# CLIMATE CHANGE RESILENT WITH SMART AGRICULTURAL DRAINAGE SYSTEM

**Dr. Mohamed Wahba**

**VPH - ICID**

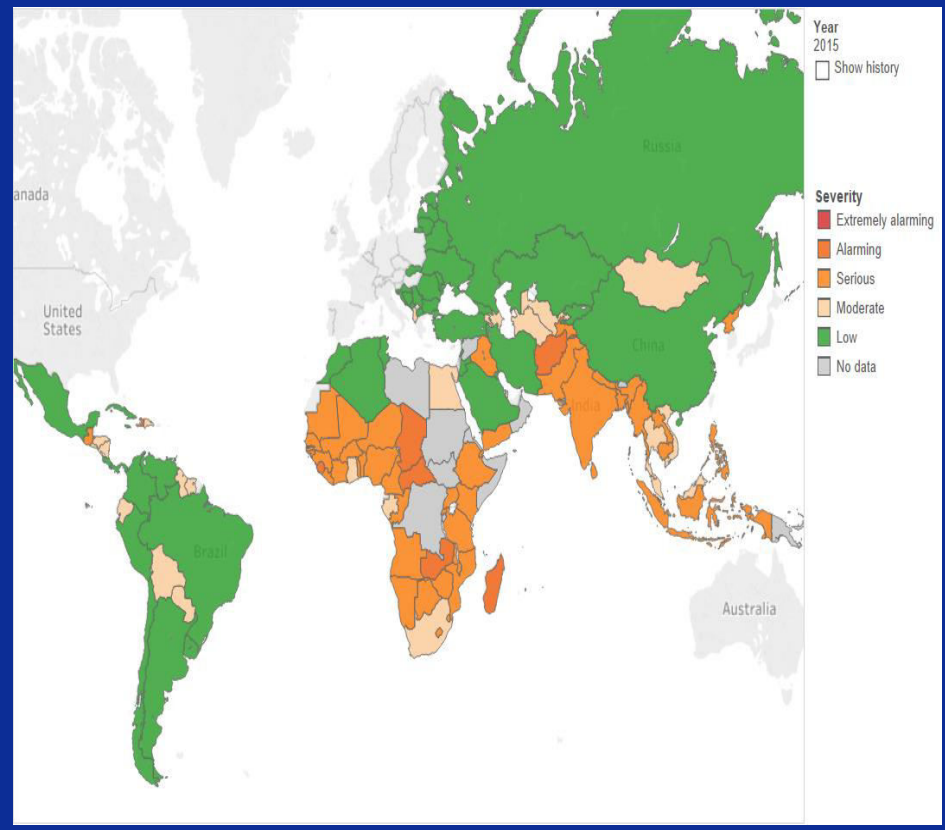
**Chairman of AFRWG & CDTE-WG of ICID**

# Key points from presentation:

- The Challenges
- Current impacts of Climate Changes
- Introductions about Agricultural Drainage
- Smart Agricultural Drainage system
- The Way forward

# The Challenges

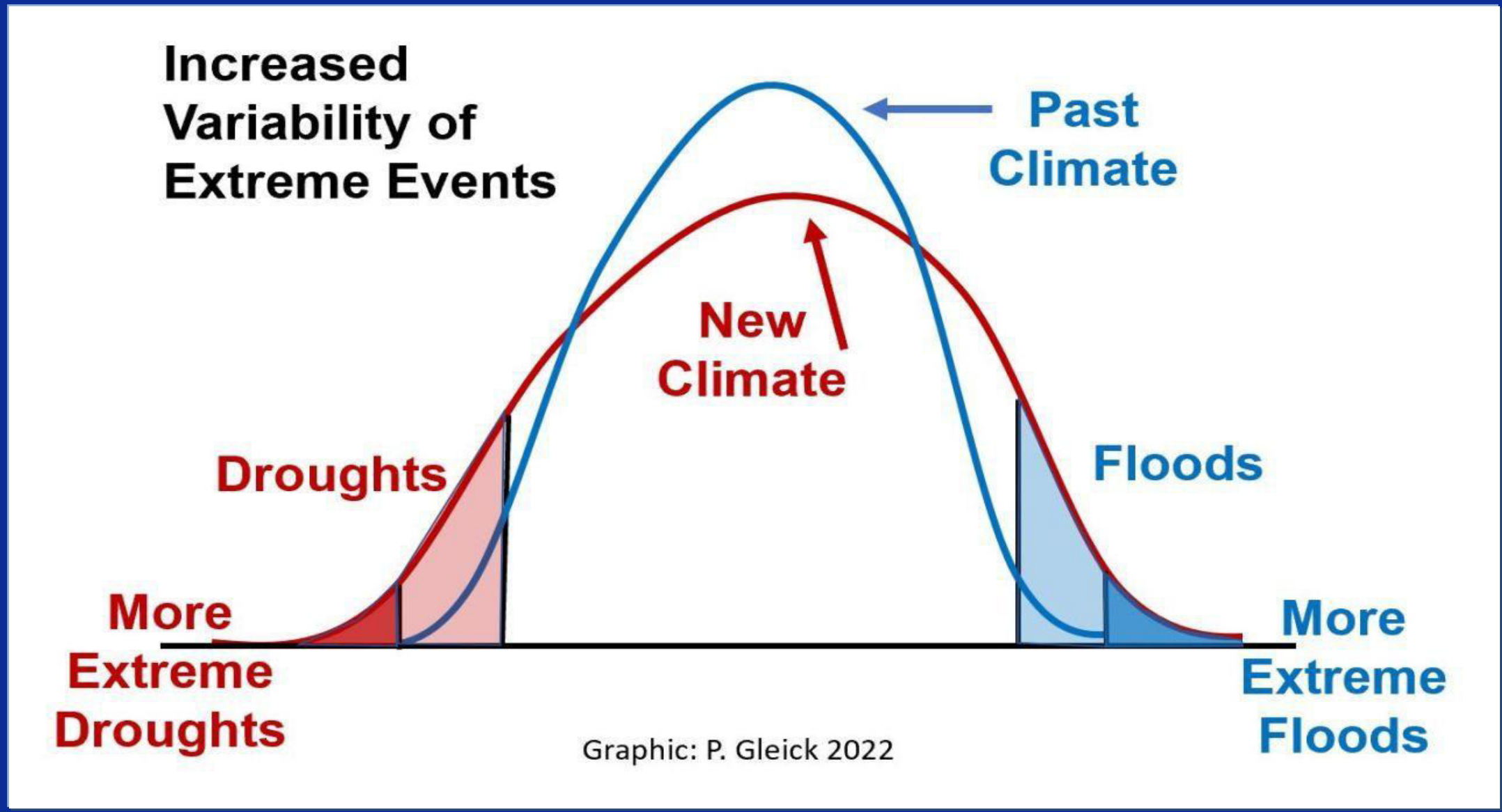
- At present, almost **a billion people** in the world are food-insecure and Many of them are also **lacking sufficient reliable water** to meet their needs
- **Double food production** to feed 10 billion by 2050
- **Limited water resources** and the Water use is expected to increase by 50% by 2050




