

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>



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

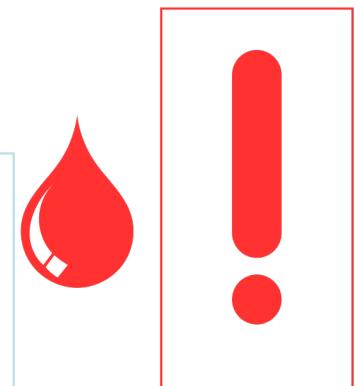
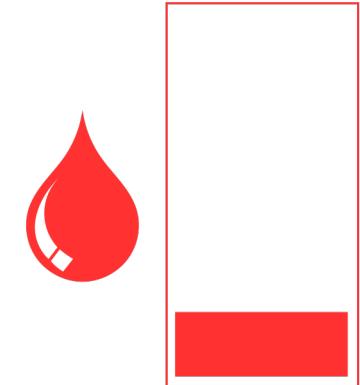
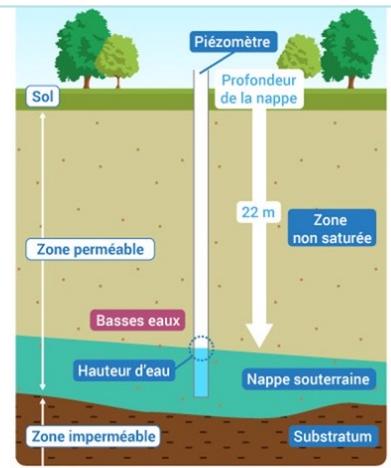
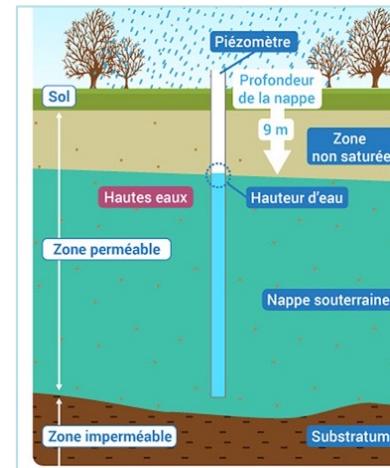
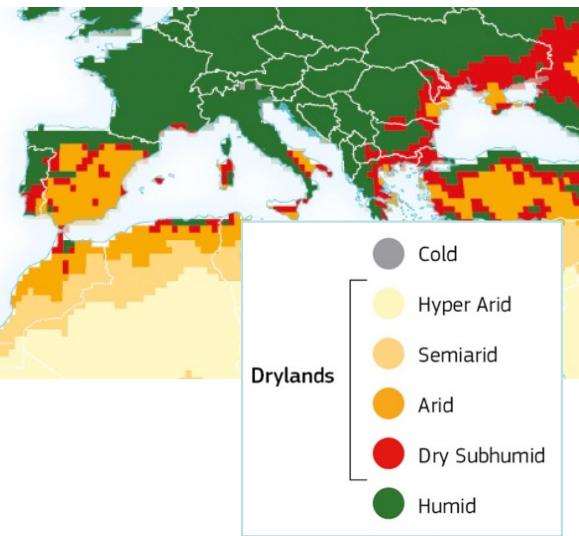
PRIMA S2 2020 INTEL-IRRIS

- 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/>



Water resource is precious!



?

Optimizing irrigation in agriculture

- About 70% of water is used for agriculture activities
- **Digital technologies** can help reducing and optimizing usage of water, **but...**



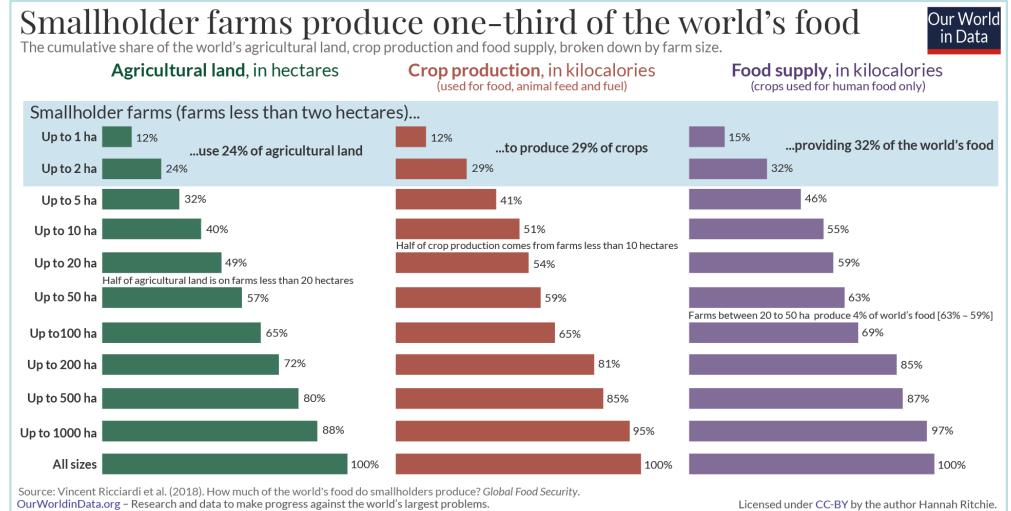
Possible for large farms



Out of reach for smallholders!

Smallholders – up to 2ha

- Most (84%) of the world's 570 million farms are smallholdings
- Provide about 32% of world food supply, on about 24% of agriculture land

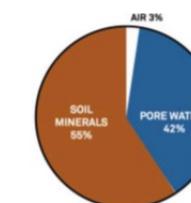
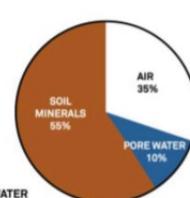
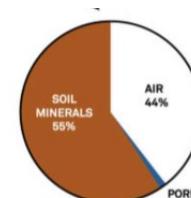
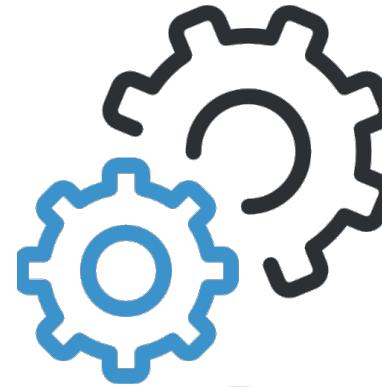
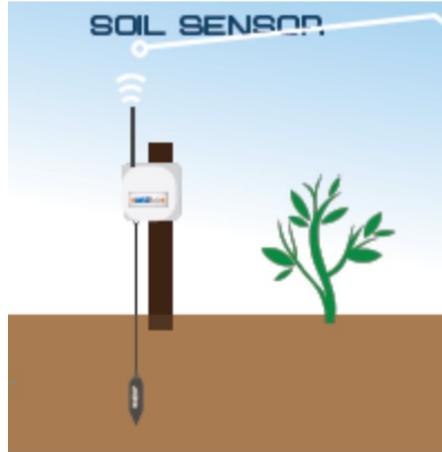


<https://ourworldindata.org/smallholder-food-production>

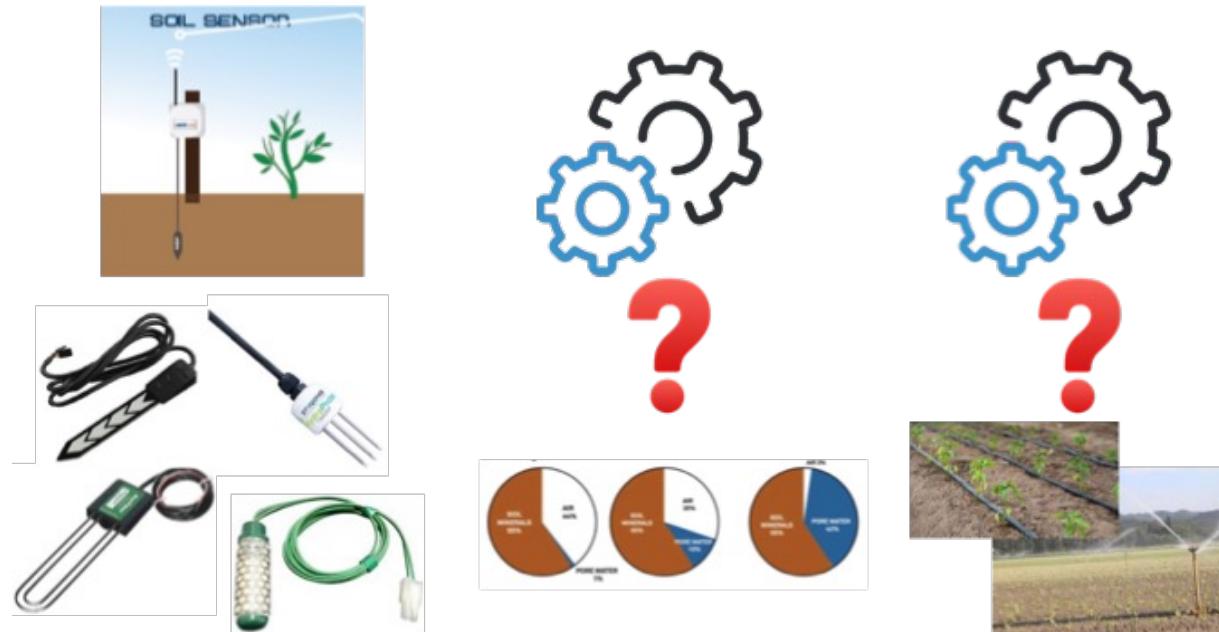


Too expensive
 Too integrated
 Highly specialized
 Difficult to customize
 Difficult to upgrade

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

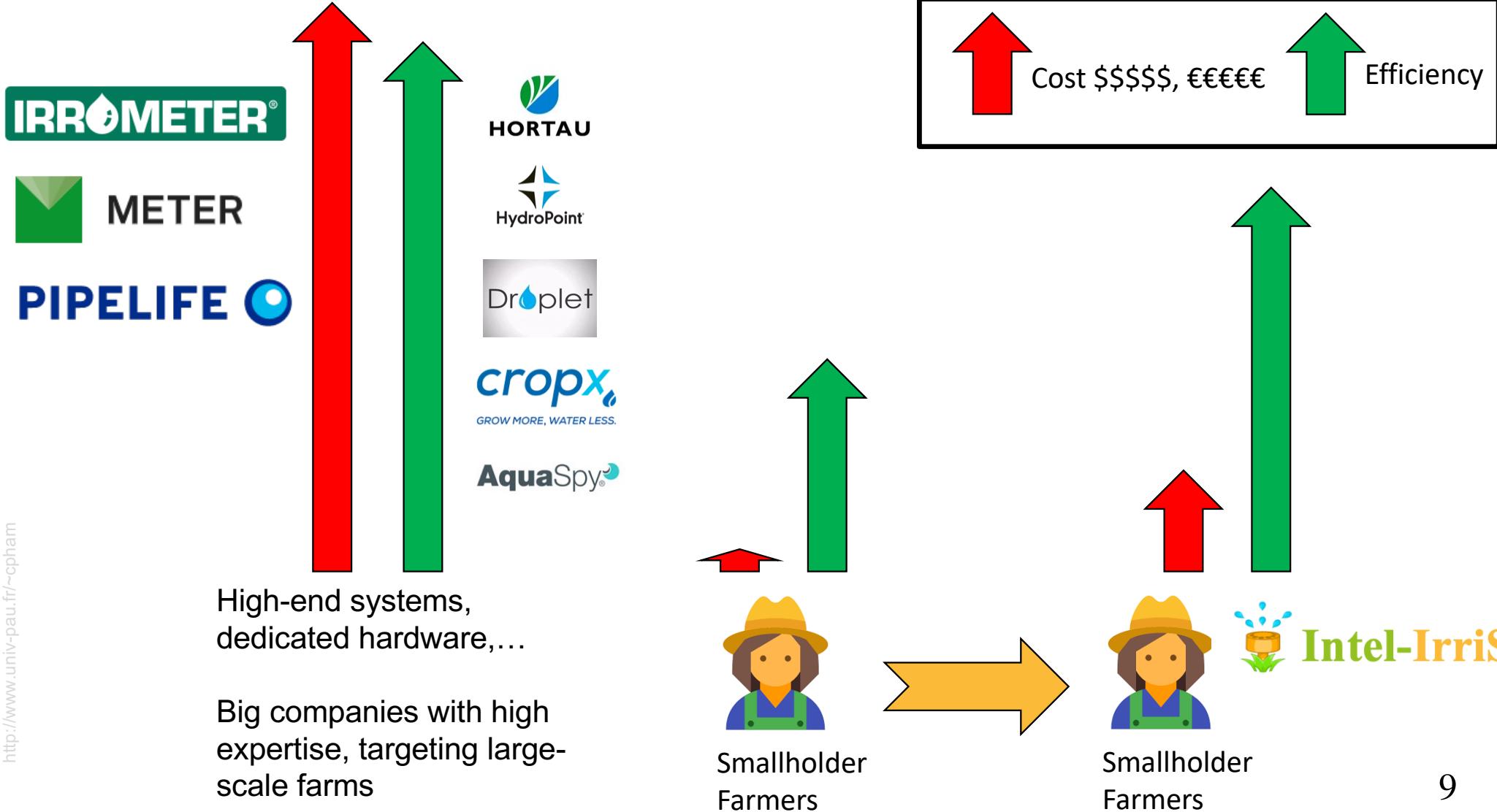
Evapotranspiration, soil-
plant-atmosphere
continuum,....

