



ICID-CIID

INTERNATIONAL COMMISSION ON IRRIGATION AND DRAINAGE (ICID)

# Turning common challenges of irrigation into opportunities: insights from global experiences

Marco Arcieri - ICID President

PLATINUM JUBILEE



**Indo-Global Irrigation Summit 2025**  
24-25 June 2025, New Delhi, India

The World is experiencing a conjuncture of great difficulty and uncertainty



*Where do we come from? Who are we? Where are we going?*  
Paul Gauguin, 1897



## THE GREAT CHALLENGE FOR AGRICULTURE IN A CHANGING CLIMATE

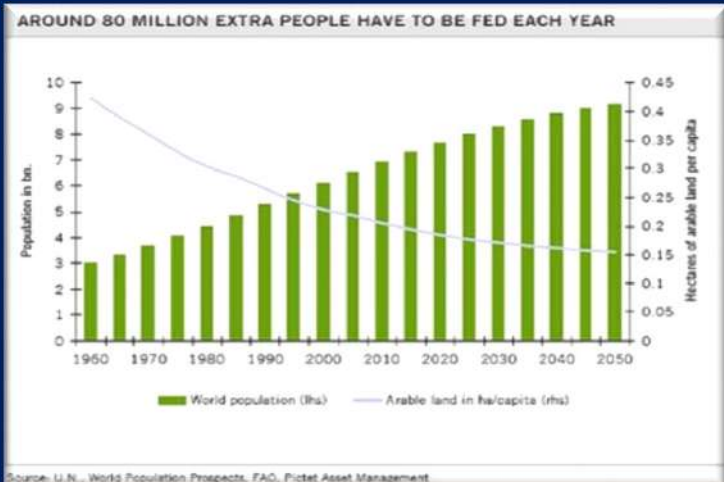
World agriculture faces an enormous challenge over the next years: produce almost 50% more food up to 2030 and double agricultural production by 2050.



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## THE GREAT CHALLENGE FOR AGRICULTURE IN A CHANGING CLIMATE

World agriculture faces an enormous challenge over the next years: produce almost 50% more food up to 2030 and double agricultural production by 2050.



By 2050, there'll be almost 10 billion people living on our planet...



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## THE GREAT CHALLENGE FOR AGRICULTURE IN A CHANGING CLIMATE



### Key drivers

- Increasing population and urbanization
- Changing diets



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## THE GREAT CHALLENGE FOR AGRICULTURE IN A CHANGING CLIMATE



### Key drivers

- Increasing population and urbanization
- Changing diets
- Rapidly growing water demand for industrial, energy and domestic sectors



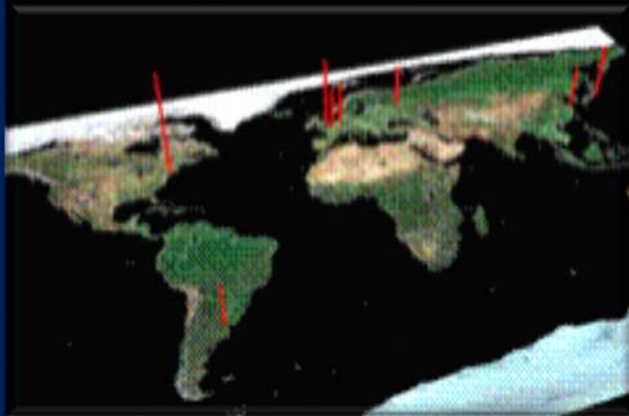
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## INCREASING POPULATION AND URBANIZATION

**in 1960**  
1/3 Urban  
2/3 Rural

**In 2007**  
1/2 Urban  
1/2 Rural

**In 2050**  
2/3 Urban  
1/3 Rural



**1950** CITIES WITH MORE THAN 5 MILLIONS INHABITANTS



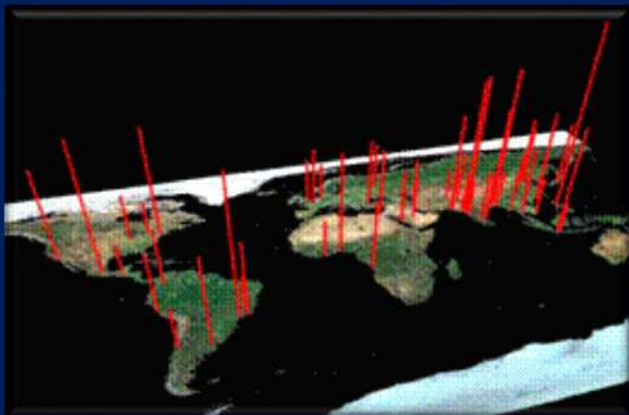
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**2015** CITIES WITH MORE THAN 5 MILLIONS INHABITANTS



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## THE GREAT CHALLENGE FOR AGRICULTURE IN A CHANGING CLIMATE



### Key drivers

- Increasing area under cultivation of bio-energy crops



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## THE GREAT CHALLENGE FOR AGRICULTURE IN A CHANGING CLIMATE



### Key drivers

- Increasing area under cultivation of bio-energy crops
- Climate change impacts on environment and agriculture
- Increasing freshwater scarcity



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## THE GREAT CHALLENGE FOR AGRICULTURE IN A CHANGING CLIMATE

Today global water demand exceeds reliable and exploitable water resources. Hence, on the one hand we need to reach an appropriate balance between the limited supply and the increasingly demand which, at the moment, is heavily uneven.



