Digital platforms and embedded AI to target the smallholder communities

Transdisciplinary research for a healthy planet

March 30-31 mars 2023 – Université de Reims

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

European Commission | Horizon 2020 European Union funding for Research & Innovation

WAZIUP
IoT – from idea to reality
WAZIHUB

HUBiquitous
Paving for the next 10 years of innovation in IoT and AI

PRIMA PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

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

Healthy planet?

Google

healthy planet

Together Beyond Animal Health

Healthy Planet – Together Beyond Animal ...

Facebook

Healthy Planet - Home | Facebook

EURACTIV.com

healthy people on a healthy planet ...

123RF

Healthy Planet With Green Leav...

Down to Earth Organic and Natural

Healthy Living = Healthy Planet | Down ...

Trivitron Healthcare

A Healthy Planet for Healthy People ...

Campus Safety Magazine

Healthy People, Healthy Places, Healthy ...

The Big Carrot

Healthy People Healthy Planet - Carrot ...

Mars Petcare - Mars, Incorporated

Healthy Planet | Mars, Incorporated

MAHB

FT HealthWorld

The George Institute for Global Health

healthyplanetusa.org

2 transdisciplinary PRIMA projects

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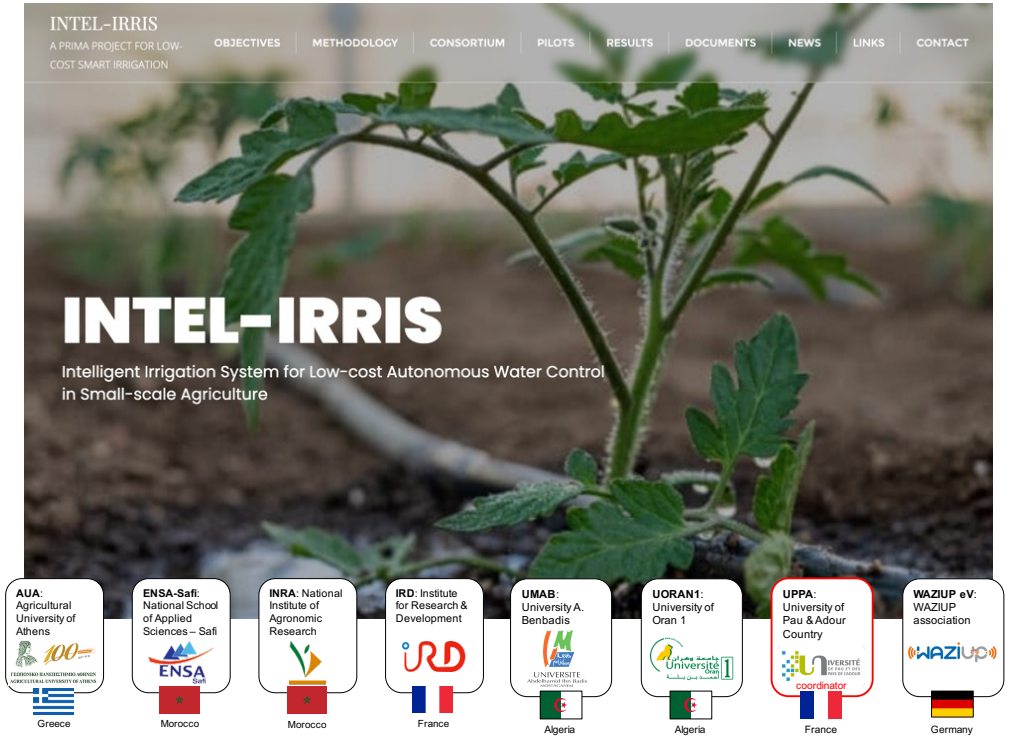


Optimize irrigation in small-scale agriculture farms

https://intel-irris.eu

Intel-IrriS

June 2021-24

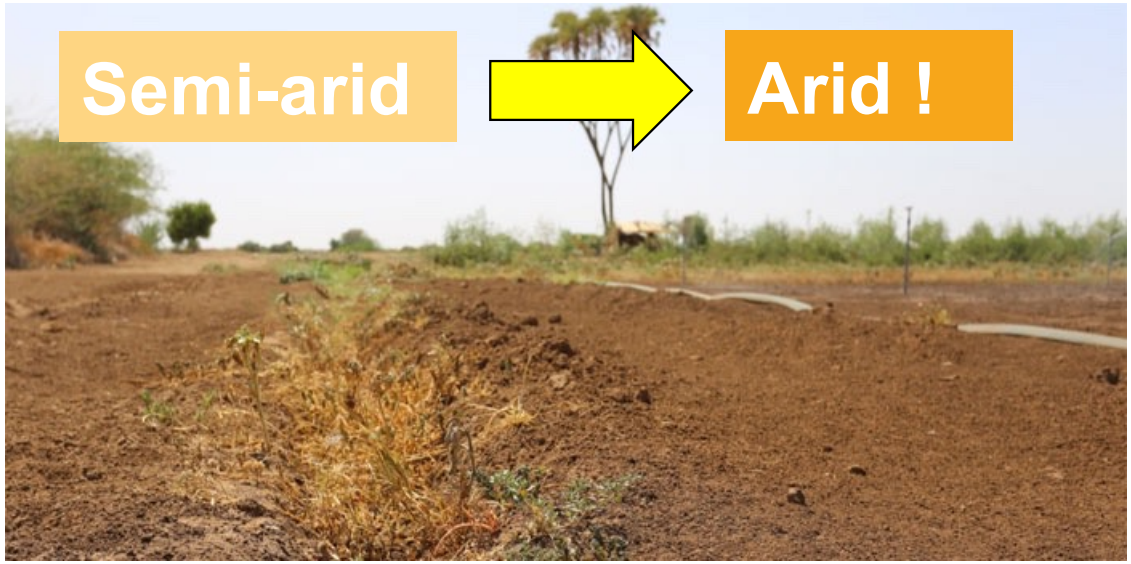
Resource sharing in smallholder communities

