

INTEL-IRRIS

Intelligent Irrigation System for Low-cost Autonomous Water Control
in Small-scale Agriculture



Intelligent Irrigation System for Low-cost Autonomous Water Control in Small-scale Agriculture

Système intelligent, autonome et à faible coût pour optimiser l'irrigation dans les petites exploitations agricoles



The INTEL-IRRIS starter-kit targeting smallholder farmers

Prof. Congduc Pham
<http://www.univ-pau.fr/~cpham>



Horizon 2020
European Union funding
for Research & Innovation



Intel-IrriS **RESICOOLINK**
Advanced and disruptive IoT/AI technologies targeting the smallholder community for increased resilience

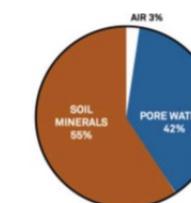
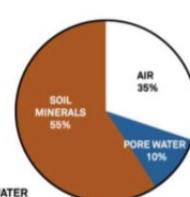
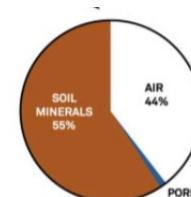
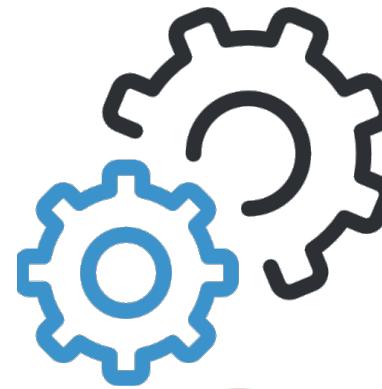
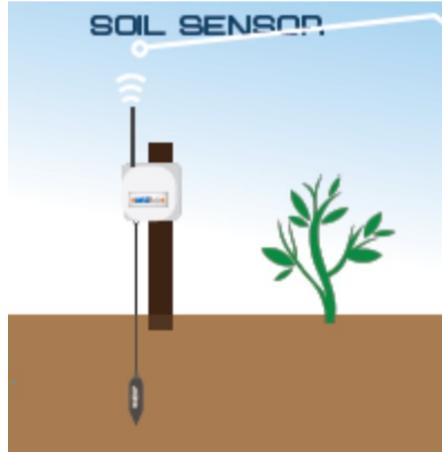
PRIMA S2 2020 INTEL-IRRIS

- Partnership for Research and Innovation in the Mediterranean Area
- R&I approaches to improve water availability and sustainable agriculture distressed by climate change, urbanisation and population growth
- Appel à projet: Section 2 Multitopic 2020
- Thematic Area 1-Water management
 - Low cost, lean solutions for enhancing irrigation efficiency of small-scale farms

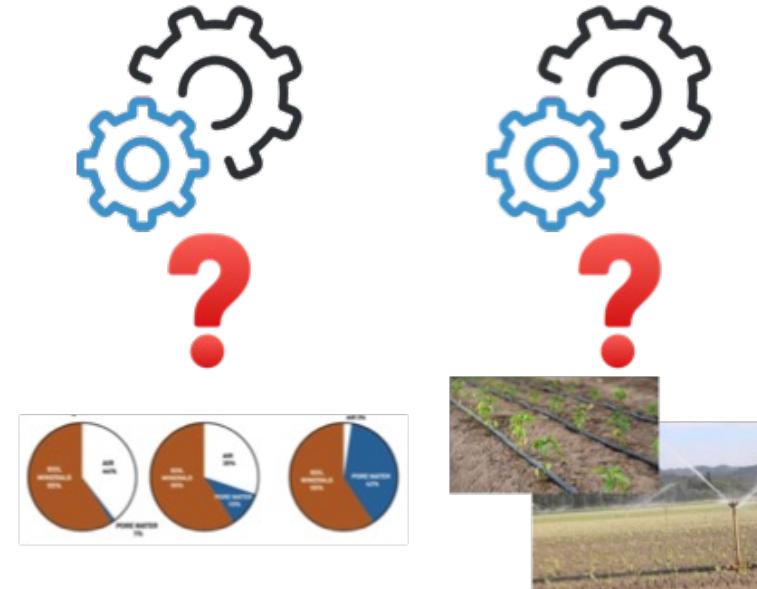
<https://prima-med.org/>



Irrigation with soil moisture sensing



Not as simple as it seems 😞



Volumetric Water Content,
Water Potential, Water
Tension,....

TDR, FDR, capacitance,
resistance,

Soil characteristics: bulk
density, soil salinity, soil
texture & soil type

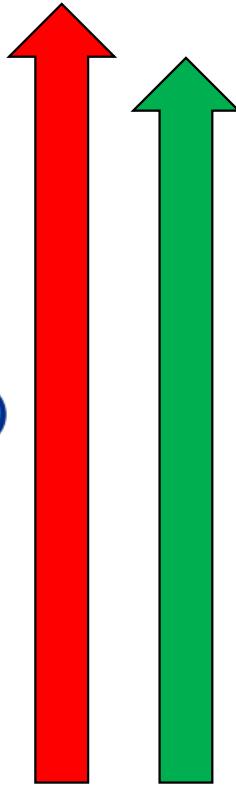
Evapotranspiration, soil-
plant-atmosphere
continuum,....

Irrigation type: drip,
furrow, sprinkler,...

Plant/Crop varieties

Relationship with other
agriculture inputs

It is always a tradeoff...

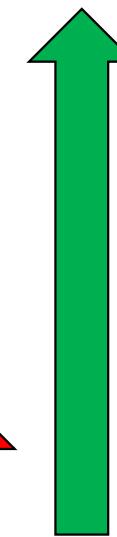
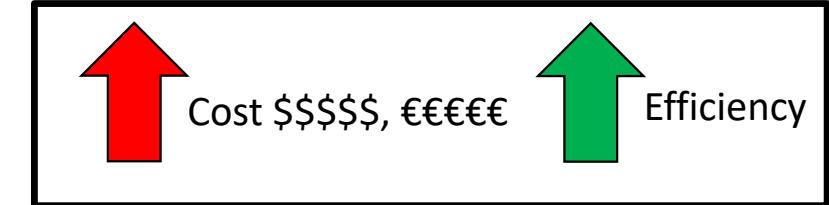


High-end systems,
dedicated hardware,...

Big companies with high
expertise, targeting large-
scale farms



Smallholder
Farmers



Smallholder
Farmers



INTEL-IRRIS starter-kit

- At the beginning: **an idea...**
- "Intelligent Irrigation in-the-box", "plug-&-sense"



INTEL-IRRIS starter-kit

- "Intelligent Irrigation in-the-box", "plug-&-sense"
- From idea to reality!