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## THE GREAT CHALLENGE FOR IRRIGATION IN A CHANGING CLIMATE

That's exactly where modern irrigation fits in...



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That's exactly where modern irrigation fits in...  
Changing the economics of global agriculture



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## THE GREAT CHALLENGE FOR IRRIGATION IN A CHANGING CLIMATE

That's exactly where modern irrigation fits in... Changing the economics of global agriculture and allowing farmers to produce more food per hectare of land and per cubic meter of water used.



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**Modern irrigation will become increasingly indispensable to increase yields of crops and agricultural food production.**



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## THE GREAT CHALLENGE FOR IRRIGATION IN A CHANGING CLIMATE

That's exactly where modern irrigation fits in... Changing the economics of global agriculture and allowing farmers to produce more food per hectare of land and per cubic meter of water used.

Modern irrigation will become increasingly indispensable to increase yields of crops and agricultural food production.

Food security must necessarily be achieved improving irrigation efficiency.



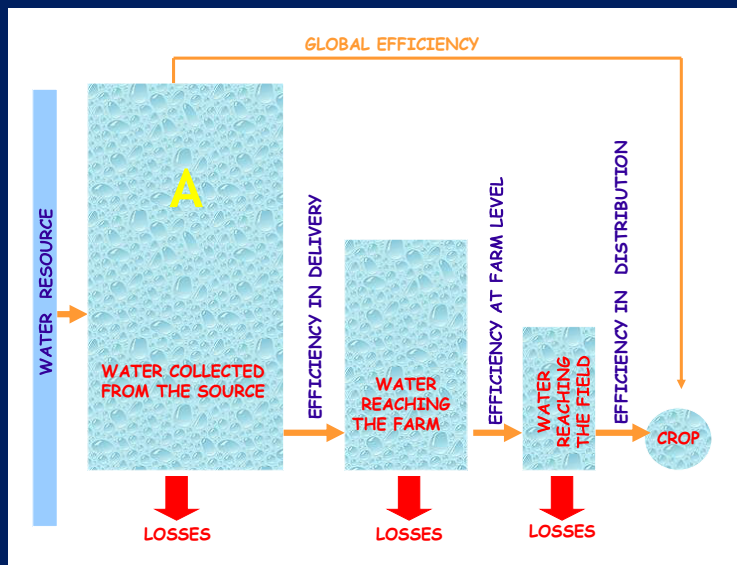
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### A. Improving Efficiency

Efficiency must be sought all the way from source to the plant, reducing non-positive losses with technological strategies.

Proper time of irrigation and correct amount of water to give are essential to determine a high physiological efficiency in water distribution to the plant (*more crop per drop*).

#### A. EFFICIENCY IN WATER CONVEYANCE & DISTRIBUTION



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**A. EFFICIENCY IN WATER CONVEYANCE & DISTRIBUTION**

**B. EFFICIENCY IN IRRIGATION SYSTEMS**

The diagram illustrates the water flow process from source to crop. It starts with 'WATER RESOURCE' on the left. An arrow points to a large blue box representing 'WATER COLLECTED FROM THE SOURCE'. Below this box is a red arrow pointing down labeled 'LOSSES'. An arrow labeled 'EFFICIENCY IN DELIVERY' points to a medium-sized blue box 'WATER REACHING THE FARM', which also has a red arrow labeled 'LOSSES' below it. A yellow letter 'B' is placed inside this box. An arrow labeled 'EFFICIENCY AT FARM LEVEL' points to a smaller blue box 'WATER REACHING THE FIELD', with a red arrow labeled 'LOSSES' below it. A final arrow labeled 'EFFICIENCY IN DISTRIBUTION' points to a small blue circle labeled 'CROP'. A large orange arrow labeled 'GLOBAL EFFICIENCY' spans the entire process from the source to the crop. The background of the diagram is a light blue sky with white clouds.

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**A. EFFICIENCY IN WATER CONVEYANCE & DISTRIBUTION**

**B. EFFICIENCY IN IRRIGATION SYSTEMS**

**C. EFFICIENCY IN IRRIGATION SCHEDULING**

This diagram is identical to the one above, showing the stages of water flow from source to crop. However, in the 'WATER REACHING THE FARM' box, a yellow arrow points from the top right towards the bottom left, indicating a specific focus or action within that stage. The rest of the diagram, including the 'LOSSES' arrows and the 'GLOBAL EFFICIENCY' arrow, remains the same.