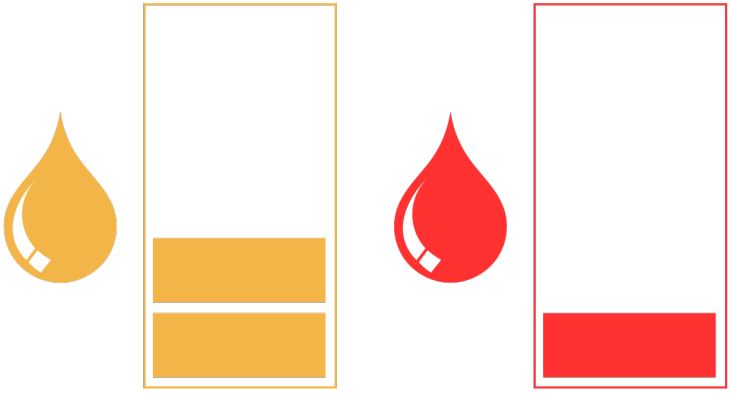
RESILINK

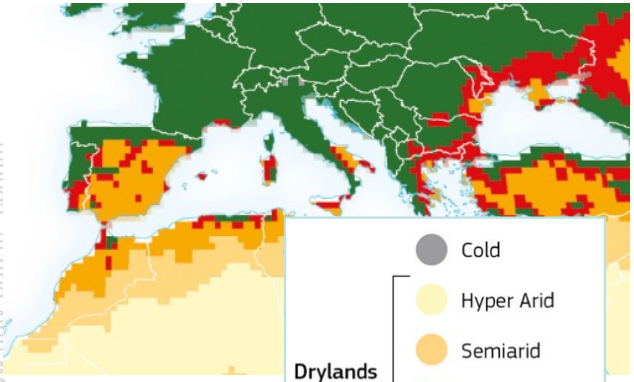
https://resilink.eu

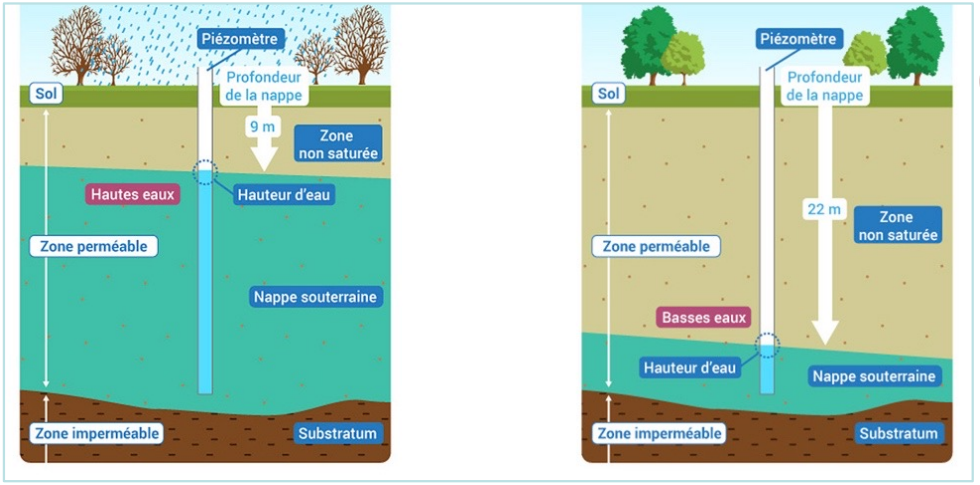
June 2022-26

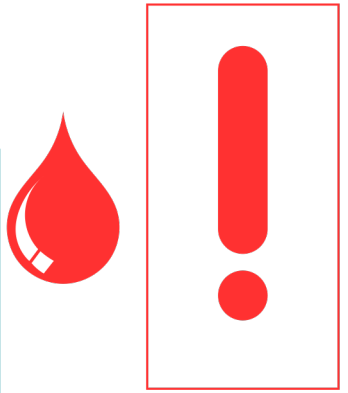
Water resource is precious!











Optimizing irrigation in agriculture

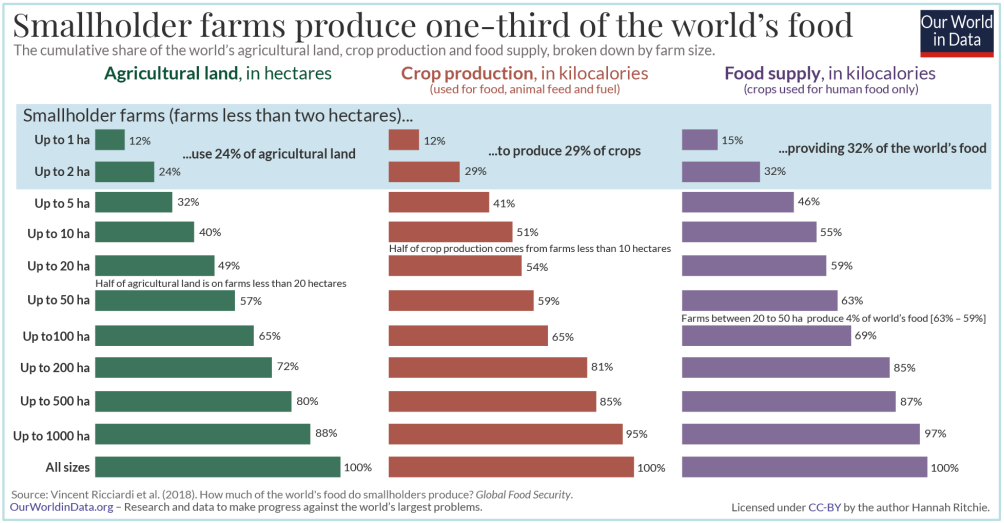
- About 70% of water is used for agriculture activities
- Digital technologies can help reducing and optimizing usage of water, **but…**

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

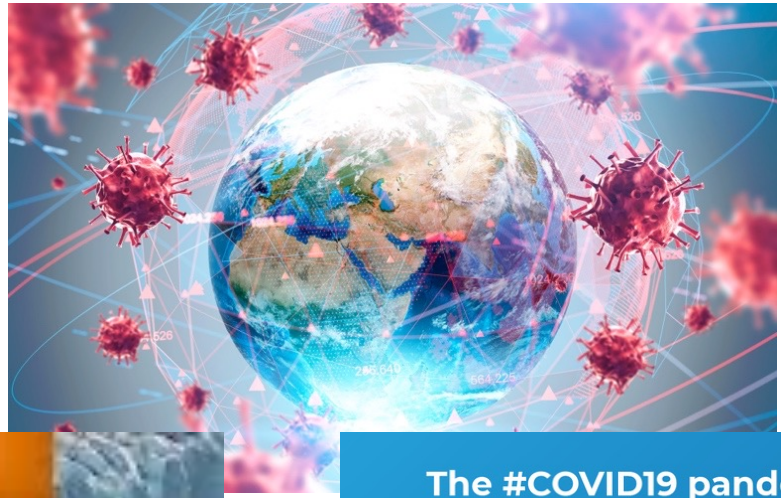


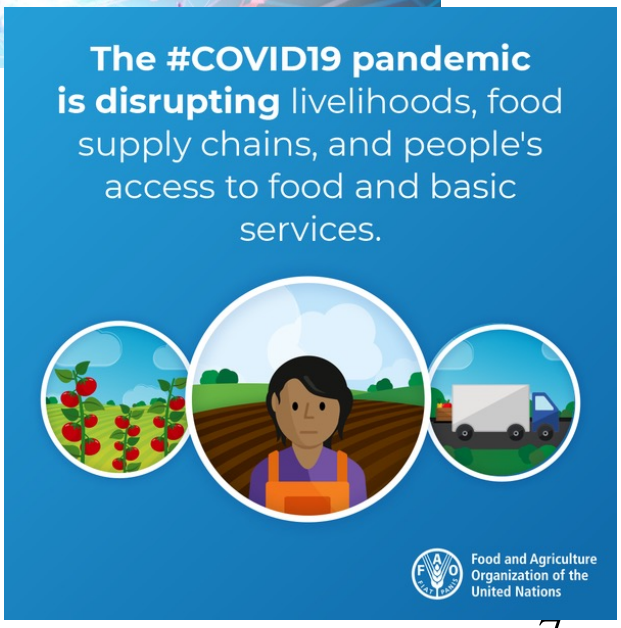
https://ourworldindata.org/smallholder-food-production

Technologies

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

Towards more frequent crisis?