Global hunger index (GHI) 2015 (Xie et al, 2016)

# The challenges

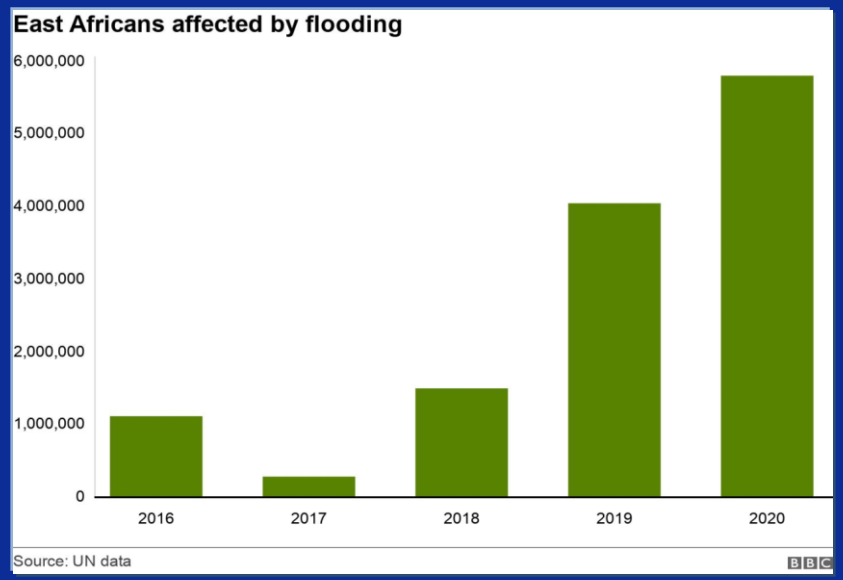
- **Climate change** predicted to increase vulnerability of agricultural sector in most developing countries


Increased
Variability of
Extreme Events
Past
Climate
New
Climate
Droughts
Floods
More
Extreme
Droughts
More
Extreme
Floods
Graphic: P. Gleick 2022

# Floods in Yemen -2016

# Challenges of Floods in Africa

- From March - May 2020 multiple countries in central and east Africa have continued to experience heavier and more widespread than usual rainfall in the "long-rains" season, leading to transboundary flooding and food insecurity.
- The most severe flood conditions as of May 7th 2020 include those in the nations of Kenya, Somalia, Sudan, South Sudan, and the Democratic Republic of the Congo.
- Flooding hits six million people in East Africa




https://www.bbc.com/news/world-africa-54433904

# Floods in Sudan -2022


# Currently Floods in Pakistan.

- 1350 people killed
- 50M people displaced
- 900K livestock deaths
- 1M houses washed away
- 40+ reservoirs breached
- 220+ bridges collapsed
- 90% cropped damaged
- -$10B loss to economy
- 1/3 country underwater


Source - PDMA / NDMA

**Sunflowers suffer from lack of water, as Europe is under an unusually extreme heat wave, in Ury, 112 miles south of Paris, France, Aug. 8, 202**


# China issues first national drought emergency amid scorching temperatures

A section of a parched river bed is seen along the Yangtze River in Jiujiang in China's central Jiangxi province on August 19, 2022.

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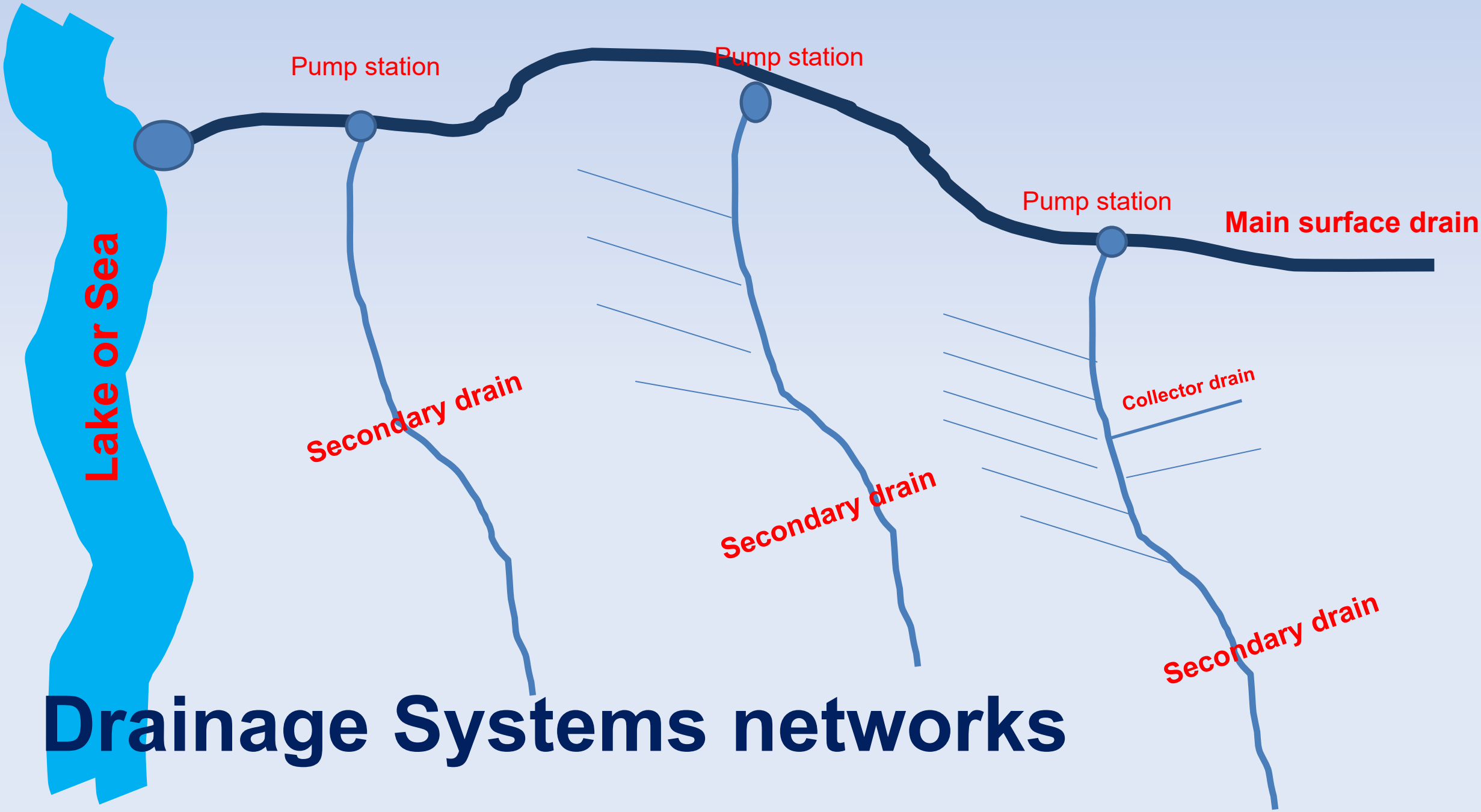
# Introduction about Agricultural Drainage

