

**INOVAGRI International Meeting
&
IV WINOTEC:
Workshop Internacional de Inovações Tecnológicas na Irrigação**

IFAPA

**Canal automation: a key tool for
improving flexibility and efficiency**

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Why is flexibility and efficiency necessary ?

- **Competition for water** (irrigation, industrial, urban, recreational and environmental sectors)
- **Improving irrigation systems** to *save water* and to provide *more flexible water delivery services*
- Need for **increasing agricultural water productivity**

Irrigation Water Delivery System

Objectives

Irrigation system designed and operated to deliver water to the farmers **at the**:

- right quantity
- right flow rate
- right time

Irrigation Water Delivery System

Objectives

Irrigation system designed and operated to deliver water to the farmers **with:**

- equity
- flexibility
- reliability
- efficiency
- adequacy

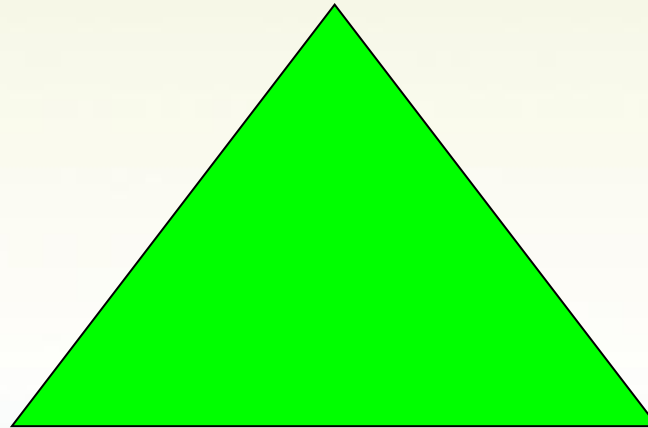
Modalities of water distribution



Modalities of water distribution

The three main *variables* involved in scheduling of *irrigation* applications are:

Frequency



Duration

Flow rate

Modalities of water distribution

Demand vs Supply oriented irrigation systems

- On-demand

⋮

- Arranged

⋮

- Fixed rotation

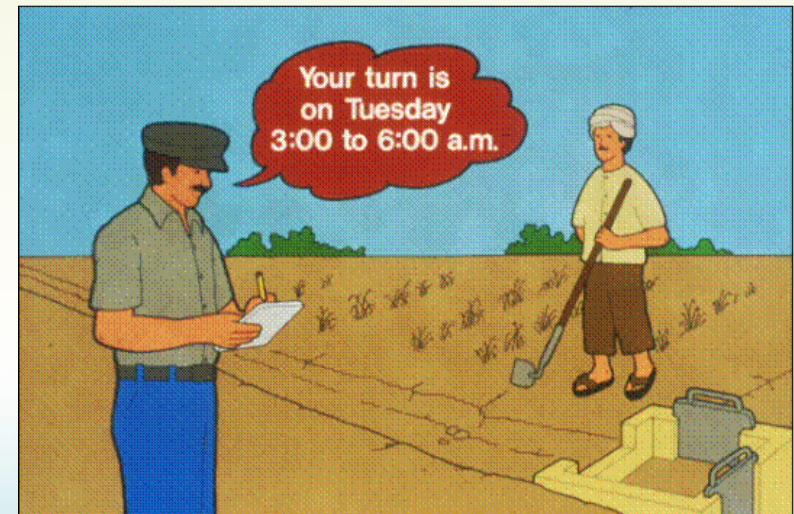
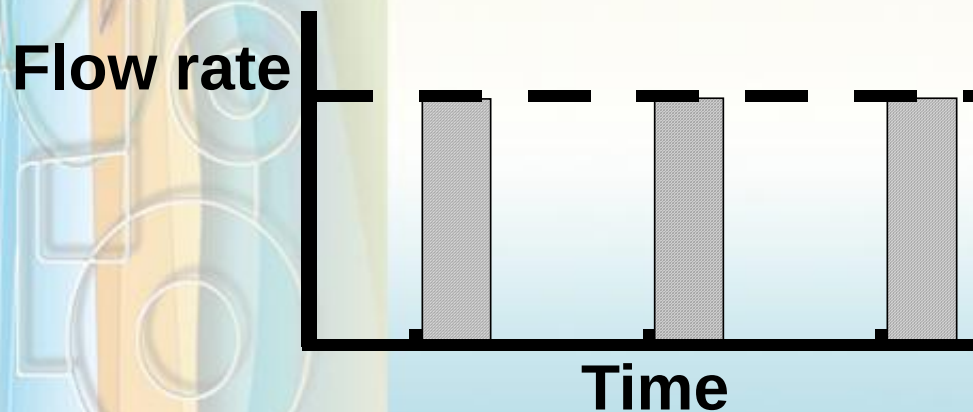
Demand oriented

Supply oriented

Modalities of water distribution

Fixed rotation

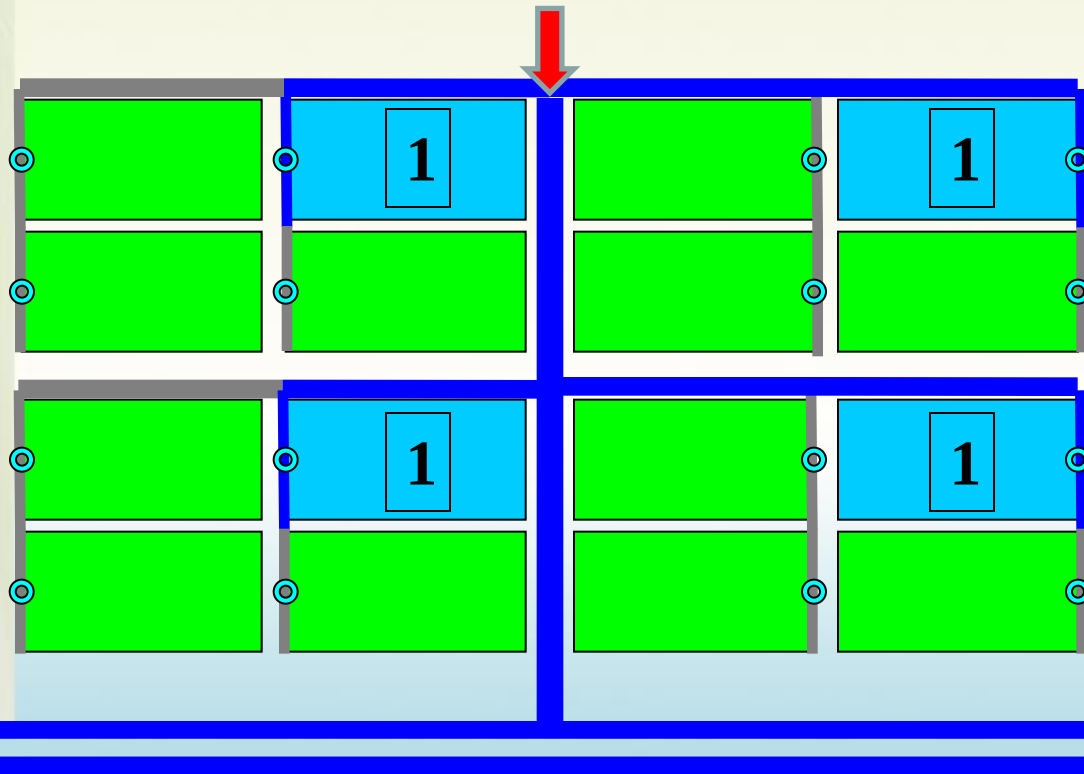
- Fixed: Frequency, duration and flow rate
- Water delivery rotates
- Fixed turn