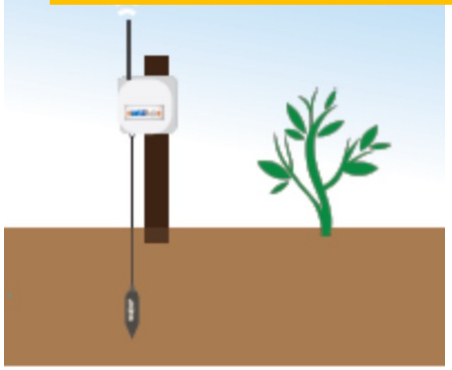


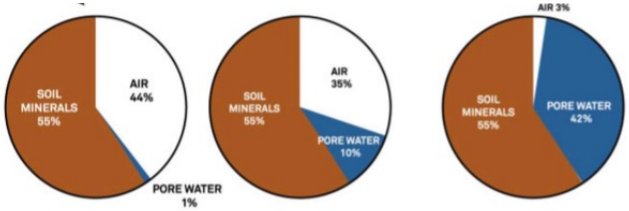
Smallholders are more vulnerable!

- Smallholder farmers: first to be impacted by climate change, unexpected crises. They are very economically fragile!

Irrigation with soil moisture sensing

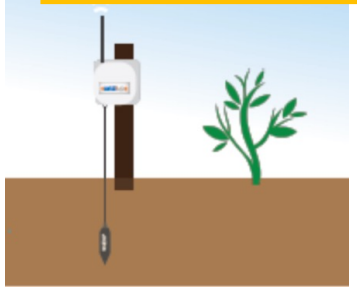
1 **Propose low cost but highly efficient water control systems for irrigation optimization**





Not as simple as it seems ☹

1 Propose low cost but highly efficient water control systems for irrigation optimization

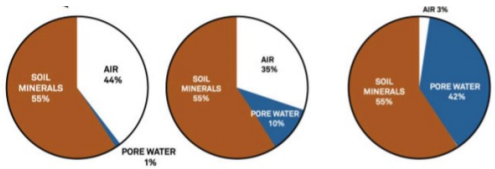


Volumetric Water Content, Water Potential, Water Tension,…

TDR, FDR, capacitance, resistance, ….

Low-cost sensor less accurate

2 Use cutting-edge technologies to propose highly innovative systems yet simple to deploy and adapted to smallholders



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

Evapotranspiration, soil-plant-atmosphere continuum,…

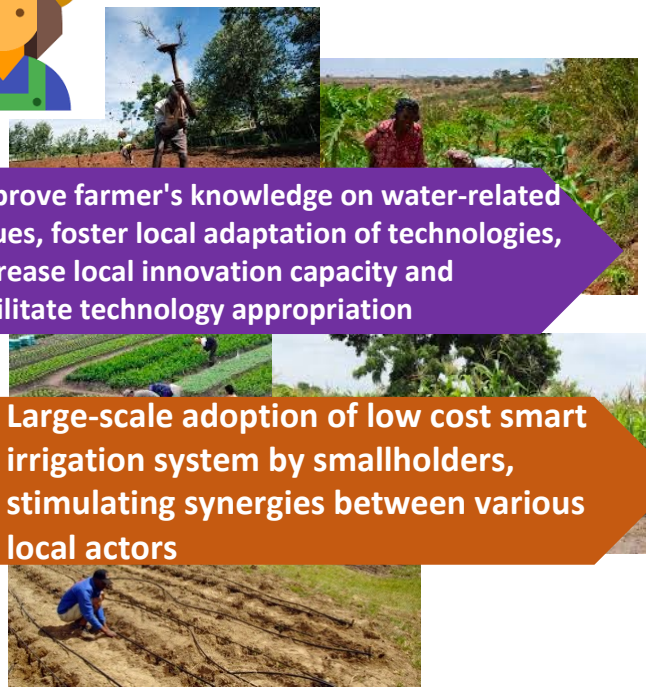
3 Seamless integration into existing irrigation system and/or local customs and practices

Irrigation type: drip, furrow, sprinkler,…

Plant/Crop varieties

Relationship with other agriculture inputs

Not only the cost barrier…



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

High acceptability of technologies, even complex ones

Very low acceptability of technologies because too complex!

INTEL-IRRIS starter-kit

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

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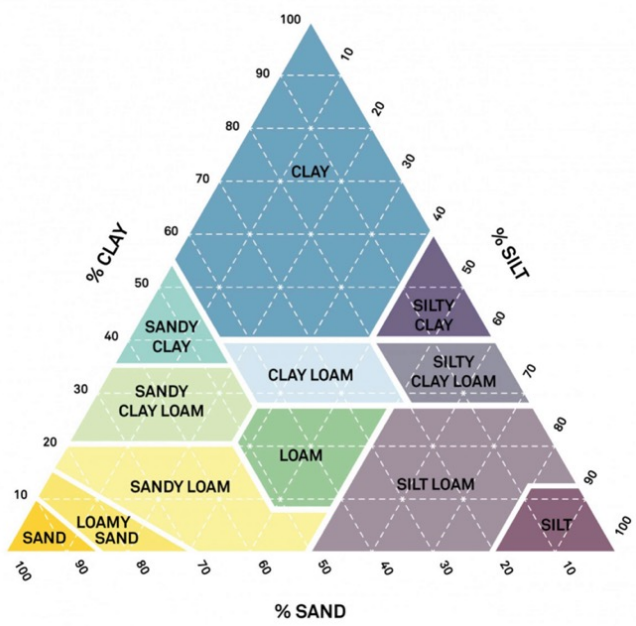
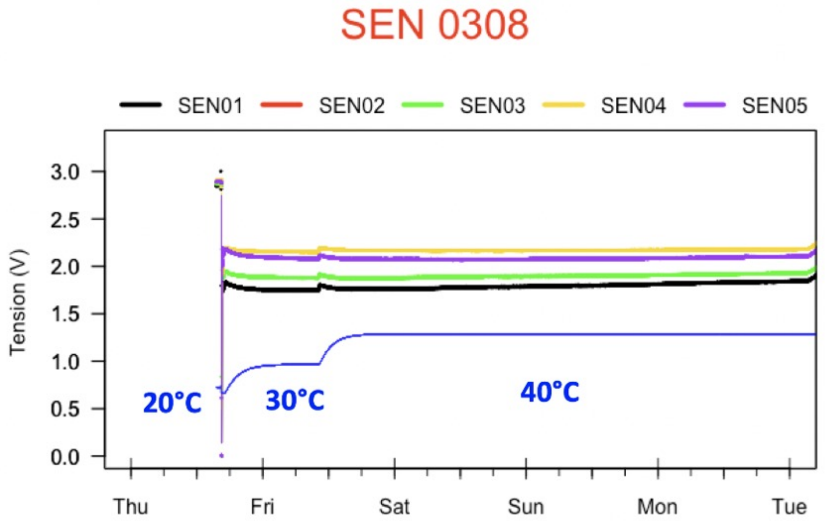
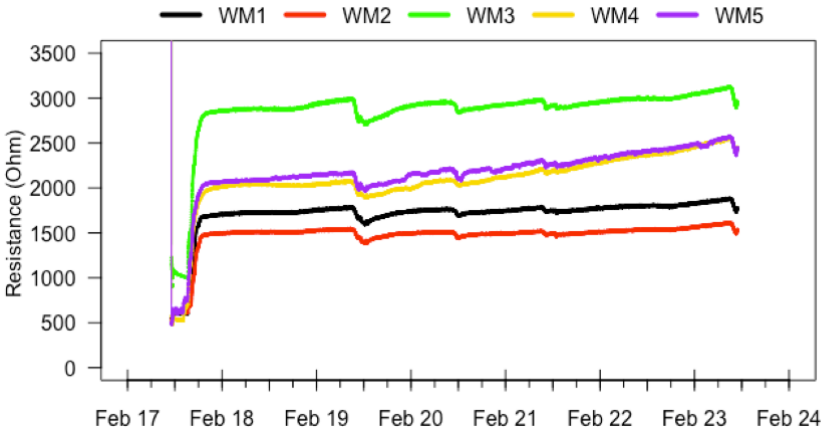
Calibration for more accuracy