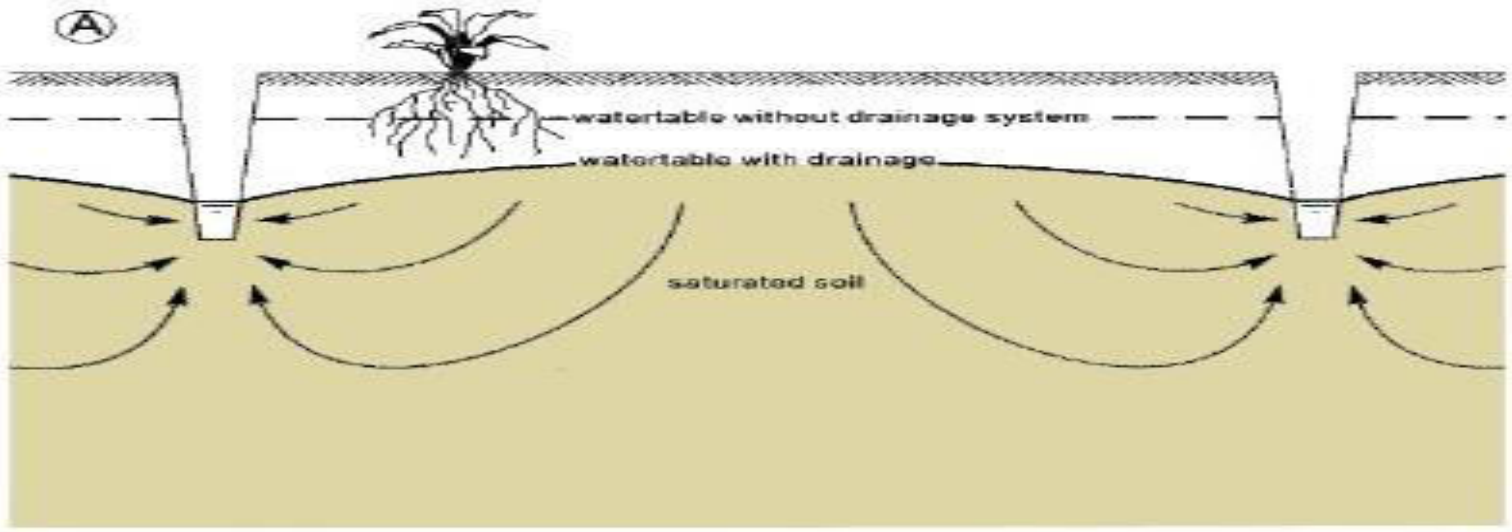
- **Soil salinization** is projected to increase in future climate change scenarios due to sea level rise and impact on coastal areas.
- The **rise in temperature** that will **surely** lead to increase evaporation and further salinization.

# Why do we need subsurface drainage?

- Subsurface Drainage Systems (SDS) are very important for the sustainability of irrigated agricultural.
- SDS have played great role with regards to:
  - Preventing water logging
  - Reducing soil salinity
  - Maintaining crop yield




# Drainage Systems networks

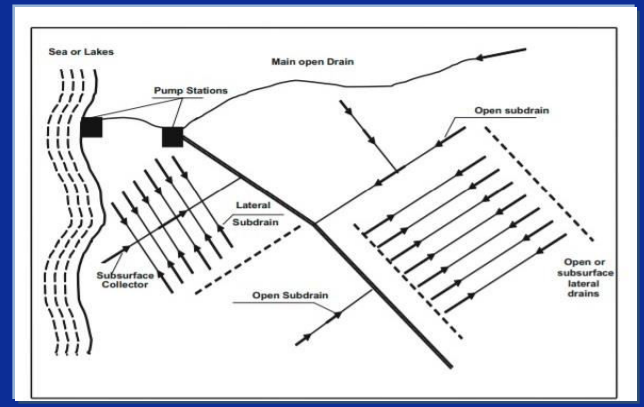


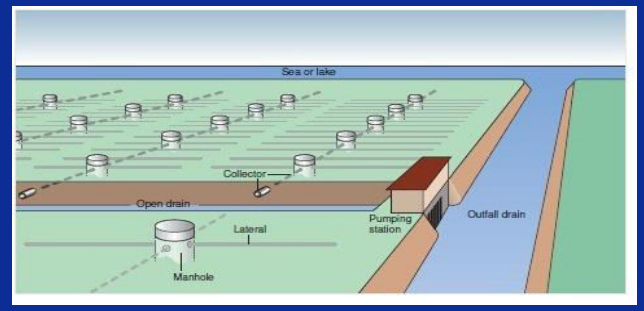

*Open drain (A) or pipe drain (B) can effectively control waterlogging and salinity*

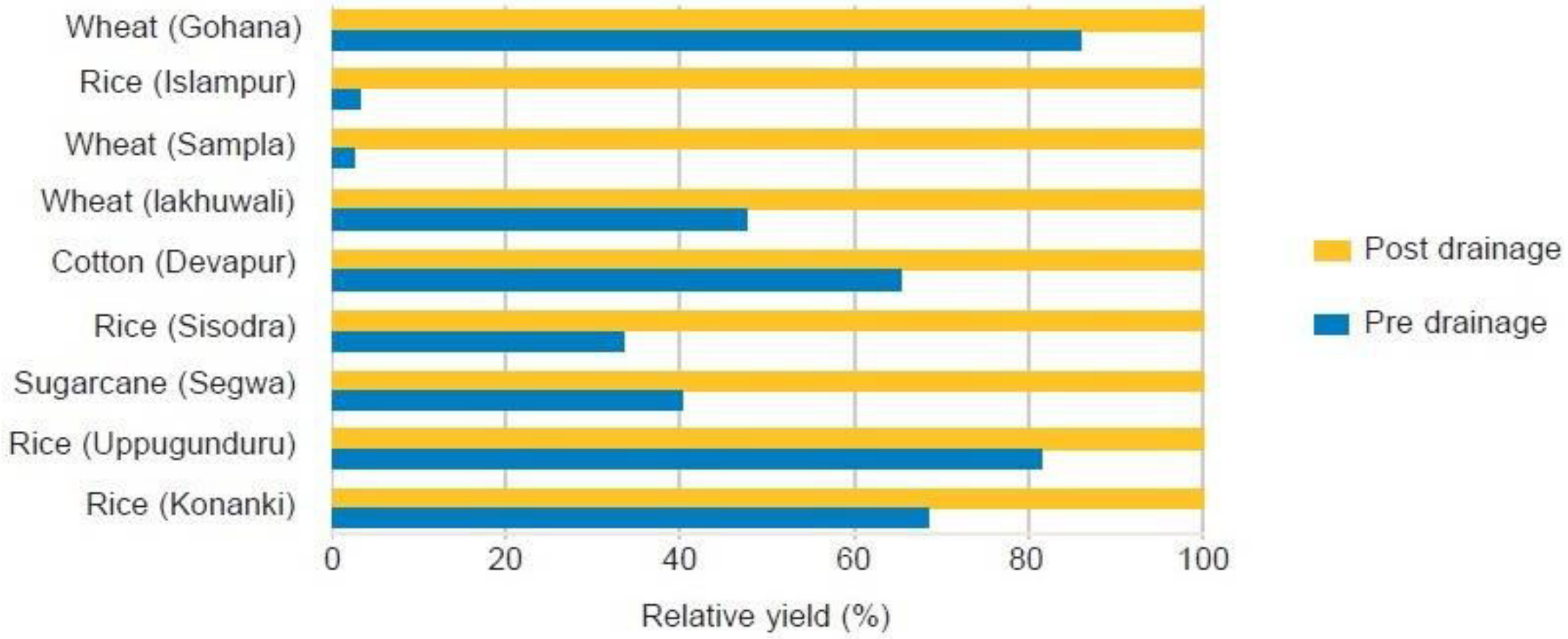
**How drainage can control waterlogging and salinity (Source: Alterra - ILRI- )**