Modalities of water distribution

Fixed rotation

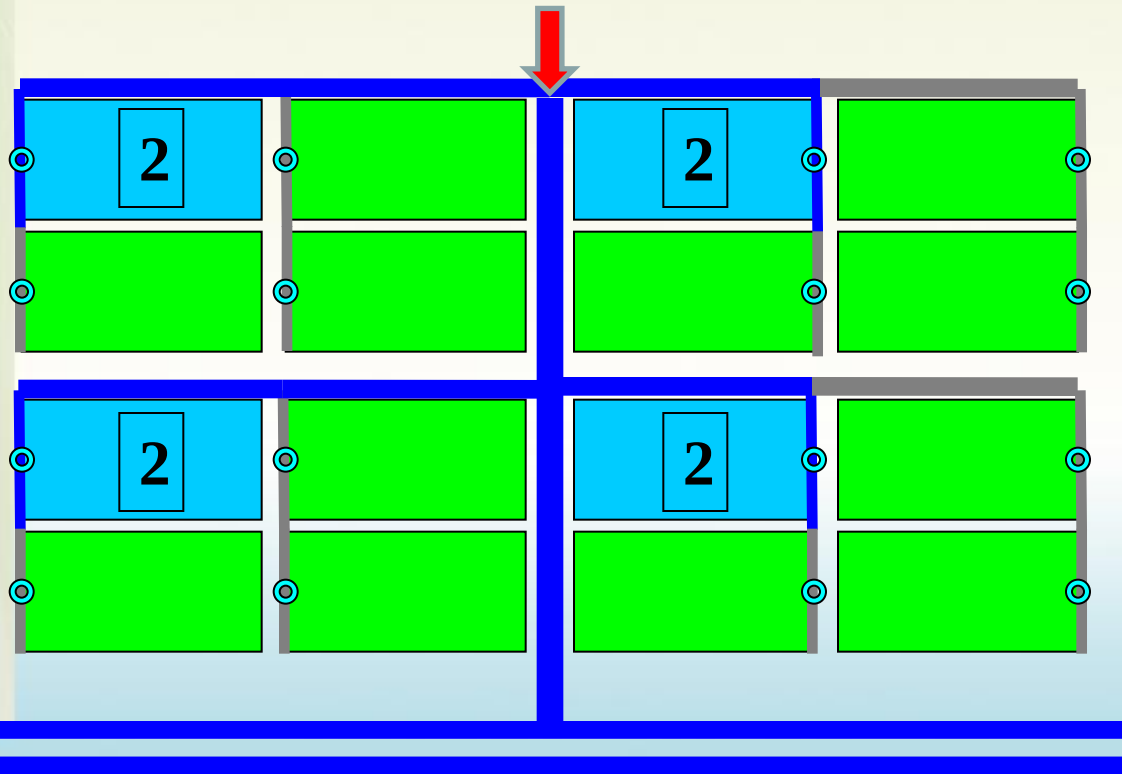
Day 1 06:00 - 18:00



Modalities of water distribution

Fixed rotation

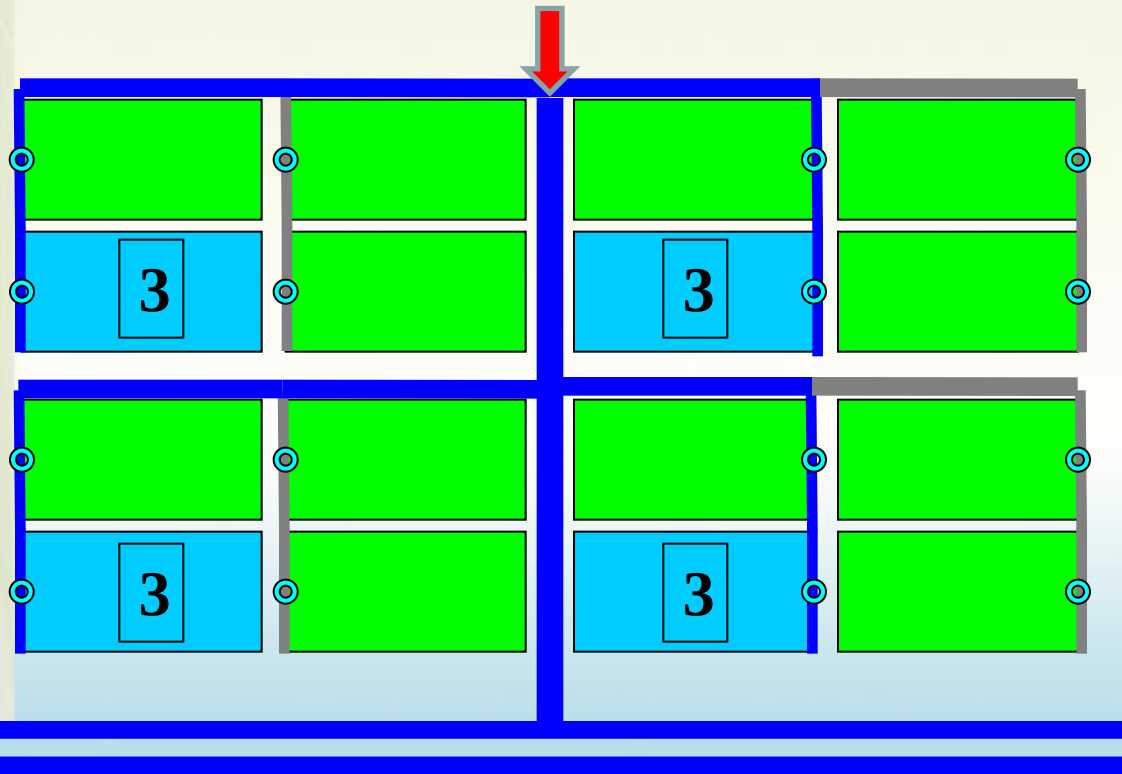
Day 2 06:00 - 18:00



Modalities of water distribution

Fixed rotation

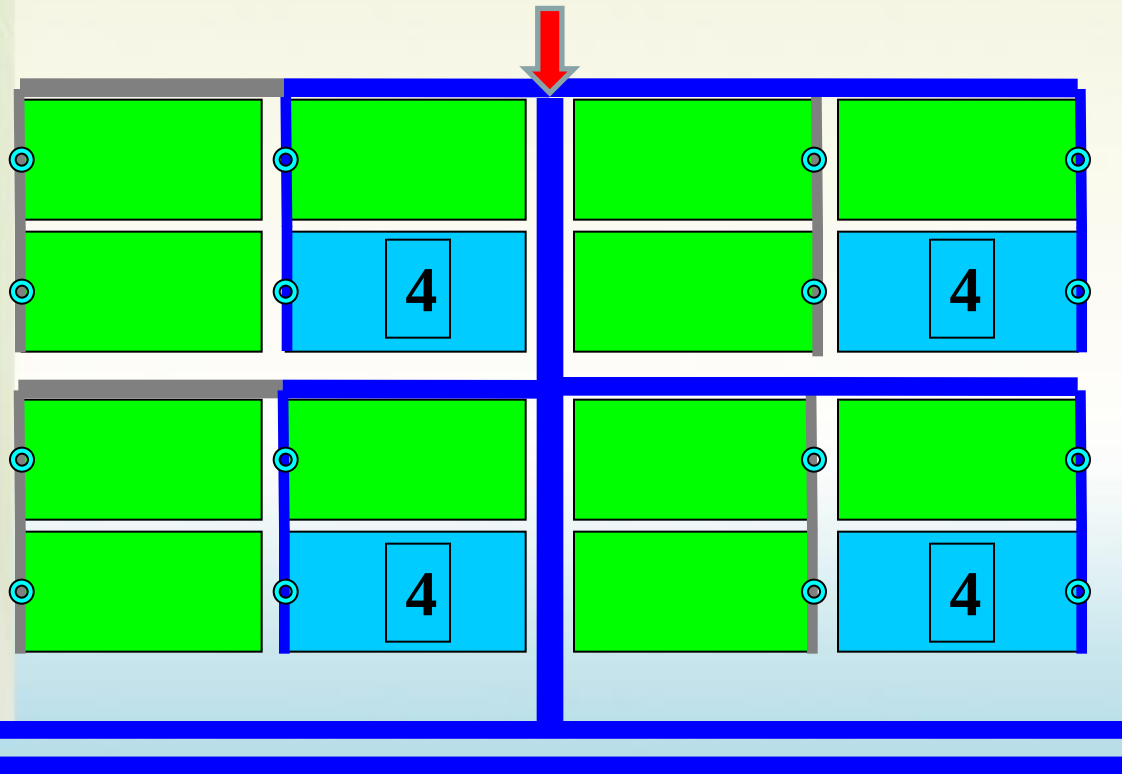
Day 3 06:00 - 18:00



Modalities of water distribution

Fixed rotation

Day 4 06:00 - 18:00



Modalities of water distribution

On-demand

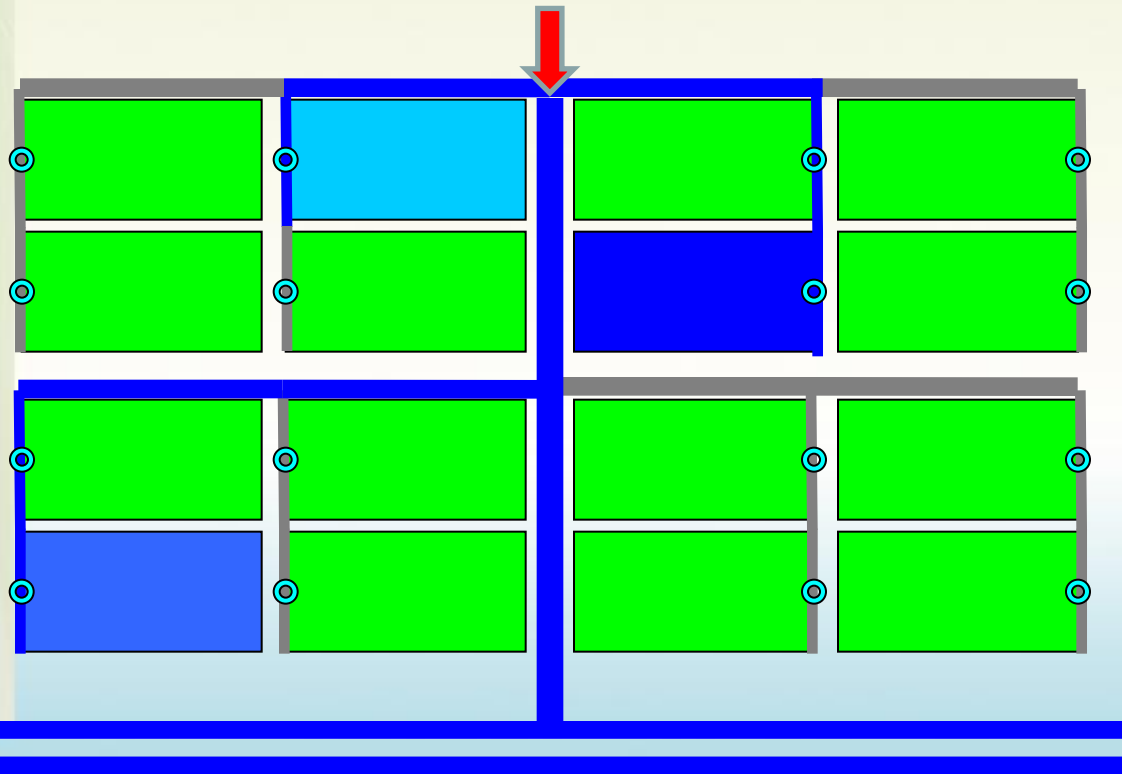
- Farmer decides...
 - When and how often to irrigate
 - How much (flow and volume)
 - Duration