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

Plant/Crop varieties

Relationship with other
agriculture inputs

It is always a tradeoff...



Not only the cost barrier...



**High acceptability
of technologies,
even complex ones**

4

Improve farmer's knowledge on water-related issues, foster local adaptation of technologies, increase local innovation capacity and facilitate technology appropriation

5

Large-scale adoption of low cost smart irrigation system by smallholders, stimulating synergies between various local actors

INTEL-IRRIS starter-kit

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

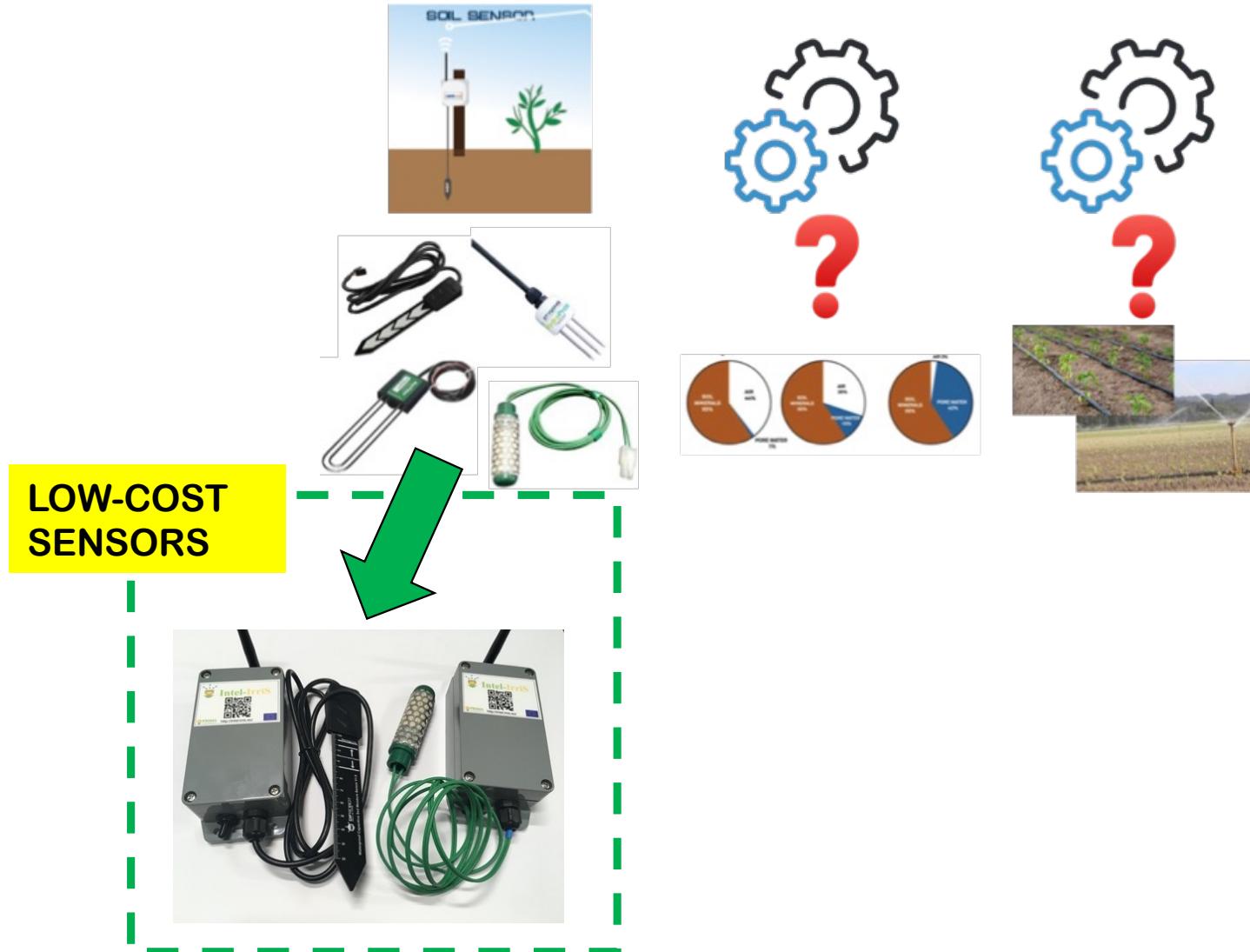


2 versions of the soil device

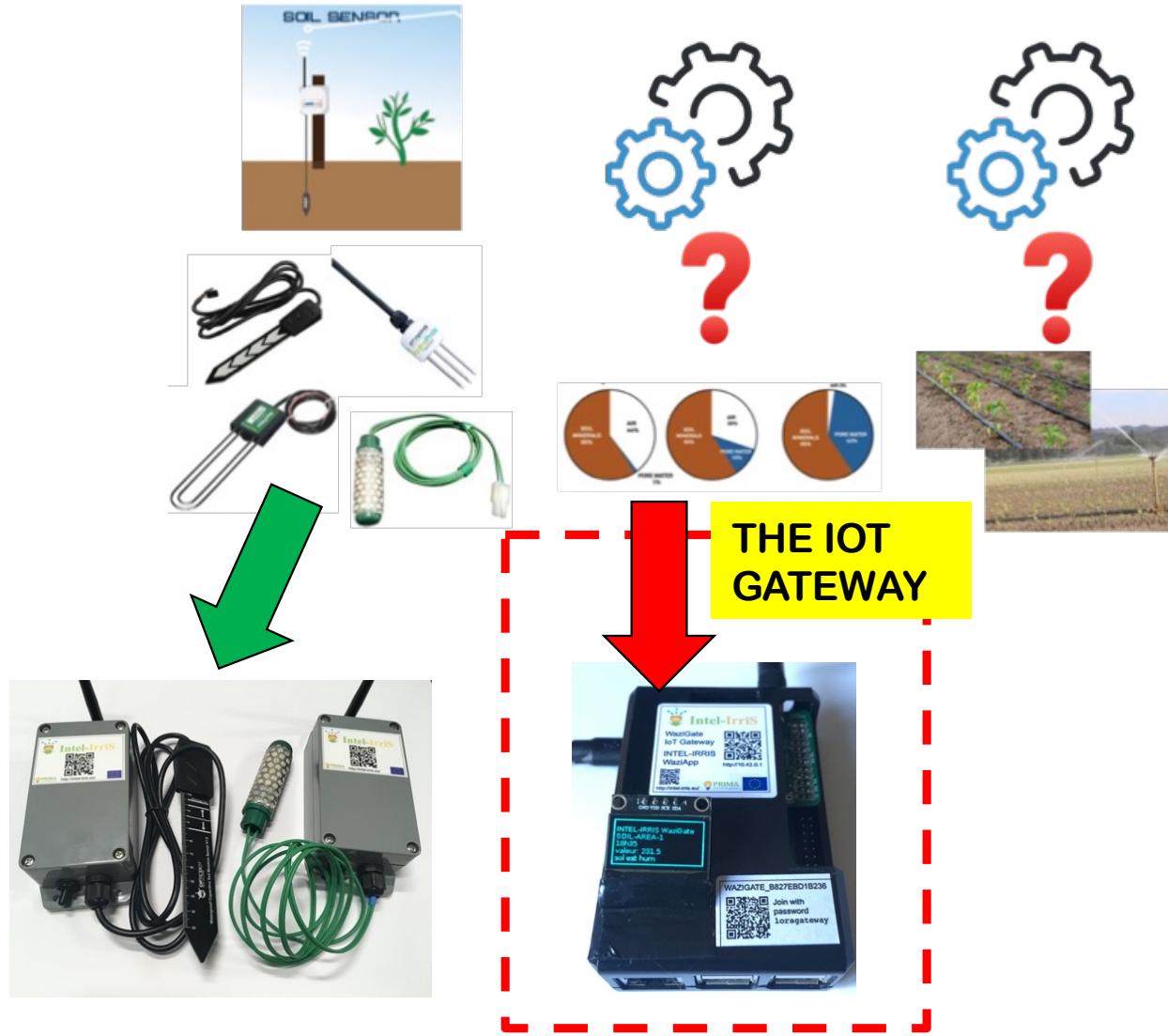


A soil temperature sensor can be added

INTEL-IRRIS: sensing node part



INTEL-IRRIS: gateway part



نظام ري ذكي - النموذج الابتدائي - Intel-Irris

عرض آخر قيمة تم الحصول عليها وحالة رطوبة التربة

INTEL-IRRIS Wazigate SOIL-AREA-1 0 mins valeur: 915 sol est très sec

SEN0308 capacitive sensor Watermark WM200 Water tension sensor

يتم تسليمها مع بوابة واحدة ومستشعر سعوي أو مقاييس رطوبة التربة

دالة الرطوبة

مرتوفي رطب جاف جداً جاف

Testing with capacitive device

INTEL-IRRIS Wazigate SOIL-AREA-1 0 mins valeur: 915 sol est très sec

Testing with tensiometer device

INTEL-IRRIS Wazigate SOIL-AREA-2 0 mins valeur: 34 sol sec-hum

INTEL-IRRIS Wazigate SOIL-AREA-1 915 sol est très sec

SOIL-AREA-2 34 0 mins sol sec-hum

INTEL-IRRIS Irrigation WAZIGATE! الذي تم تثبيته على!

النماذج الابتدائي لا يزال في مرحلة التطوير والاختبار والتغذية. القيم المميتة هي إرشادية لمرحلة الاختبار.

<https://www.irrometer.com/basics.html#using>

لوحة العيادة التي تعرض بيانات المصنع الأصلية لأجهزة الاستشعار

عرض آخر قيمة مستلمة وحالة رطوبة التربة

Testing with capacitive device

INTEL-IRRIS Wazigate SOIL-AREA-1 0 mins valeur: 915 pas de capteur!