# Objectives of Drainage system

- Protection against Soil Erosion and Flooding
- Soil Aeration
- Soil Moisture and Trafficability
- Salinity and Water-logging Control
- Maintaining Crop Yields
- Reclamation of Saline soils
- Toxic Substances and Disease






**Yield for some crops pre and post drainage**
**(Source: Alterra - ILRI-)**

Salts buildup in furrow irrigation system


Wetting zone and salinity buildup in drip irrigation system

Source :Zaman el al,. 2018)

# Facts about Agricultural Drainage

- Irrigation and drainage systems are designed, constructed, and managed **separately**.. And almost of time the applied irrigation water exceed the crop water requirement (**over irrigation**)
- The subsurface drainage system is **over designed and** lateral drains are always designed at depths suitable for **deeper root crops** and **one depth all the time**.

All these lead to :

**Losses of irrigation water.**

**Losses in the applied fertilizers.**

**Pollution of ground and drainage water.**

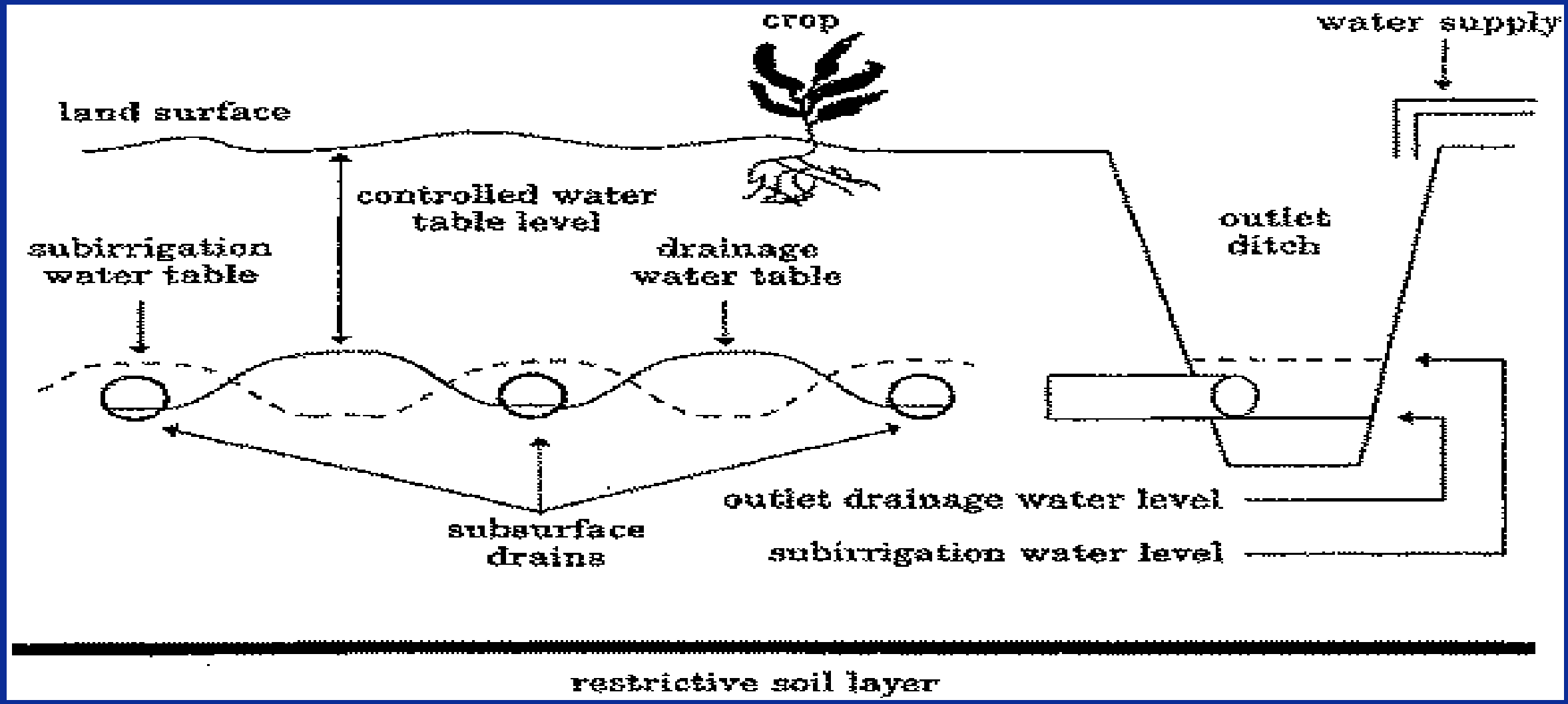
# Smart Agricultural Drainage Systems

# Why Do We Need Subsurface Drainage Management ?

- These systems have been designed with fixed drain depths and spacings to specific criteria that only occur over short periods.

- After the system is implemented the drain spacing and depth ***cannot be changed***, even though the system parameters such as crop type, crop root development, weather, quantity and quality of irrigation water, and available water resources are ***constantly changing***.