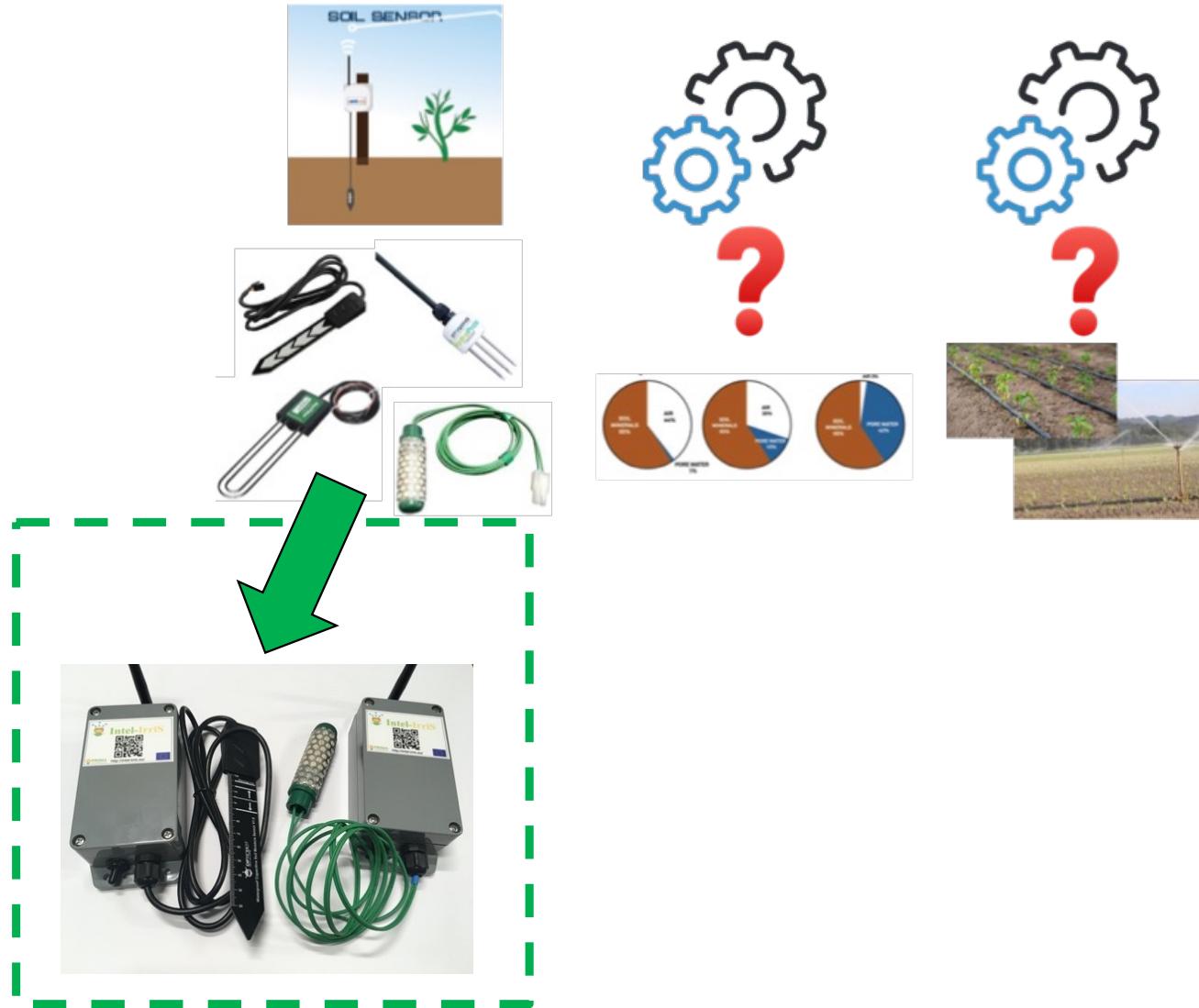


2 versions of the soil device

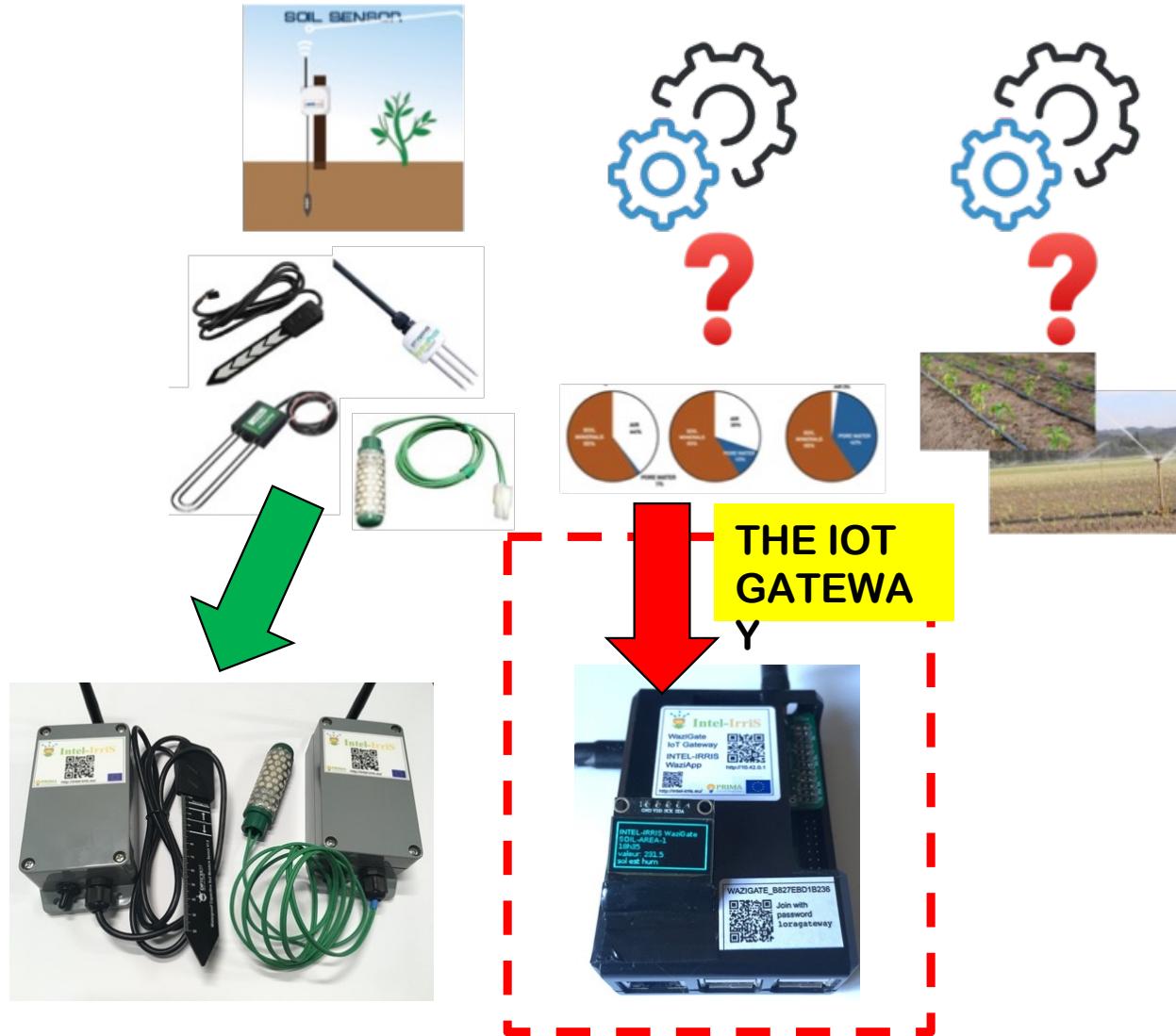


A soil temperature sensor can be added

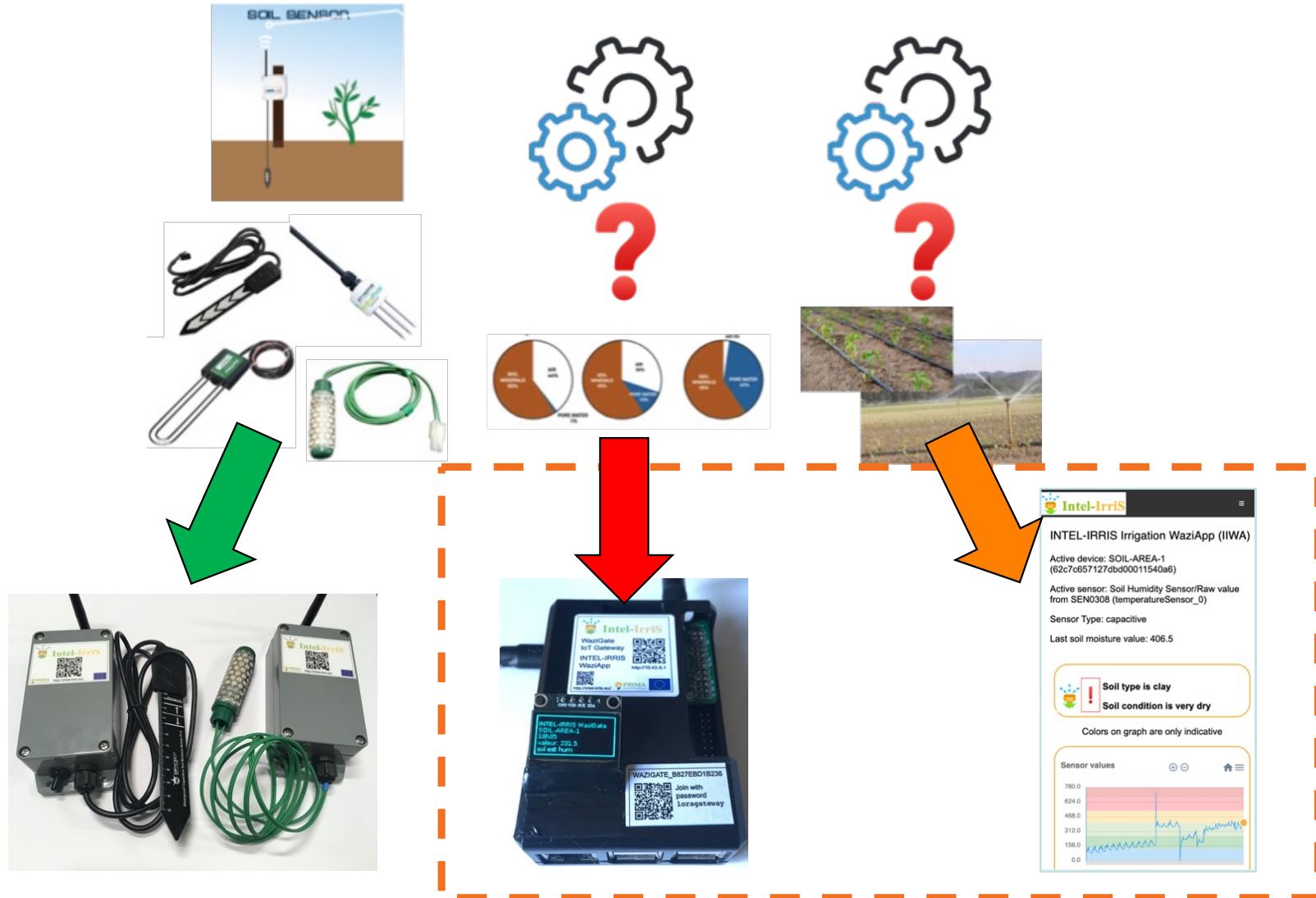
INTEL-IRRIS: sensing node part



INTEL-IRRIS: gateway part



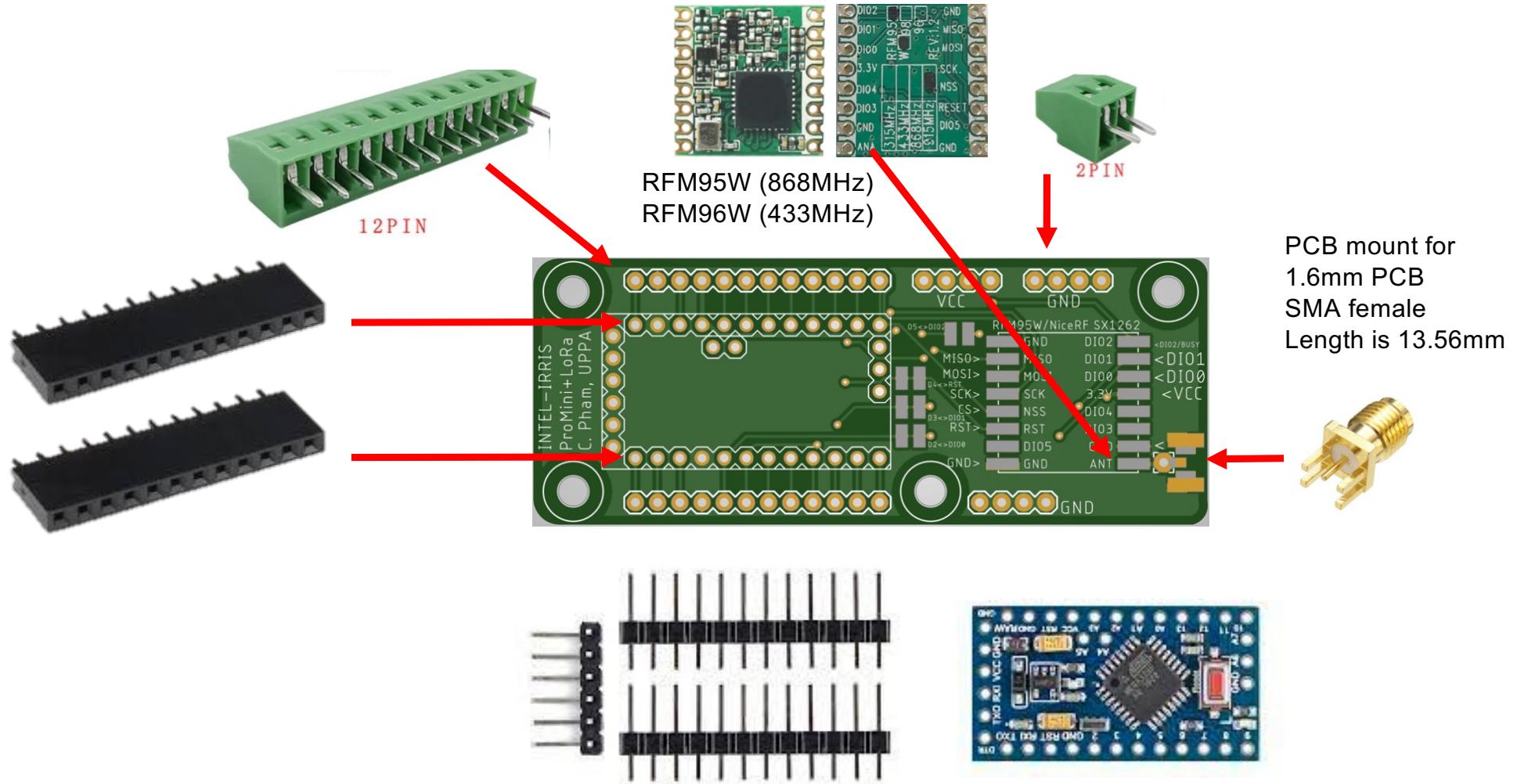
INTEL-IRRIS: add intelligence



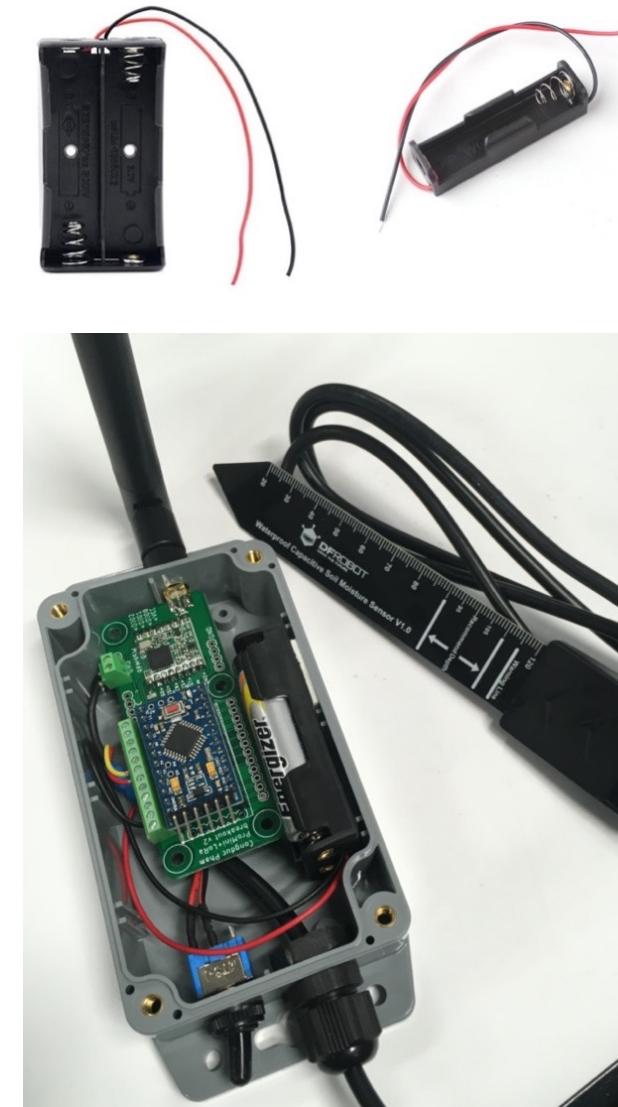
Deployment



Soil sensor: electronic parts

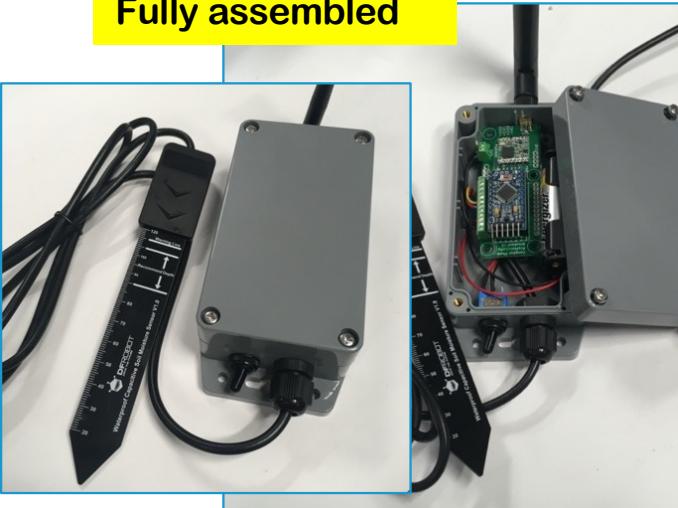


Soil sensor: integration



Soil sensor...in kit!

Fully assembled