Testing with tensiometer device

INTEL-IRRIS Wazigate SOIL-AREA-2 0 mins valeur: 34 pas de capteur!

INTEL-IRRIS Wazigate SOIL-AREA-1 915 sol est très sec

INTEL-IRRIS Wazigate SOIL-AREA-2 34 0 mins sol sec-hum

INTEL-IRRIS Irrigation WAZIGATE! الذي تم تثبيته على!

10.42.0.1:5000 http://10.42.0.1 PRIMA

ID b827eb6d21eb1c

SOIL-AREA-1 ID 639c34b368f3190904...

Soil Humidity Sensor Raw value from SEN0308 3 hours ago

Battery voltage volt, low battery when lower than 2.85V 3 hours ago

SOIL-AREA-2 ID 639c34b468f3190904...

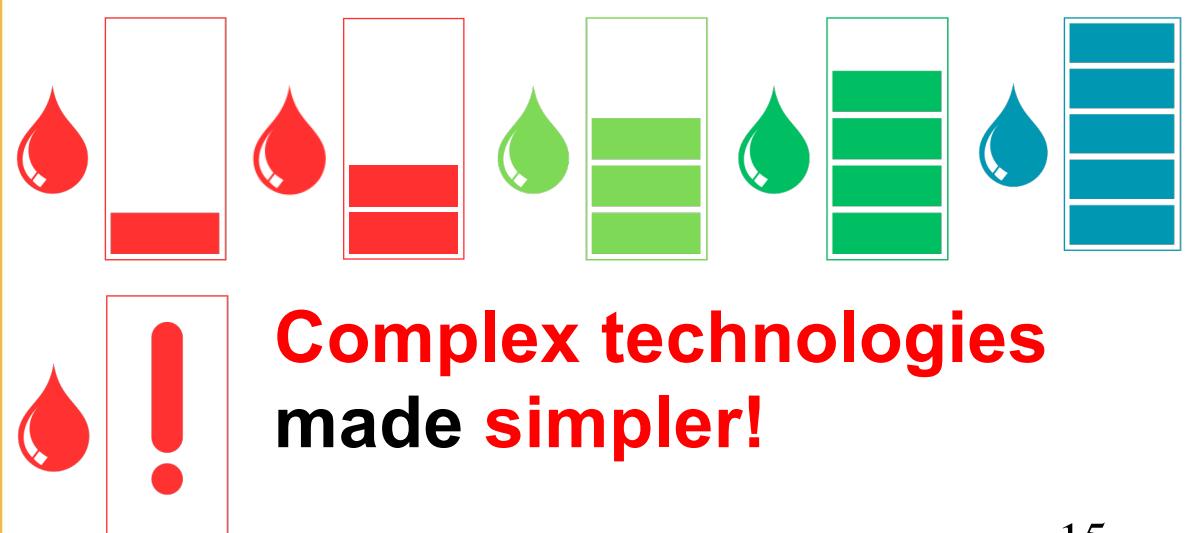
Soil Humidity Sensor centbars from WM200 3 hours ago

Soil Humidity Sensor scaled value from WM200 realx10 3 hours ago

Soil Temperature Sensor degree Celsius 3 hours ago

Battery voltage volt, low battery when lower than 2.85V 3 hours ago

10.42.0.1:5000



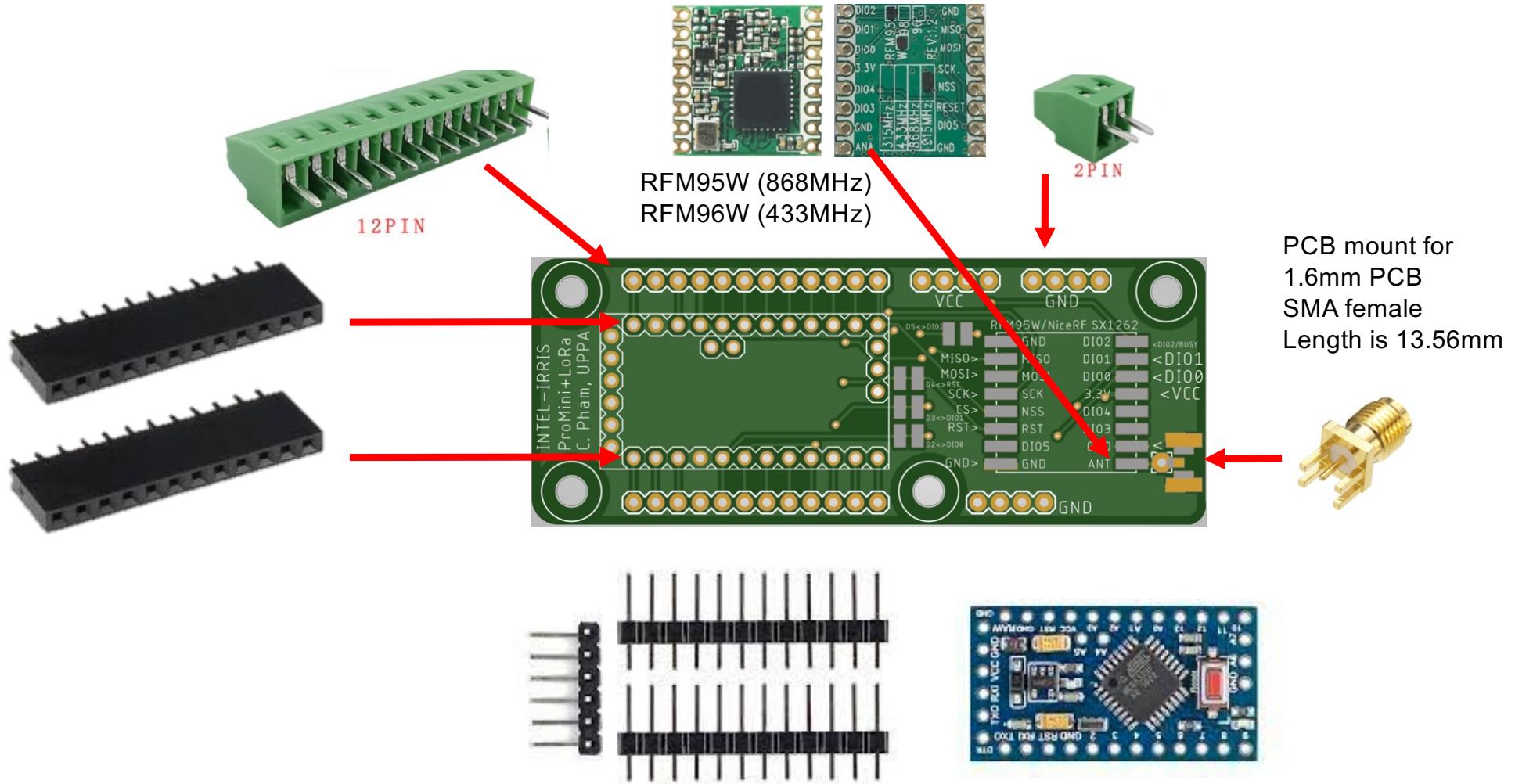
A close-up photograph of a young green plant with several leaves and a thin stem, growing out of dark brown soil. The background is slightly blurred.

INTEL-IRRIS

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

LOW-COST?

Soil sensor: simple electronic parts

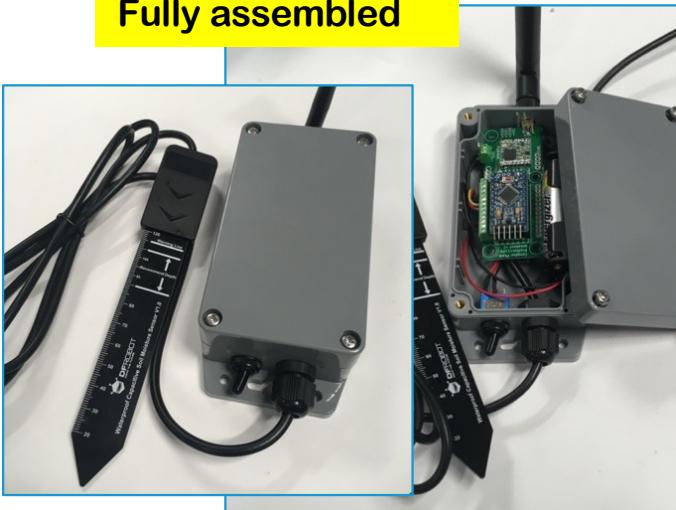


Soil sensor: easy integration

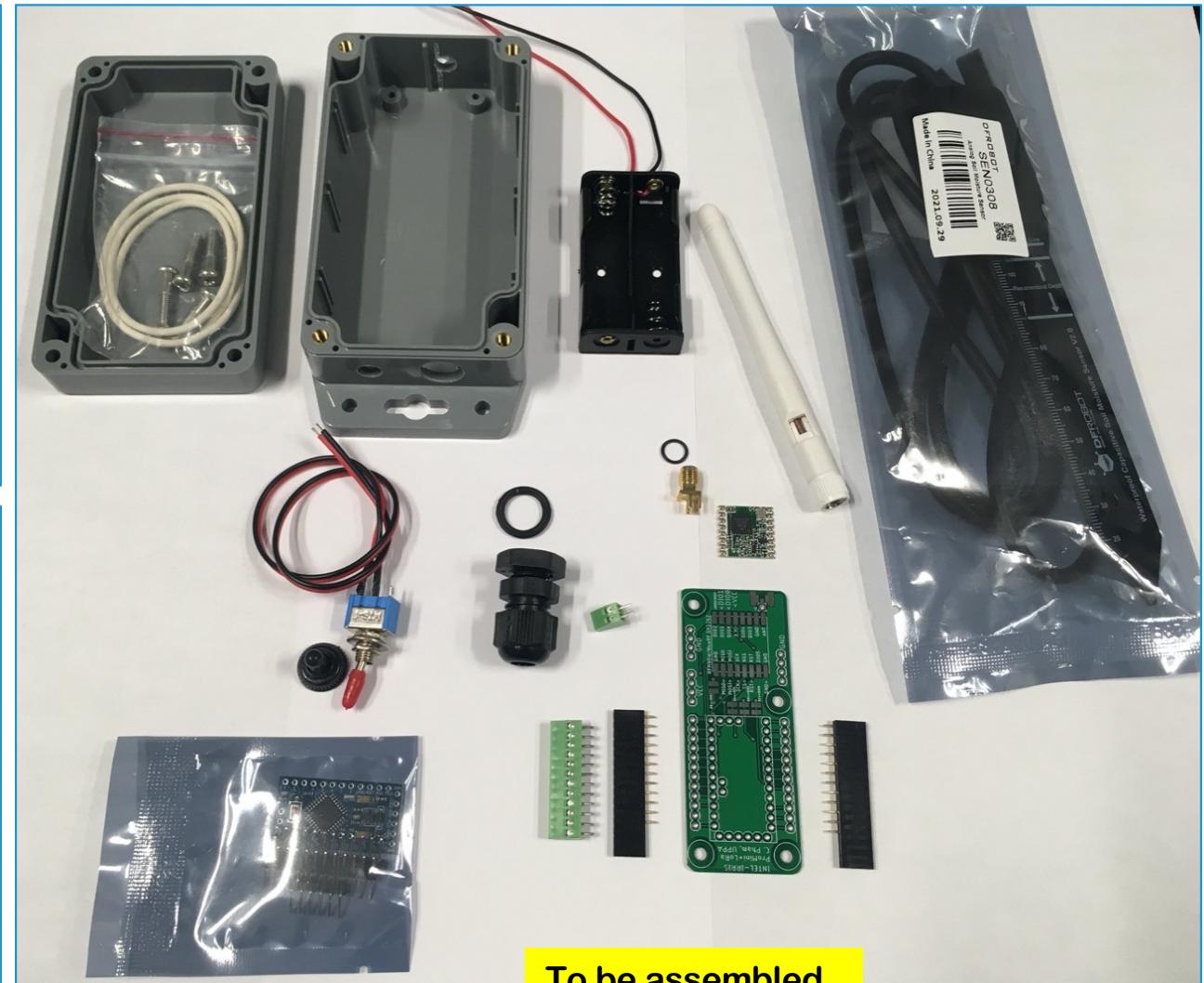


Starter-kit...in kit!