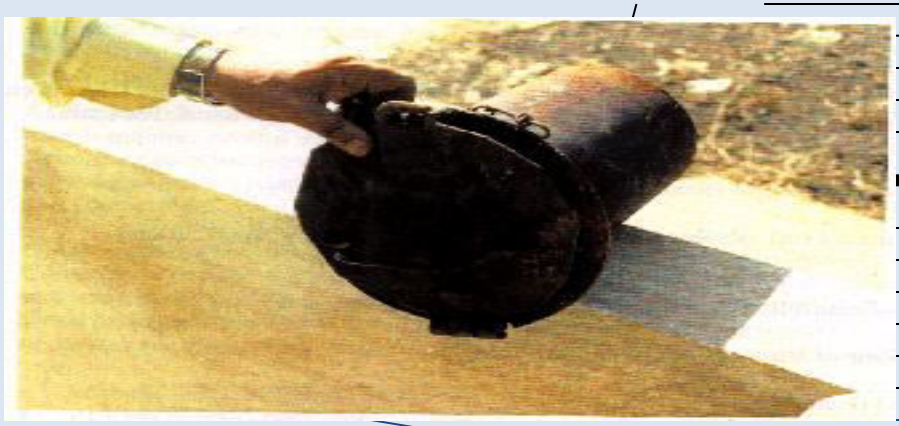
# Water table management

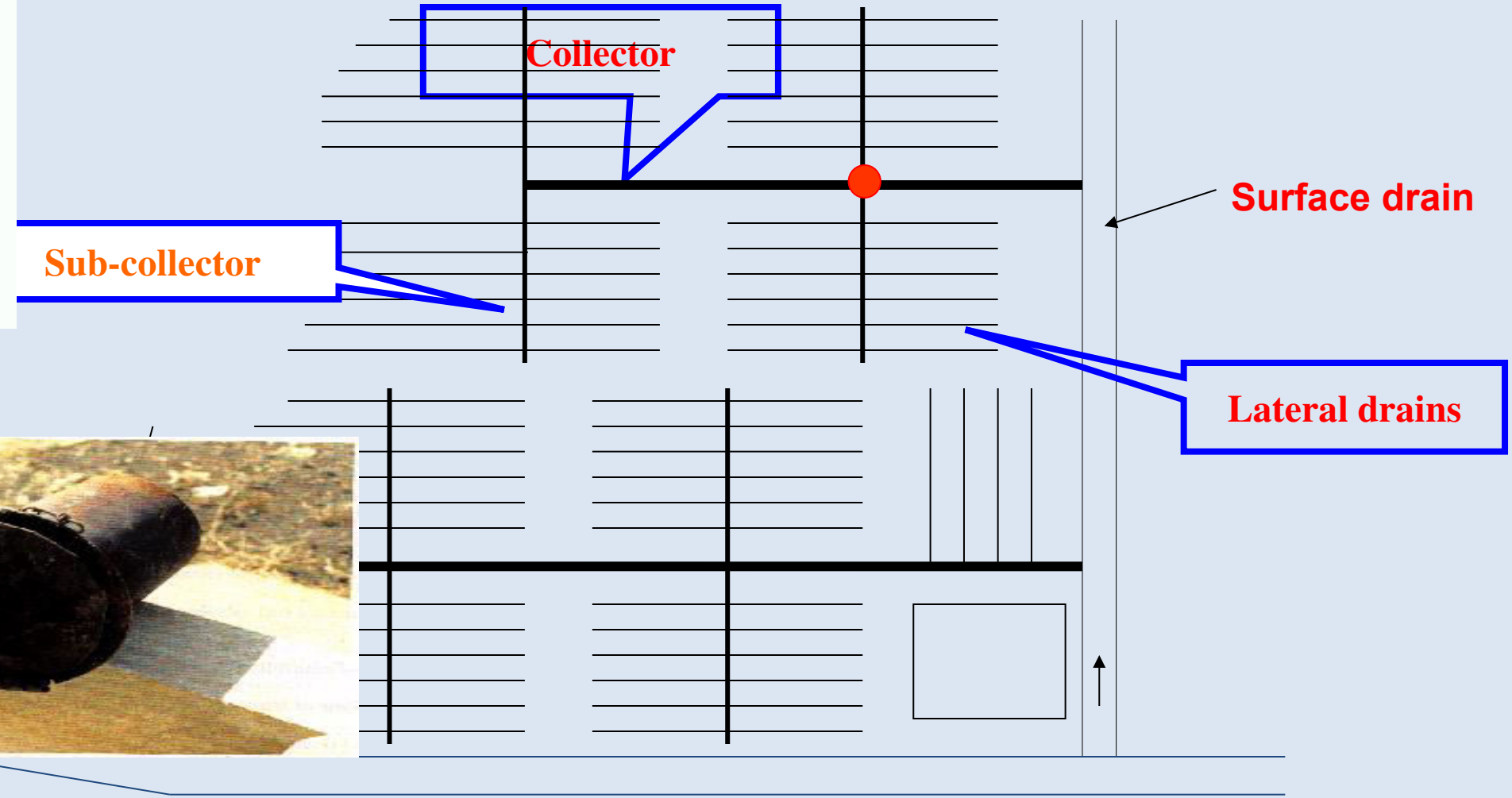


# Benefits of Water table management (Controlled Drainage)

- **Removing** excess water to permit farming of poorly drained soils.
- **Protecting** crops from excessive soil water conditions.
- **Controlling** soil salinity.
- **Saving** in irrigation water.
- **Conserving** soil water.
- **Increasing yield** by reducing or eliminating stress caused by deficit soil water conditions.
- **Reducing losses** of nutrients and other pollutions via drainage water.

# Increasing water productivity by utilizing of Existing drainage system





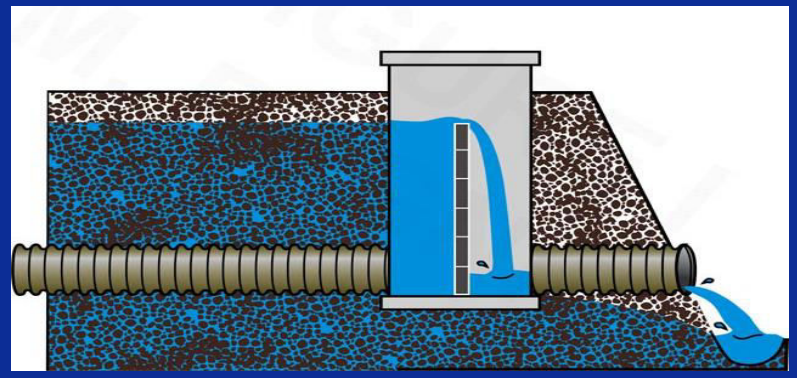
# Water table control from surface drains