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## A. Improving Efficiency

### INNOVATION CONVEYING AND TRANSPORT OF WATER

#### MAIN SOLUTIONS

- Canal lining and waterproofing.



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- Canal lining and waterproofing.
- Replacement of earth canals with pipelines



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- Functional restoration of the steel and cement aqueducts.



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### INNOVATION CONVEYING AND TRANSPORT OF WATER

#### MAIN SOLUTIONS

- Canal lining and waterproofing.
- Replacement of earth canals with pipelines
- Functional restoration of the steel and cement aqueducts.
- Use of long duration and low maintenance pipelines

**EFFICIENCY = + 20÷30%**



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## A. Improving Efficiency

### INNOVATION

#### AUTOMATION OF THE DELIVERY SYSTEM

Gates and sluices operate as a result of the CWR and irrigation scheduling of the companies/farms adopting *Expert System* such as IRRINET/ IRRIFRAME



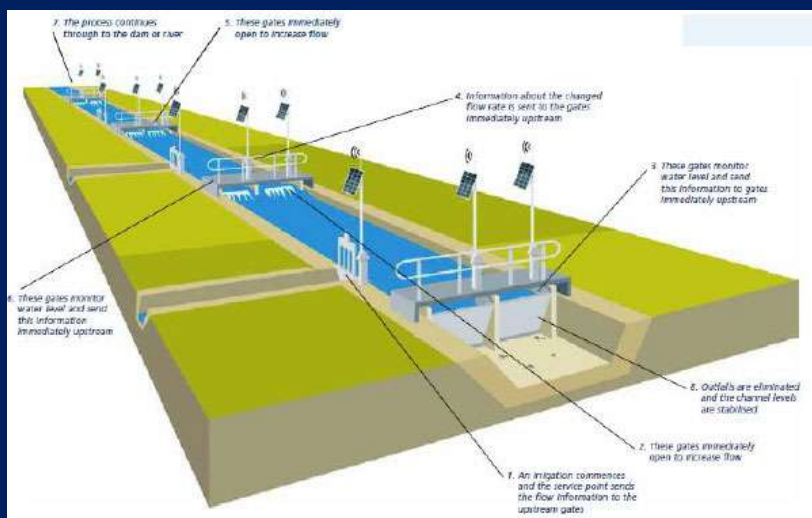
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Photo Voltaic energy gate, with remote control and automatic flow rate or level regulator.



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## A. Improving Efficiency

### INNOVATION

#### AUTOMATION OF THE DELIVERY SYSTEM

Photo Voltaic energy gate, with remote control and automatic flow rate or level regulator.

Can interact automatically with other sluice gates or sensors to control an entire canal and/or basin system.



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## A. Improving Efficiency

### INNOVATION

#### REMOTE CONTROL OF AUTOMATED WATER DELIVERY GROUPS

Automated delivery groups with use of electronic card withdrawal allow:

- Fair distribution of water and cost sharing



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- Possible regulation of water
- Turnover amongst delivery groups instead of sectors
- Reduction of non-useful withdrawals

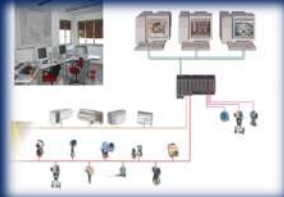


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#### REMOTE CONTROL OF AUTOMATED WATER DELIVERY GROUPS



If also remotely controlled:

- Remote reading: fewer employees and lower operational costs



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If also remotely controlled:

- Remote reading: fewer employees and lower operational costs
- Telephone alarms (failures) and emergency services

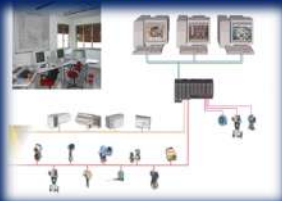


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#### REMOTE CONTROL OF AUTOMATED WATER DELIVERY GROUPS



If also remotely controlled:

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- Telephone alarms (failures) and emergency services
- Remote suspension of the supply (drought management-defaulting users)



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## B. Efficiency in Irrigation Systems

Irrigation systems can have very different application efficiencies, with significant effects on yield, quality of crop production and required operating pressure (€):



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- Flooding (paddy fields) - 25÷30%



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- Gravity or Surface flow (furrow) - 40÷50%



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- Modern Center Pivot - 70÷80%



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- Micro irrigation & Subsurface micro irrigation - 80÷90%



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- Ultra Low Drip irrigation - 90÷95%



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## B. Efficiency in Irrigation Systems

INNOVATION  
ULTRA LOW DRIP IRRIGATION

ULDI :

- Flow - 0,1-0,3 l/h

Traditional Micro Irrigation:



Ultra Low Drip Irrigation:



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## B. Efficiency in Irrigation Systems