- Working with low-cost sensor means more calibration!
- Soil-specific calibration with soil specialist!
- Impact of external "noise"





Ambient air emperature has low impact, except...



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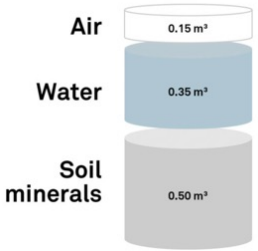
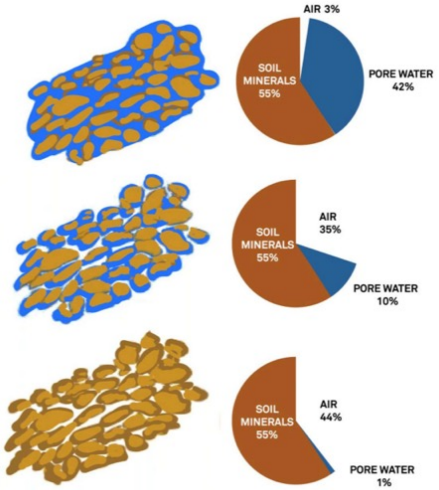
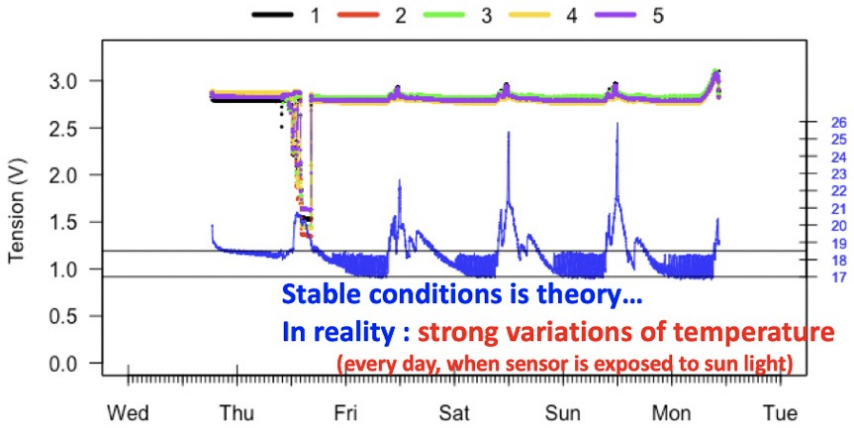
Capacitive sensor





From METER group

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

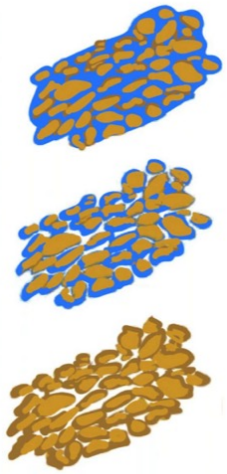


Impact of temperature ?

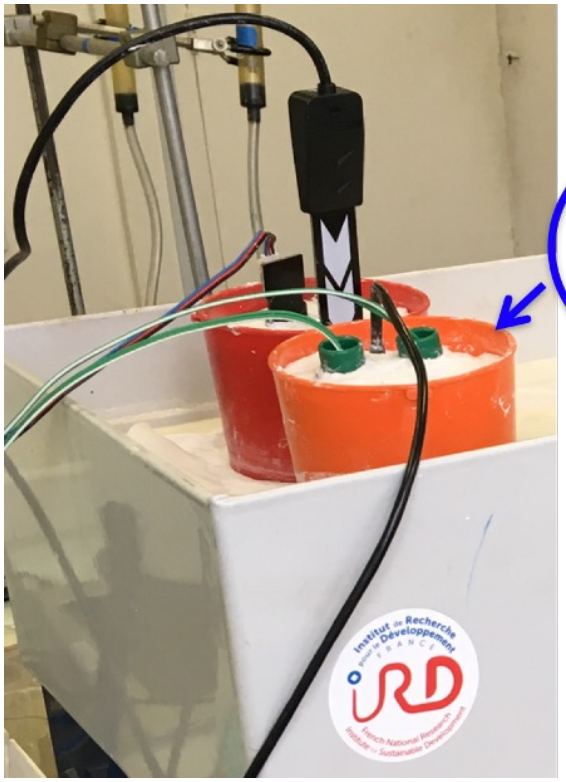
IRD in conducting extentise test on the accucary and the stability of the low-cost SEN0308 capacitive sensor

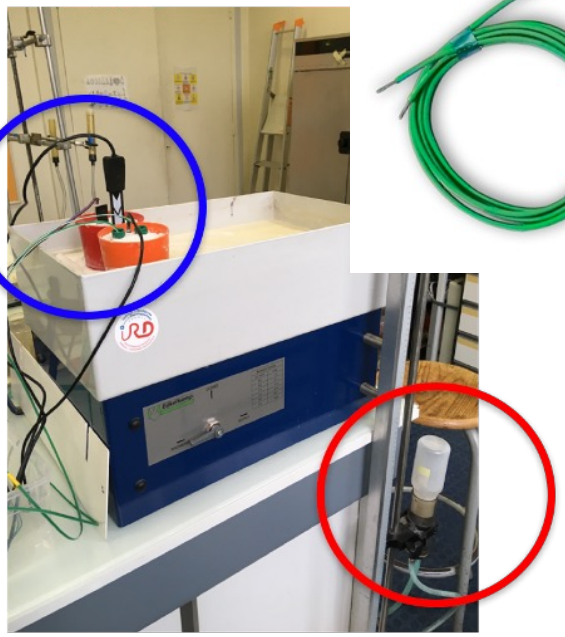
Water tension sensor

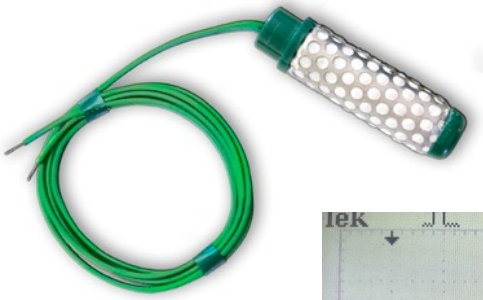
- Water tension sensor measures the amount of force required to extract water from soil's pores