Packaging in enclosure



To be assembled

A generic platform

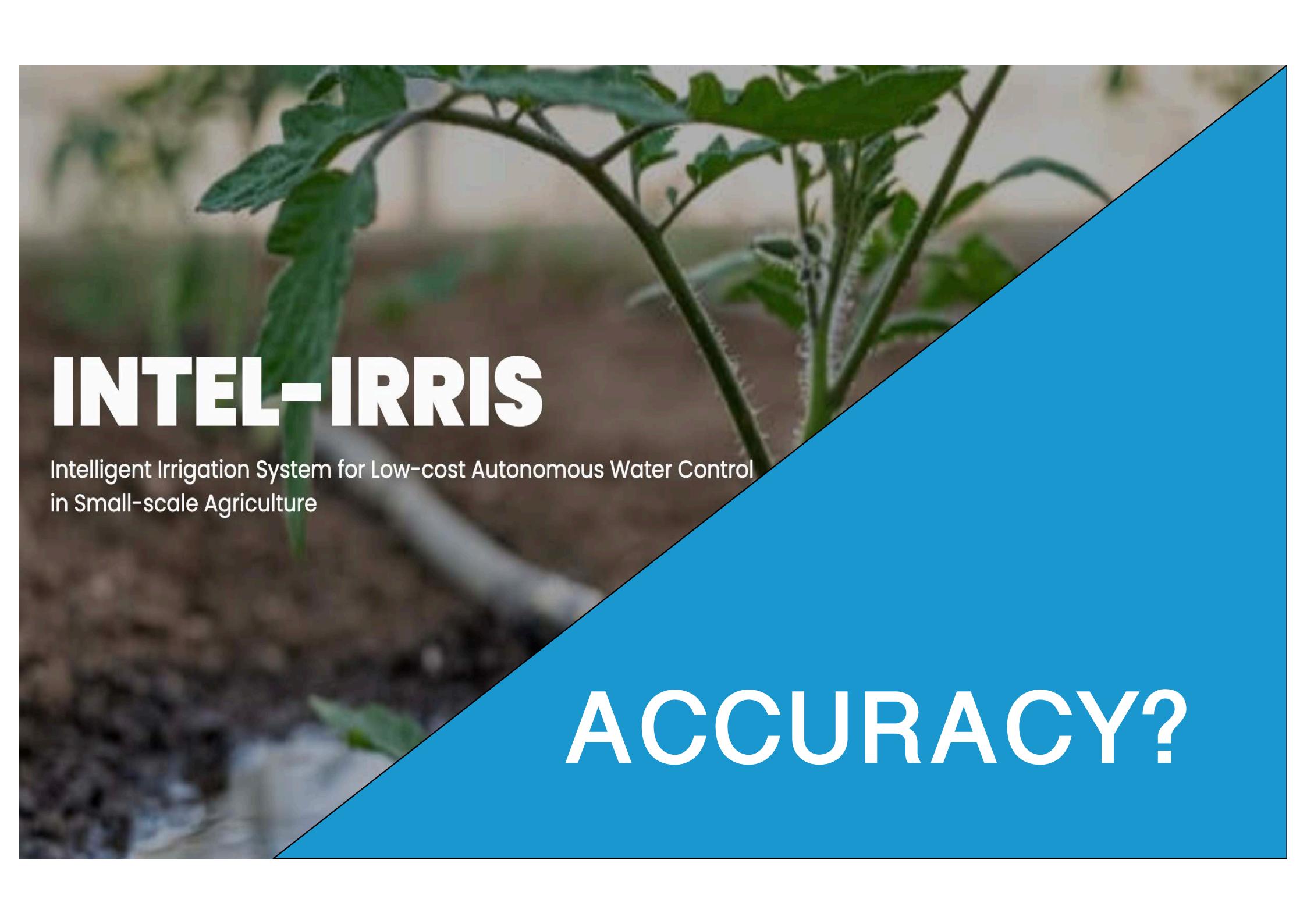
- Low-cost: < 20€
- Off-the-shelves composants
- Easily duplicated
- Assembling by local partners
- Can connect several sensors
- Can be adapted by local partners



Available tutorials

- Instructional videos provide technical information for local partners to build locally the soil sensor devices



A close-up photograph of a young green plant with several leaves and a thin stem, growing out of dark brown soil. The background is slightly blurred.