Modalities of water distribution

On-demand

Day 1

07:10 - 09:35

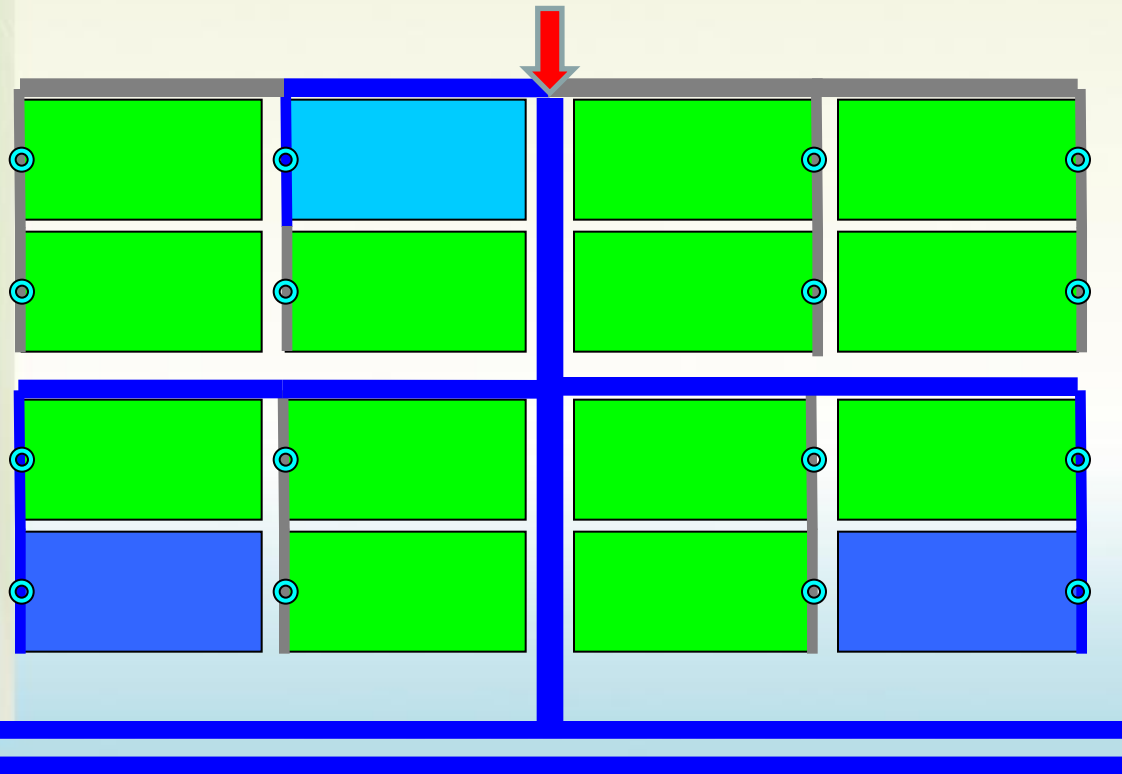


Modalities of water distribution

On-demand

Day 1

09:35 - 11:45

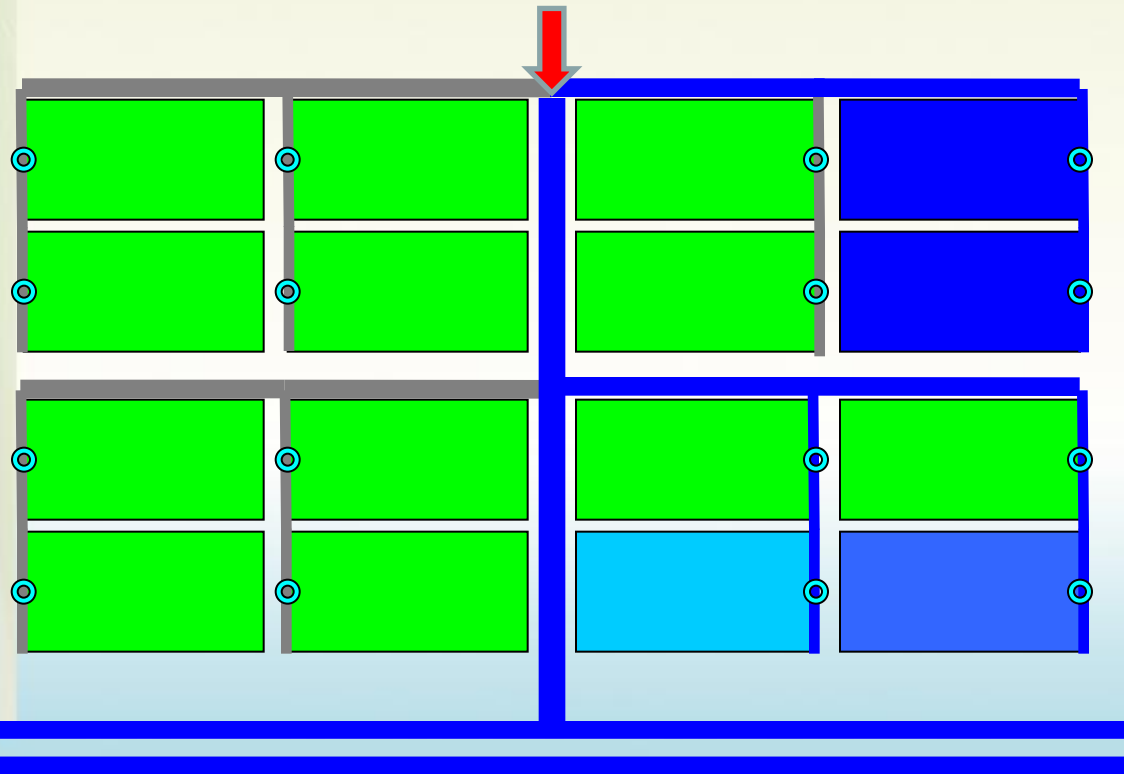


Modalities of water distribution

On-demand

Day 1

11:45 - 13:50

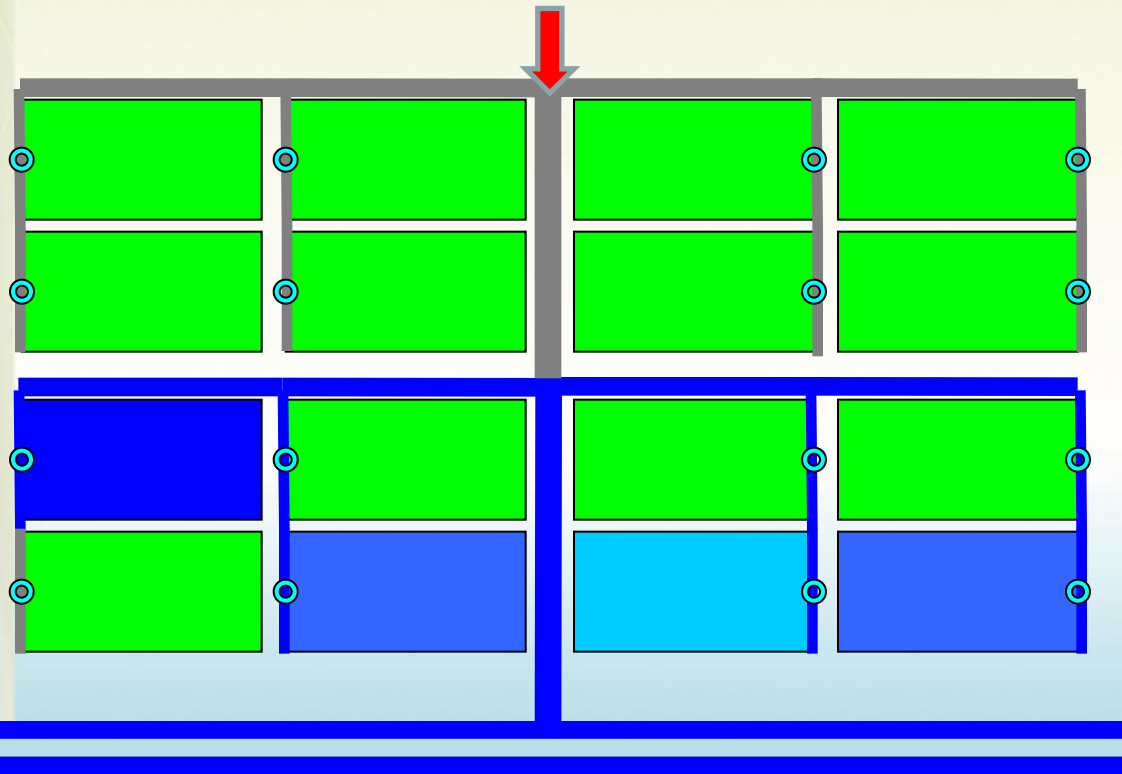


Modalities of water distribution

On-demand

Day 1

13:50 - 17:30



Modalities of water distribution

Objectives of modern irrigation delivery

- Water flow control
- Water level control
- Canal control under variable flow conditions

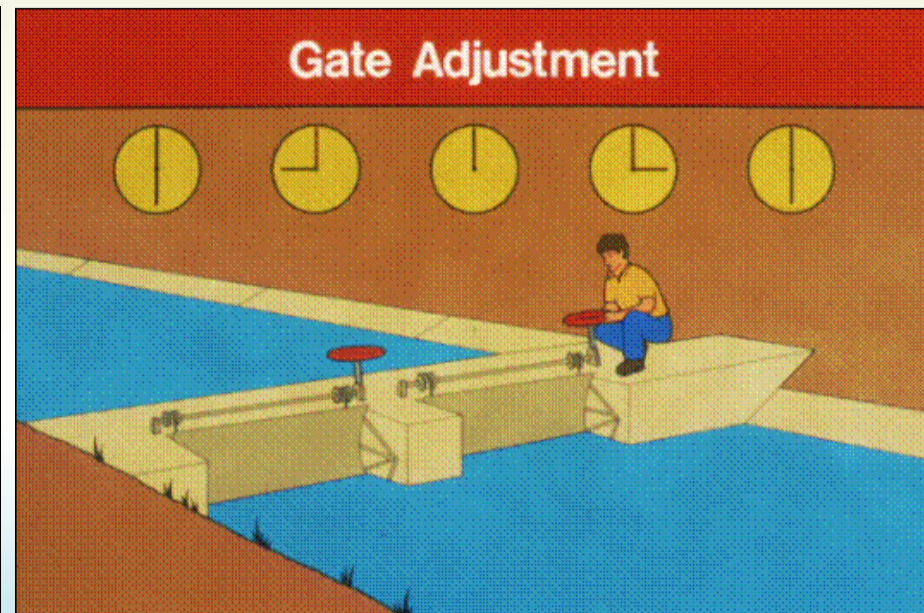
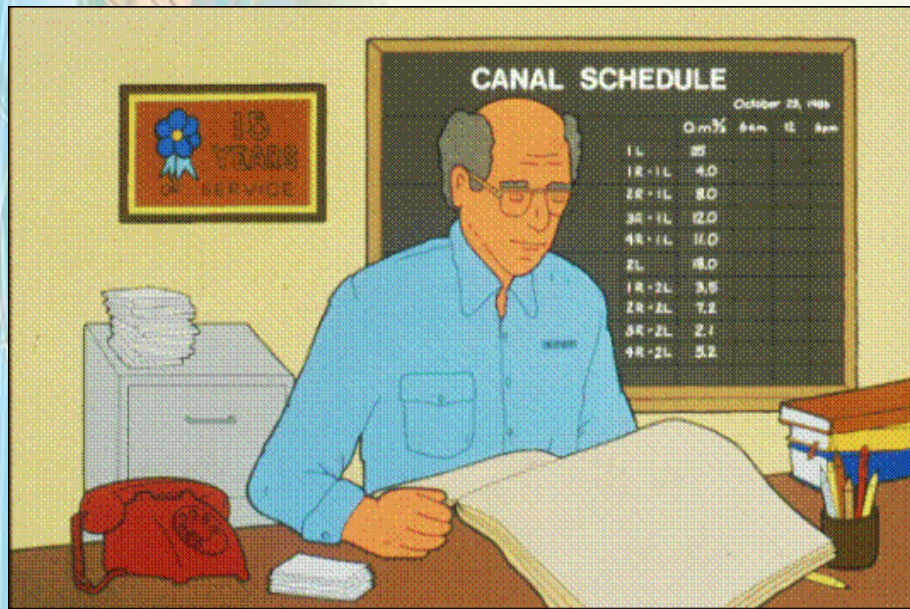
HOW

can we get MORE flexibility and efficiency?

Canal control

Traditional (manual) control is based on experience

- Ditchrider: one or two trips along the canal

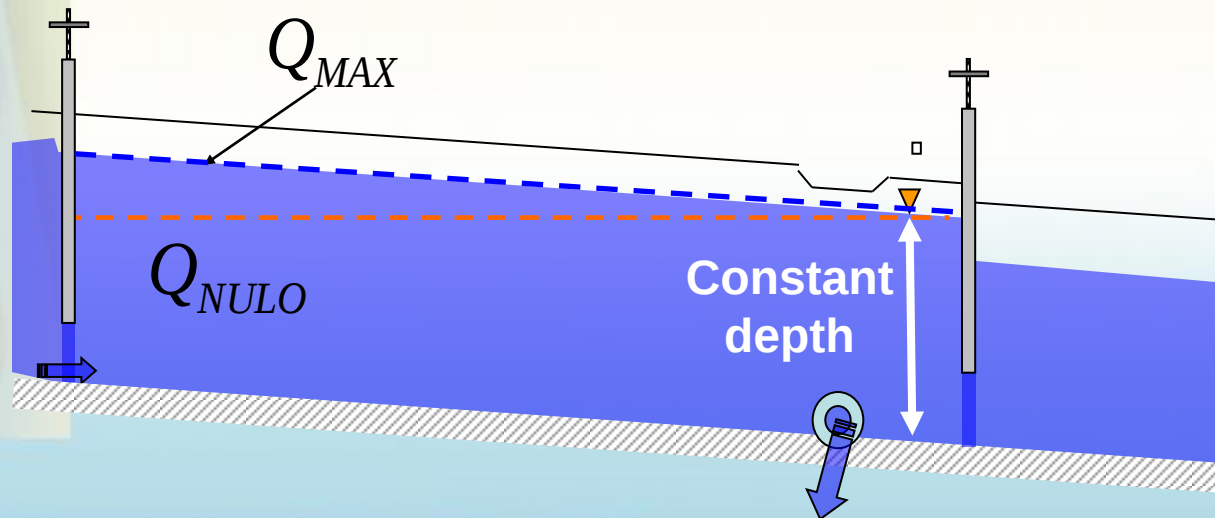


Local manual control



Local UPSTREAM control

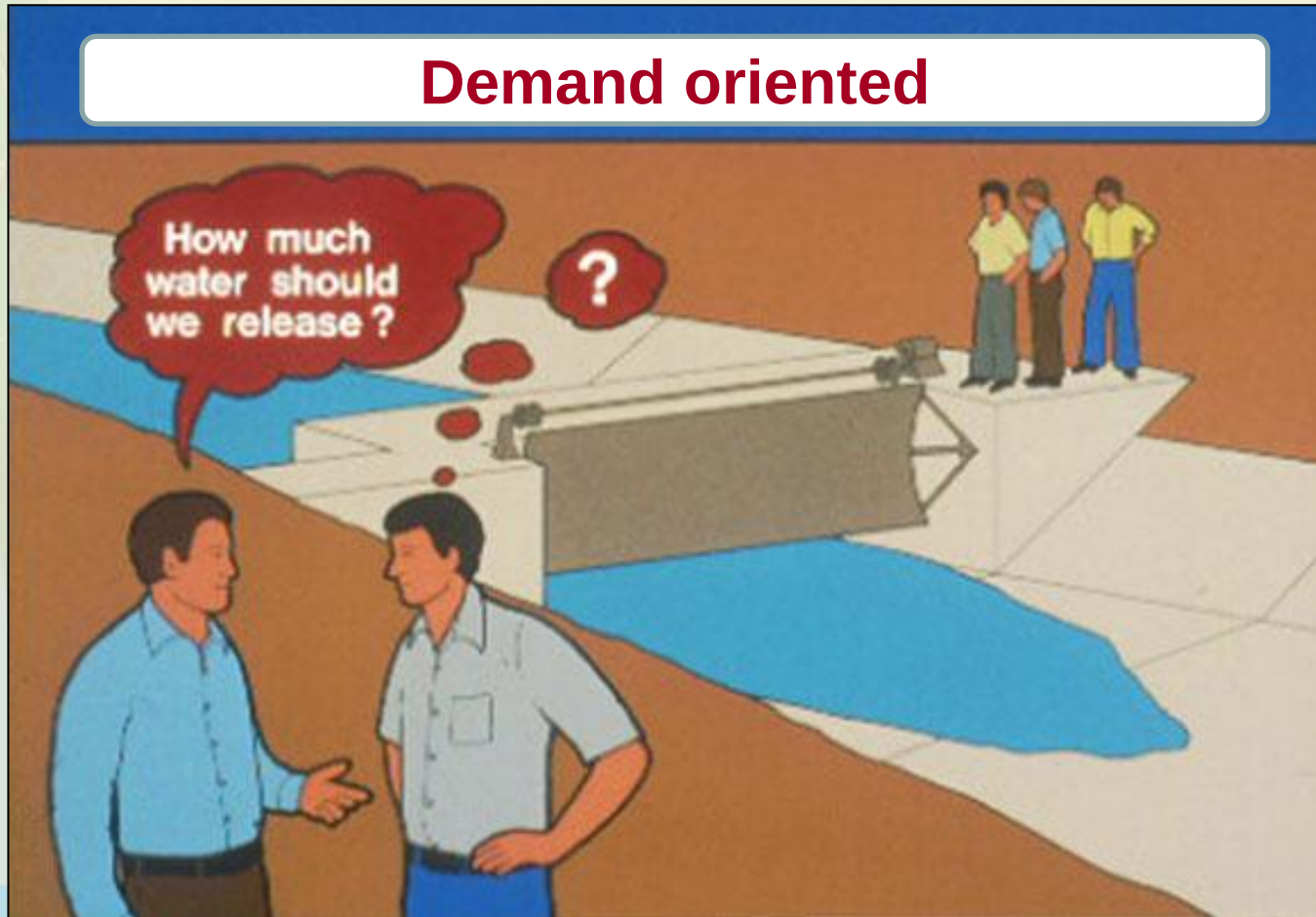
- Supply-driven (slow response to changes in demand)
- **Operational losses** are unavoidable
- **Maximum transport capacity**