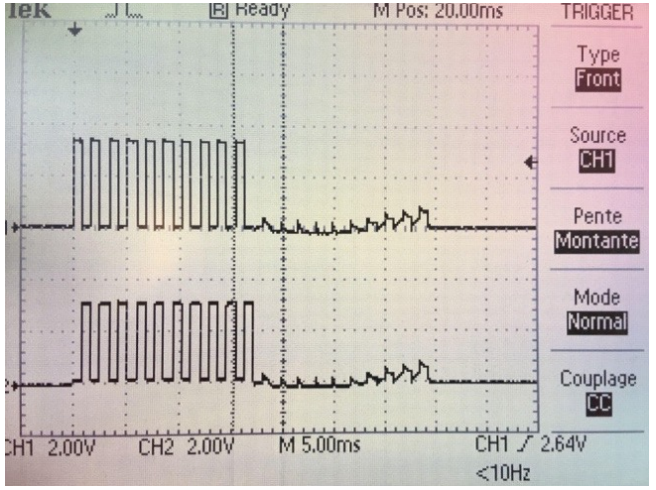


From METER group

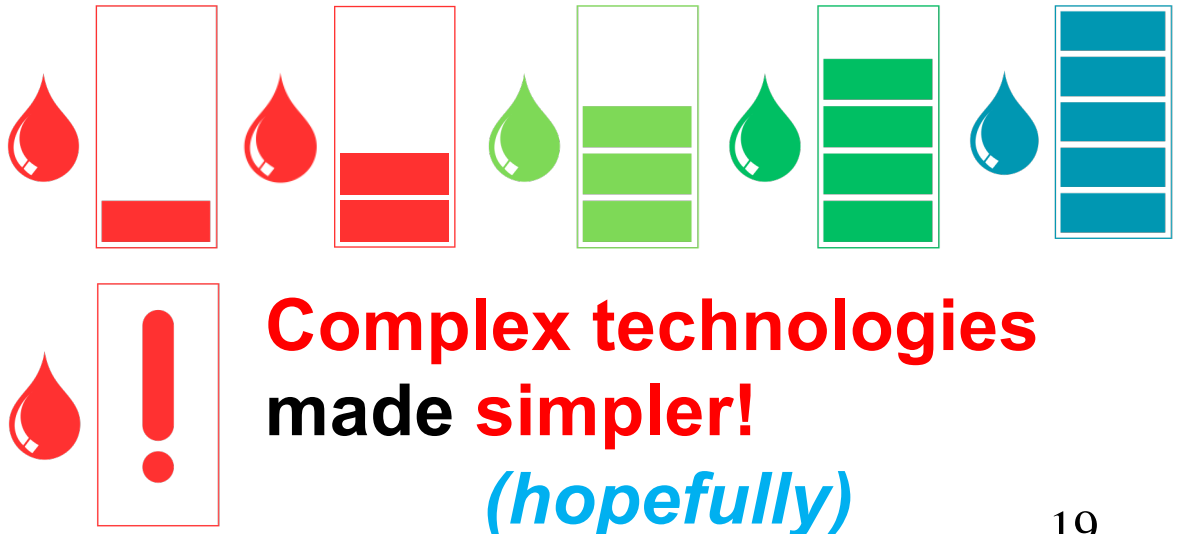








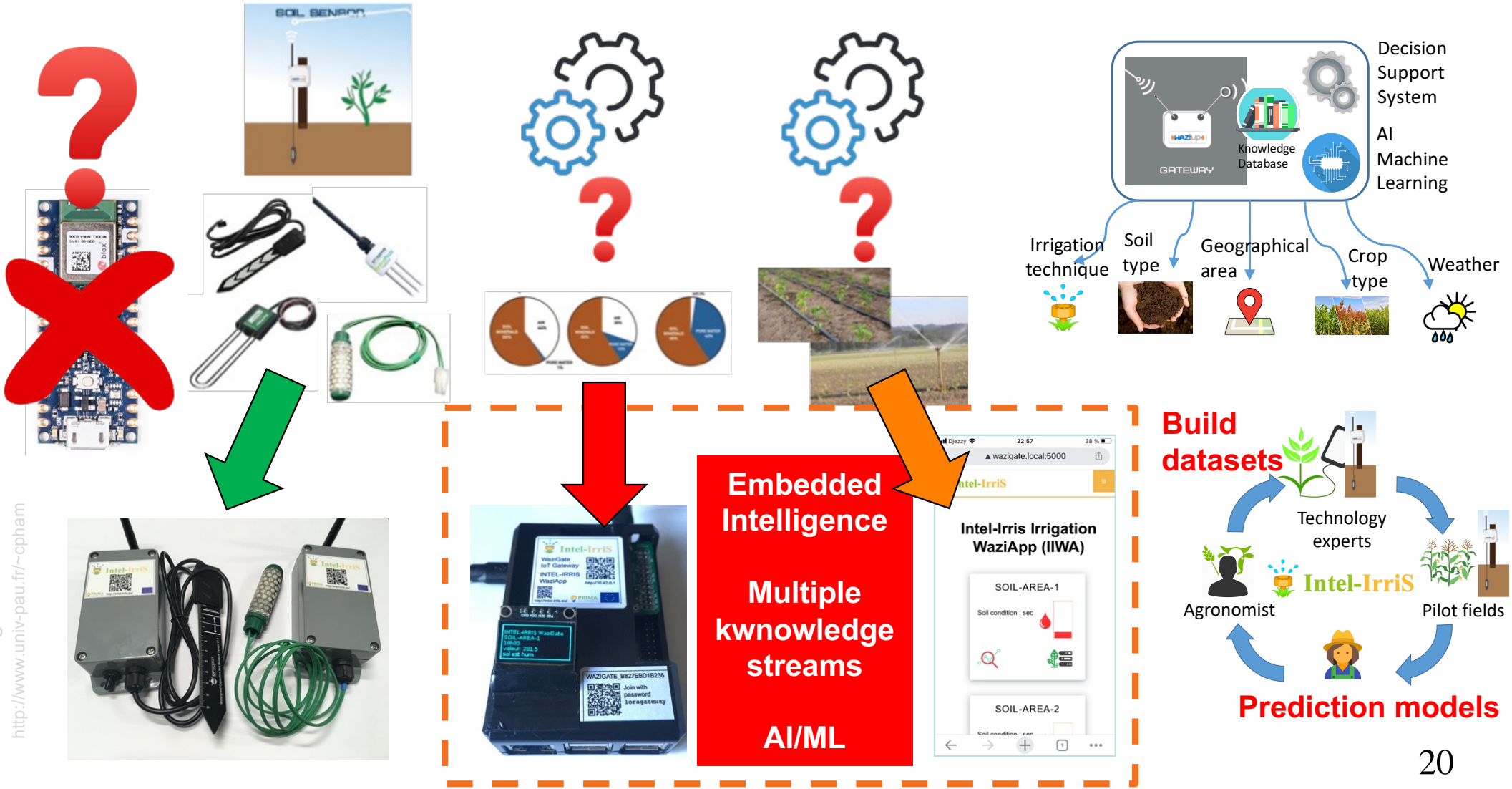
IRD in conducting extensive tests on the stability & suitability of microcontroller-based usage of the Watermark water tension sensor



Complex technologies made simpler!