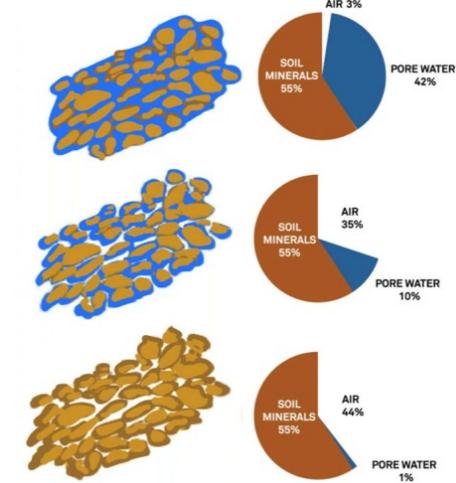
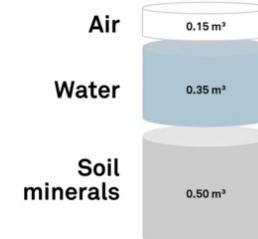
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ACCURACY?

Capacitive sensor

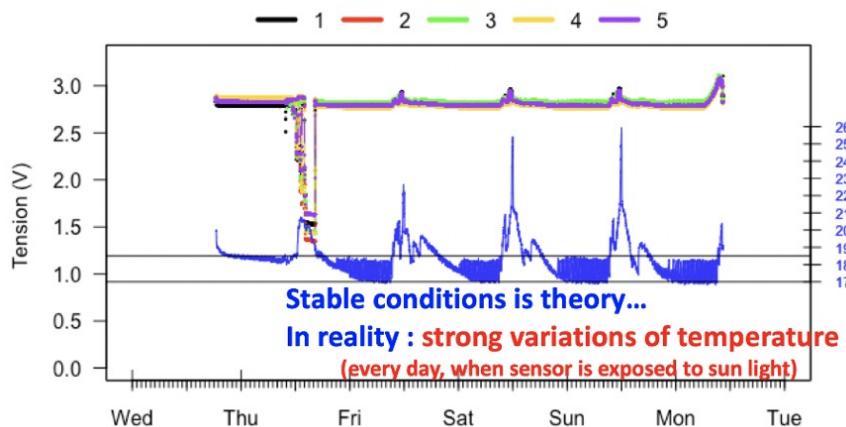
- Capacitive soil moisture sensors usually measure volumetric water content
- Soil density & soil texture are important parameters



From METER group



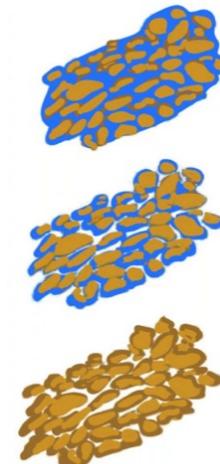
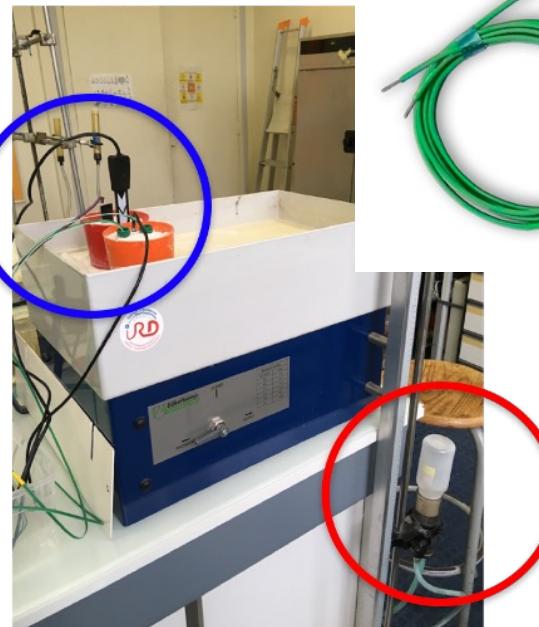
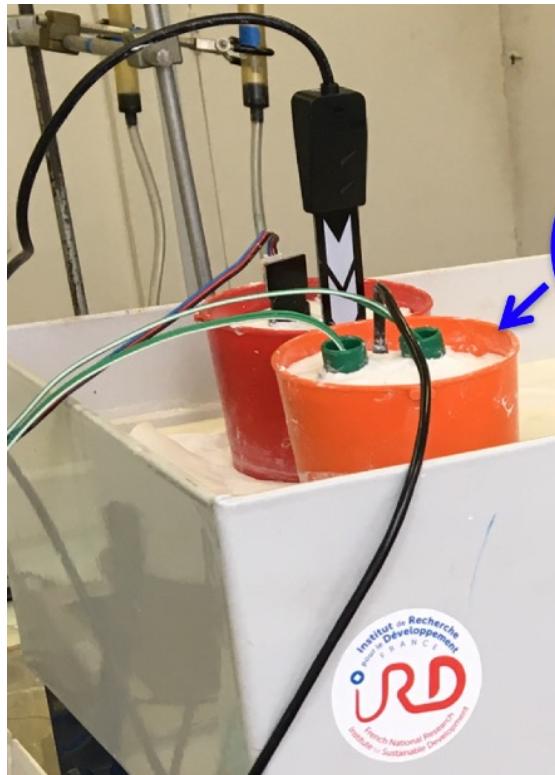
5 sensors are placed in a sand tank at constant water content



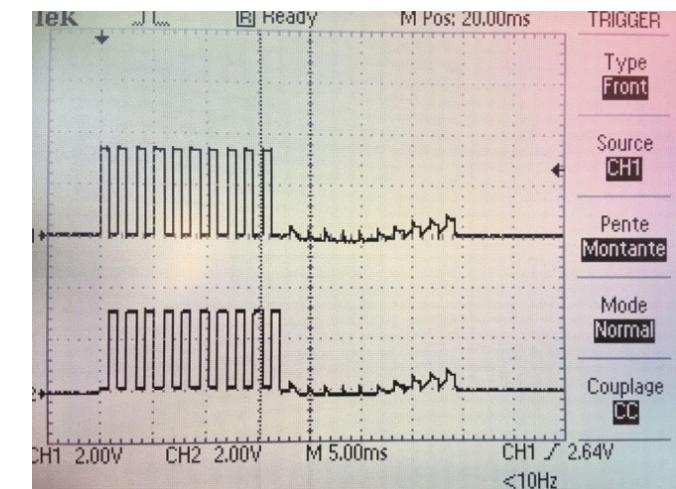
IRD in conducting extentise test on the accucary and the stability of the low-cost SEN0308 capacitive sensor 20

Water tension sensor

- Water tension sensor measures the amount of force required to extract water from soil's pores