Fully assembled



Packaging in enclosure



To be assembled

A generic platform

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

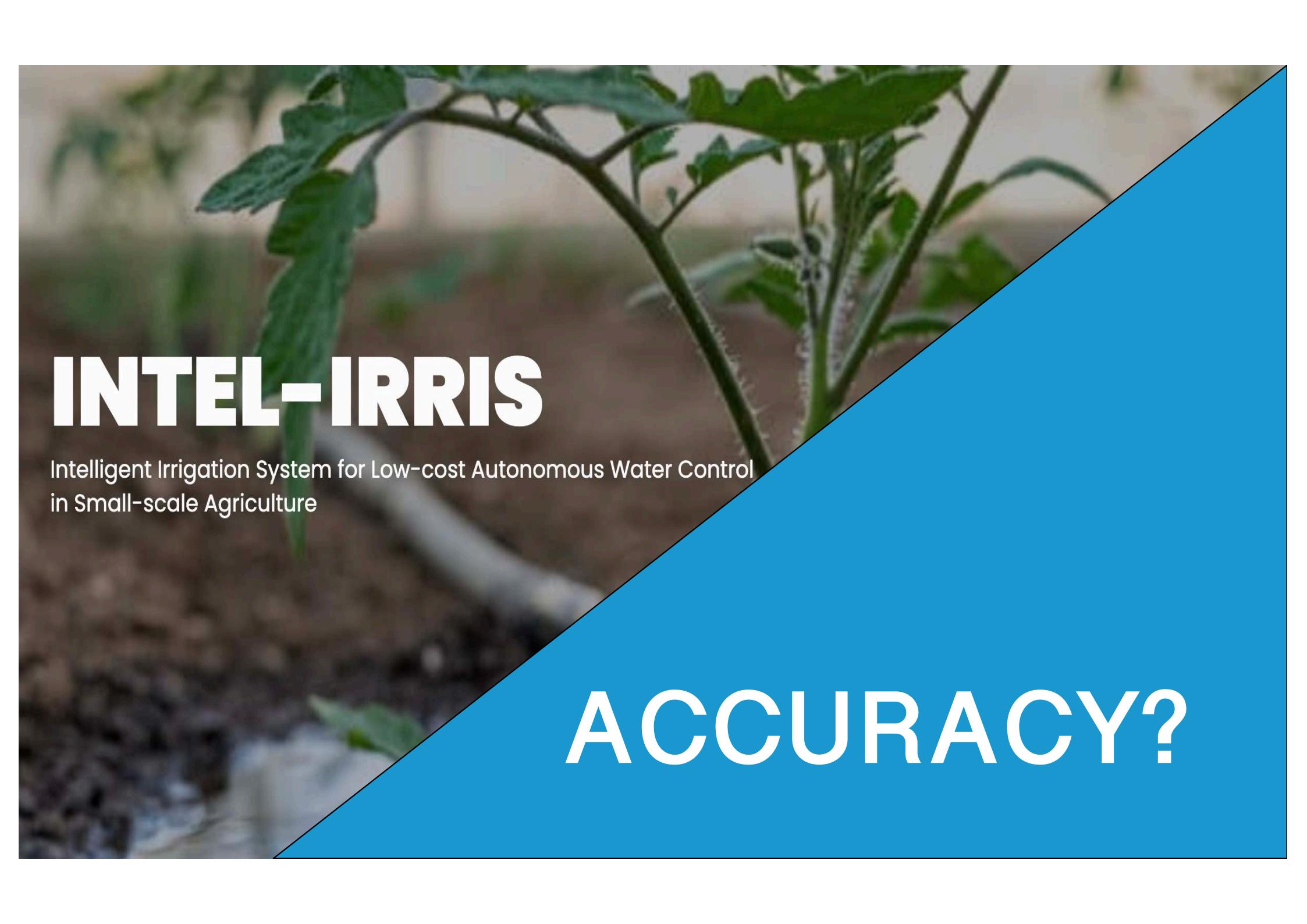


Available tutorials

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

<https://intel-irris.eu/tutorials-slides>



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.

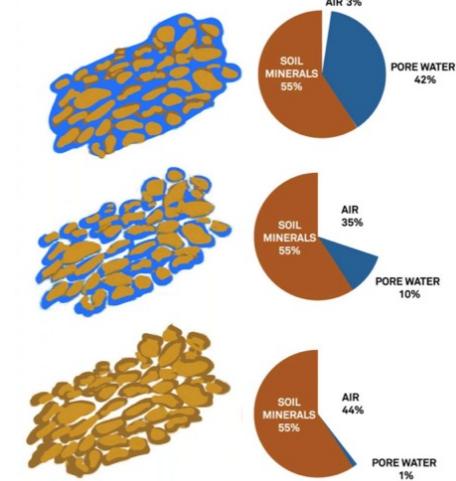
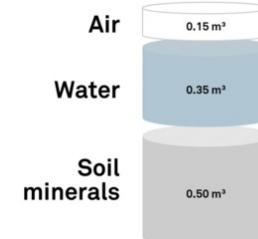
INTEL-IRRIS

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

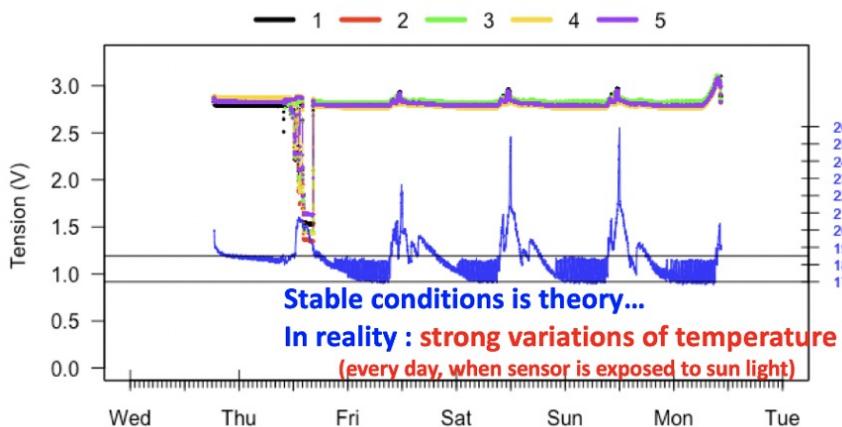
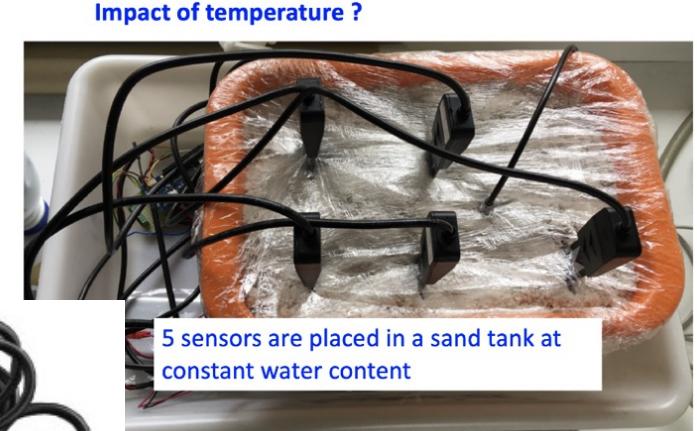
ACCURACY?

Capacitive sensor

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



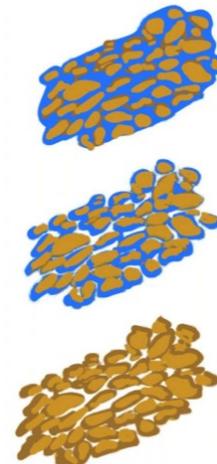
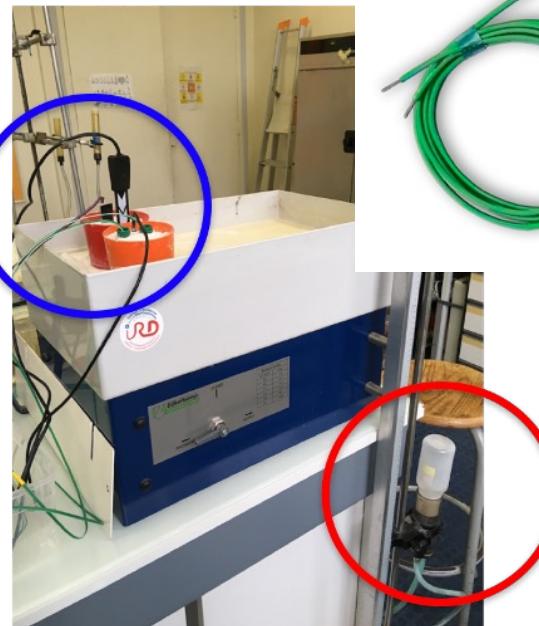
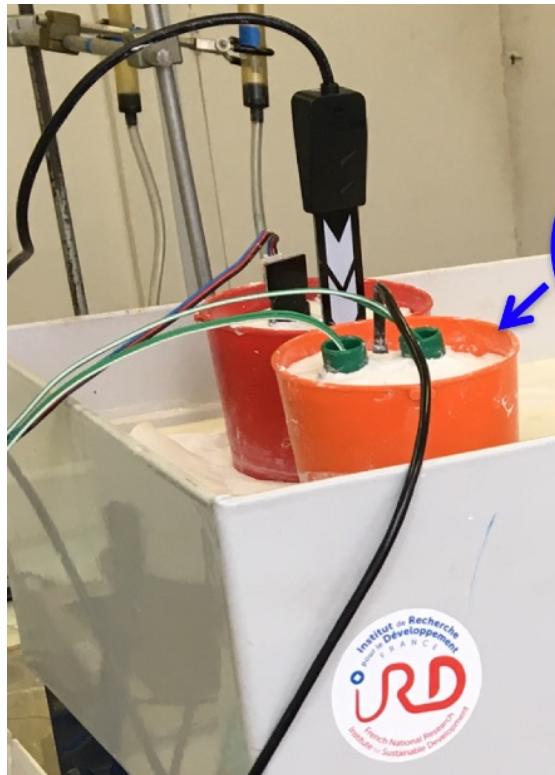
From METER group