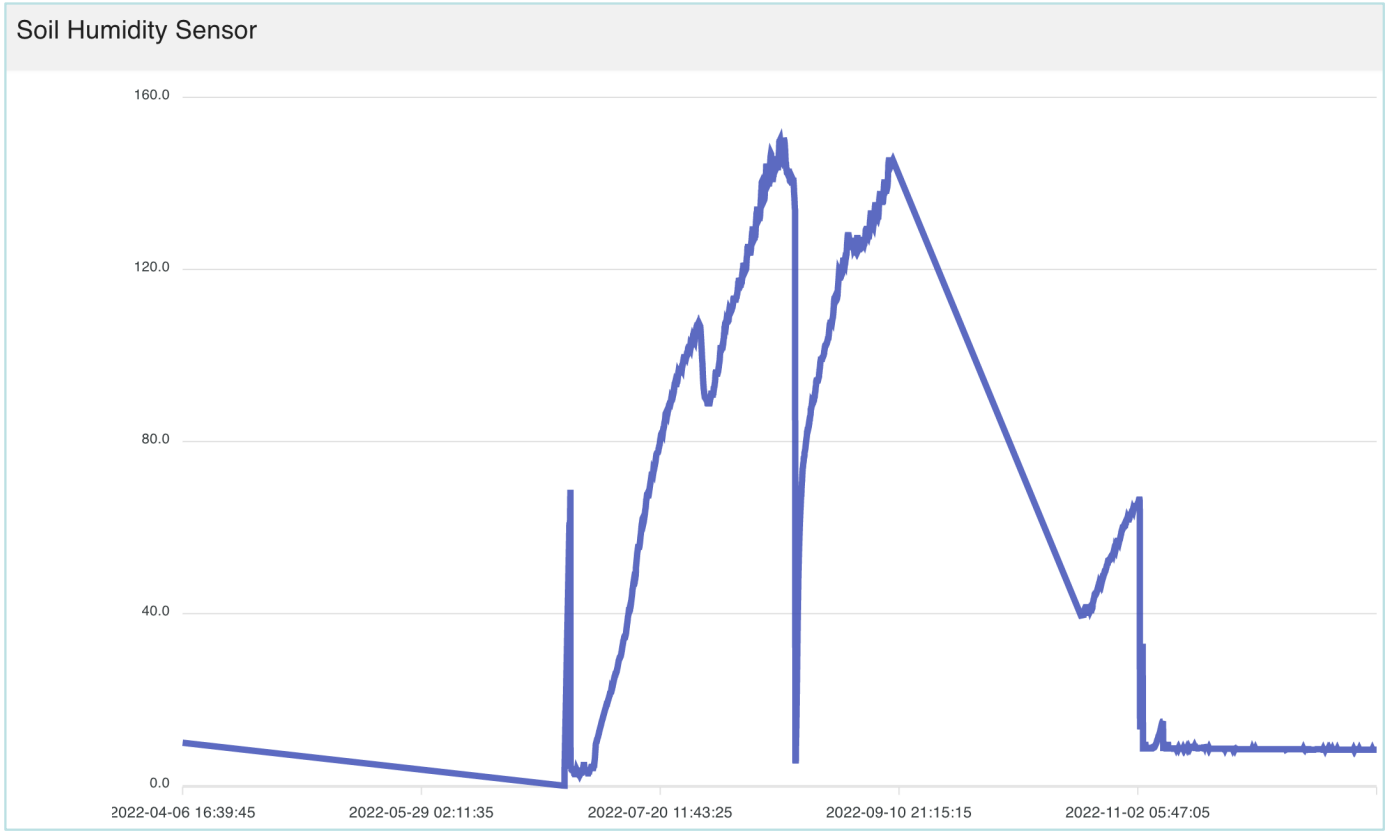
(hopefully)

INTEL-IRRIS: embedded intelligence



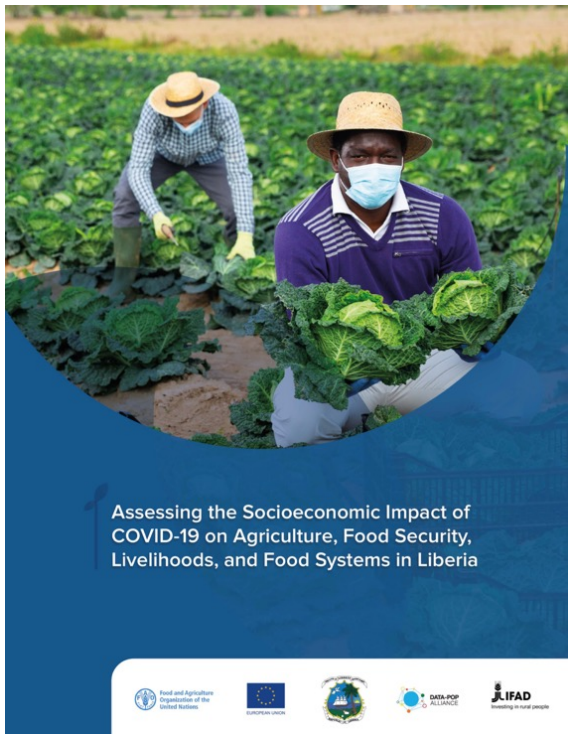
How to build irrigation datasets?

- Soil type, plant type, evaporation, weather condition,…
- Where to apply IA, how to handle irrigation cycles, …?