### INNOVATION ULTRA LOW DRIP IRRIGATION

#### ULDI :

- Flow - 0,1-0,3 l/h
- Longer period of water release

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- No percolation
- Excellent water saving

#### Traditional Micro Irrigation:



#### Ultra Low Drip Irrigation:



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## B. Efficiency in Irrigation Systems



- Water applies at a low rate over a longer time and with more frequent intervals

### Ultra Low Drip Irrigation



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## B. Efficiency in Irrigation Systems



- Water applies at a low rate over a longer time and with more frequent intervals
- Water is applied at or near the root zone
- Emitters discharge the water from the distribution line to the soil

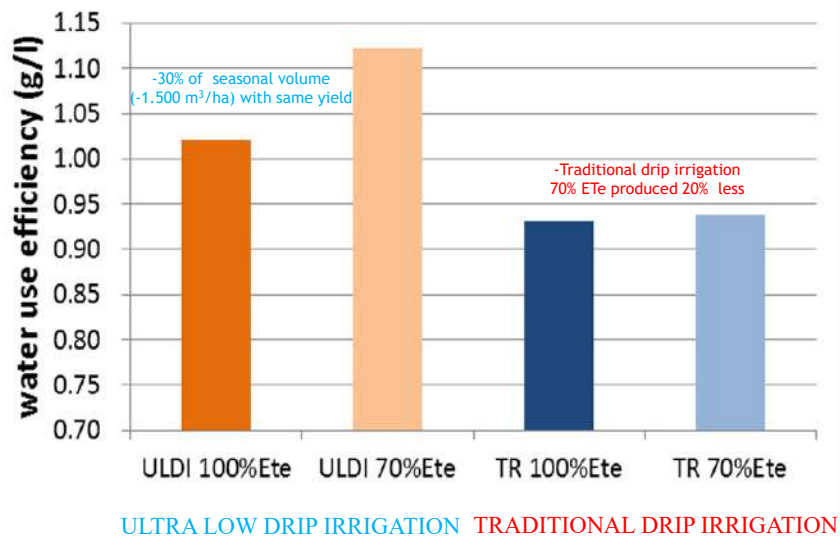
### Ultra Low Drip Irrigation



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## B. Efficiency in Irrigation Systems

### WATER USE EFFICIENCY

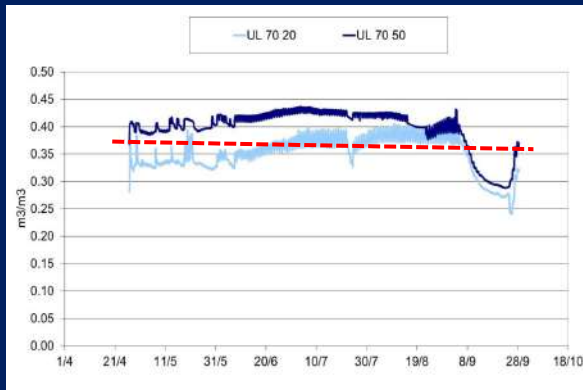


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## B. Efficiency in Irrigation Systems

### SOIL MOISTURE

#### Ultra Low Drip Irrigation



#### Traditional Drip Irrigation



Restitution of **70% Et** according to IRRINET



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## C. Efficiency in Irrigation Scheduling

Irrigation scheduling defines the correct frequency and duration of watering, i.e. when and how much water to apply in the field.

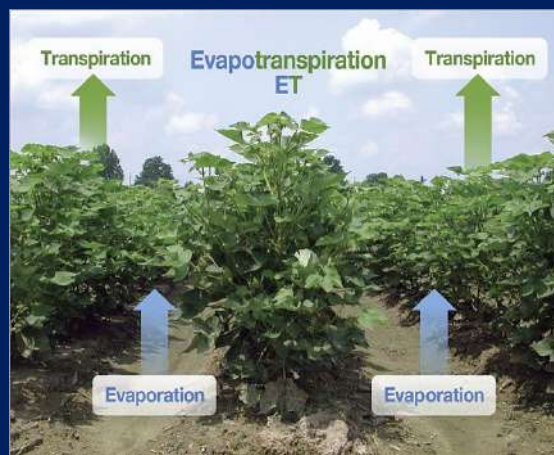


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Its purpose is to maximize irrigation efficiency by applying the exact amount of water needed to replenish the soil moisture lost, due to crop Evapotranspiration and to the evaporative demand of the environment.



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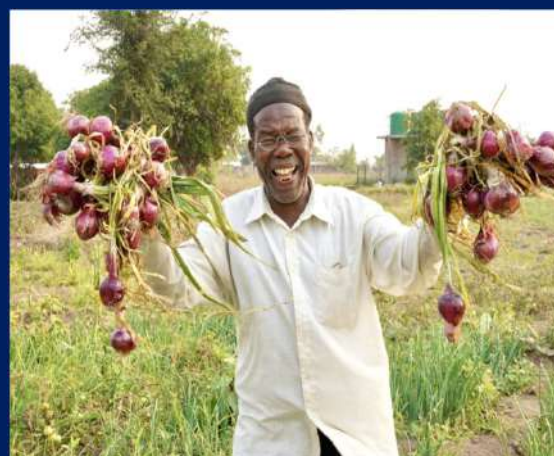
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Proper Irrigation scheduling can save water and energy.