**Crops consolidation is a key driver for large scale application (Rice and Sugarcane)**

# Drainage water management

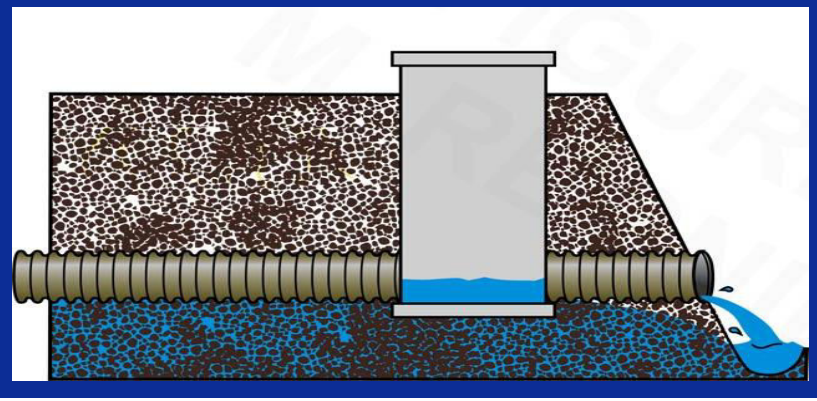
## After harvest

The outlet is raised after harvest to reduce nitrate delivery during winter



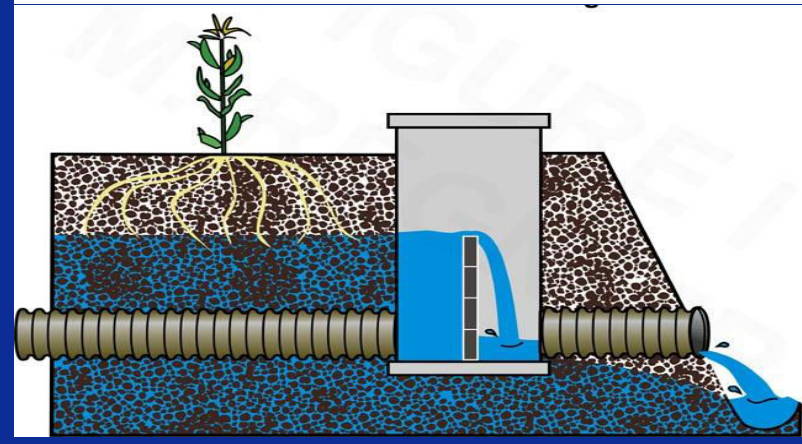
## Before planting or harvest

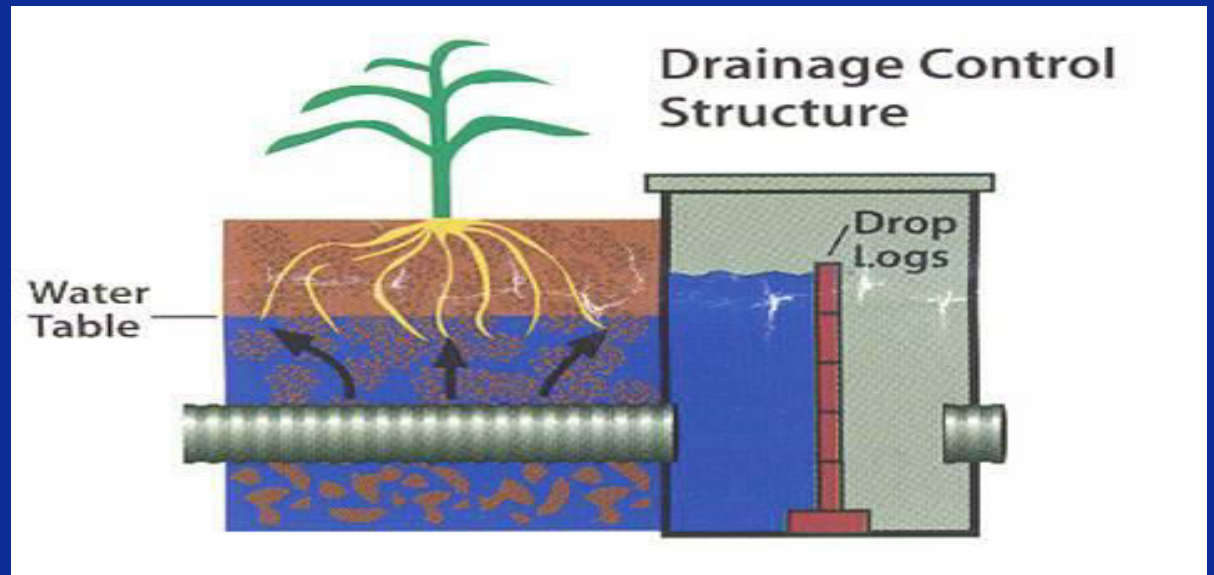
The outlet is lowered a few weeks before planting and harvest to allow the field to drain more fully



## After planting

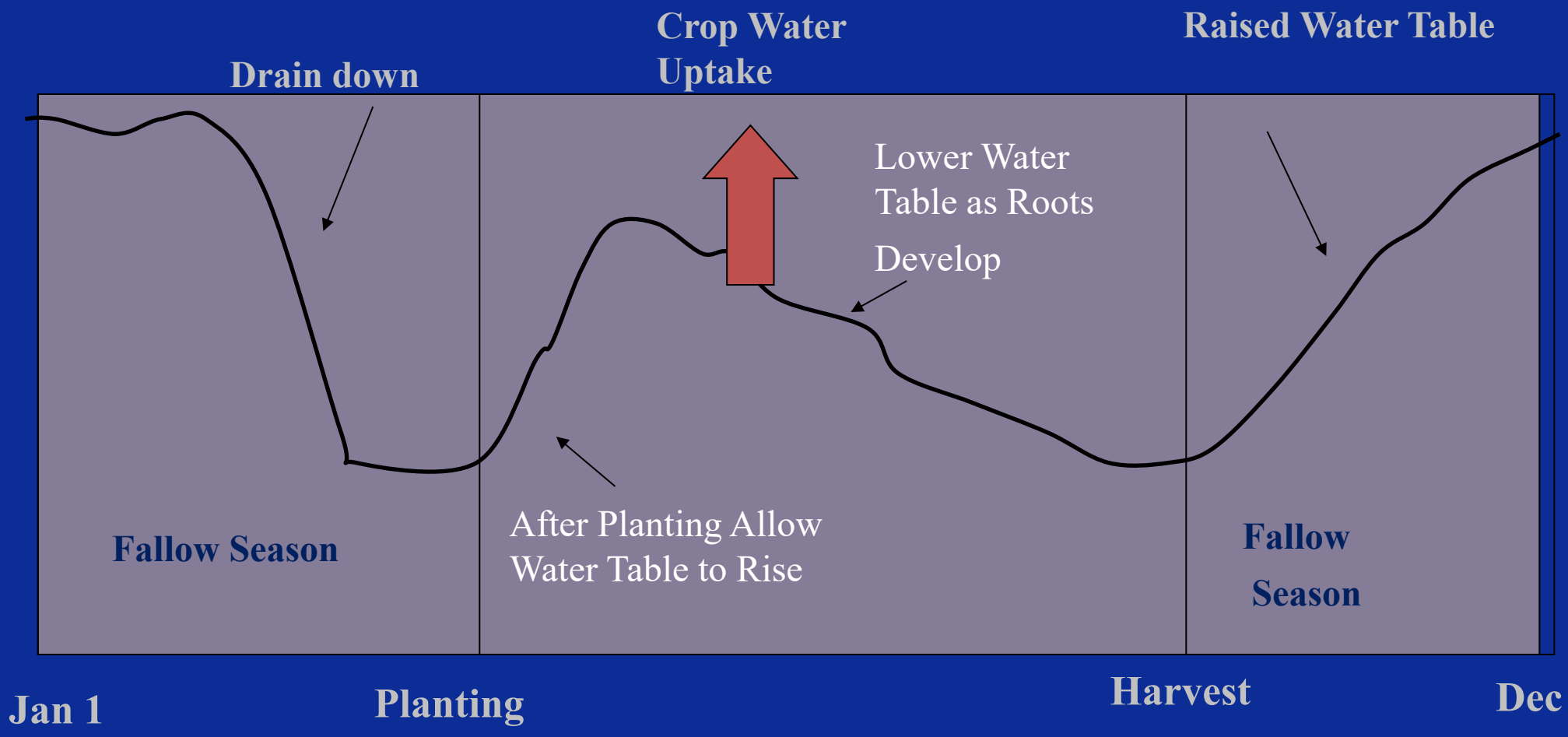
The outlet is raised after planting to potentially store water for crops