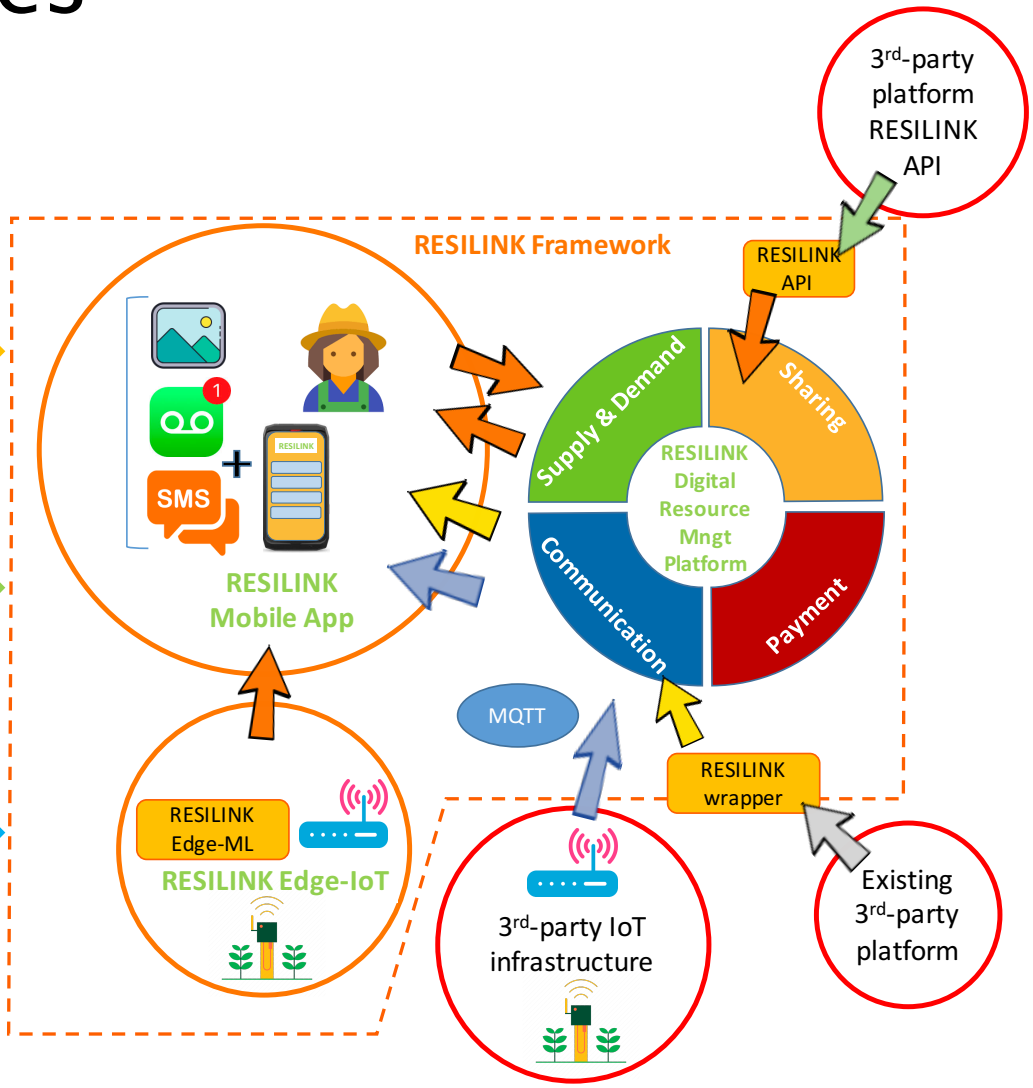
Increase smallholder's resilience?

- RESILINK will increase smallholder's resilience by providing continuity of access to both resources and markets in crisis situations



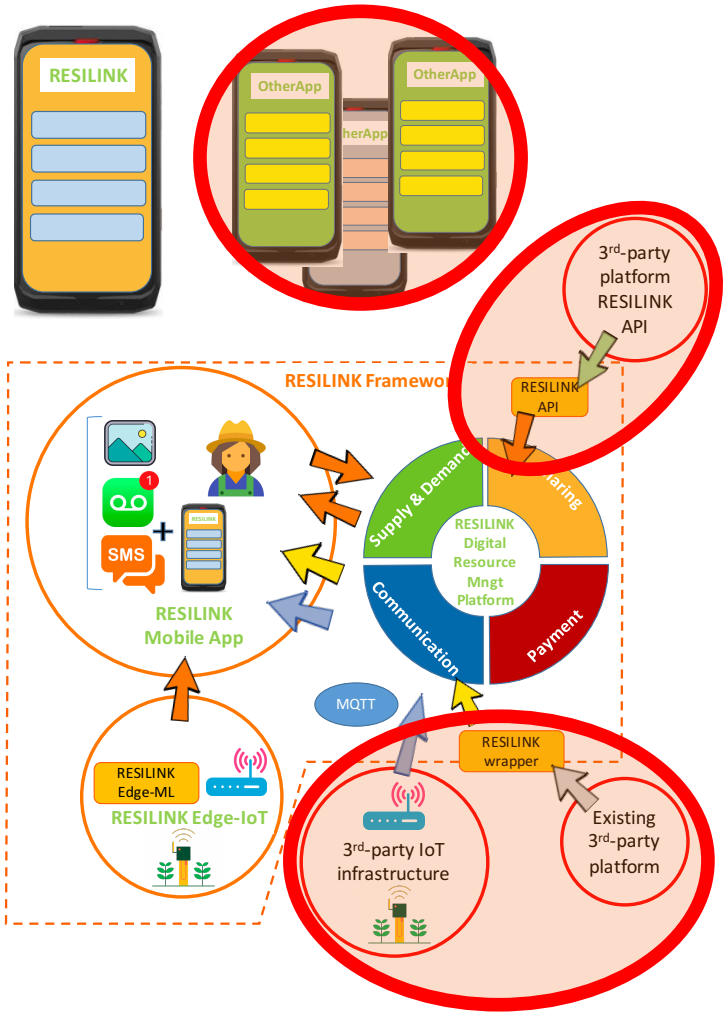
RESILINK's objectives

1. Improve the agri-food value chain by optimizing usage of local resources, generalizing local resource sharing approach and facilitating territorial markets
2. Develop distributed digital resource management platform for real-time exchange of information on territorial resources and supplies & demands; connecting smallholders to new supply, sharing opportunities and distribution channels
3. Use cutting-edge digital technologies to connect fields and farms resources, automatize and add intelligence in the agri-food value chain to provide simple application interfaces adapted to smallholders



RESILINK digital platform

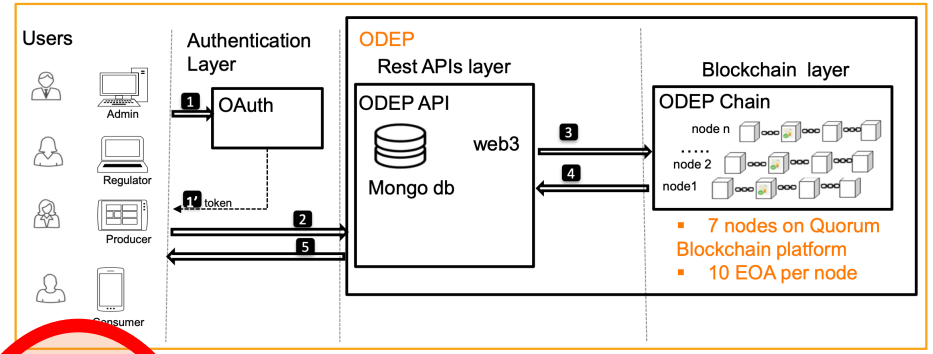
- will enable real-time exchange of information on territorial resources and supplies & demands; connecting smallholders to new supply, sharing opportunities and distribution channels
- will provide an open architecture and API to seamlessly integrate third-party platforms into comprehensive dashboards/portfolios
- The open API will enable the platform-of-platforms approach for promoting a much wider and appealing ecosystem
- Incrementally add disruptive technologies such as Internet-of-Thing (IoT), Edge Computing, Linked-Data and AI-based clustering & recommendation system