= MORE INCOME



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## C. Efficiency in Irrigation Scheduling

Several “Expert Systems” are available today, providing each farmer information on the following parameters:

- Crop water requirements (volumes of water)



Irrigation  
Volume



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- Real-time information (day-by-day) on how much water is needed and when to irrigate crops (interval and frequency)



Irrigation  
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Irrigation  
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- Economic convenience threshold to irrigate



Irrigation Volume

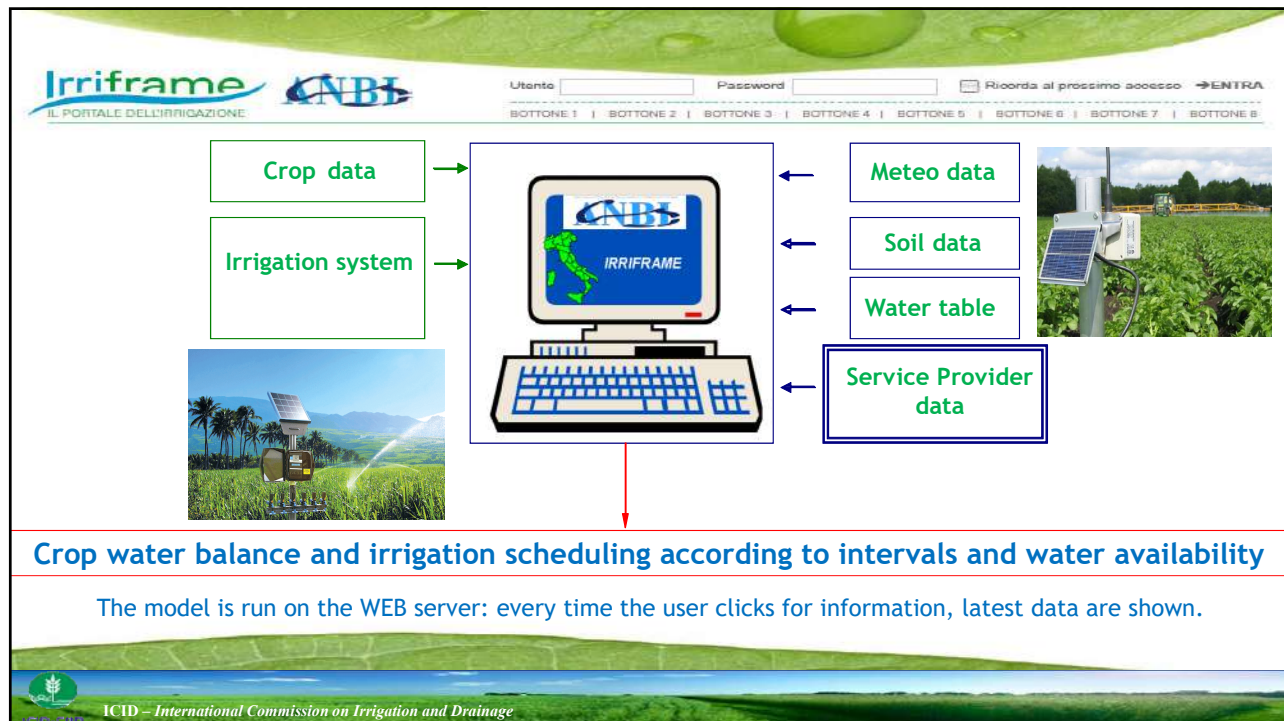
Irrigation Frequency

Economic Convenience

After first log in, inputs are automatically assigned by the system



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**Irriframe** IL PORTALE DELL'IRRIGAZIONE **ANBI**

Utente  Password   Ricorda al prossimo accesso **ENTRA**

BOTTONE 1 | BOTTONE 2 | BOTTONE 3 | BOTTONE 4 | BOTTONE 5 | BOTTONE 6 | BOTTONE 7 | BOTTONE 8

**IRRIFRAME** can be easily accessed by Internet or provided by messages, directly sent to the farmer. Irrigation Service Providers only need to:

- Acquire geo referenced data on irrigated areas
- Provide information on irrigation intervals and conditions.

Internet access to IRRIFRAME server is achievable by entering ANBI website or directly from Irrigation Agency website. The farmer is provided with a password, in order to receive the irrigation advice concerning his farm.