Purdue University

# Seasonal Water Table Level with Drainage Management

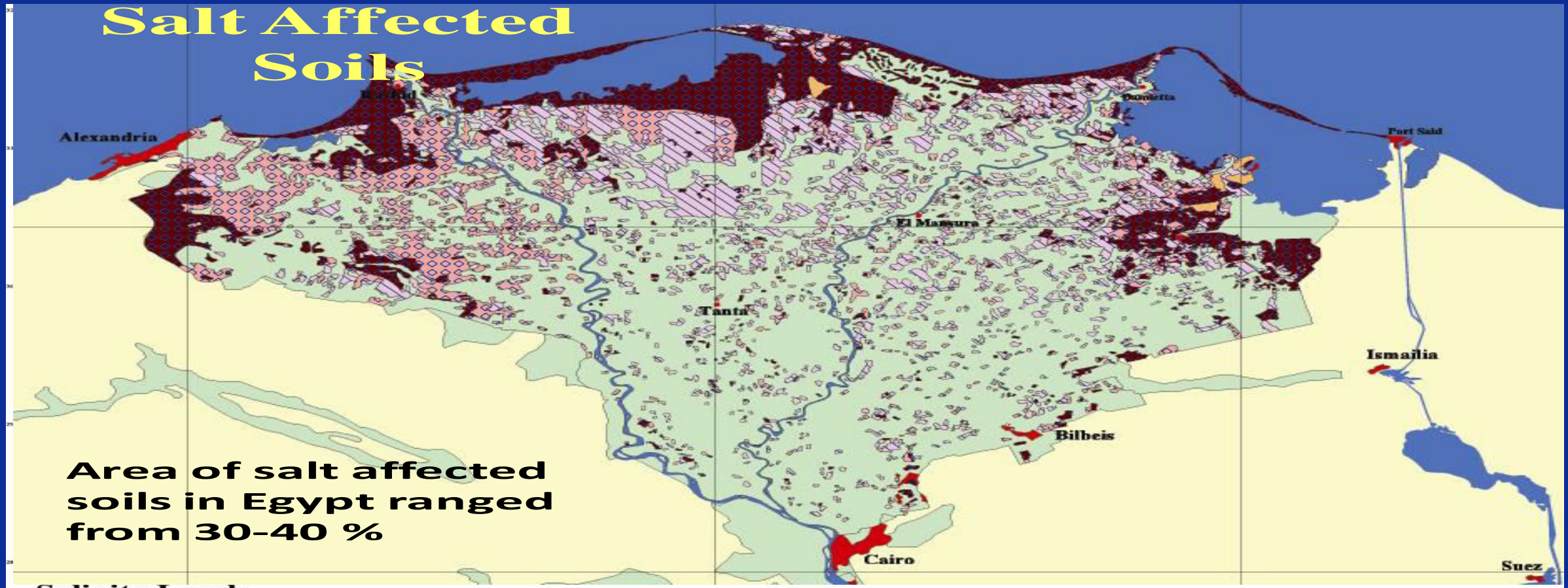



Source: Don Pitts; USDA, NRCS; Champaign, IL

# Agricultural Drainage in Egypt

In the **1970's,** the Egyptian Government started Drainage programme to implement subsurface drainage system in approximately **2.5 million ha**

# Salt Affected Soils




**Area of salt affected soils in Egypt ranged from 30-40 %**

**Salinity Levels**

- Non-Saline Soil (Less Than 4 mmhos/cm.)
- Moderately Saline Soil (4-8 mmhos/cm.)
- Highly Saline Soil (8-16 mmhos/cm.)
- Verey Highly Saline Soil (More Than 16 mmhos/cm.)