Changing from traditional to modern

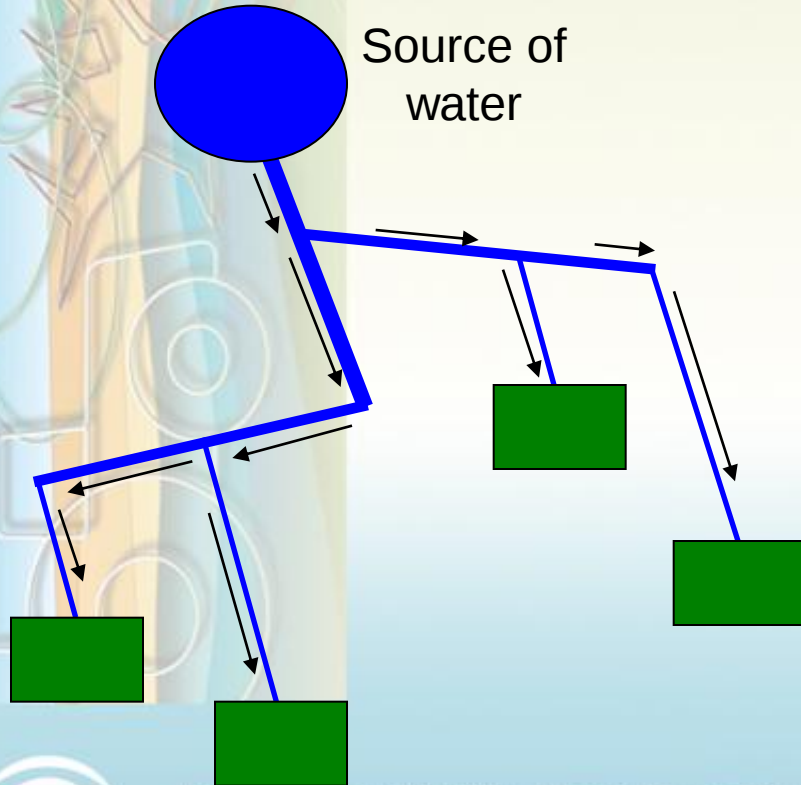
Changing the OPERATION concepts

Demand oriented

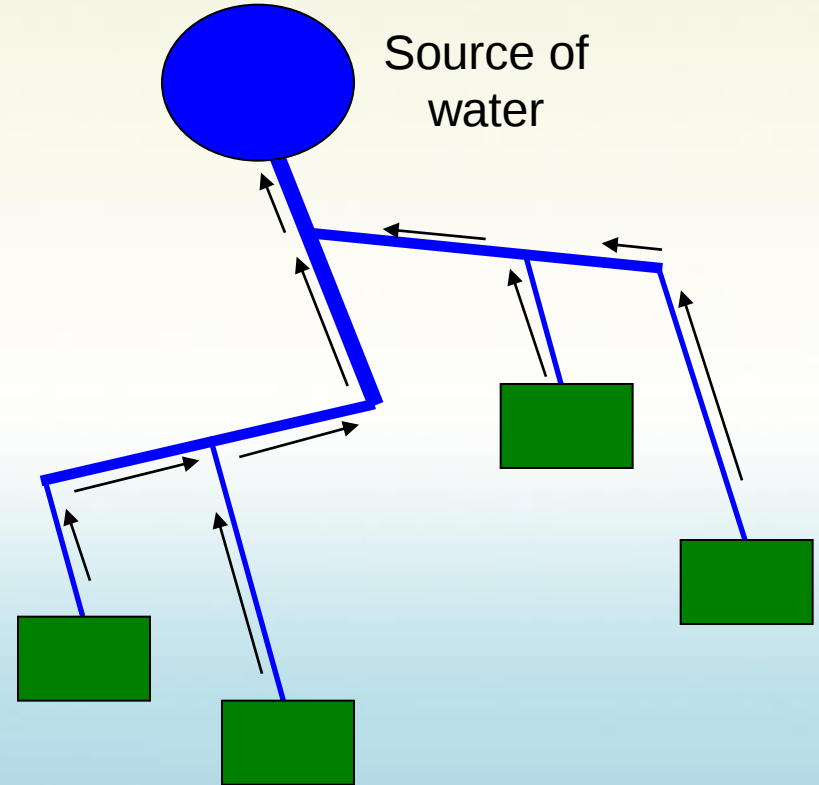


Canal OPERATION concepts

- Upstream operation
(traditional)

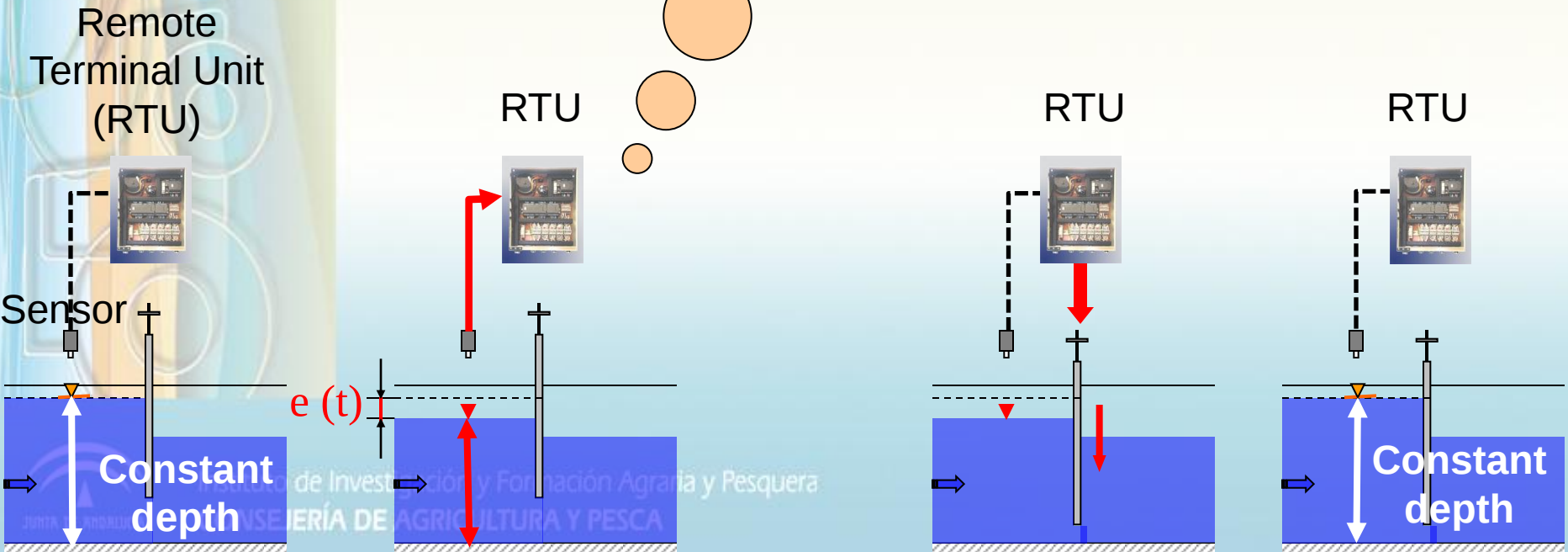
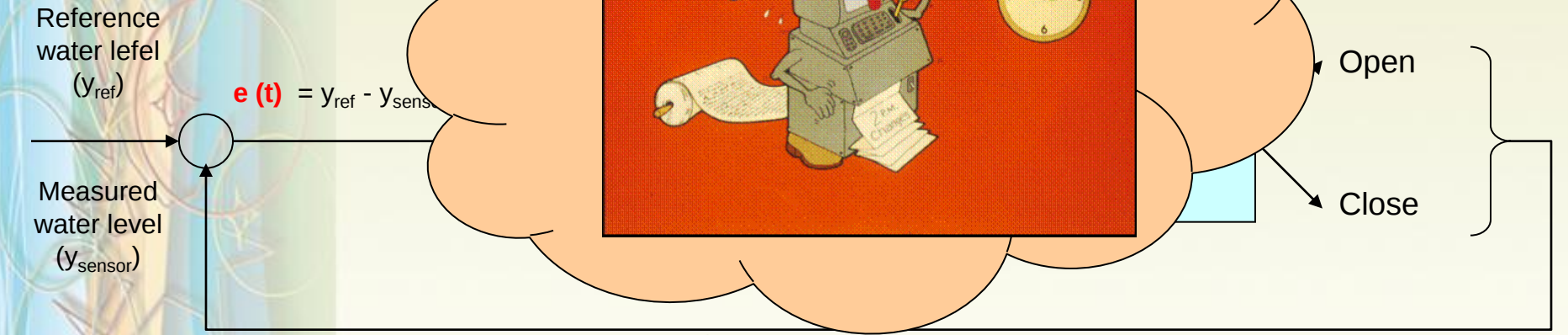


- Downstream operation
(modern)

