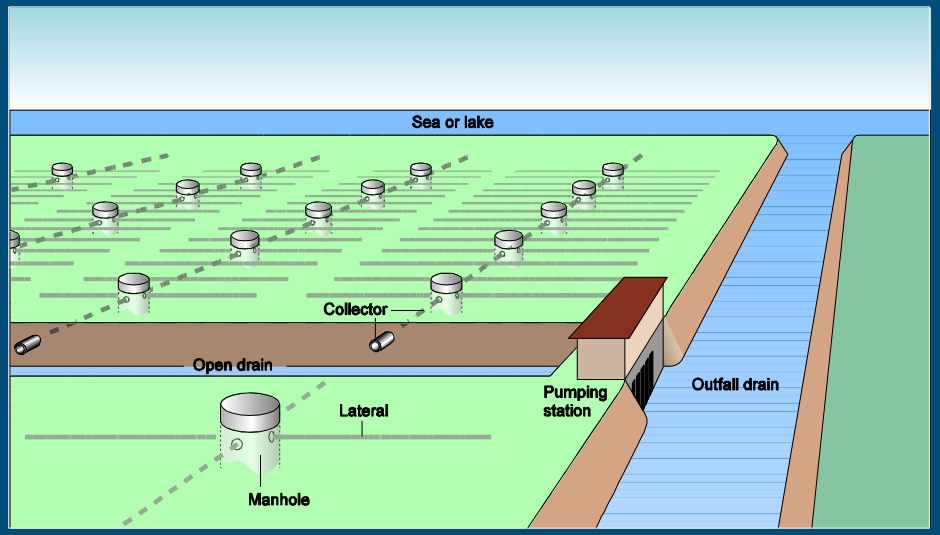


Comparison between The Netherlands and Egypt



Question:

What is the difference?