- Towns
- Salt Marshes
- Water Bodies
- Desert

**Salinity Risk**

- Slight Salinity Risk
- Moderate Salinity Risk
- High Salinity Risk

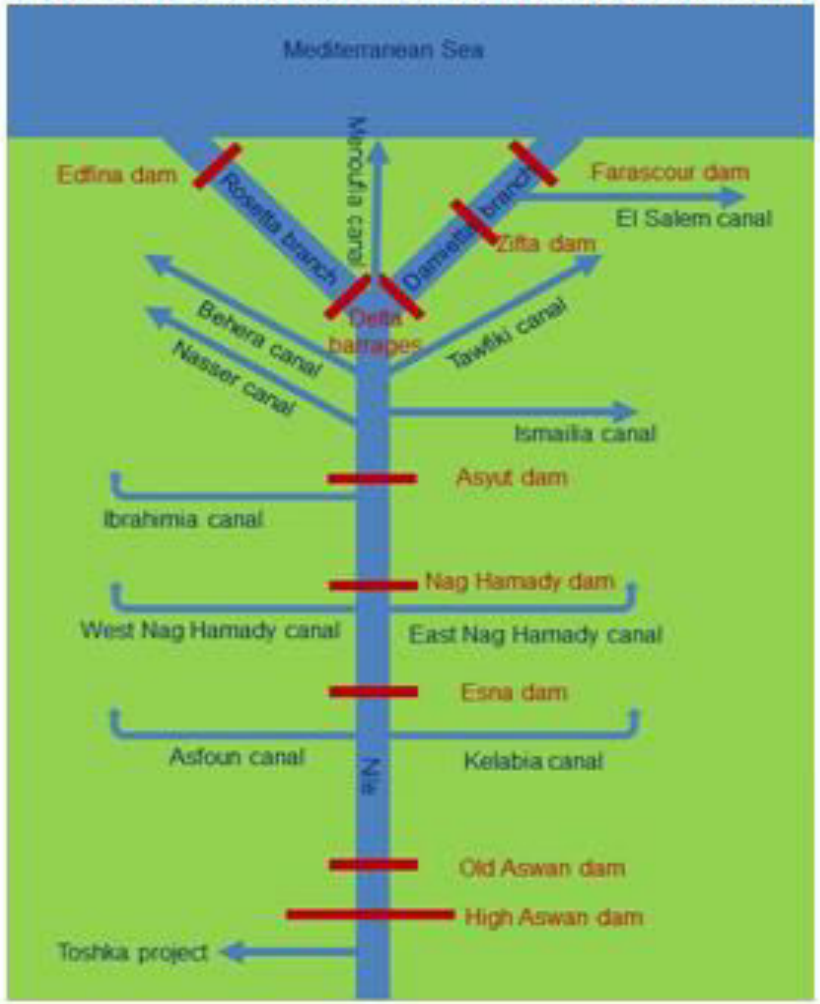
Scale 1:1000000

100 0 100 Kilometers

1
2
3

# Irrigation & Drainage Systems in Egypt

FIGURE 1
**Main canals and dams on the Nile river in Egypt**




**Irrigation Canals : 37, 000 Km**

**Surface Drains : 29, 000 Km**

**1600 Pumping Stations**

**Area served more than 8.8 M Acre**

# National Drainage Program

- Program components and area coverage
  - Main **Open Drainage**
  - On-farm **Subsurface drainage**
  - **Pumping stations**
- Implementation rate
  - **60,000 – 90,000 ha/yr**

**By the Year 2017**

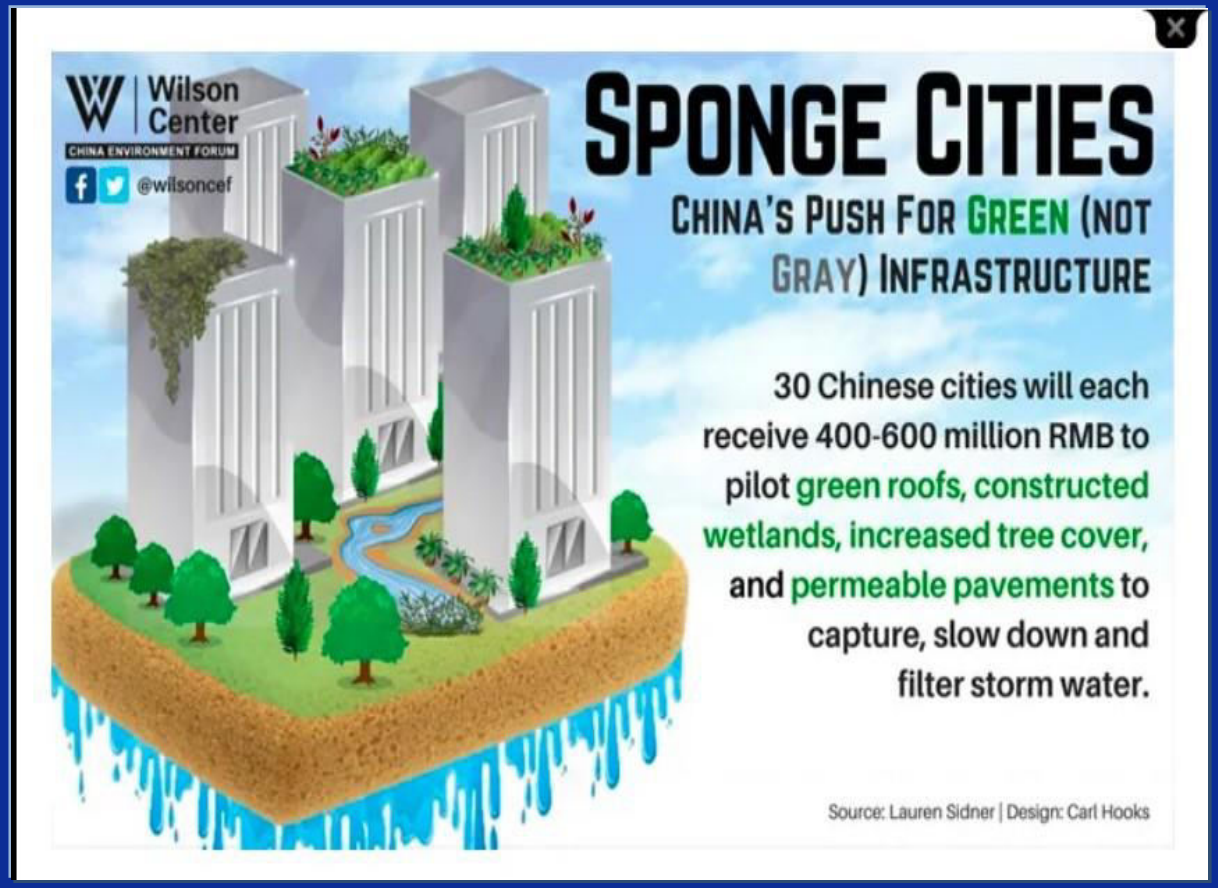
- **6.4 million acre**, New Subsurface Drainage Systems
- **2.48 million** acre, Rehabilitation of Subsurface Drainage Systems
- **7.2 million acre**, Open Drainage Systems

# Maintenance of surface water

# Experimental sponge city in China

- In 2016, Lingang in Shanghai announced that it will become a sponge city, with an area of 79 square kilometres, Lingang becomes the largest experimental area of a sponge city in China.
- The city built wide streets with sidewalks to drain water into the soil.
- The buildings are covered with green roofs and water tanks.
- Water is collected in rain gardens filled with soil and vegetation, while the artificial lake of Deshui controls the flow of water.

# New technology for Mitigating floods and heavy rains




# Sponge cities

# Key drivers

- **Utilizing all available water resources.**
- **Smart management** of existing Irrigation & drainage and sewage systems
- Public awareness and contributions during flood and drought periods
- **Deficit irrigation for water scarcity condition**

# How to be ready for climate change?

- The importance of early warning and early forecasts to prepare for climate changes
- Irrigation and drainage networks are considered a great national wealth and must be preserved and maintained with the highest efficiency at all times
- Flexible management of these networks and good management of all available water resources according to changing climatic conditions

# How to be ready for climate change?

- Training on different scenarios of all levels Spreading awareness and taking responsibility for all beneficiaries and citizens
- The importance of giving priority to establishing, preserving and maintaining sewage networks in residential and urban areas, and the importance of community participation in reducing loads, especially in periods of heavy rain and torrential rain.
- The importance of benefiting from the experiences of other countries in the field of confronting climate change

# Thank you