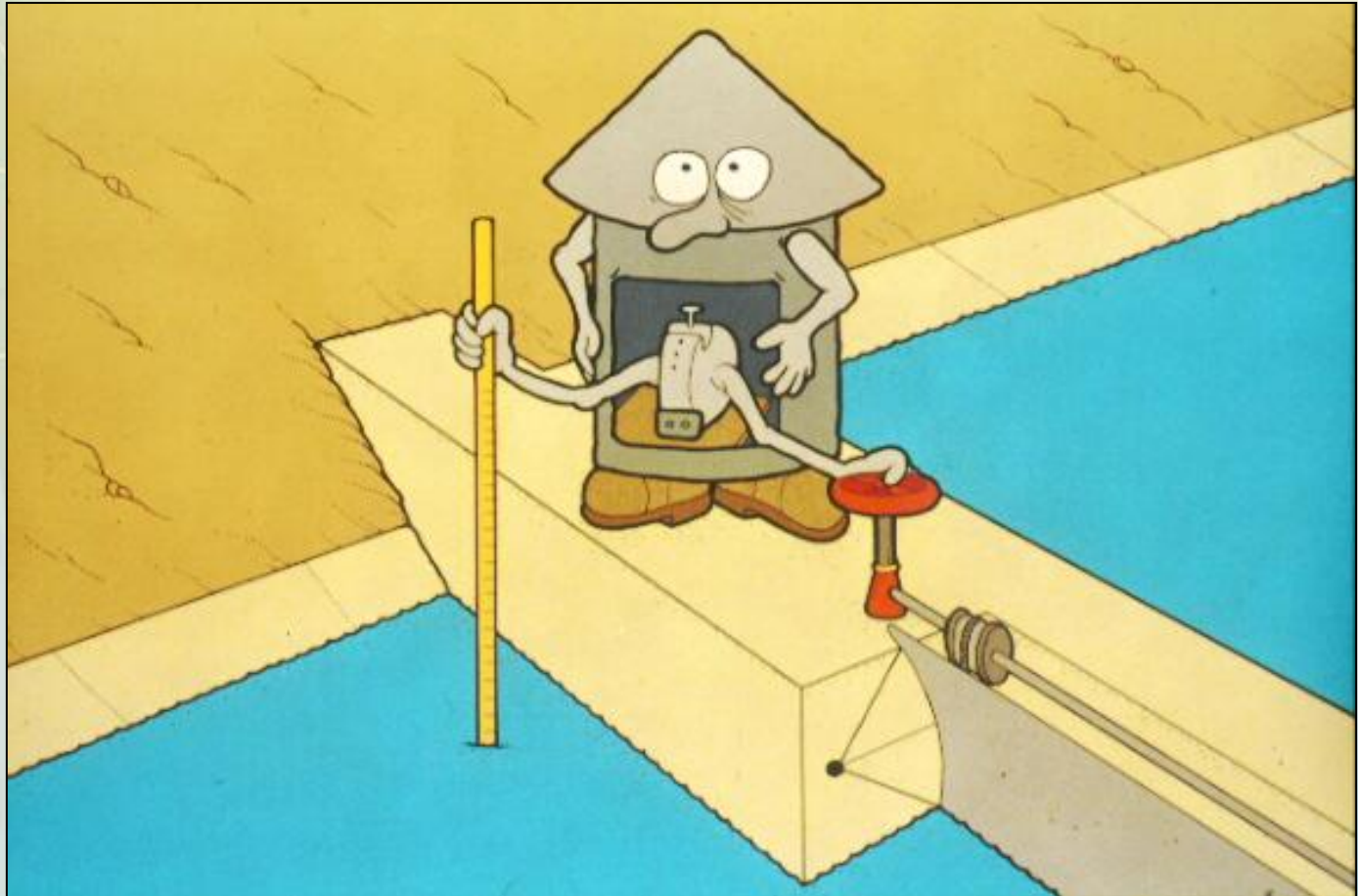


Control algorithm

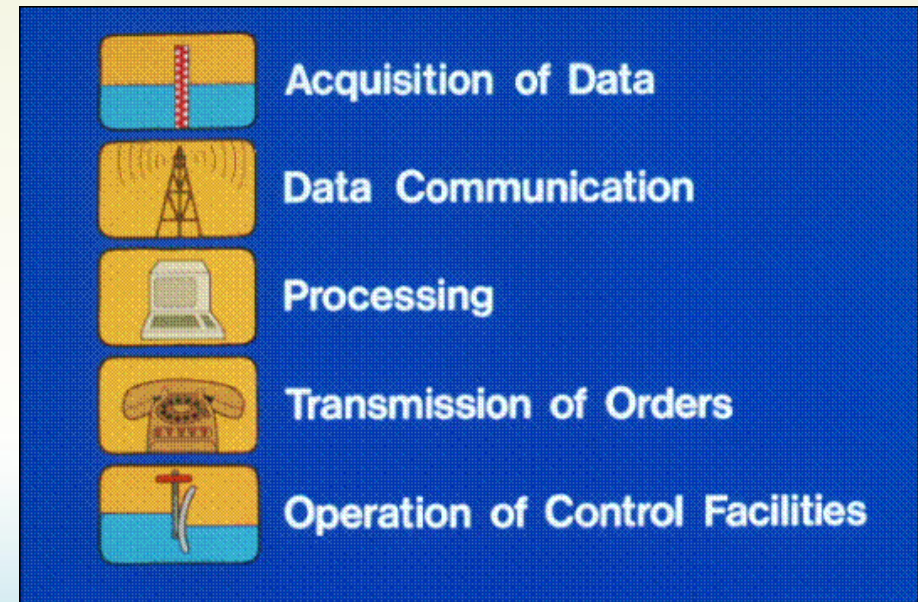
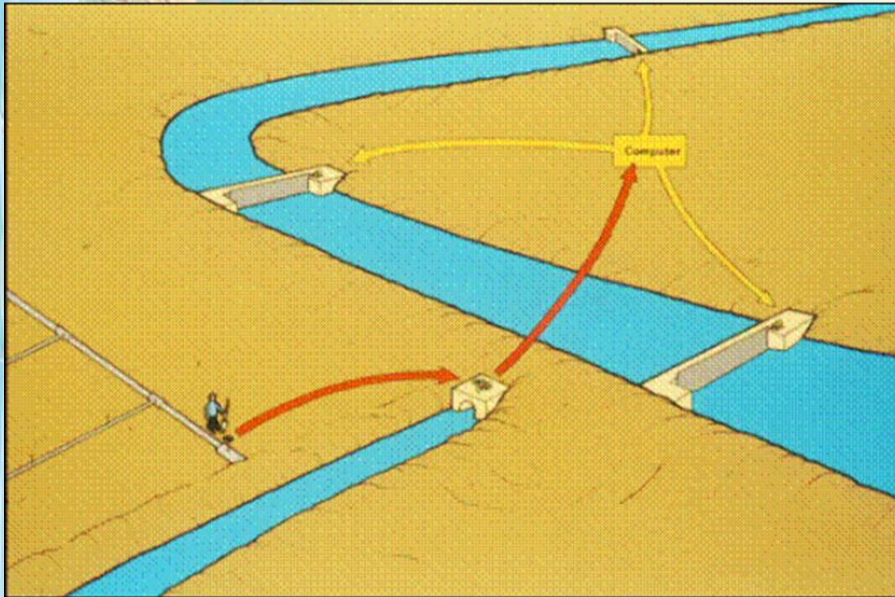
Canal control



Local automatic control

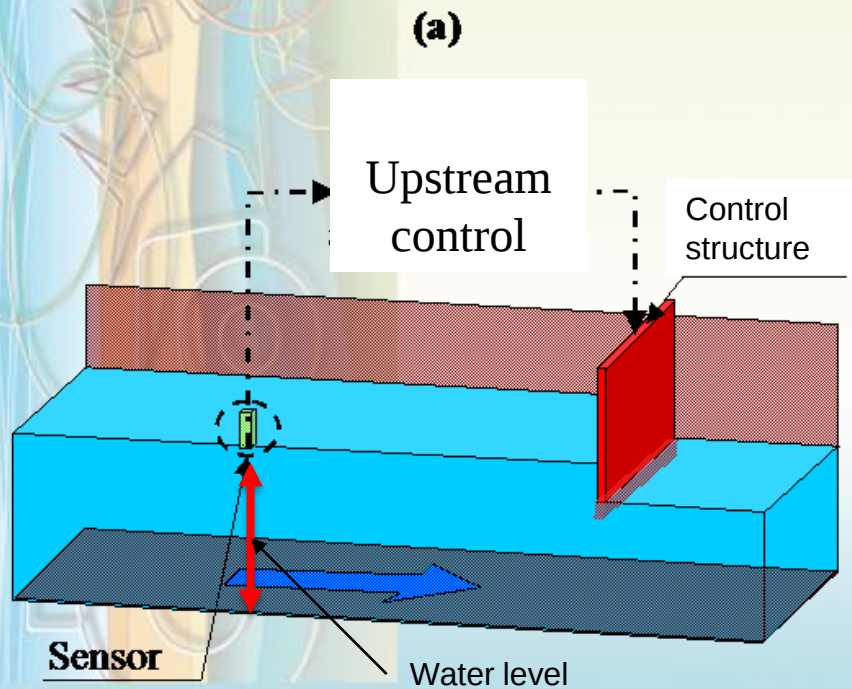


Centralized automatic control

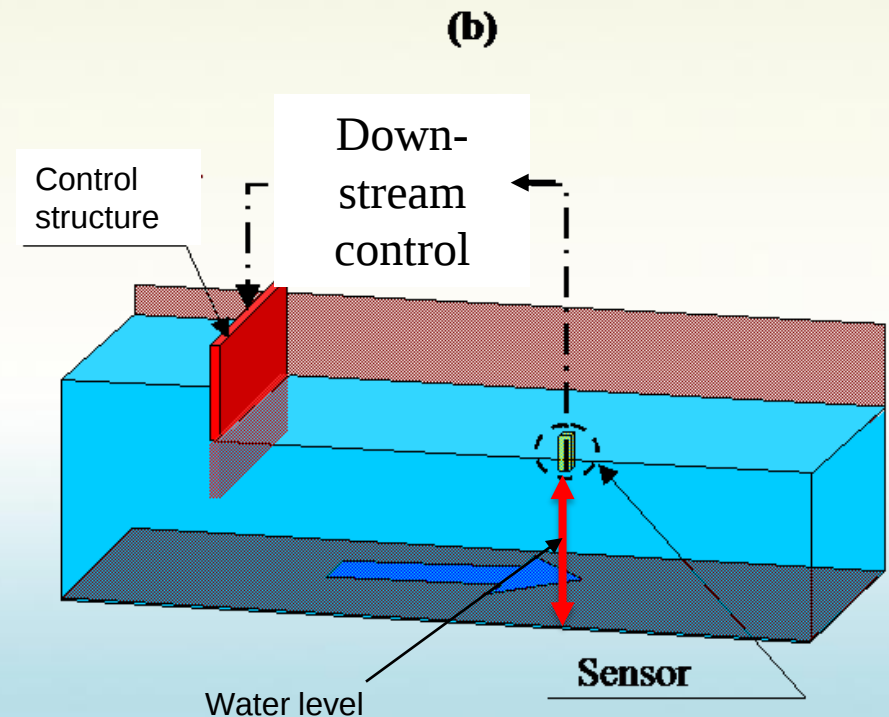


Canal CONTROL concepts

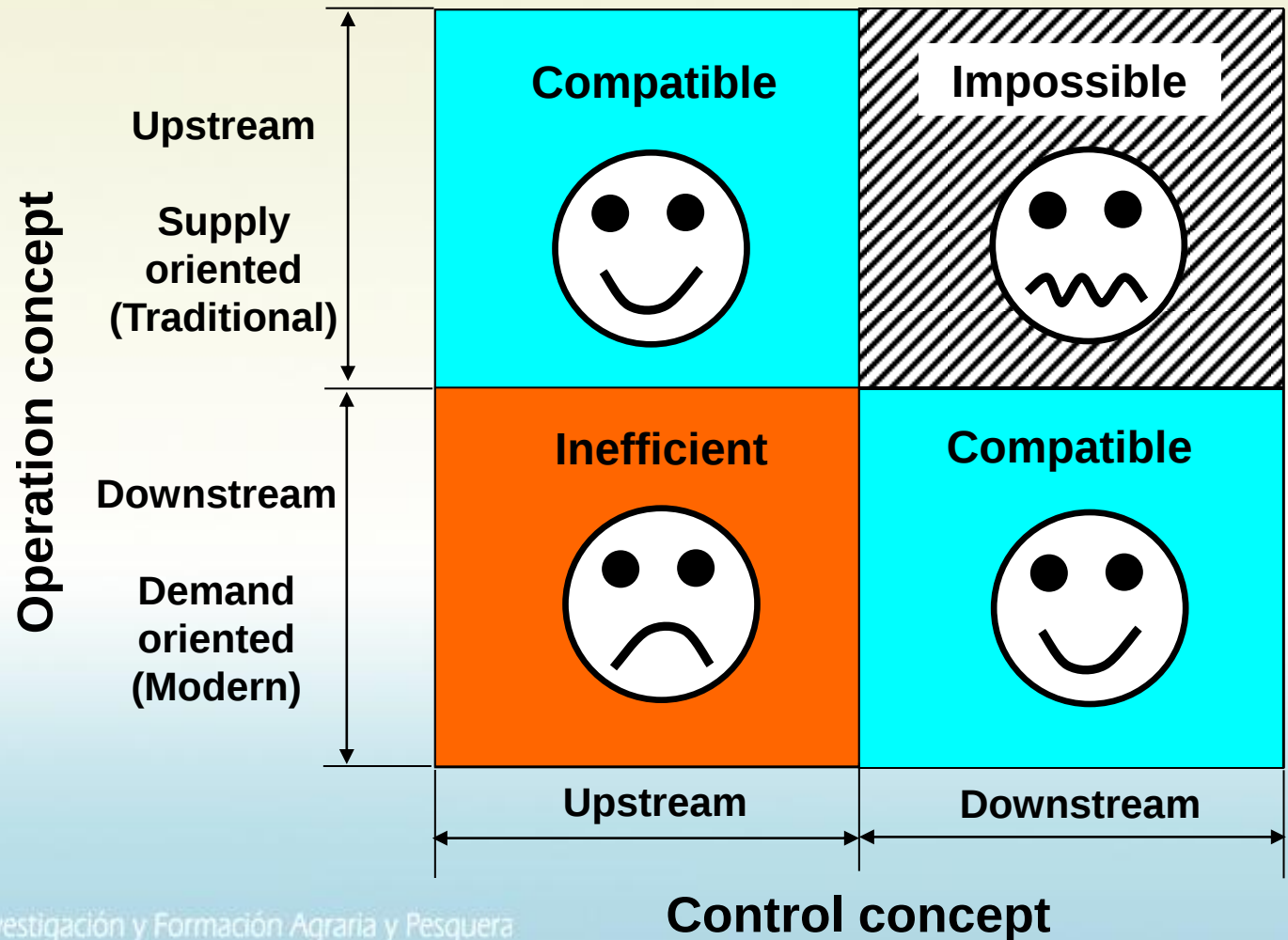
- Upstream control



- Downstream control

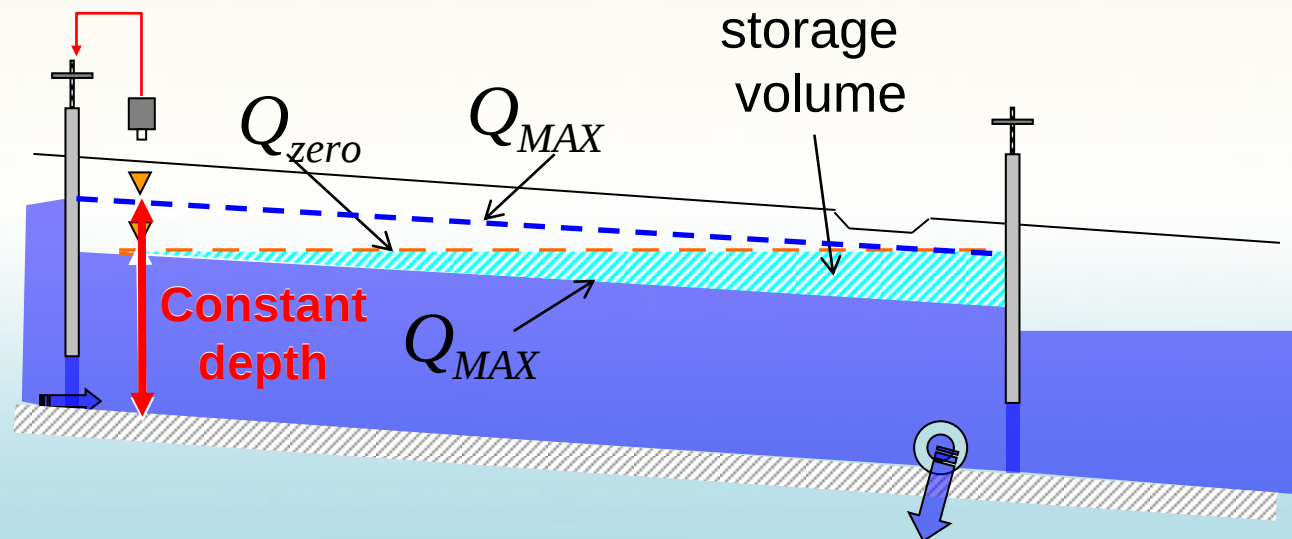


Operational and control concept compatibility



Local DOWNSTREAM control

- Demand driven (immediate response)
- There are **no operational losses**
- **Transport capacity is reduced**