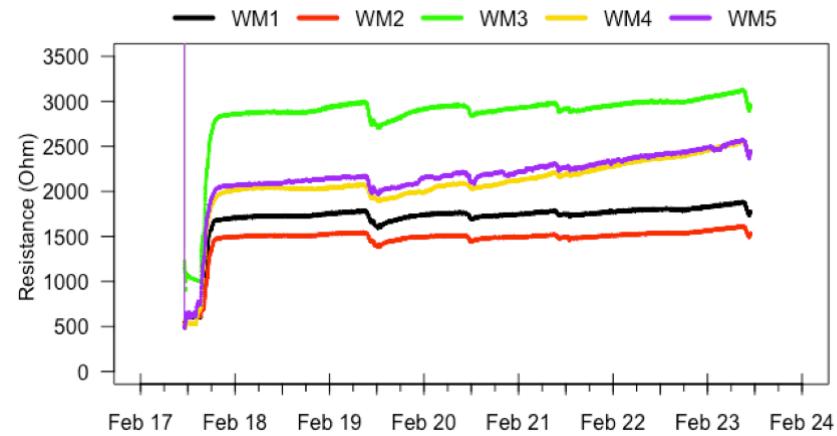
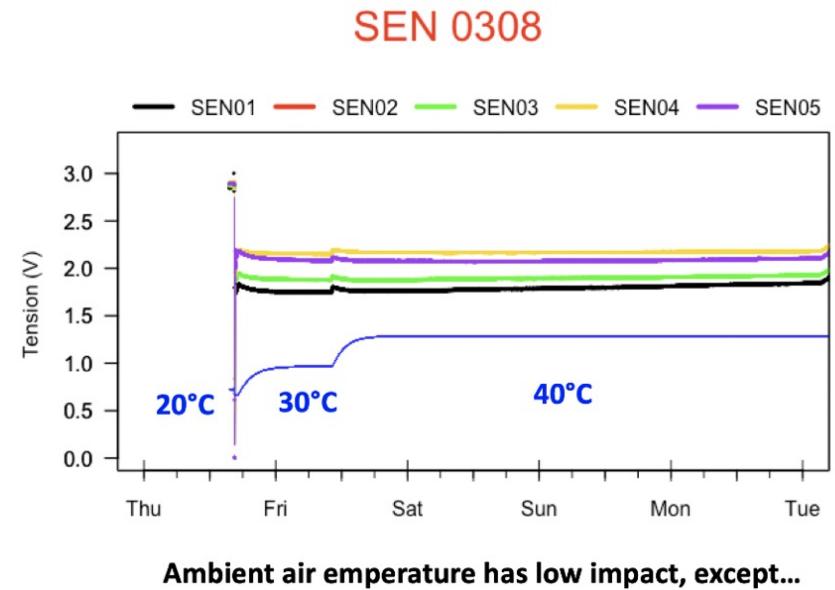
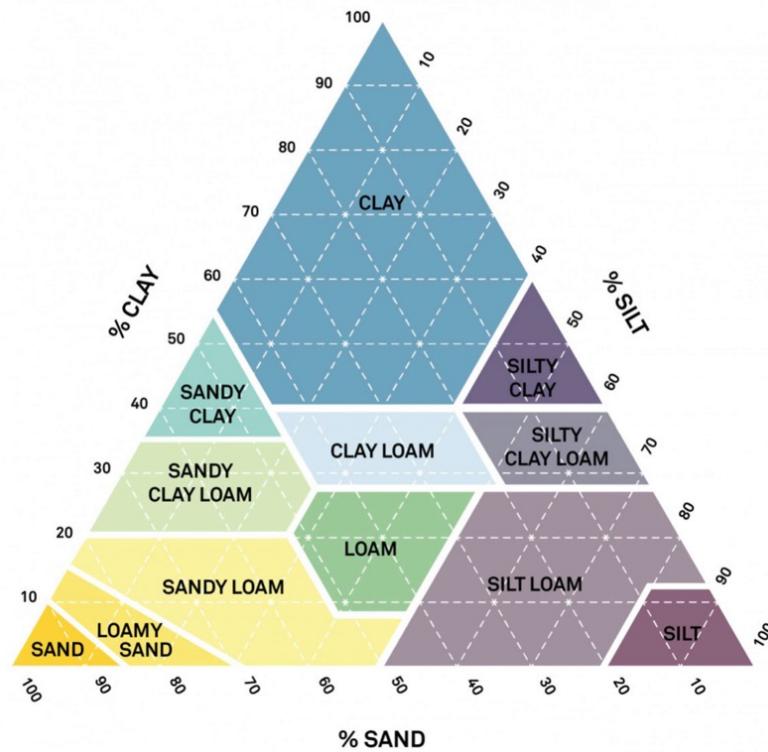
From METER group

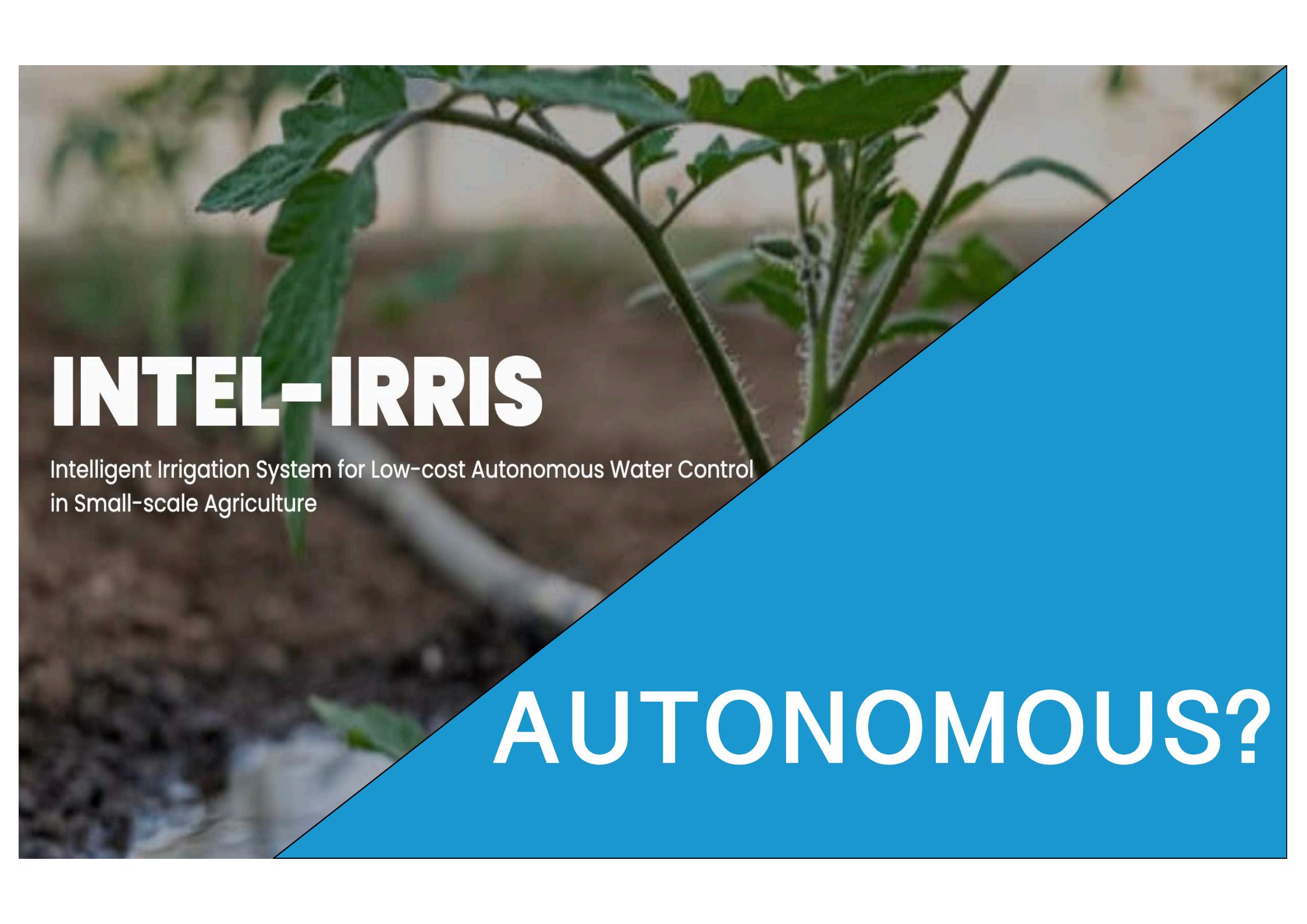


IRD in conducting extensive tests on the stability & suitability of microcontroller-based usage of the Watermark water tension sensor

Calibration

- Soil-specific calibration
- Impact of external "noise"



A close-up photograph of a young green plant with several leaves and a thin stem, growing out of dark brown soil. The background is slightly blurred.

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AUTONOMOUS?

Gateway: collect sensor data

WAZIGATE GATEWAY

FULL EDGE-COMPUTING
 (NO INTERNET)

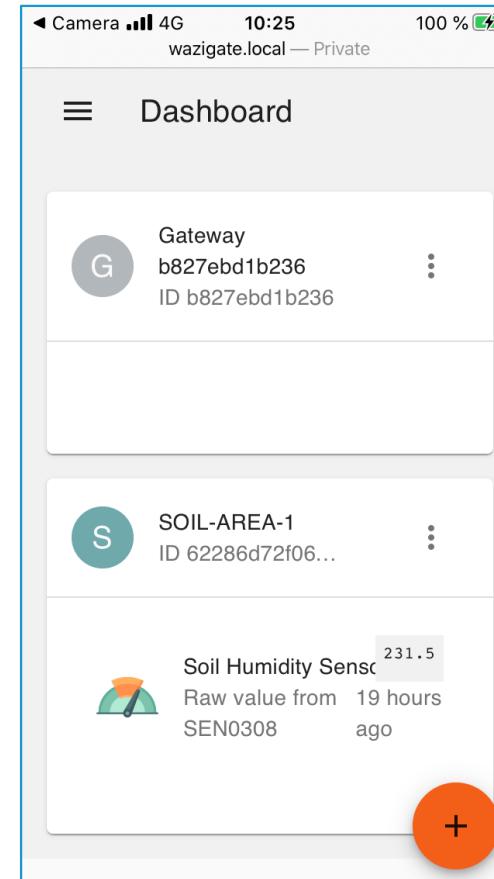
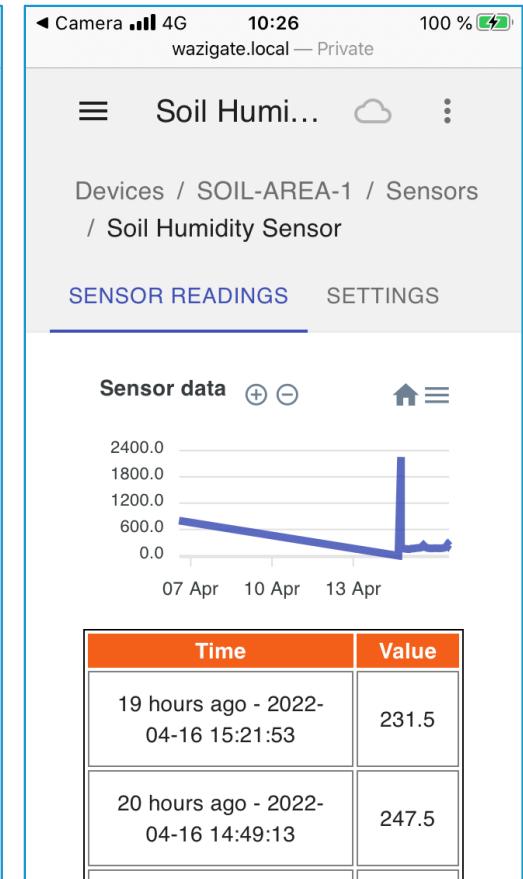
ALL DATA PROCESSING
 CAN BE DONE LOCALLY