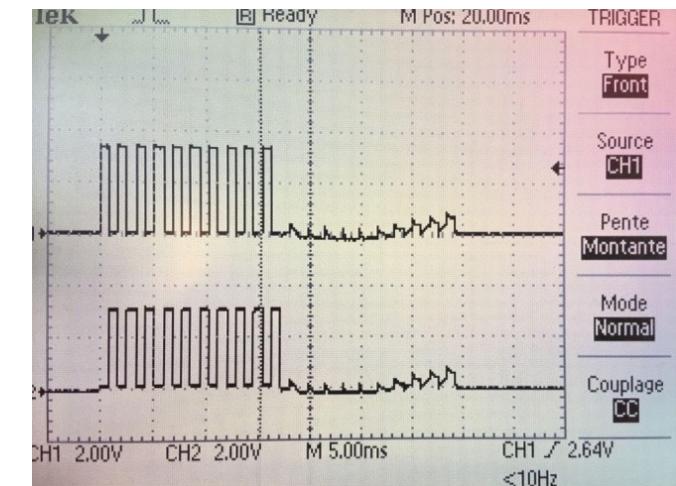
IRD in conducting extentise test on the accucary and the stability of the low-cost SEN0308 capacitive sensor 23

Water tension sensor

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



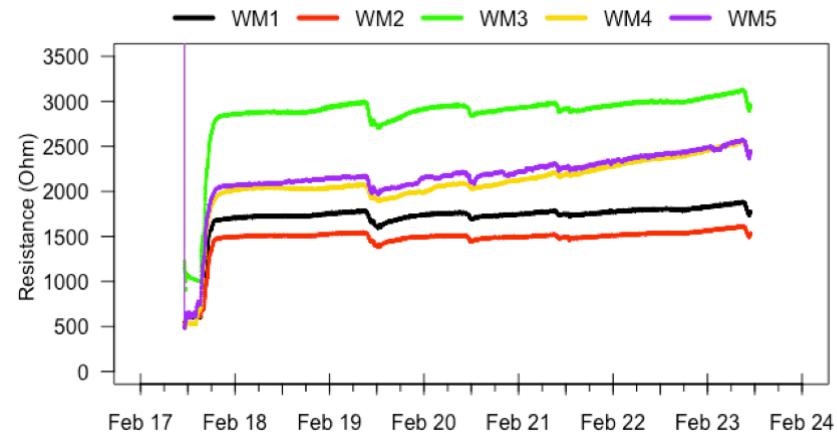
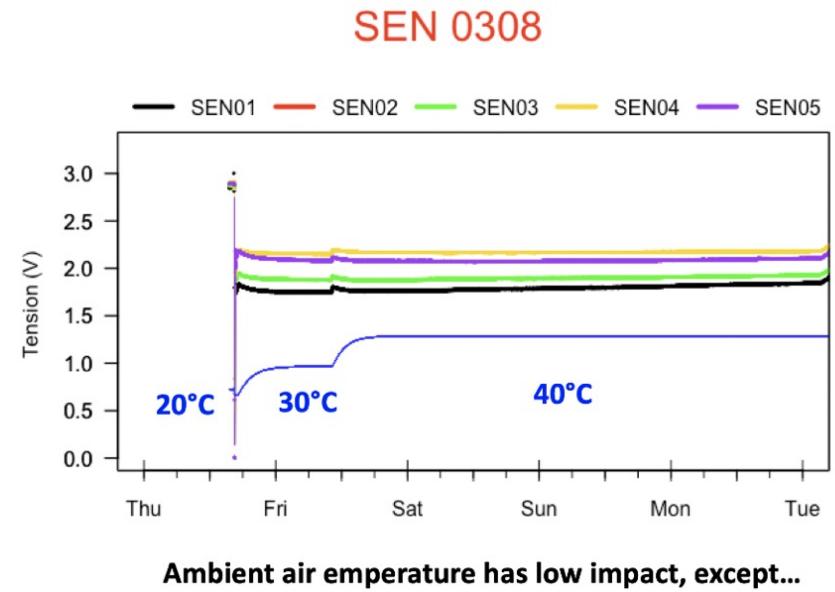
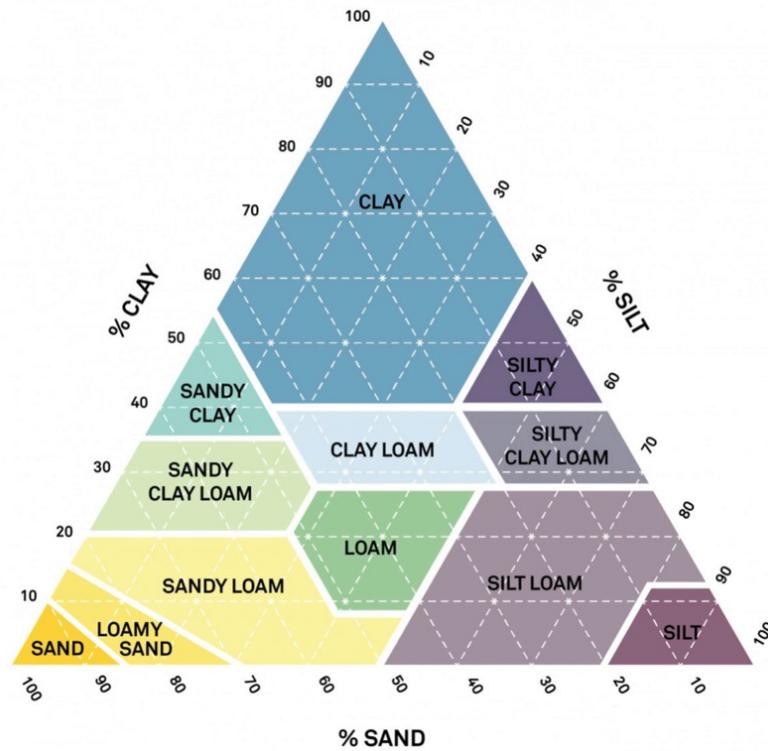
From METER group

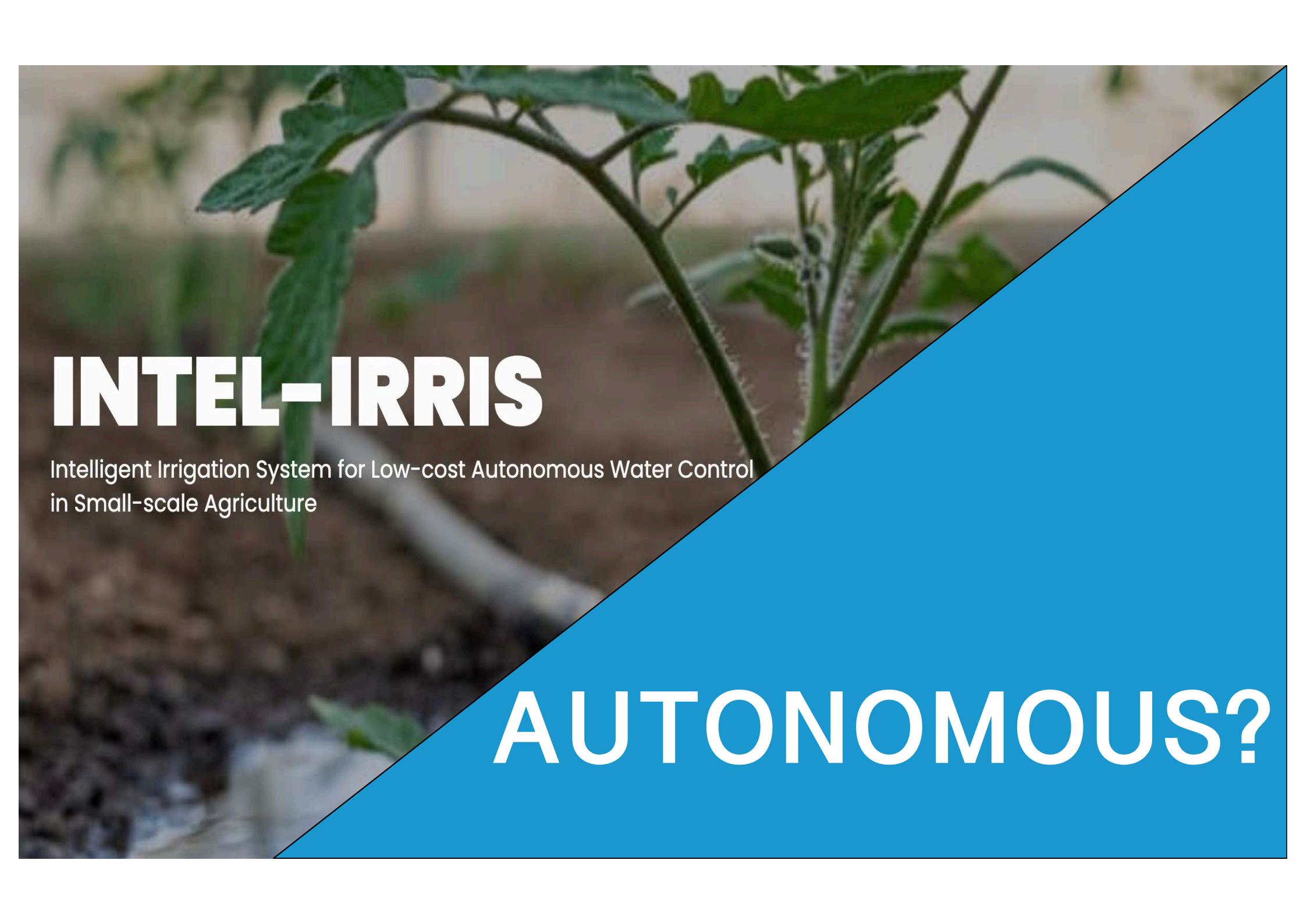


IRD in conducting extensive tests on the stability & suitability of microcontroller-based usage of the Watermark water tension sensor

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.

INTEL-IRRIS

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

AUTONOMOUS?

Gateway: collect sensor data

WAZIGATE GATEWAY

FULL EDGE-COMPUTING
 (NO INTERNET)

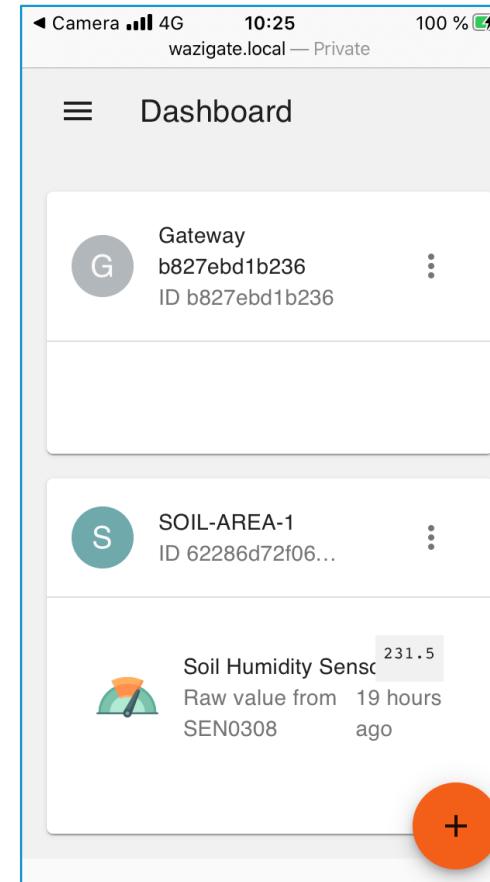
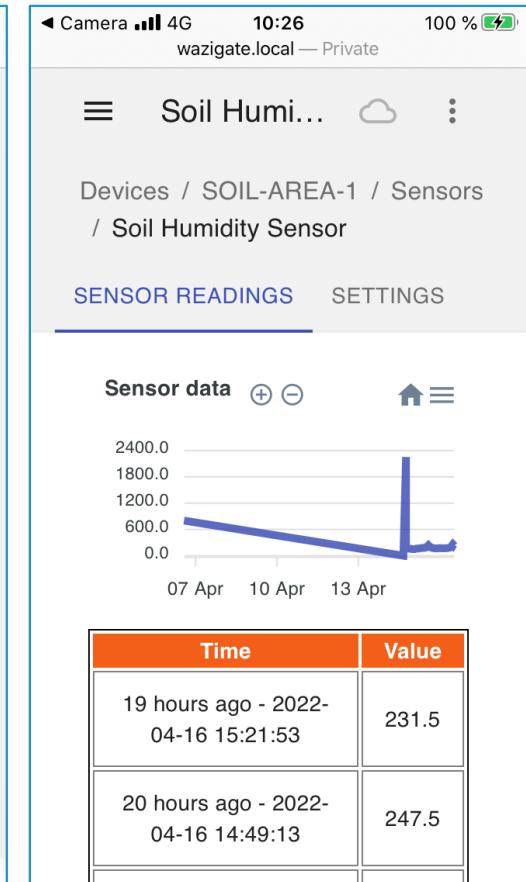
ALL DATA PROCESSING
 CAN BE DONE LOCALLY