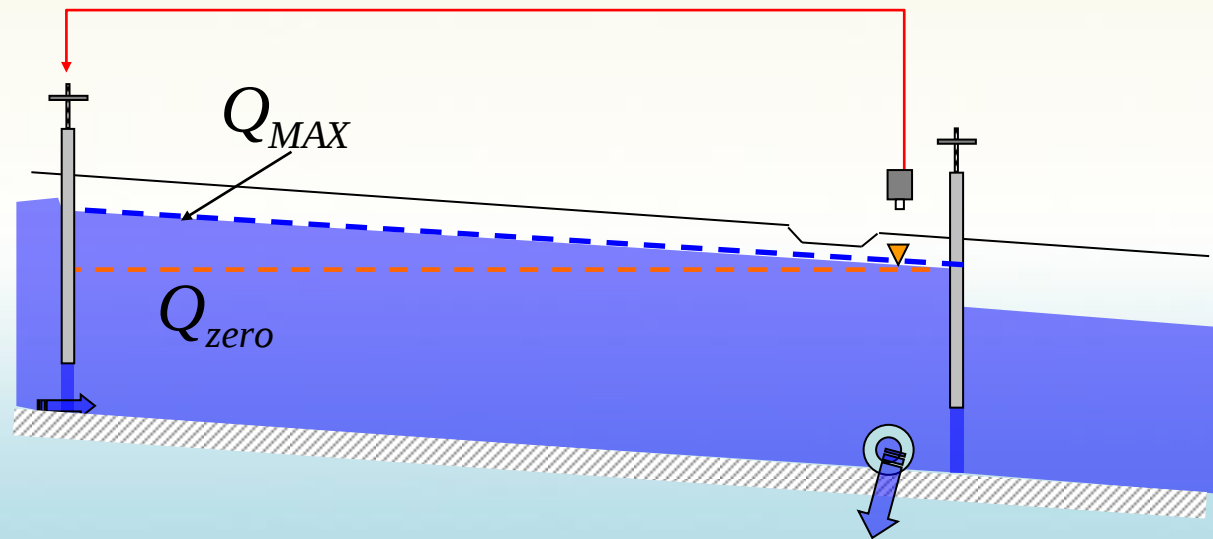


Disadvanta



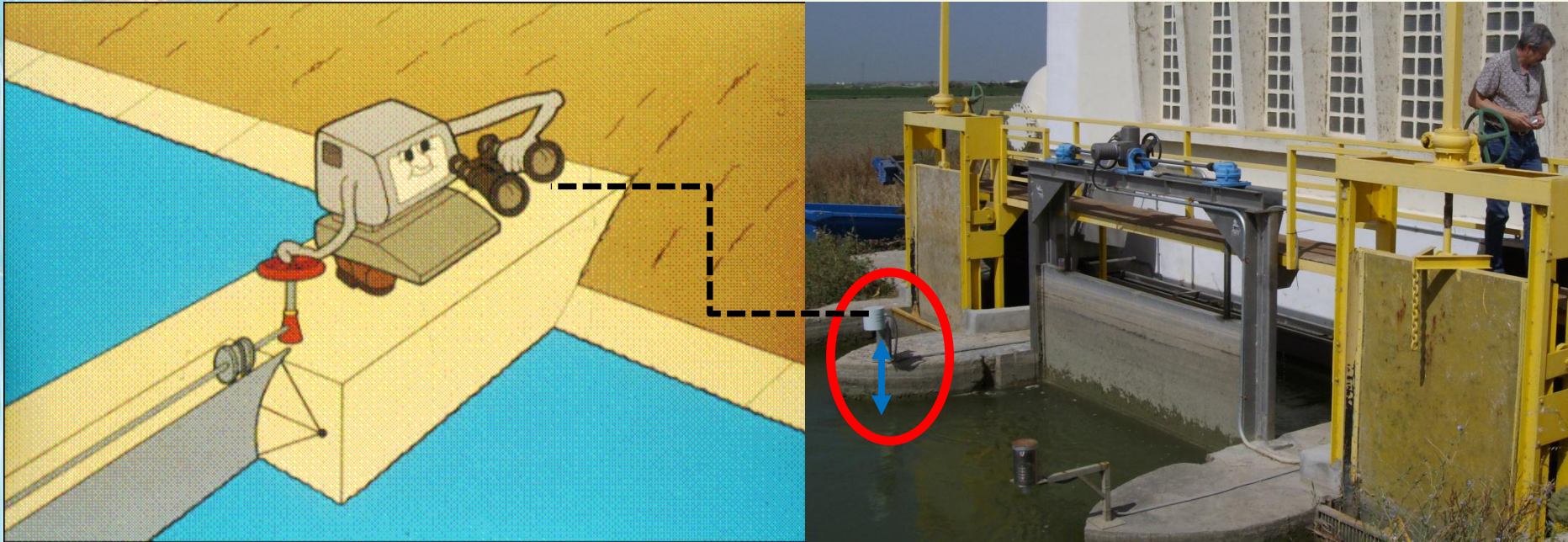
Distant DOWNSTREAM control

- Demand-driven
- There are **some operational losses**
- **Maximum transport capacity**



Distant DOWNSTREAM control

- This logic anticipates the response



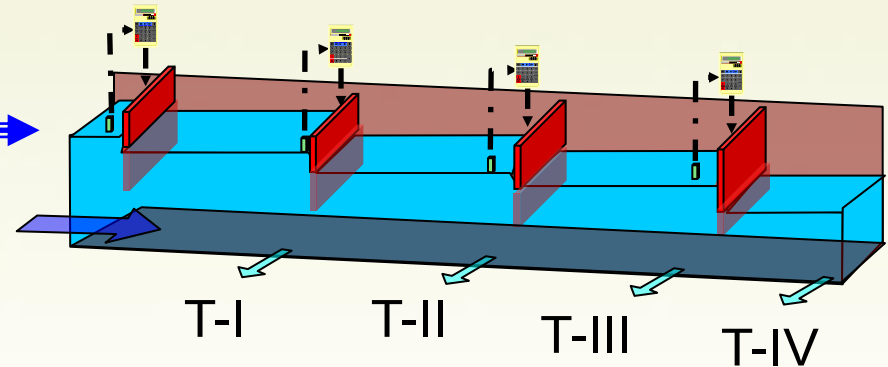
Advantage and disadvantage of control logics

Local upstream vs distant downstream

- Local upstream control (Traditional)



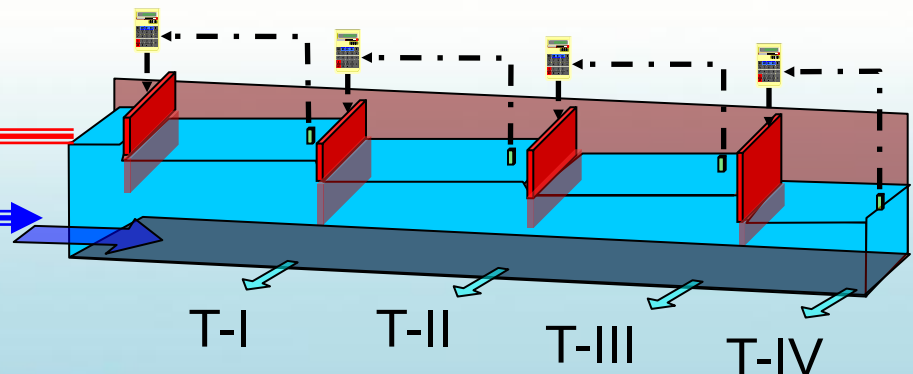
Manual



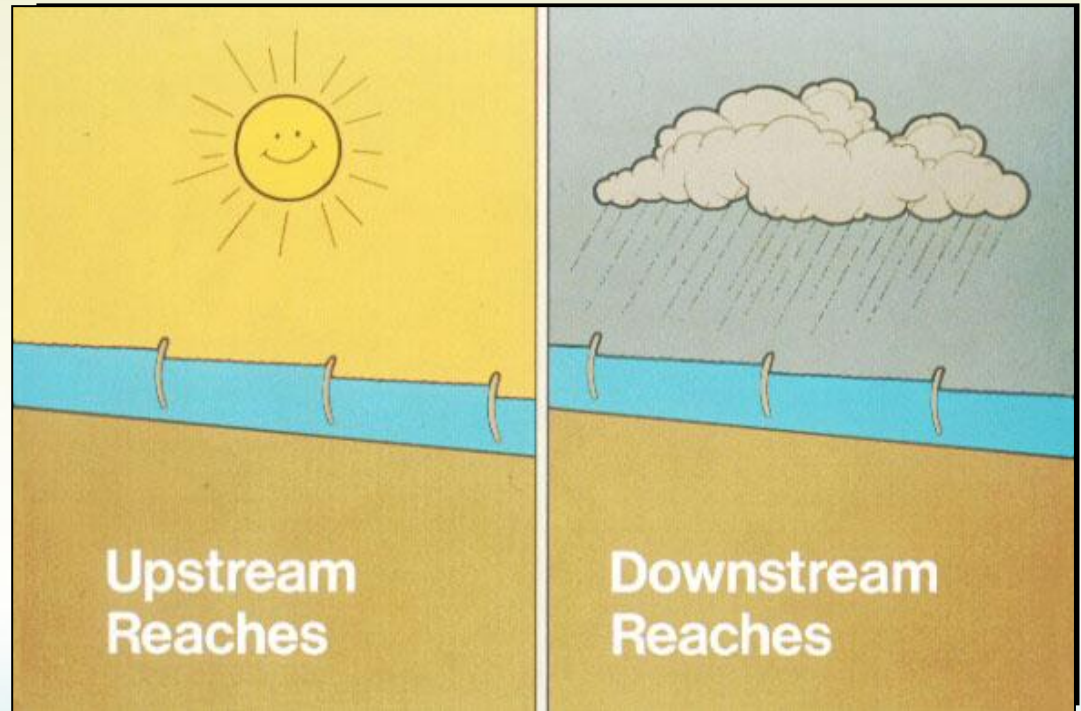
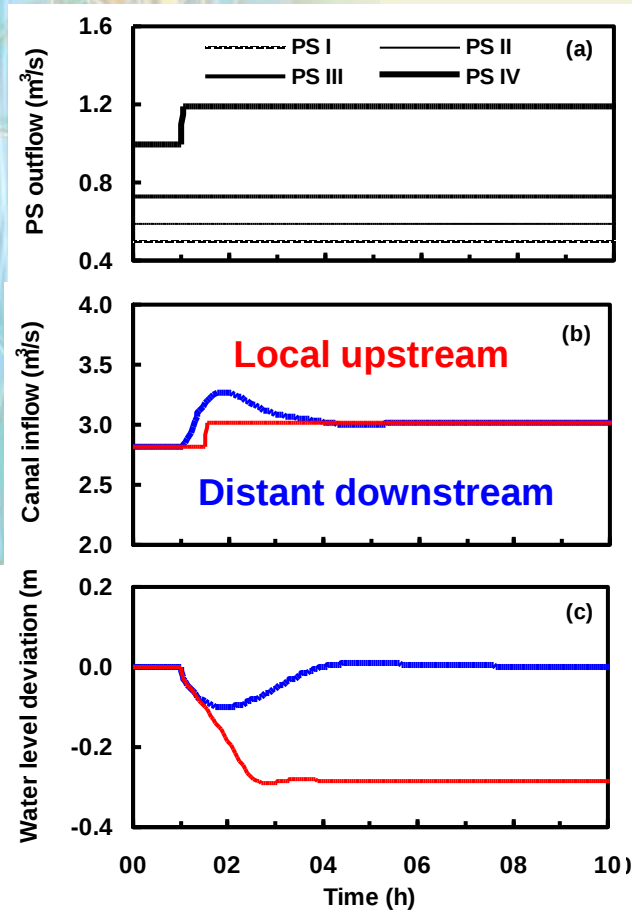
- Distant downstream control (Modern)