1 GATEWAY HANDLES
 SEVERAL DEVICES

< 50€

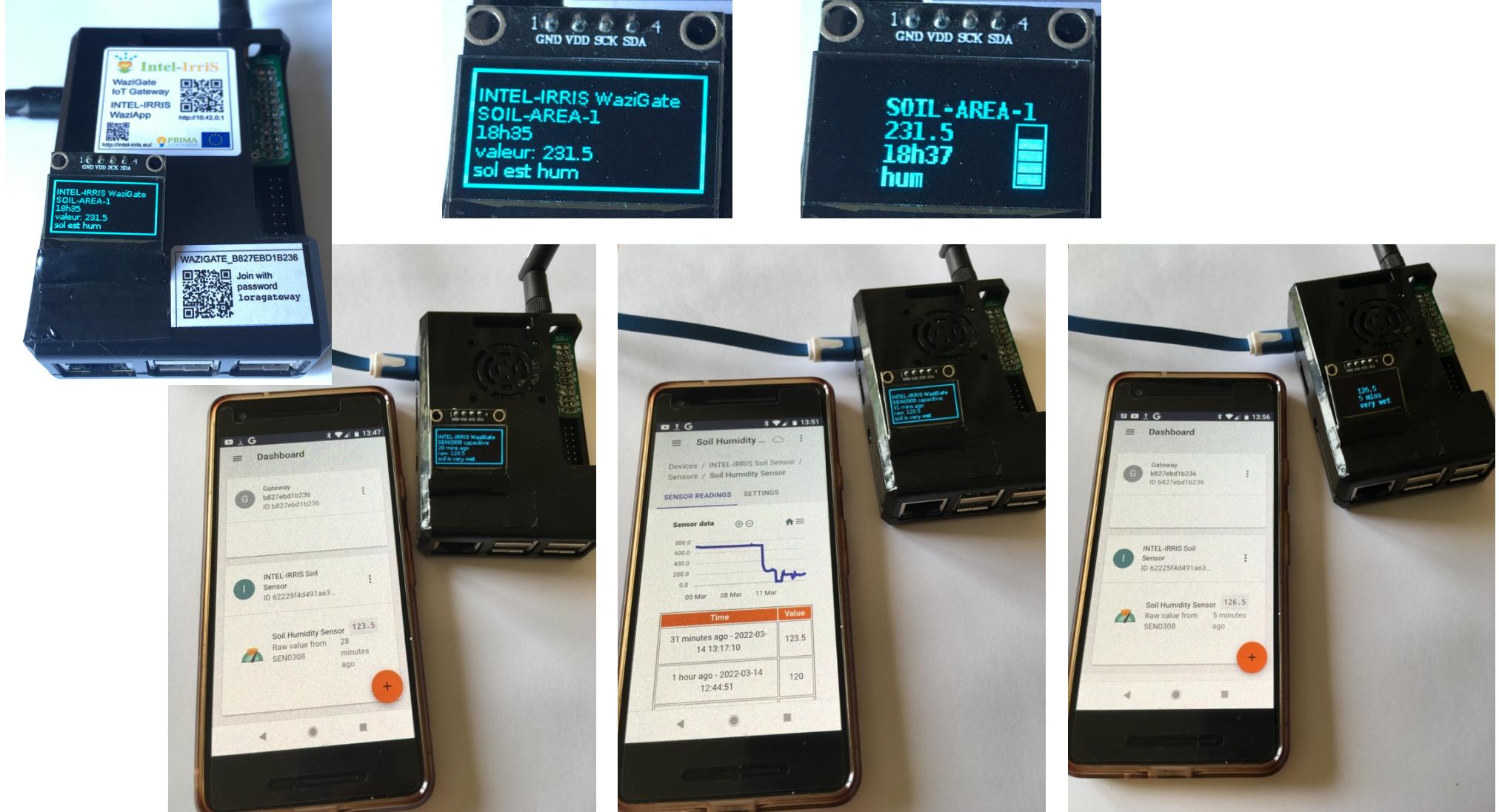
EMBEDDED WEB INTERFACE

Time	Value
19 hours ago - 2022-04-16 15:21:53	231.5
20 hours ago - 2022-04-16 14:49:13	247.5

ACCESSED FROM A SMARTPHONE

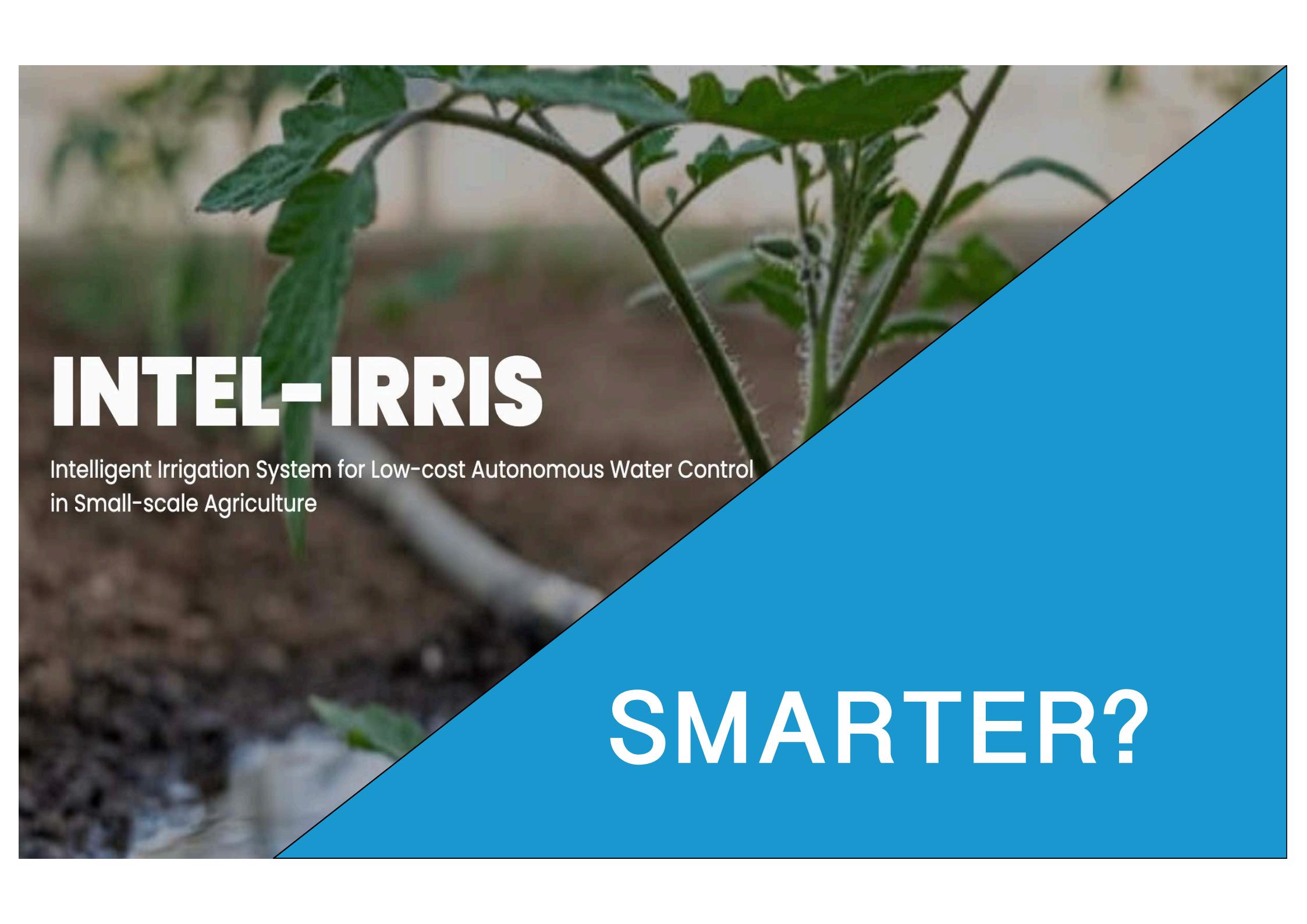
User interfaces



INTEL-IRRIS starter-kit

- "Intelligent Irrigation in-the-box", "plug-&-sense"
- From idea to reality!