1 GATEWAY HANDLES
 SEVERAL DEVICES

< 50€

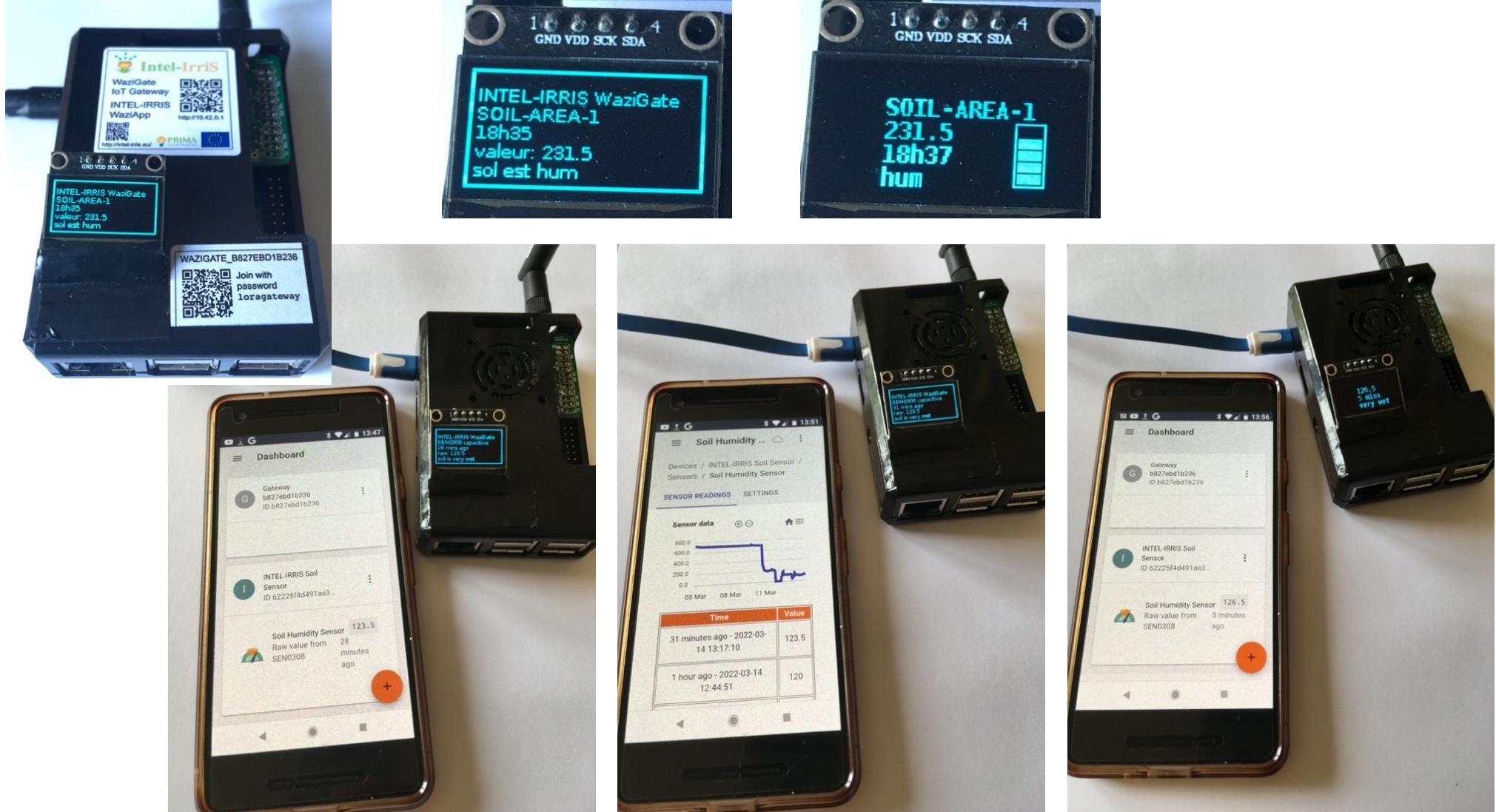
EMBEDDED WEB INTERFACE

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

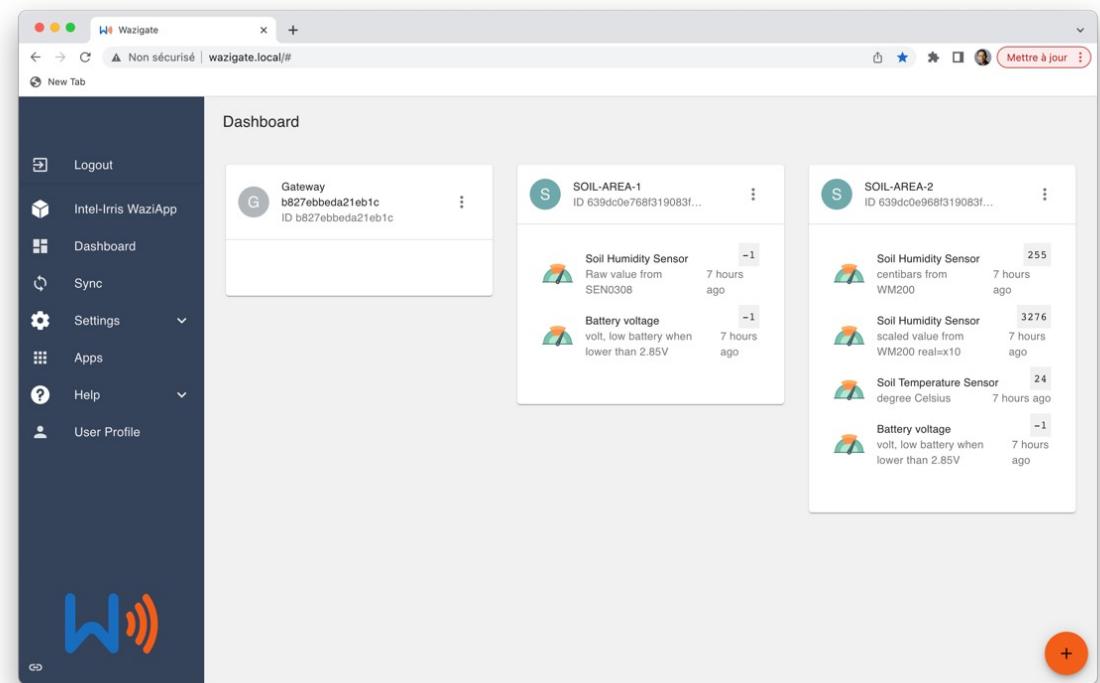
ACCESSED FROM A SMARTPHONE

Multiple user interfaces



Default gateway configuration

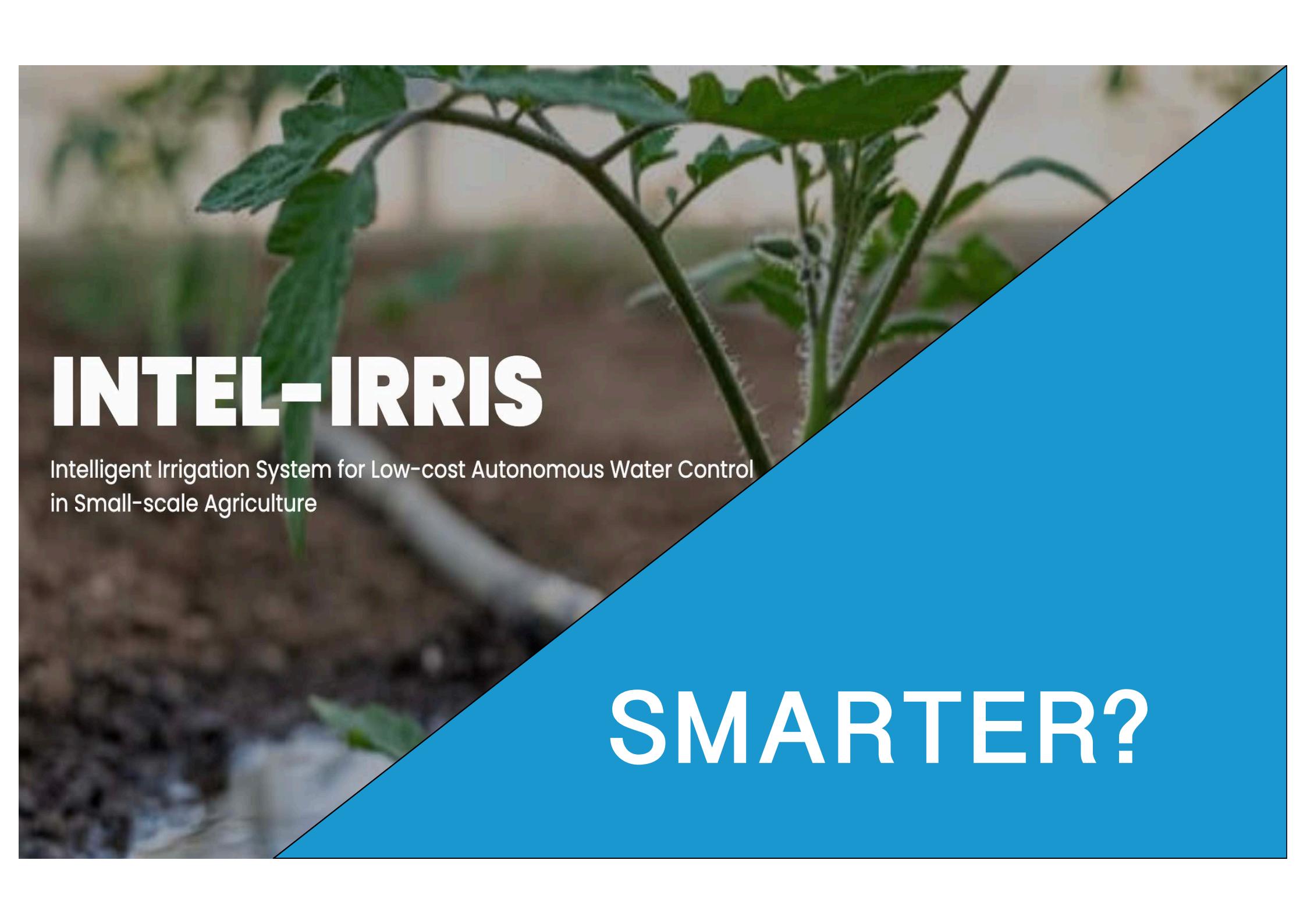
- For the starter-kit, the INTEL-IRRIS WaziGate will be ready for
 - 1 capacitive sensor named SOIL-AREA-1 with address 26011DAA
 - 1 tensiometer sensor named SOIL-AREA-2 with address 26011DB1
- Capacitive device will show humidity and battery values
- Tensiometer device will show centibar, raw resistance, soil temperature and battery values