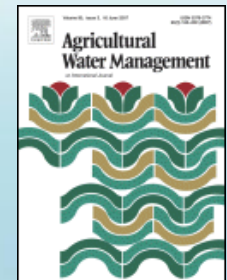
Automatic



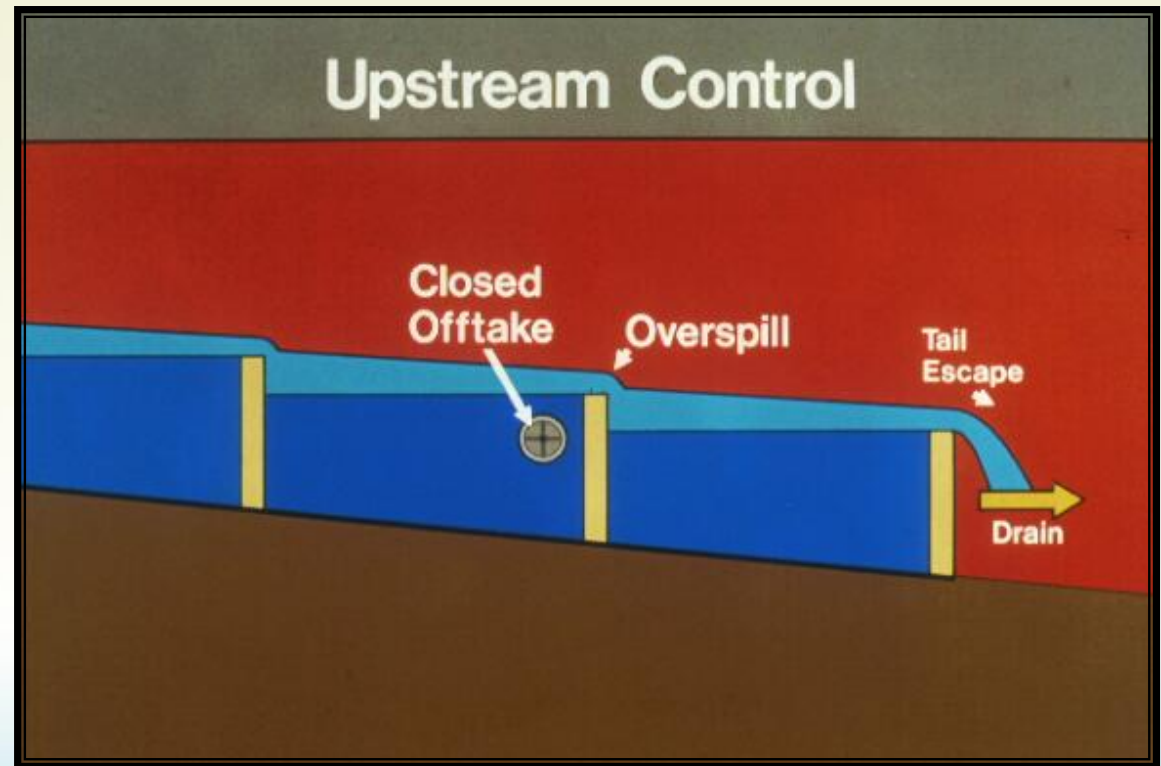
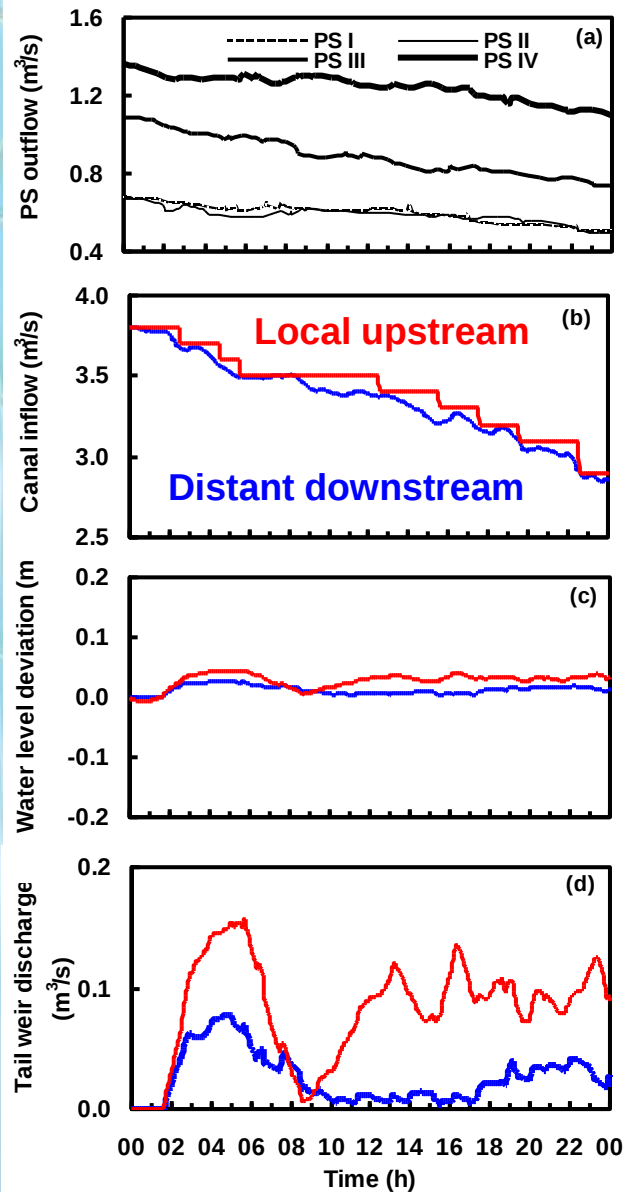
Local upstream vs distant downstream



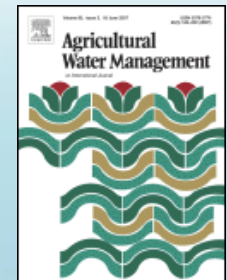
Lozano et al., AWM, (2010)



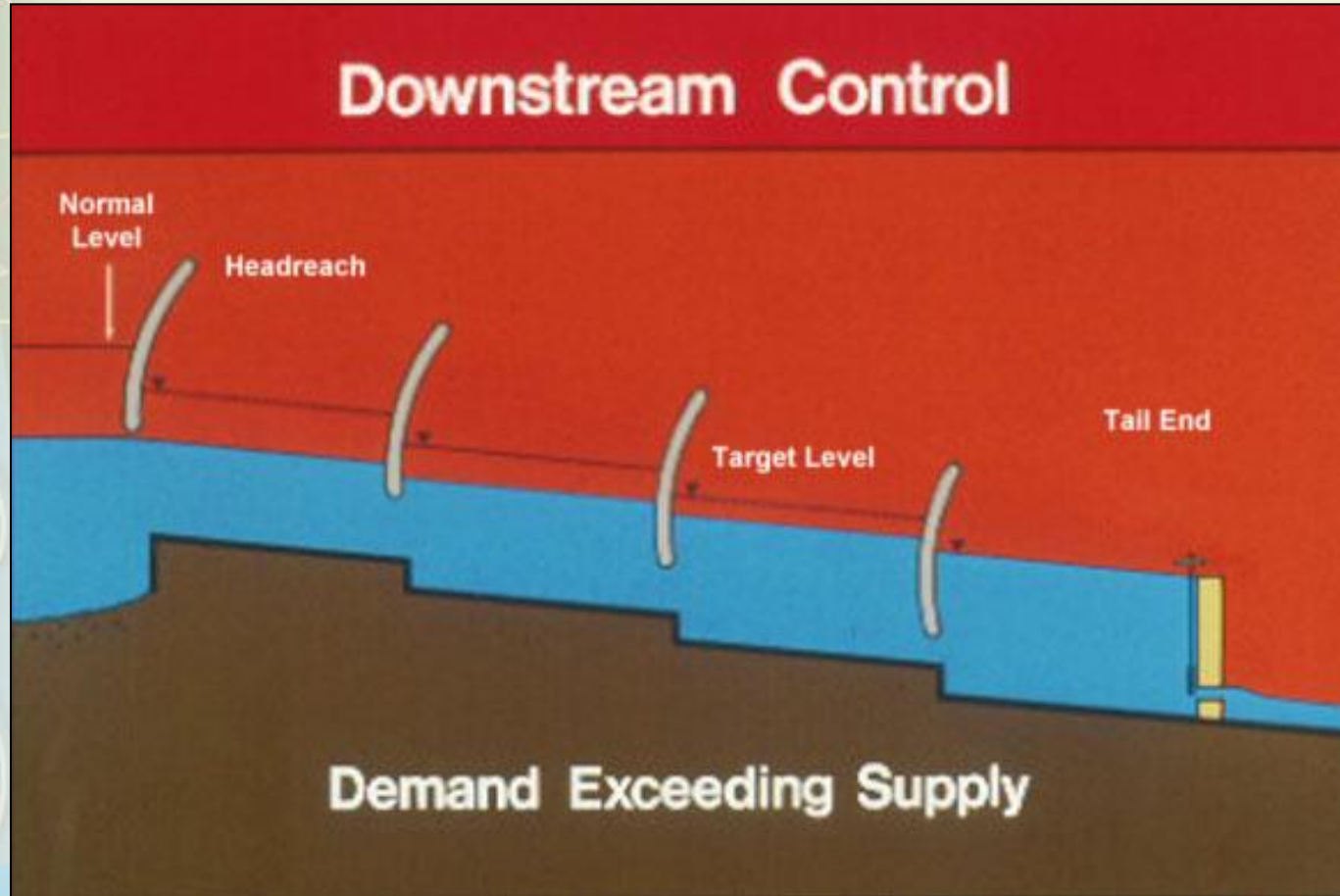
Local upstream vs distant downstream



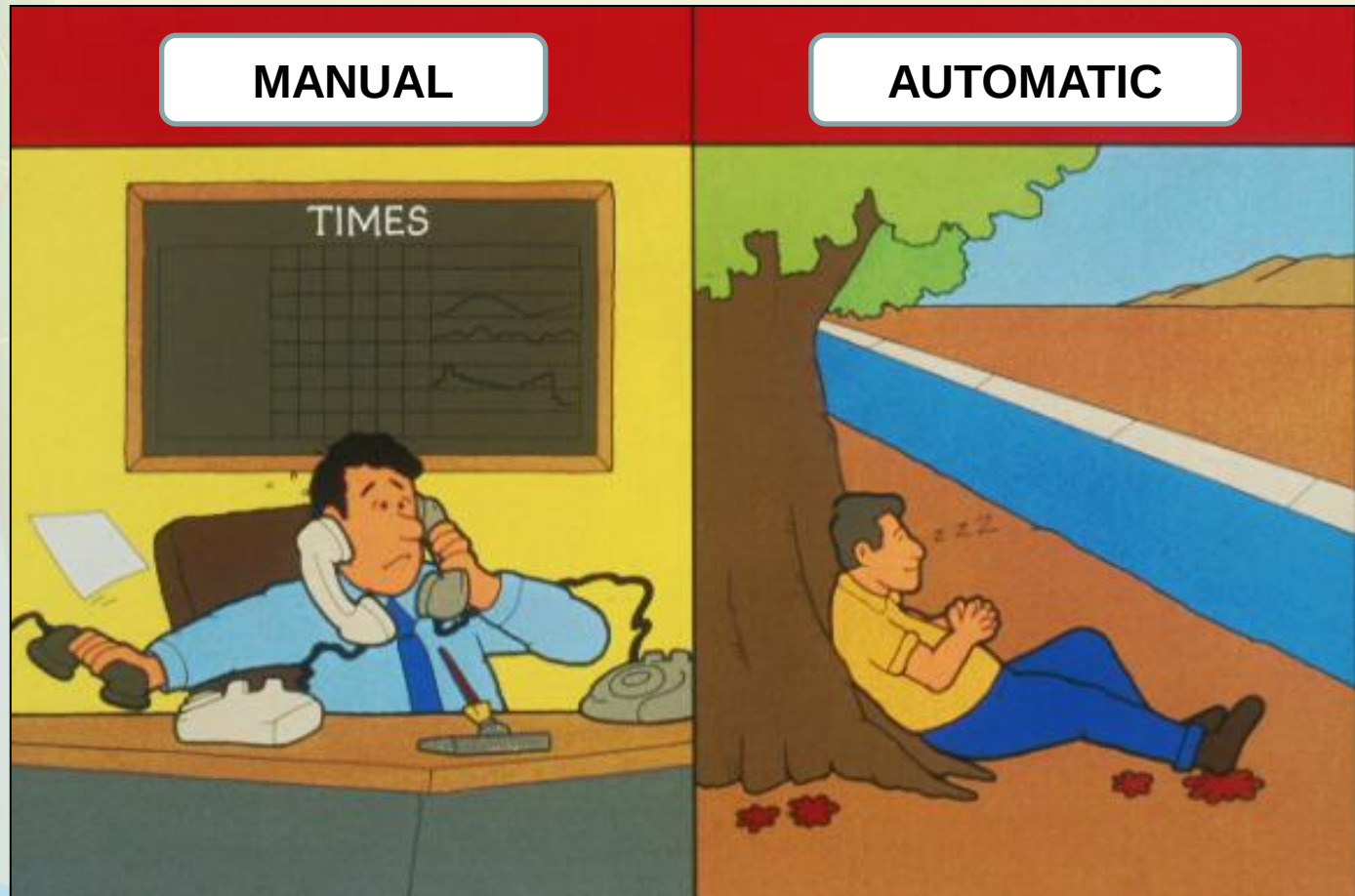
Lozano et al., AWM, (2010)



Disadvantage of downstream control



Upstream vs downstream control in demand oriented system



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Obrigado!