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### C. Efficiency in Irrigation Scheduling

Category	Yield (UVA Q /ha)
Irriframe	~285
Farmer	~252

YIELD: +13%

Category	Irrigation (m)
Irriframe	~115
Farmer	~148

WATER: -27%

Anconelli et al, 2003

**Water Use Efficiency (WUE):**

Farmer: 17 kg/m<sup>3</sup>      **IRRIFRAME: 25 kg/m<sup>3</sup> (+47%)**

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## D. Precision irrigation at Variable Rate

### THE WAY AHEAD PRECISION IRRIGATION AT VARIABLE RATE

Disposing of information regarding different areas of the field in terms of soil texture, moisture and physiological state of the crop, can allow to irrigate in a differently calibrated manner, improving yields and reducing water inputs.

Normally monitoring takes place by means of satellites or drones.



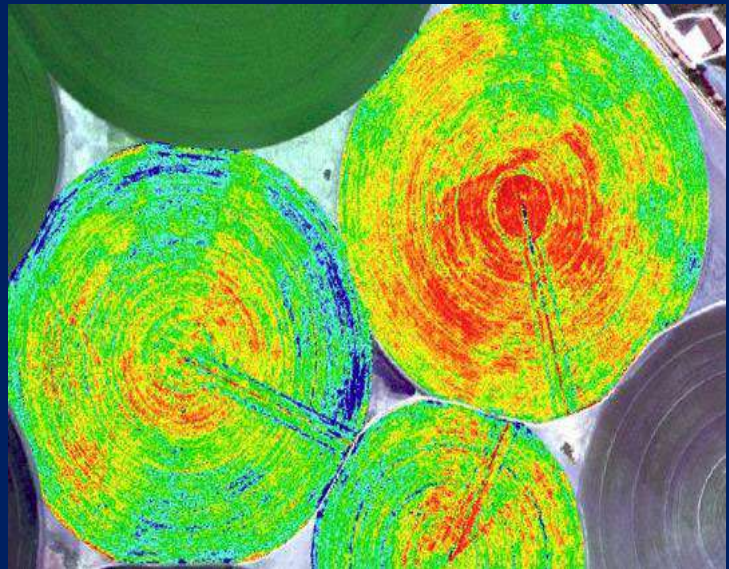
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Sometimes the monitoring is carried out directly on the ground by means of large machines (Pivot and Ranger).



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### THE WAY AHEAD PRECISION IRRIGATION AT VARIABLE RATE

Sometimes the monitoring is carried out directly on the ground by means of large machines (Pivot and Ranger).

These are provided with specific devices and/or technologies enabling control of the sprinklers flow, accordingly with the needs of the cultivated micro-zone.



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## D. Precision irrigation at Variable Rate



### THE WAY AHEAD PRECISION IRRIGATION AT VARIABLE RATE

The CER with the ALADIN project is carrying out experimental trials, in order to verify possible applications of variable-rate irrigation acquiring spatial data obtained using drones.



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## D. Precision irrigation at Variable Rate



### THE WAY AHEAD

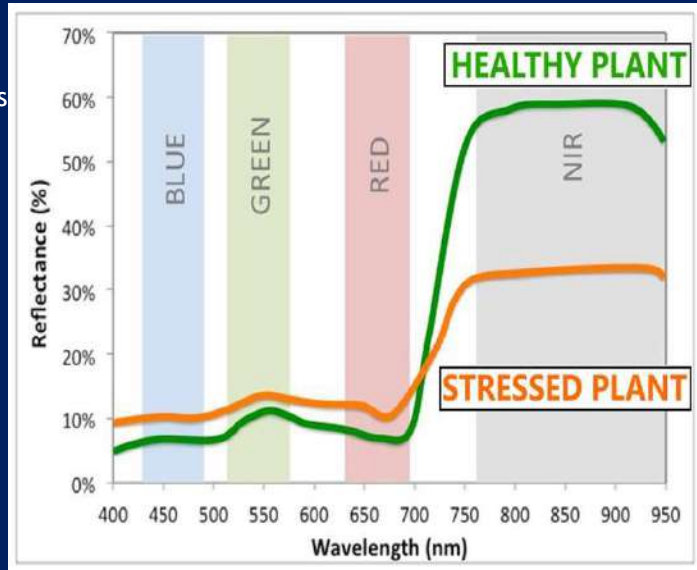
#### PRECISION IRRIGATION AT VARIABLE RATE

The combined survey of multispectral sensors calibrated to determine NDVI (Normalized Difference Vegetation Index) data

**STRESSED PLANTS** reflect less in the visible (RED) and visible RED and infrared light (NIR) the near infrared (NIR)



plus thermal infrared data for CWSI (Crop Water Stress Index) allow very efficient analysis of the different situation existing in the fields.