INTEL-IRRIS starter-kit

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



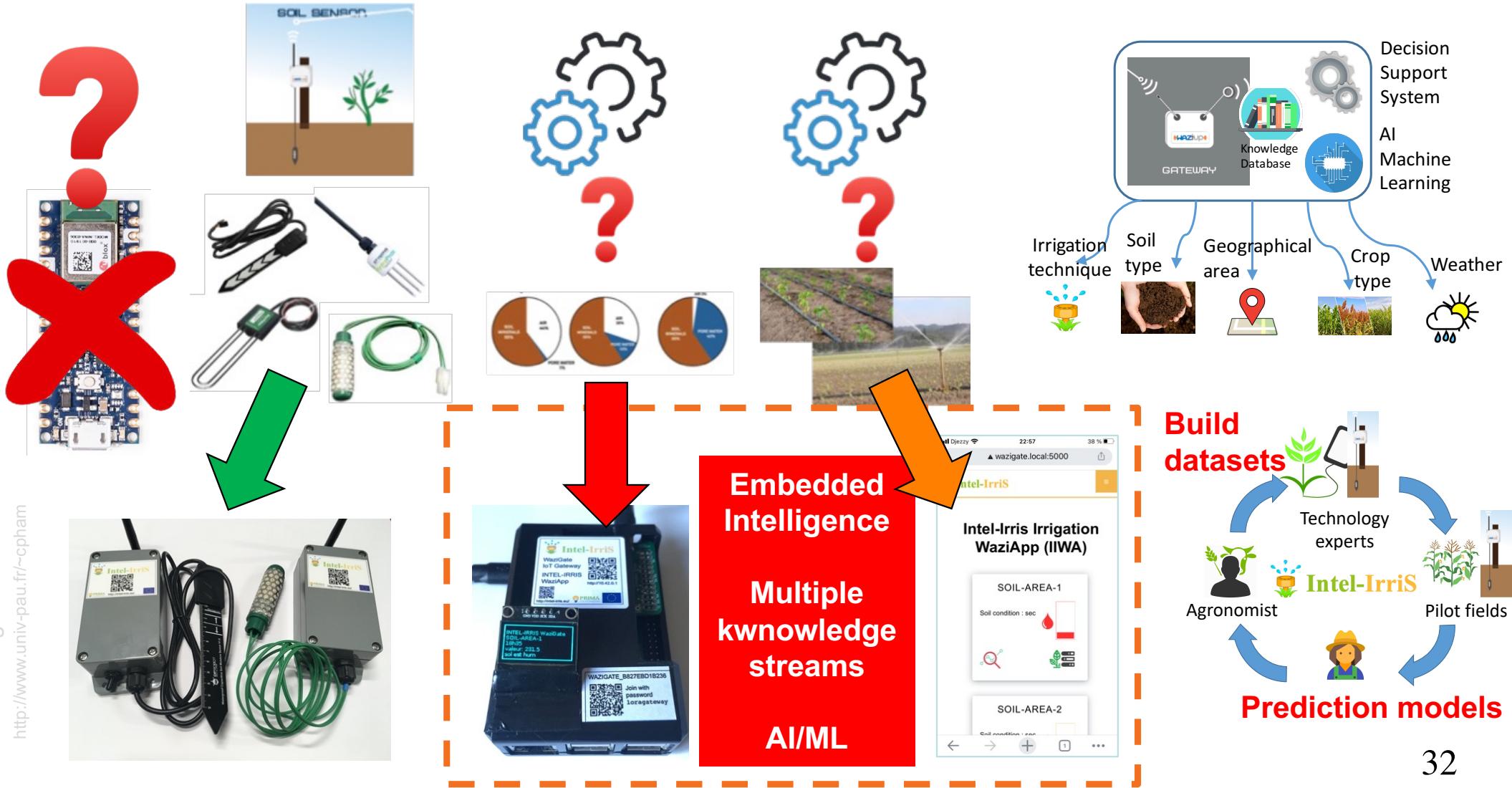
A close-up photograph of a green plant, likely a tomato or similar leafy vegetable, growing in soil. A white, flexible irrigation tube is visible, connected to the plant's stem, suggesting a smart irrigation system. The background is blurred.

INTEL-IRRIS

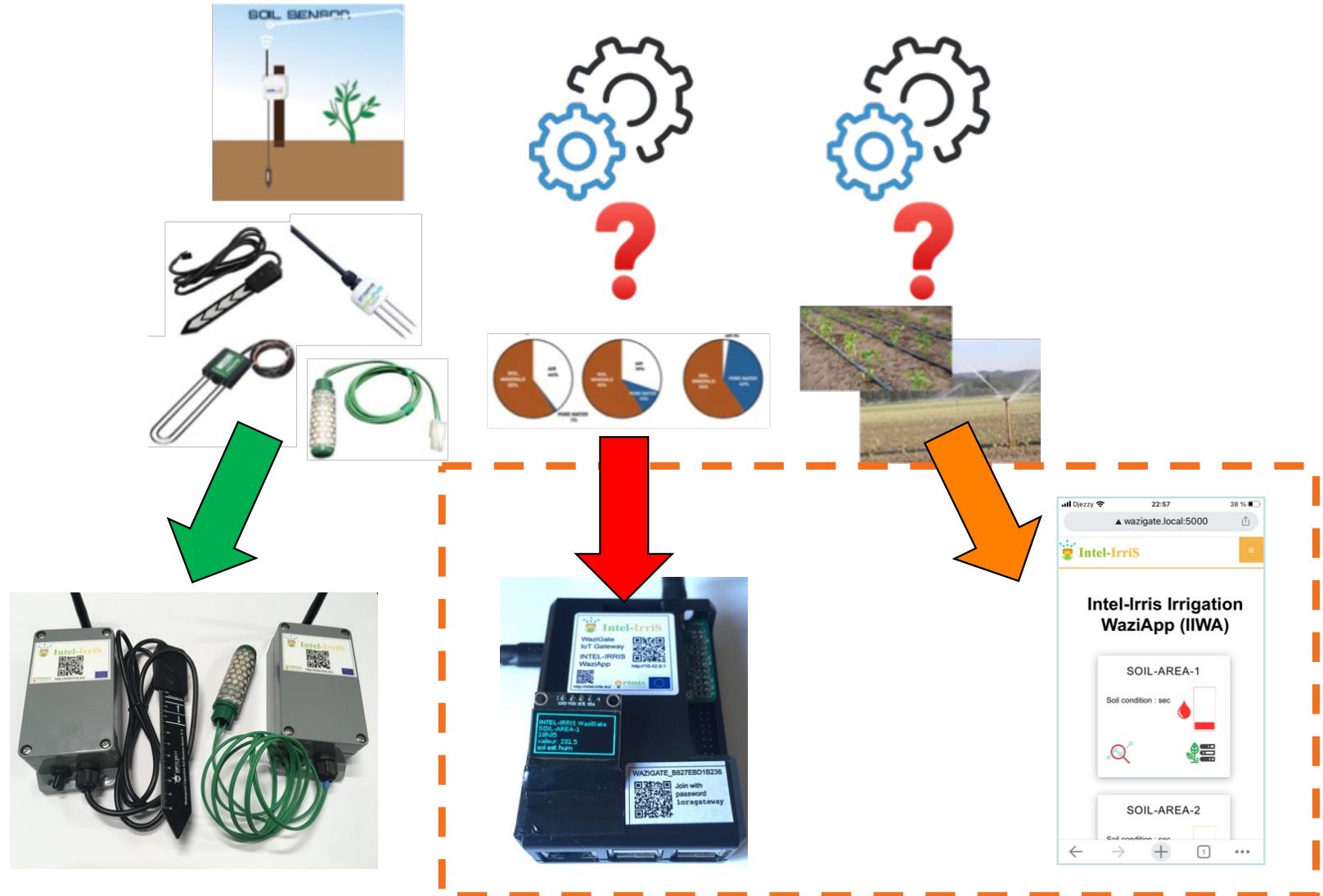
Intelligent Irrigation System for Low-cost Autonomous Water Control
in Small-scale Agriculture

SMARTER?