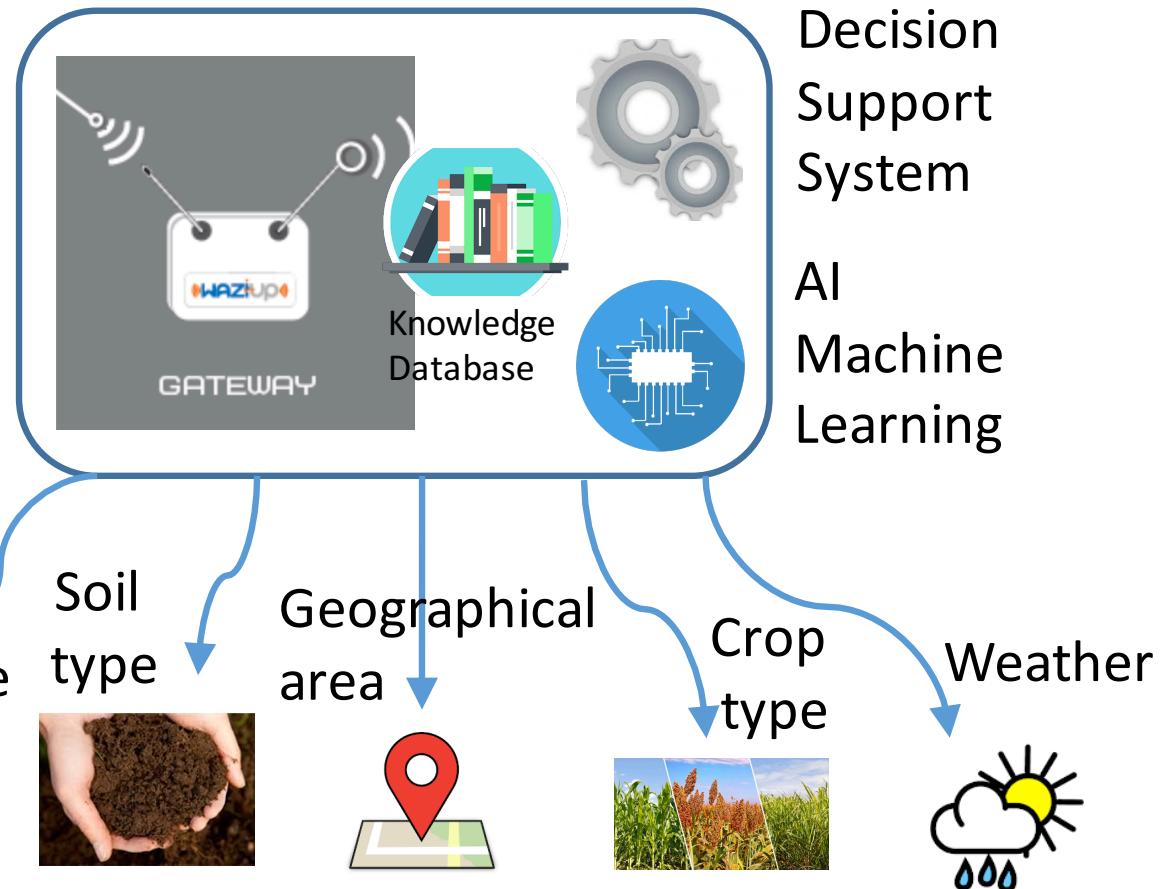
A close-up photograph of a young green plant with several leaves and a thin stem, growing out of dark brown soil. The background is slightly blurred.

INTEL-IRRIS

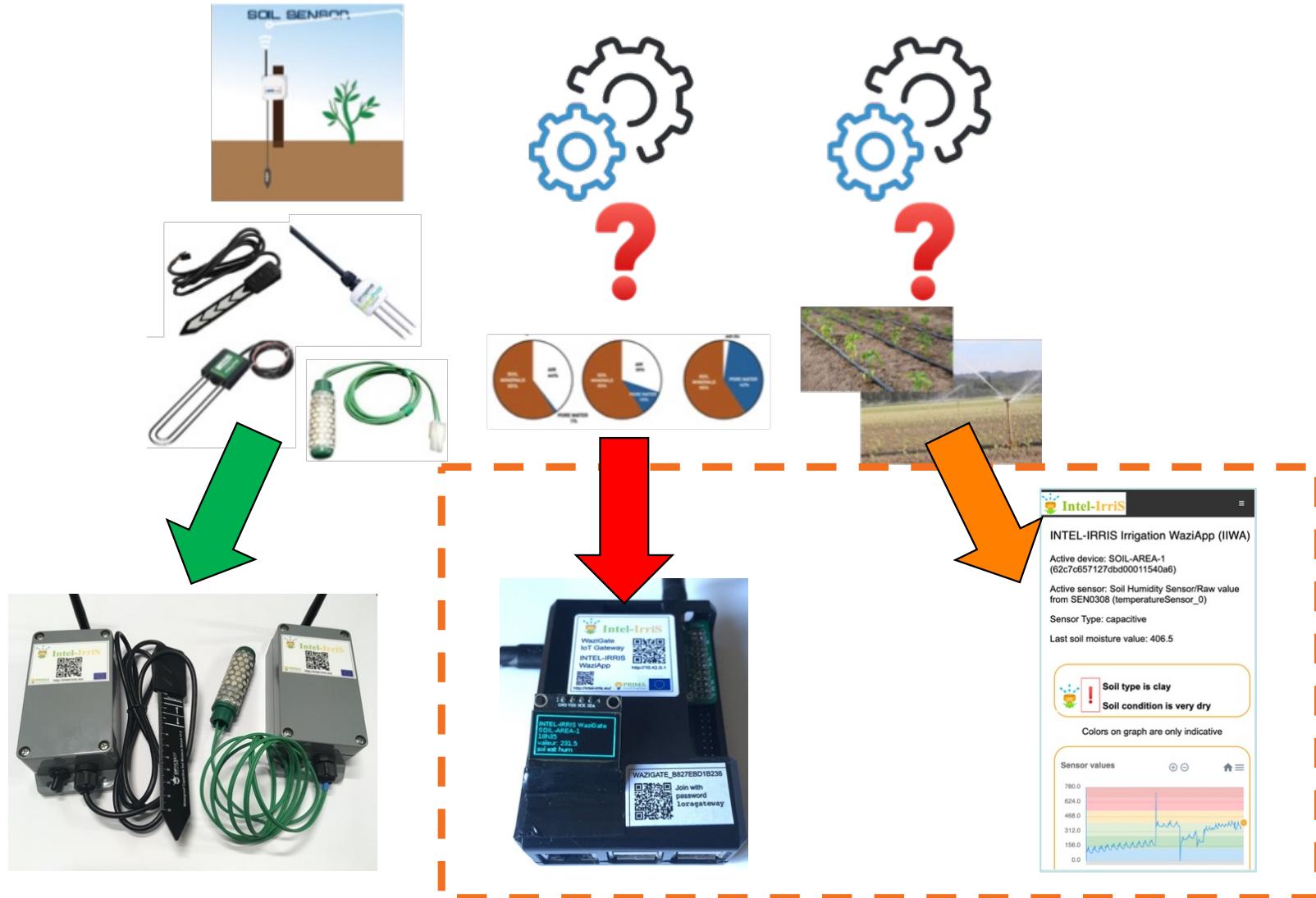
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SMARTER?

Embedded intelligence

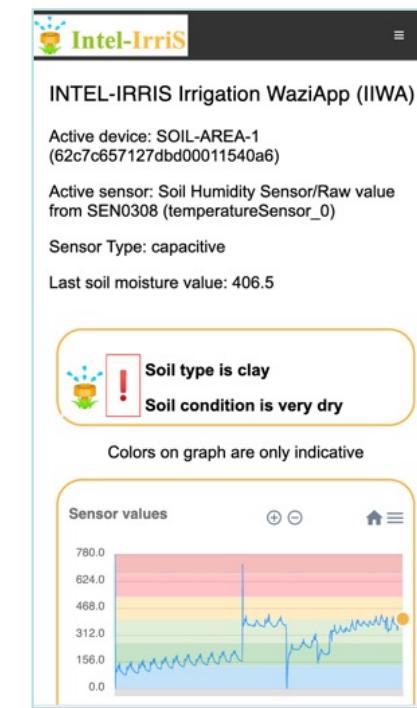


INTEL-IRRIS: add intelligence



INTEL-IRRIS Irrigation WaziApp

- Embedded application running on the INTEL-IRRIS WaziGate
- Included in the starter-kit to implement the "**intelligent Irrigation in-the-box**" & "**plug-&-sense**" approach
- Enhances the irrigation indication by applying sensor calibration models with soil/plant/weather parameters



IIWA main screens

○ Dashboard, Device Manager and Sensor Configuration

Dashboard →
 Device Manager →
 Sensor Configuration →

Intel-Irris

Menu

INTEL-IRRIS Irrigation WaziApp (IIWA)

Active device: SOIL-AREA-1 (6314f8f4127dbd00018b0f01)

Active sensor: Soil Humidity Sensor/Raw value from SEN0308 (temperatureSensor_0)

Sensor Type: undefined

Last soil moisture value: 398.5

Soil type is undefined
Soil condition is undefined

Colors on graph are only indicative

IIWA Device Manager

List of devices added to IIWA.

DEVICE ID	DEVICE NAME	SENSORS
Devices added to IIWA		

Active device determines sensors values visualization and data source for humidity index value computation.

Select an active device and sensor

Active device: **none**. Select from list

Select

Active sensor: **none**. Select from list for Dashboard & humidity index value computation

IIWA Sensor Configuration

No sensor configuration has been made!

Active Device: SOIL-AREA-1 (6314f8f4127dbd00018b0f01)

Active Sensor: Soil Humidity Sensor/Raw value from SEN0308 (temperatureSensor_0)

Settings for sensor configuration

Select a sensor to view its current configuration and update its parameters

Soil Humidity Sensor/Raw value from SEN0308 (temperatureSensor_0)

Update configurations

Sensor Type is the only mandatory parameter to be filled, other parameters can be left undefined

Example

Intel-Irris

INTEL-IRRIS Irrigation WaziApp (IIWA)

Active device: SOIL-AREA-1
(6314f8f4127dbd00018b0f01)

Active sensor: Soil Humidity Sensor/Raw value from SEN0308 (temperatureSensor_0)

Sensor Type: capacitive

Last soil moisture value: 415

 **Soil type is undefined**

 **Soil condition is dry-wet**

Colors on graph are only indicative

Sensor values  



parameters

Soil parameters

Soil Type

- ✓ Undefined
- Clay**
- Sandy
- Silty
- Peaty
- Chalky
- Loamy

Soil Salinity

disabled

Soil Bulk Density

disabled

Soil temperature

Intel-Irris

INTEL-IRRIS Irrigation WaziApp (IIWA)

Active device: SOIL-AREA-1
(6314f8f4127dbd00018b0f01)

Active sensor: Soil Humidity Sensor/Raw value from SEN0308 (temperatureSensor_0)