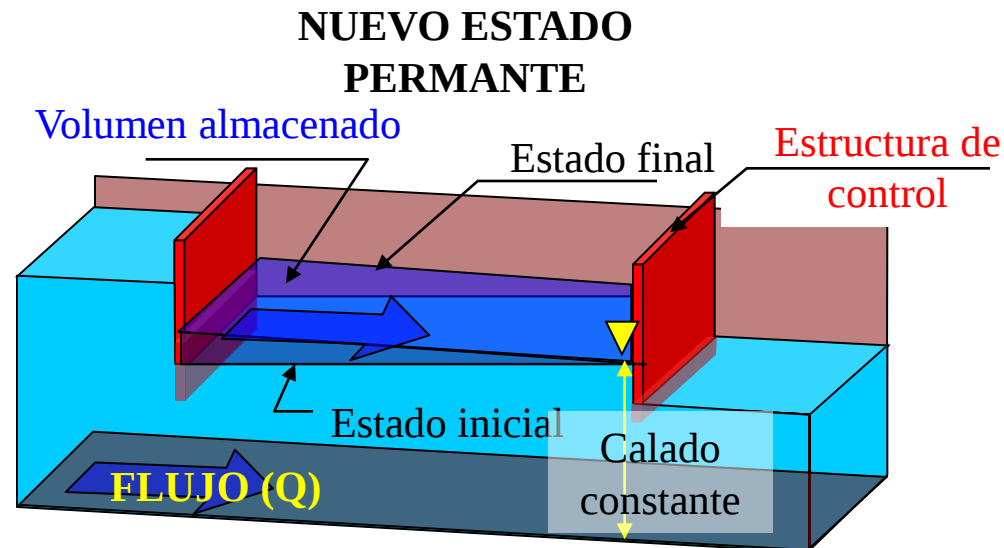
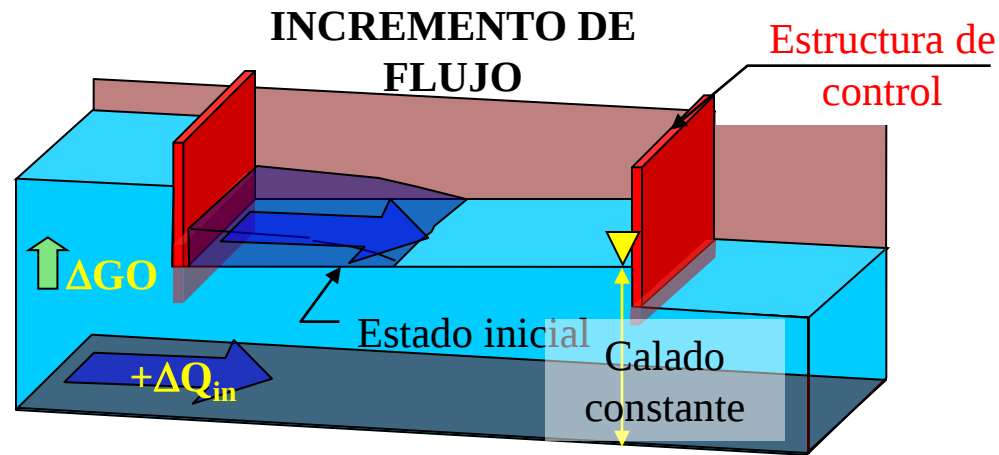
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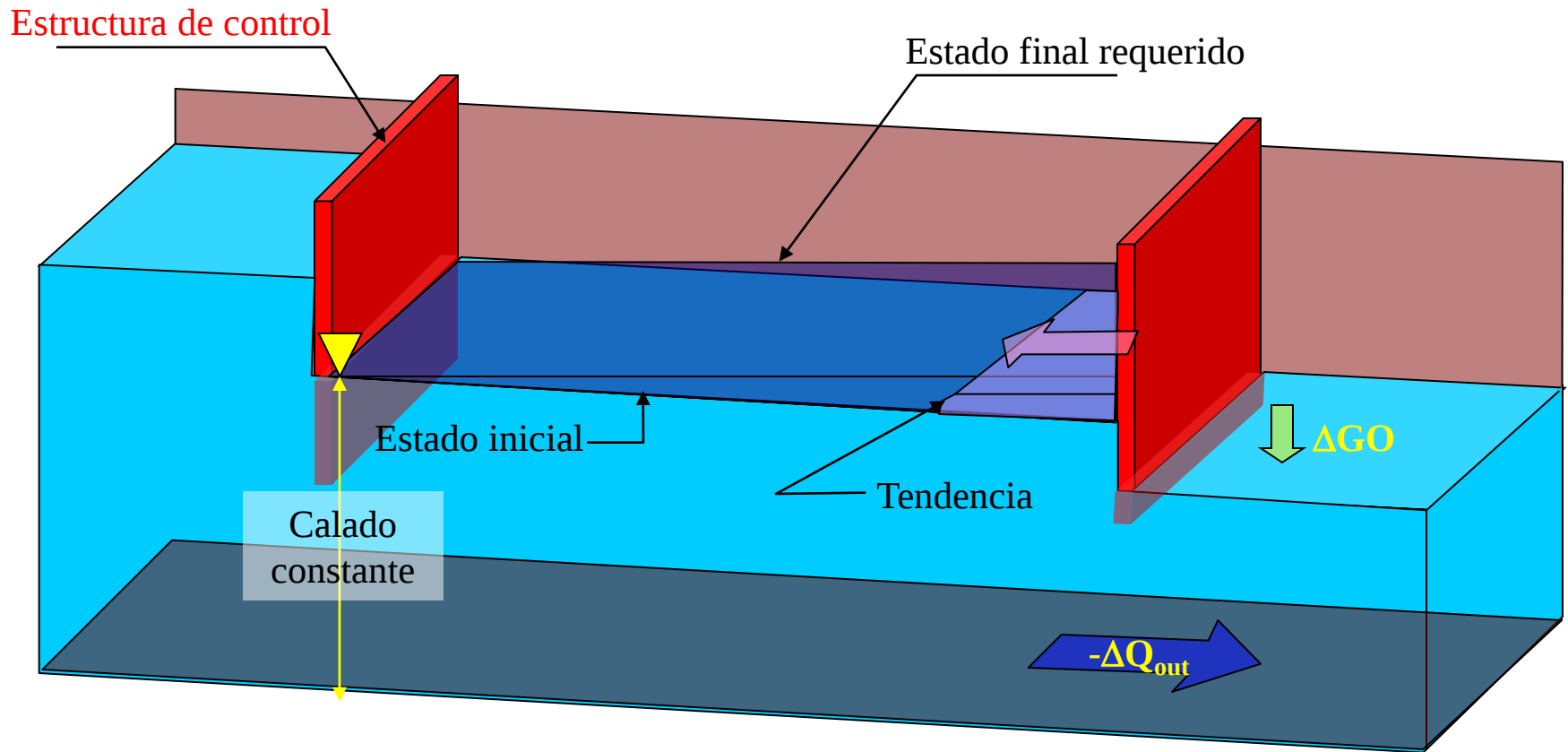
<http://www.juntadeandalucia.es/innovacioncienciayempresa/ifapa>

Métodos y tipos de control

Control y operación aguas ARRIBA

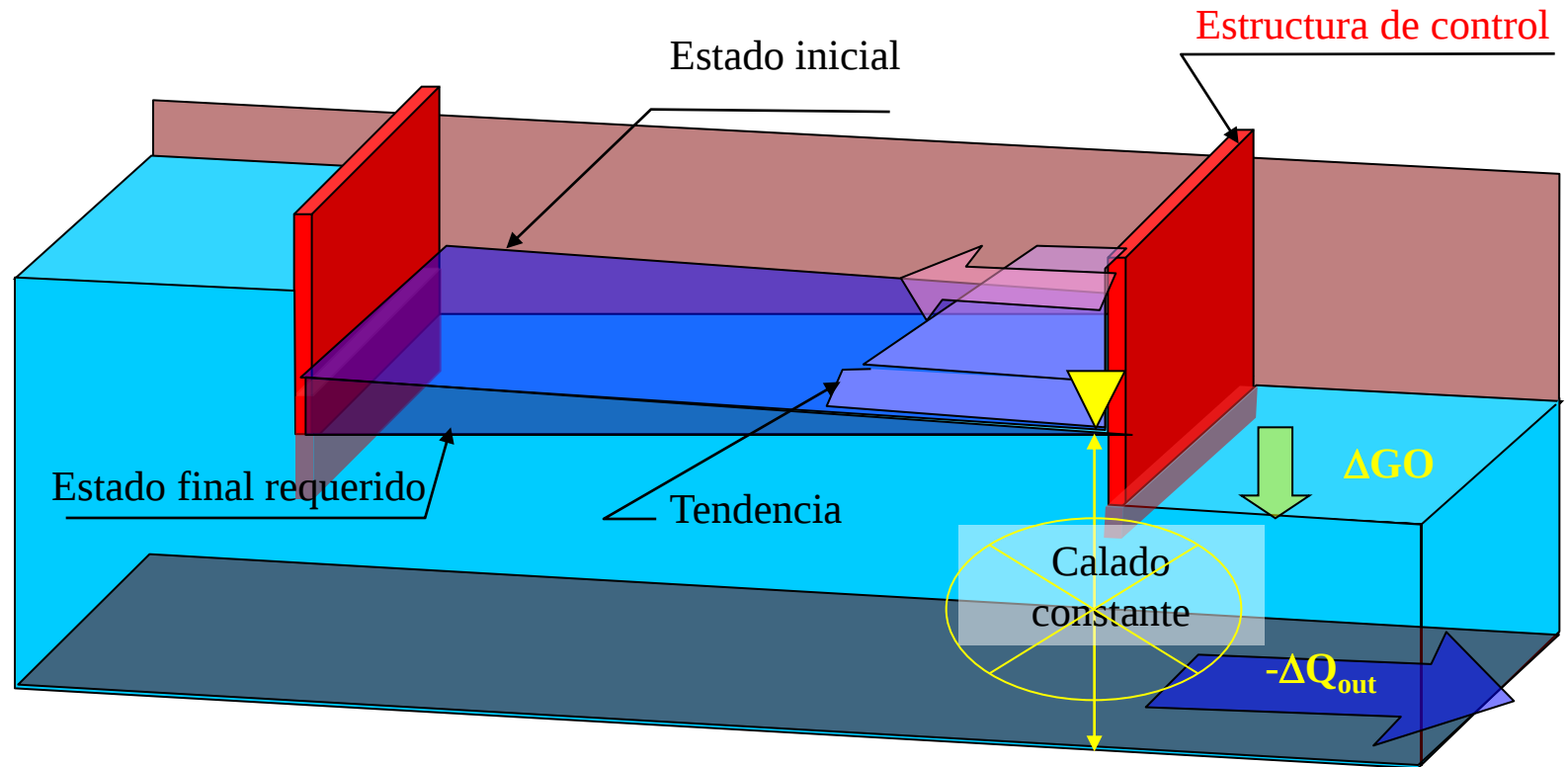


Control y operación aguas ABAJO



Métodos y tipos de control

Control aguas ARRIBA y operación aguas ABAJO



Modalities of water distribution

Reasons for flow control

- Meeting crop requirements
- Water savings
- Safety of operation
- Reduction of operating costs

Modalities of water distribution

Reasons for water level control

- Flow control offtakes
- Canal protection
- Canal safety