Embedding intelligence

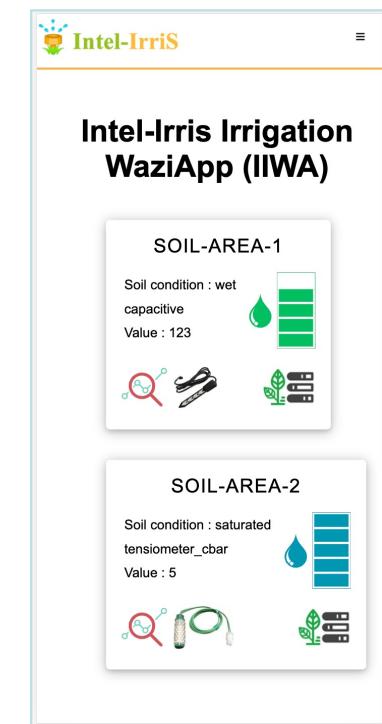


INTEL-IRRIS Irrigation WaziApp



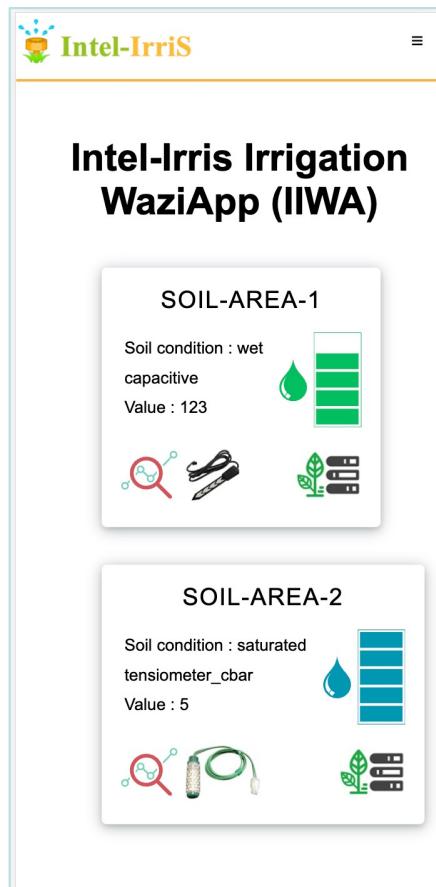
INTEL-IRRIS Irrigation WaziApp

- 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

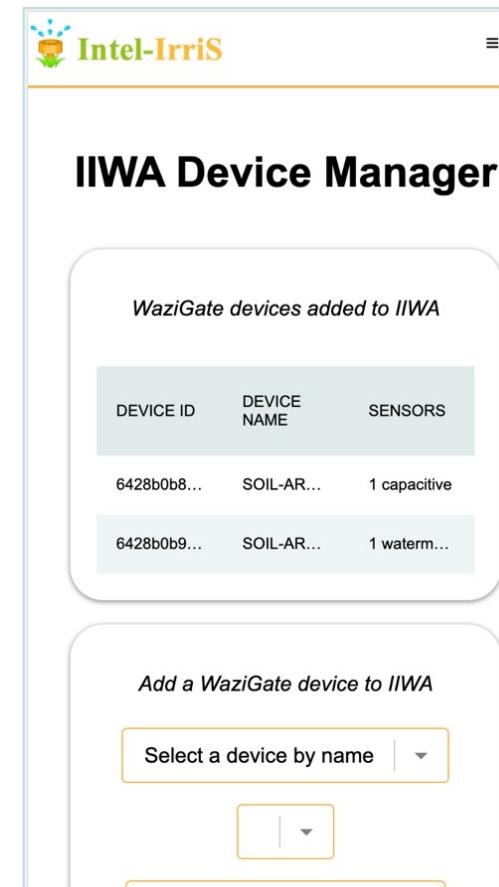


IIWA main screens

- Dashboard, Device Manager and Sensor Configuration



Dashboard

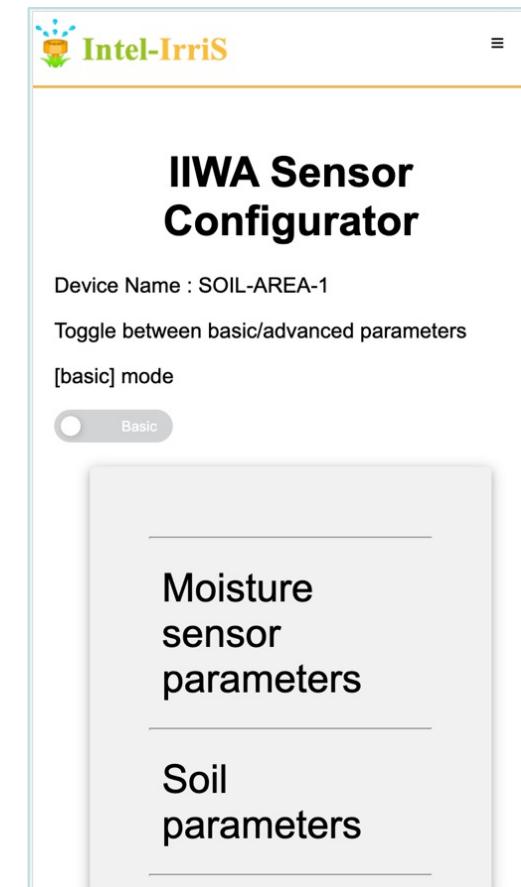


The device manager lists "WaziGate devices added to IIWA". It shows two entries:

DEVICE ID	DEVICE NAME	SENSORS
6428b0b8...	SOIL-AR...	1 capacitive
6428b0b9...	SOIL-AR...	1 waterm...

Below this is a section to "Add a WaziGate device to IIWA" with a dropdown menu labeled "Select a device by name".

Device Manager



The sensor configurator is set to "SOIL-AREA-1". It has a toggle switch for "basic/advanced parameters" currently set to "Basic". Below this are sections for "Moisture sensor parameters" and "Soil parameters".

Sensor Configuration

List of advanced parameters

Basic

More parameters will be integrated in IIWA during the project

Moisture sensor parameters

Sensor Type

- Capacitive
- Tensiometer (cbar)
- Tensiometer (raw)

Soil parameters

Plant parameters

Moisture sensor parameters

Soil parameters

Soil Type

Silty

Soil Irrigation Type

- Submerison
- Furrow
- Sprinkler
- Drip
- Subirrigation

Moisture sensor parameters

Plant parameters

Plant type

Tomatoes

Planting Date

01/04/2023

Moisture sensor parameters

Weather parameters

Region

Semi-Arid

Save configuration

Advanced

Moisture sensor parameters

Sensor age

0

Maximum sensor value

800

Minimum sensor value

0

Soil parameters

Moisture sensor parameters

Soil parameters

Soil Salinity

empty or -1 for disabled

Soil Bulk Density

empty or -1 for disabled

Soil Field Capacity

empty or -1 for disabled

Moisture sensor parameters

Plant parameters

Plant category

Vegetable

Plant Variety

feiza tomatoes

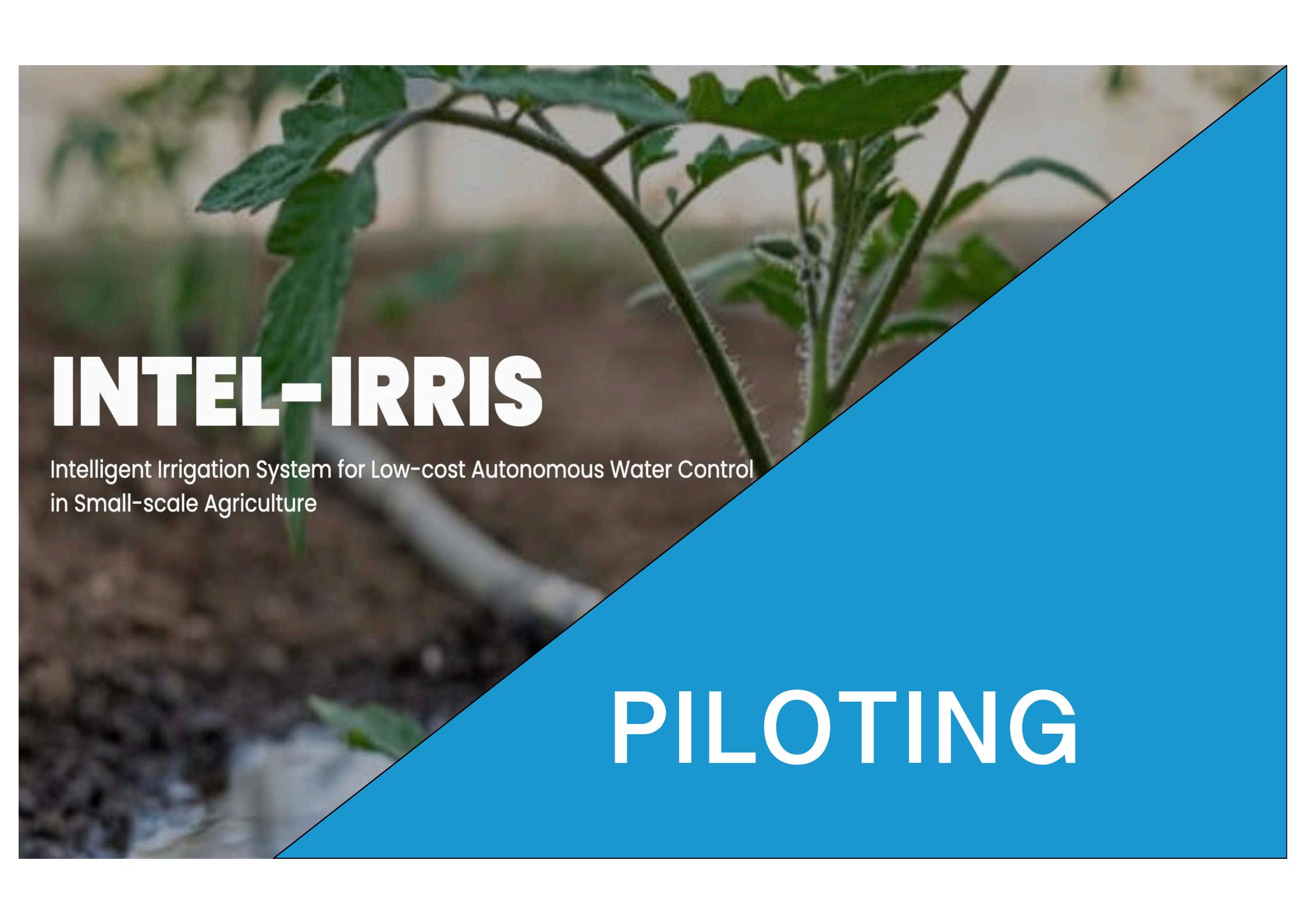
Moisture sensor parameters

Weather parameters

Weekly evaporation (in mm) value in mm

Weekly pluviometry (in mm) value in mm

Save configuration

A close-up photograph of a young green plant with large, serrated leaves growing in dark brown soil. The plant has several thin stems and small leaves. The background is slightly blurred.

INTEL-IRRIS

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

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
- Runs for 24 months to ensure that the proposed irrigation systems are well tailored for the specificities of the regional context
- 13 farms already enrolled to participate in the Piloting Program



Bousfer farm, Algeria



UMAB farm #1, Algeria



INRA farm #1, Morocco

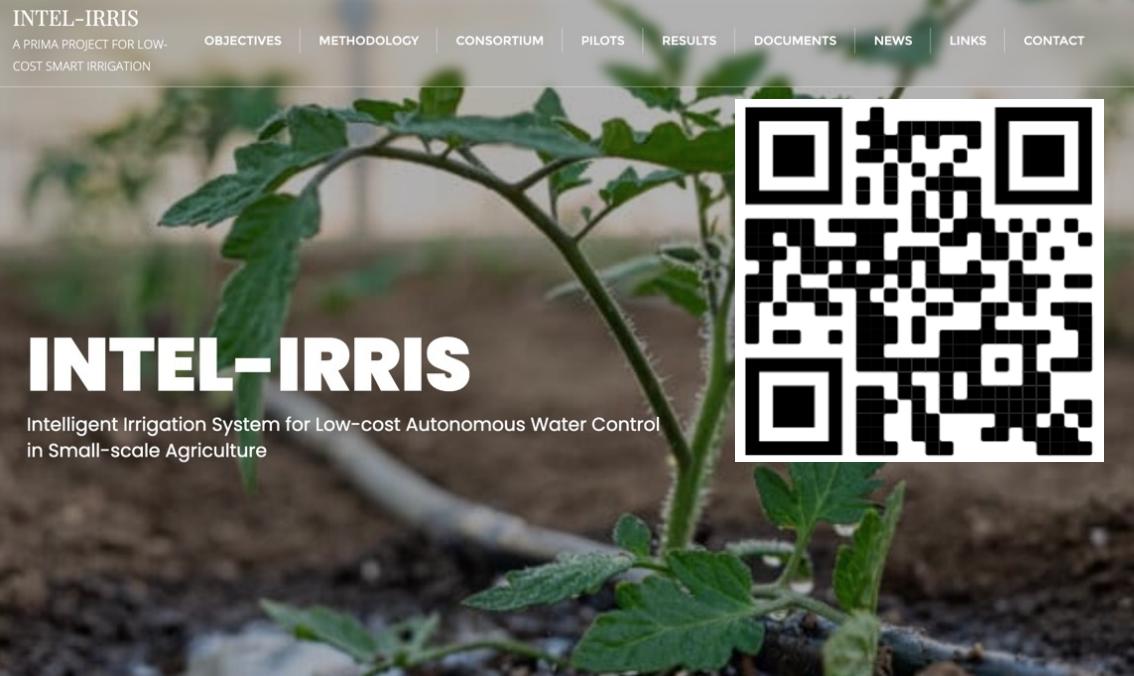


INRA farm #2, Morocco



More information

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



The website features a large image of a young tomato plant with green leaves and stems. Overlaid on the image is the project name "INTEL-IRRIS" in large white capital 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 black and white QR code.

INTEL-IRRIS
 A PRIMA PROJECT FOR LOW-COST SMART IRRIGATION

OBJECTIVES | METHODOLOGY | CONSORTIUM | PILOTS | RESULTS | DOCUMENTS | NEWS | LINKS | CONTACT

AUA: Agricultural University of Athens
 FEDORIKO HANTELIOTIMO ARSENIS
 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
 UNIVERSITE ABDERRAHMAN BEN BADIS
 MESSAKES

 Algeria

UORAN1: University of Oran 1

 Algeria

UPPA: University of Pau & Adour Country
 UNIVERSITE DE PAU ET DES PAYS DE L'ADOUR
 coordinator

 France

WAZIUP eV: WAZIUP association

 Germany

- Twitter: [@Intel_Irris](https://twitter.com/Intel_Irris)



Intel_Irris
@Intel_Irris

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