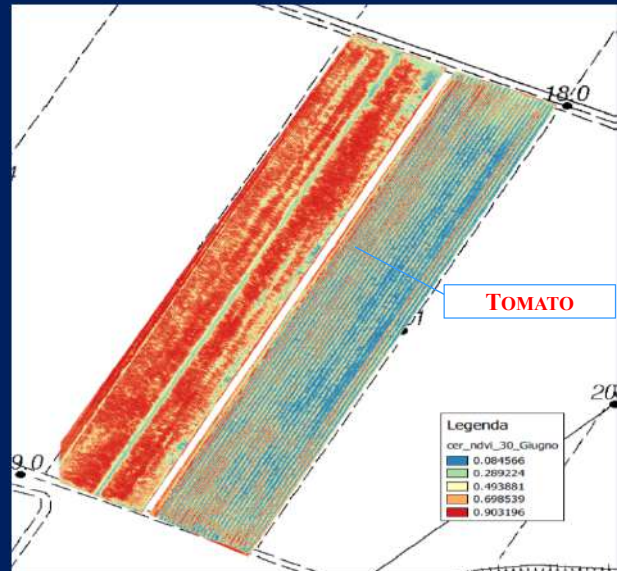


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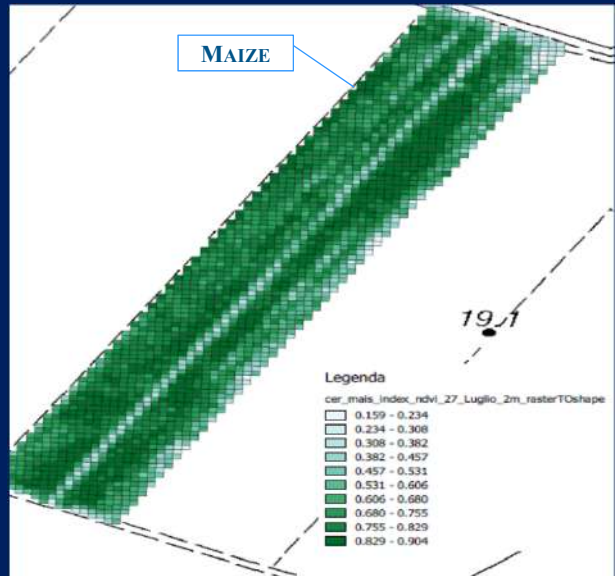
Different irrigation application rate in the same field



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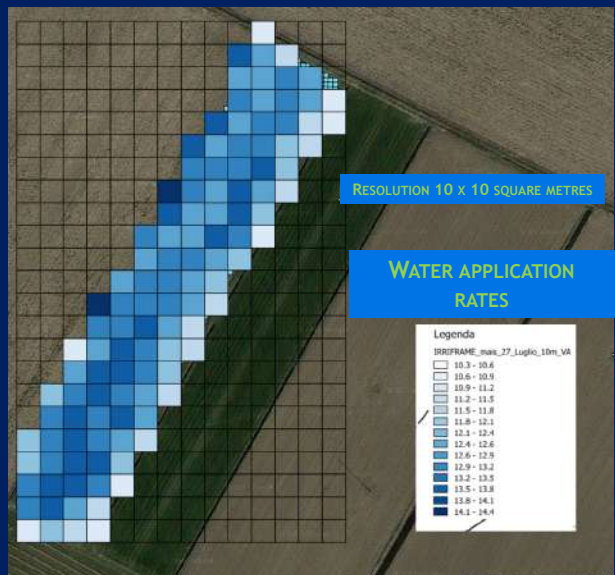
Different irrigation application rate in the same field



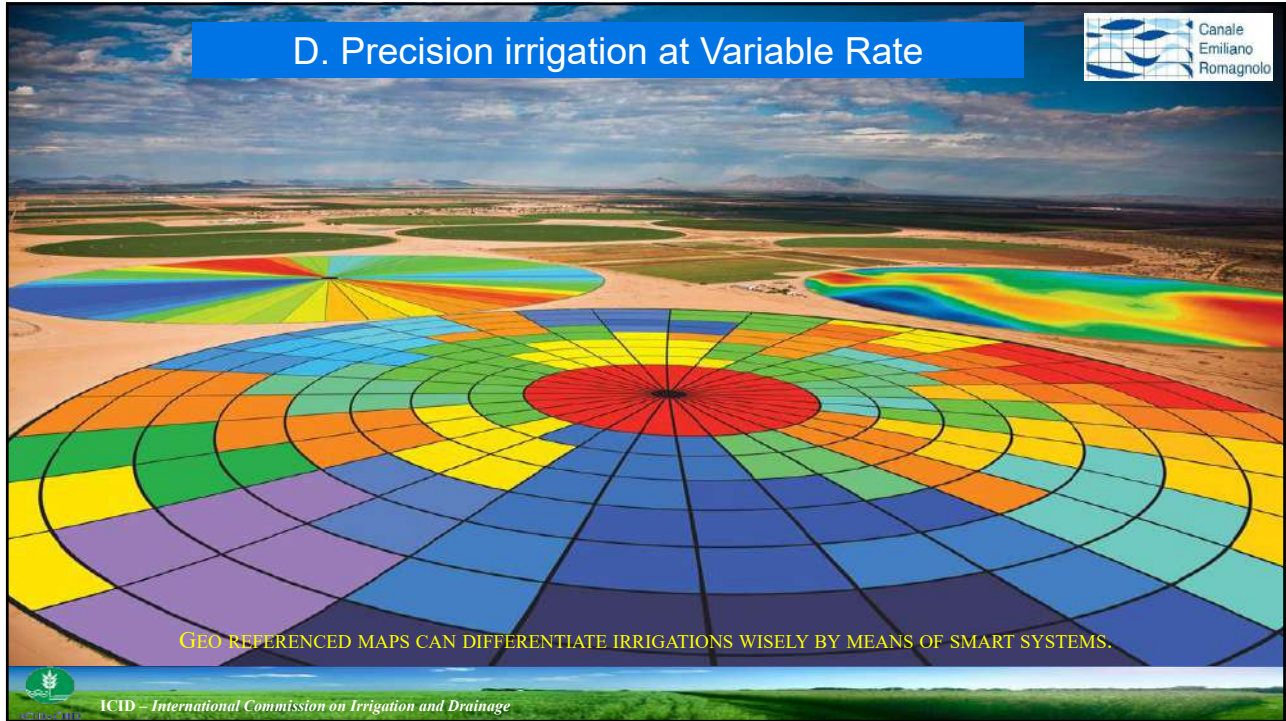
## D. Precision irrigation at Variable Rate