Field

Example from the humid tropics: Malaysia

Rainfall : 2500 – 36 00 mm/yr Evaporation: 2400 mm/yr

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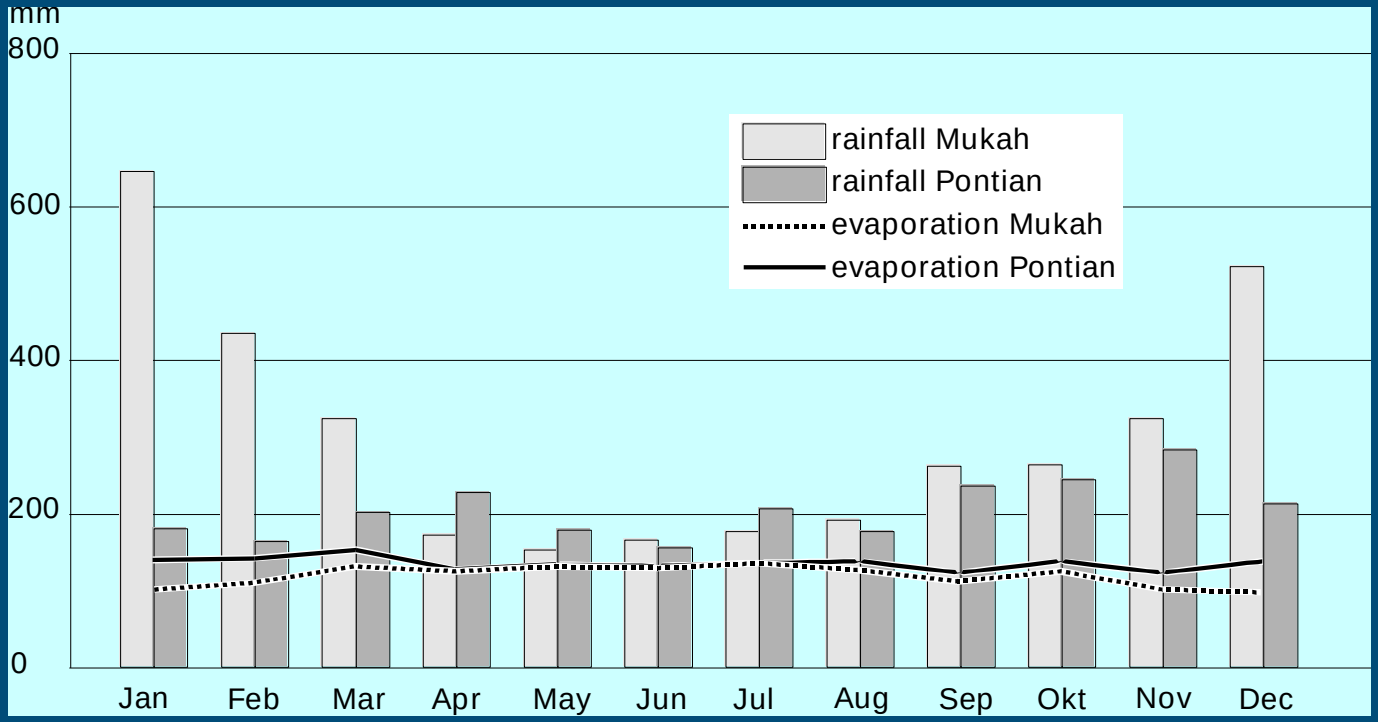
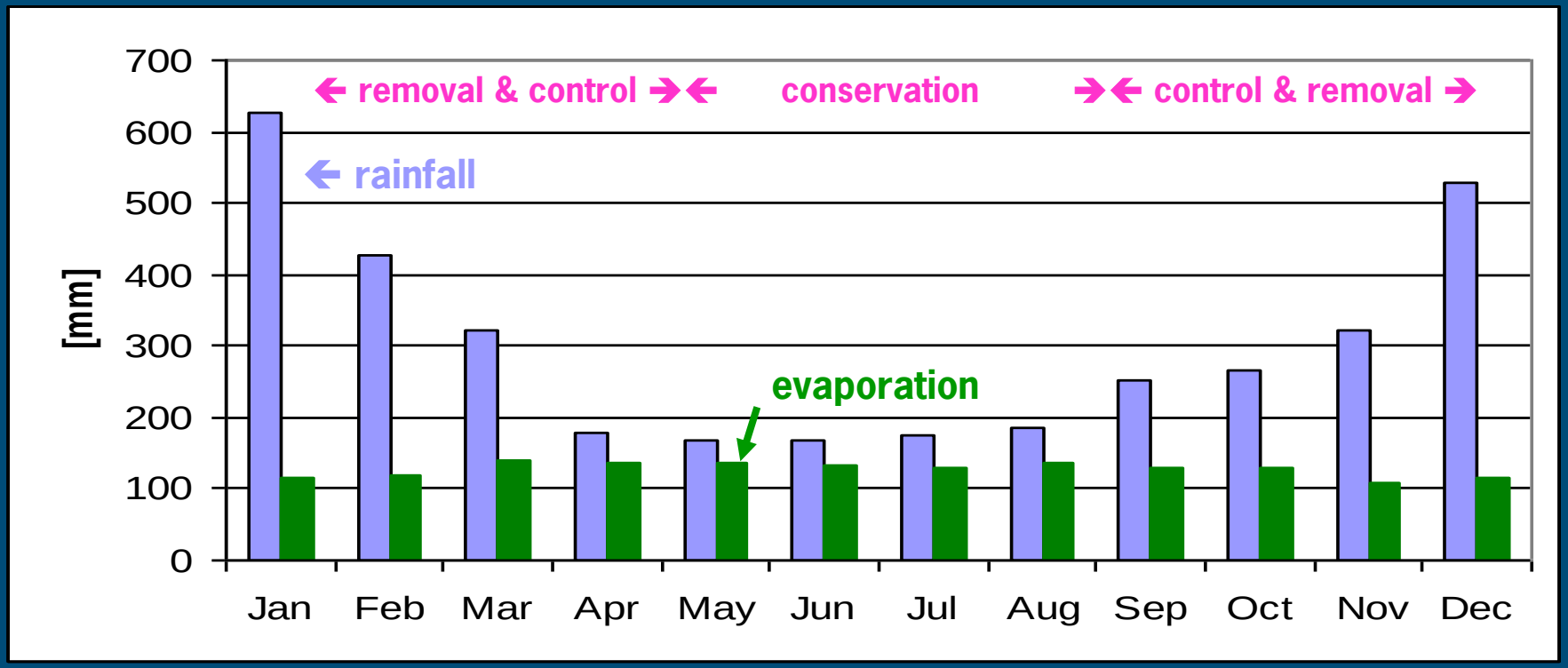