Sensor Type: capacitive

Last soil moisture value: 415

 **Soil type is clay**

 **Soil condition is very dry**

Colors on graph are only indicative

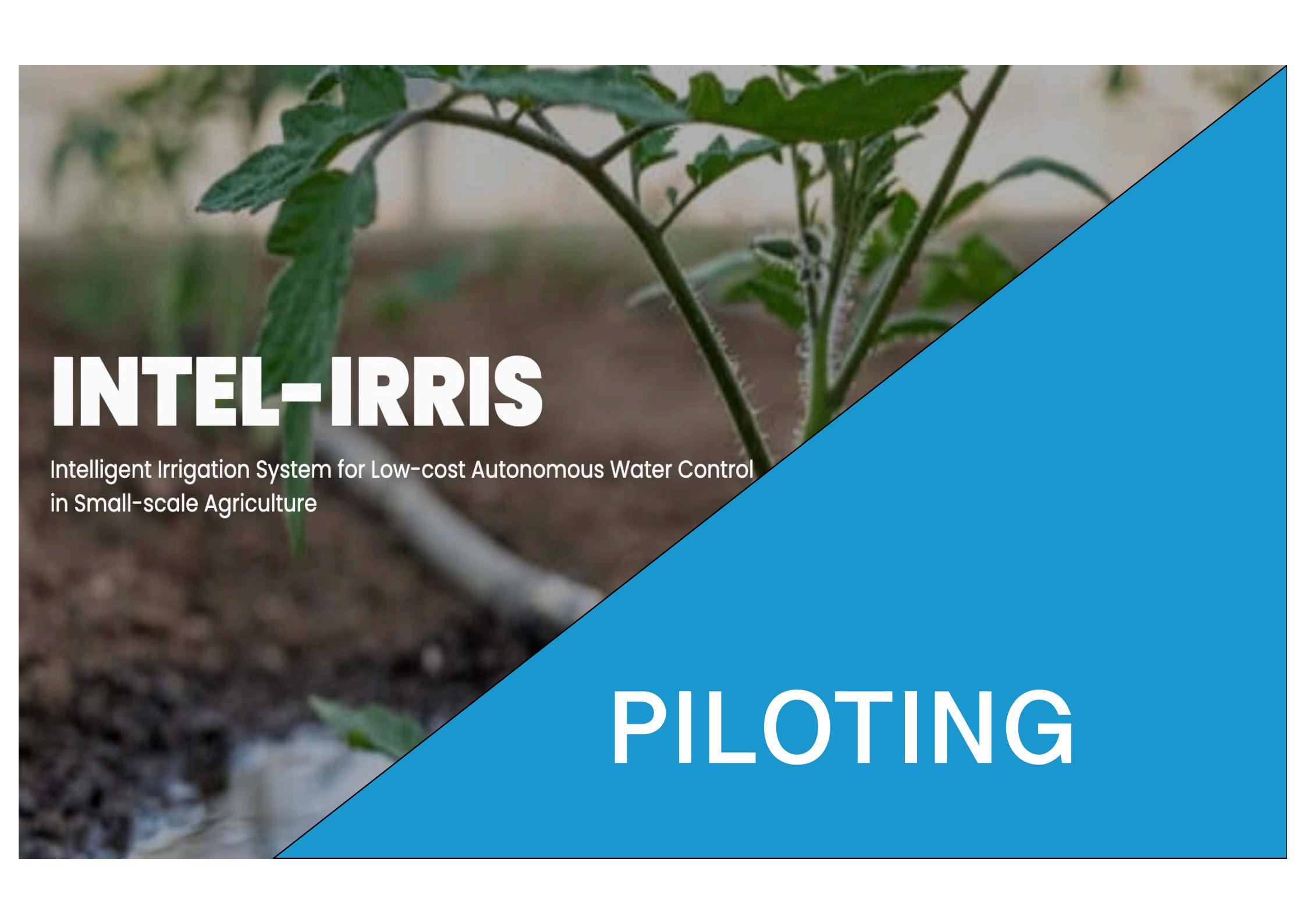
Sensor values  



List of advanced parameters

<p>Sensor parameters</p> <p>temperatureSensor_0</p> <p>Sensor Type</p> <ul style="list-style-type: none"> <input checked="" type="radio"/> Capacitive <input type="radio"/> Tensiometer (cbar) <input type="radio"/> Tensiometer (raw) <p>Sensor age</p> <input type="text" value="0"/> <p>Min value</p> <input type="text" value="0"/> <p>Max value</p> <input type="text" value="800"/>	<p>Soil parameters</p> <p>Soil Type</p> <input type="text" value="Clay"/> <p>Soil Irrigation Type</p> <ul style="list-style-type: none"> <input checked="" type="radio"/> Undefined <input type="radio"/> Furrow <input type="radio"/> Sprinkler <input type="radio"/> Drip <p>Soil Salinity</p> <input type="text" value="disabled"/> <p>Soil Bulk Density</p> <input type="text" value="disabled"/>	<p>Soil temperature</p> <p>Please select a source for soil temperature data</p> <ul style="list-style-type: none"> <input type="radio"/> user input <input type="radio"/> real sensor <p>enter temperature</p> <p>Enter device id</p> <input type="text" value="enter device id"/> <p>Enter sensor id</p> <input type="text" value="enter sensor id"/>	<p>Plant parameters</p> <p>Plant/Crop</p> <input type="text" value="Undefined"/> <p>Plant Sub-Type</p> <input type="text" value="Undefined"/> <p>Planting Date</p> <input type="text" value="jj/mm/aaaa"/> <hr/> <p>Weather parameters</p> <p>Region</p> <input type="text" value="Undefined"/> <hr/> <p>Update</p>
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More parameters will be integrated in IIWA during the INTEL-IRRIS project



INTEL-IRRIS

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PILOTING

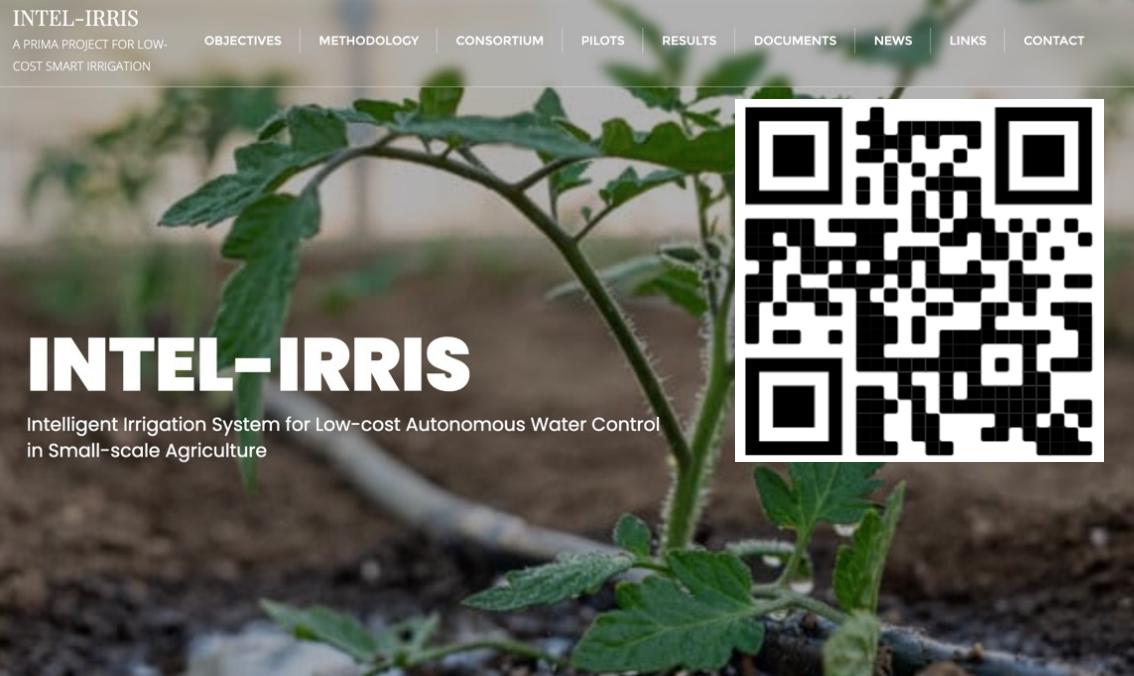
Smallholder Piloting Program

- Participatory approach to co-design & test the innovative solutions in fields
- Take into account region-dependent technical, agricultural, social, climatic and environmental aspects
- Will run for 30 months to ensure that the proposed irrigation systems are well tailored for the specificities of the regional context
- 9 farms already enrolled to participate in the Piloting Program
- Scale-up to involve at least 20 small-scale farms



More information

- Web site: <http://intel-irris.eu>



The screenshot shows the Intel-Irris website homepage. The header includes the PRIMA logo, the project name "INTEL-IRRIS", and a subtitle "A PRIMA PROJECT FOR LOW-COST SMART IRRIGATION". Below the header is a large image of a young tomato plant. Overlaid on the image is the text "INTEL-IRRIS" in large white letters, followed by a subtitle "Intelligent Irrigation System for Low-cost Autonomous Water Control in Small-scale Agriculture". To the right of the image is a large QR code.

Project Partners:

- AUA:** Agricultural University of Athens (Greece)
- ENSA-Safi:** National School of Applied Sciences – Safi (Morocco)
- INRA:** National Institute of Agronomic Research (Morocco)
- IRD:** Institute for Research & Development (France)
- UMAB:** University A. Benbadis (Algeria)
- UORAN1:** University of Oran 1 (Algeria)
- UPPA:** University of Pau & Adour Country (France)
- WAZIUP eV:** WAZIUP association (Germany)

- Twitter: https://twitter.com/Intel_IrriS



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@Intel_IrriS

Demonstration video



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