THE WAY AHEAD  
PRECISION IRRIGATION AT VARIABLE RATE

Different irrigation application rate in the same field



D. Precision irrigation at Variable Rate

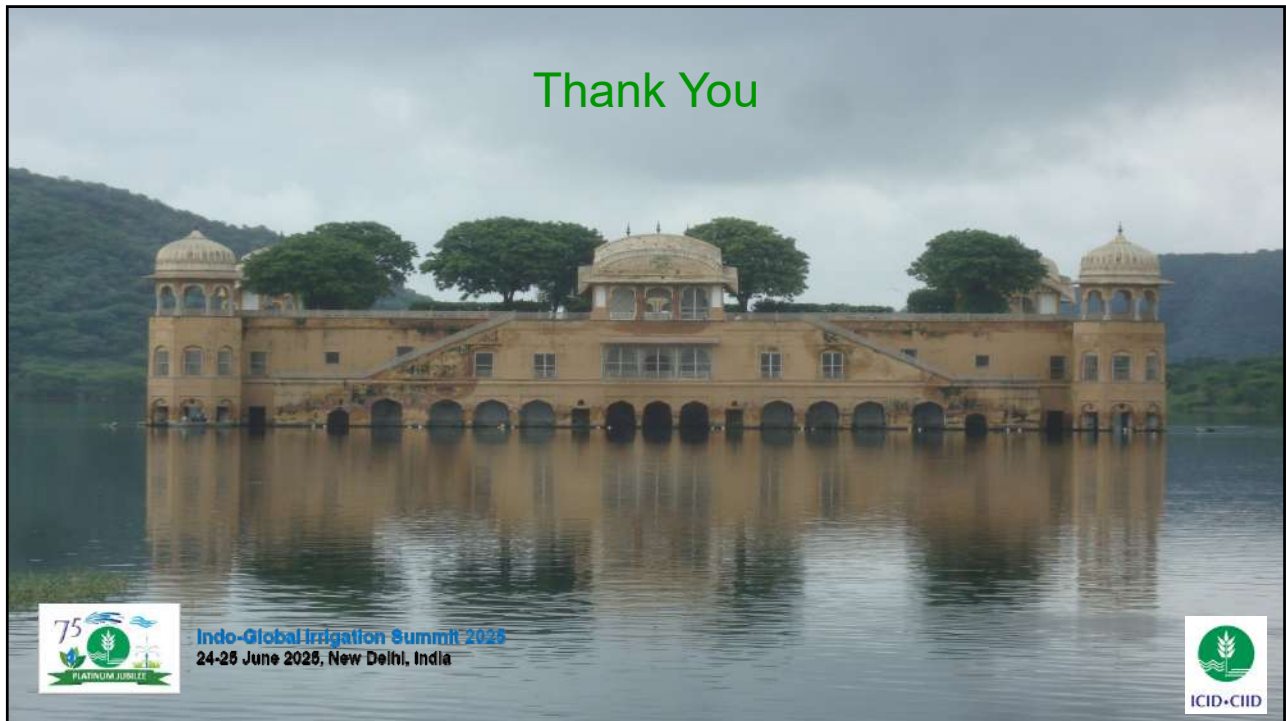


Canale Emiliano Romagnolo

GEO REFERENCED MAPS CAN DIFFERENTIATE IRRIGATIONS WISELY BY MEANS OF SMART SYSTEMS.

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Thank You



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