Drainage to remove excess rainfall

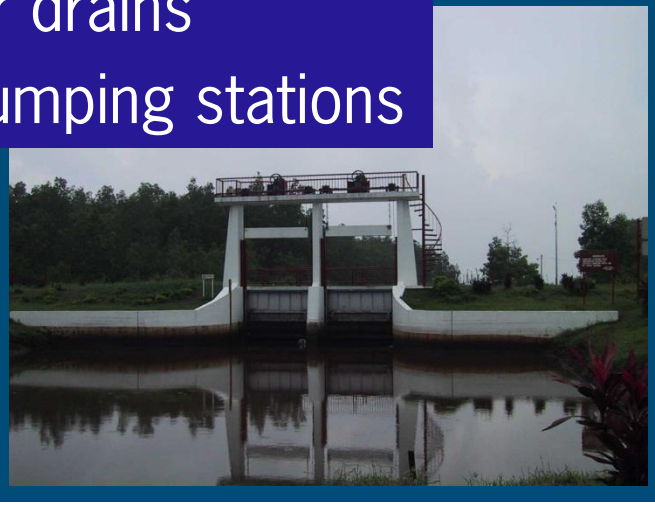
Why is water management needed?

- **Dry season:** Conserve the water
- **Rainy/ monsoon season:** Remove excess surface and subsurface water



Commonly used drainage system

- Open drains in field
- Open collector drains
- Sluices and Pumping stations



Field

Compare Malaysia, Egypt and The Netherlands

Exercise 6: Comparison design discharge between the 3 regions

- Temperate regions (The Netherlands): q = 7.5 – 15 mm/d
- Arid & Semi-arid regions (Egypt): q = 1 mm/d
- Humid tropics (Malaysia): q = 50 – 80 mm/d

Review of learning goals: subjects

- Need for drainage
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- Examples of drainage systems
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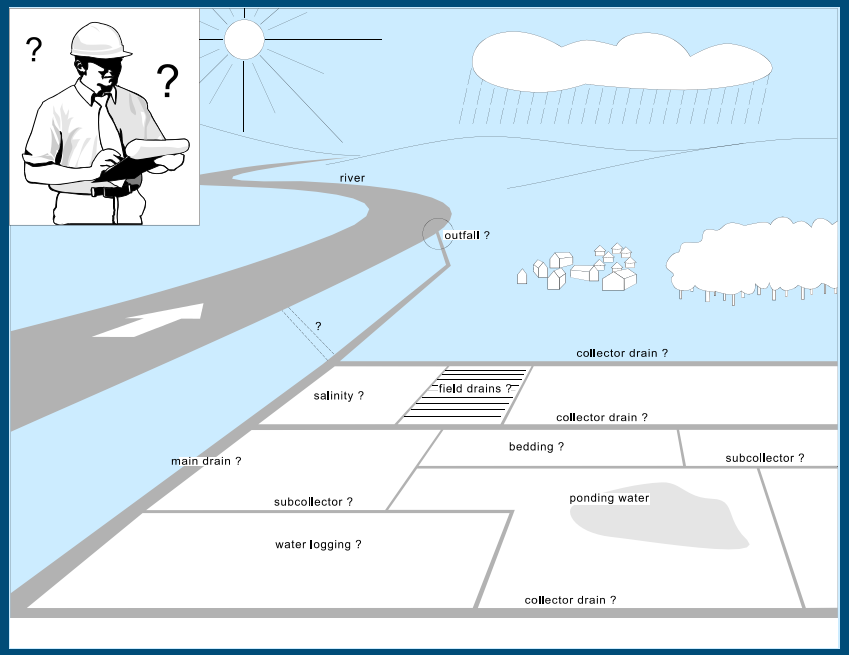
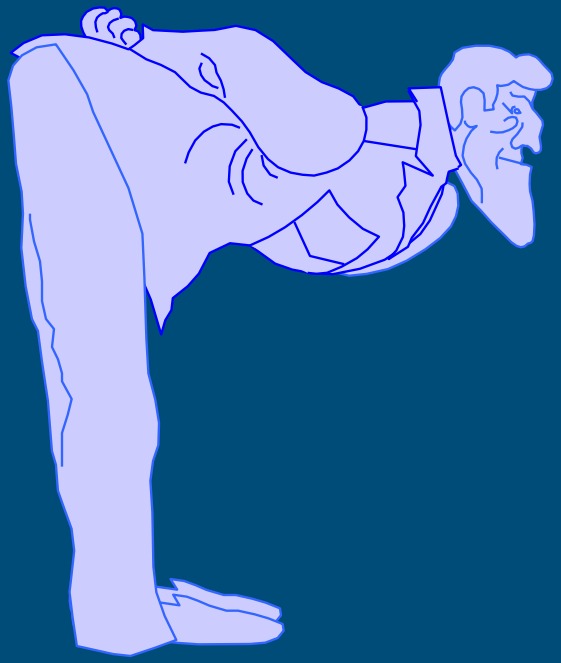


Need for drainage



Thank you

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Success