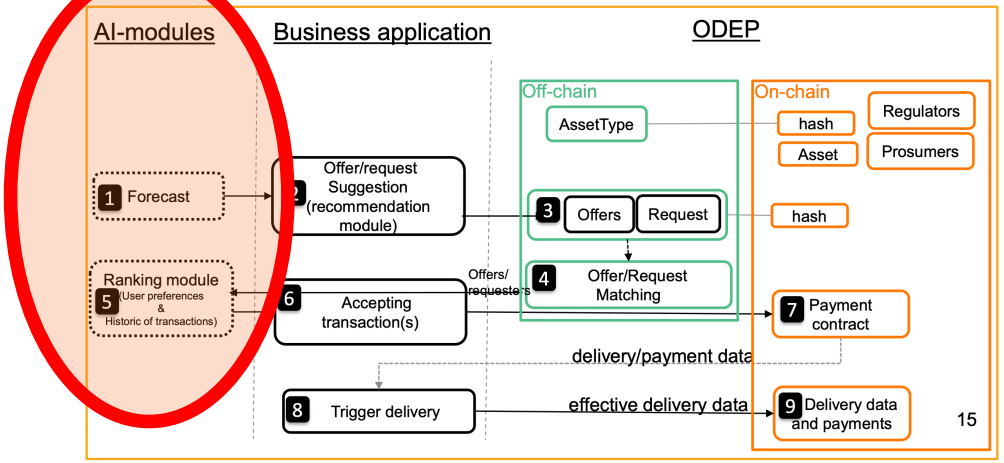


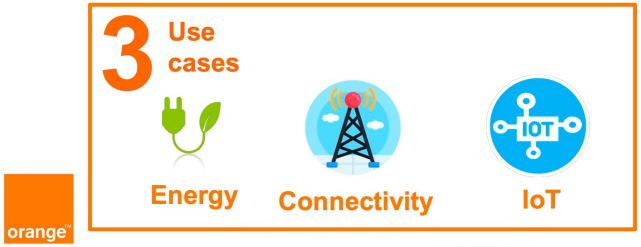
RESILINK & Orange ODEP platform

First step

Orange Decentralized Exchange Place based on Blockchain: ODEP



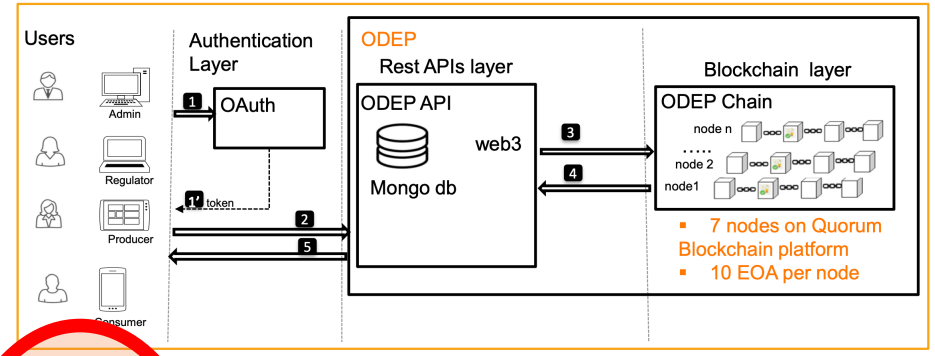


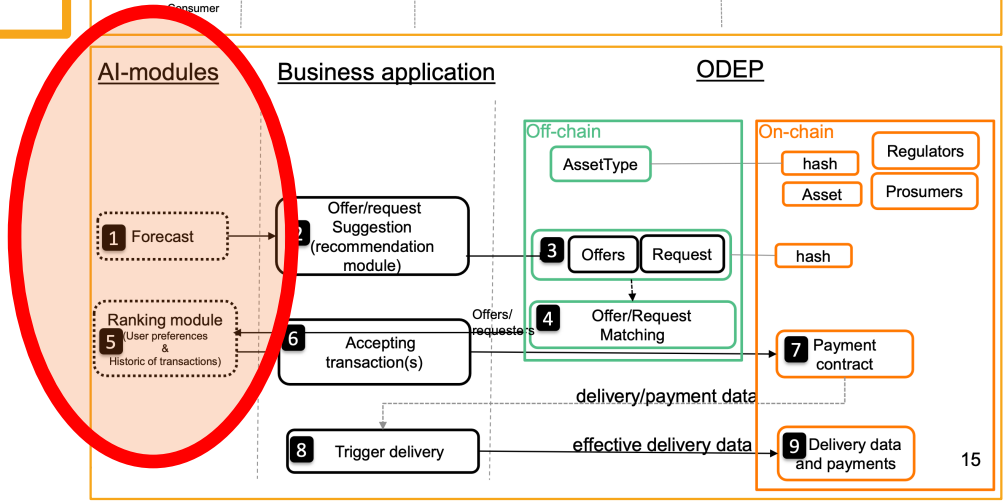


From Orange ODEP presentation. Salma Bradai, Sofrecom

RESILINK & Orange ODEP platform

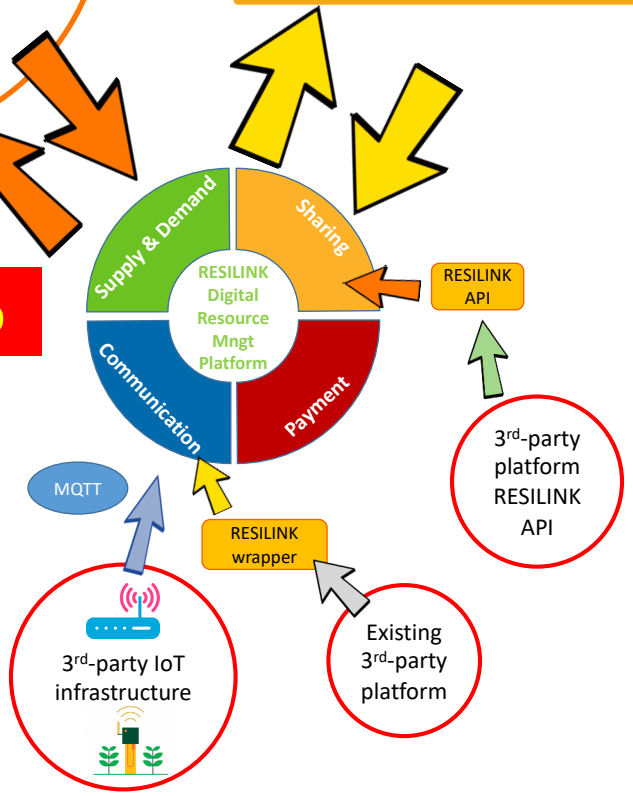
Orange Decentralized Exchange Place based on Blockchain: ODEP

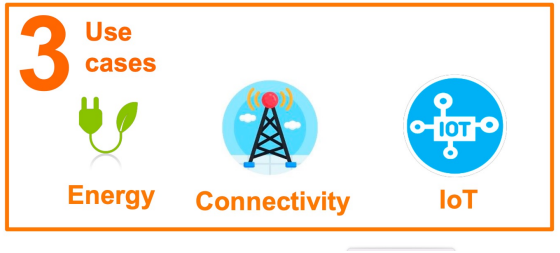




Second step

Lightweight platform to be run on Single-Computer-Board that could be locally hosted





From Orange ODEP presentation. Salma Bradai, Sofrecom

Beyond technology!

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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**

RESILINK

5 **Provide a long-term and sustainable crisis management in the agri-food value chain**

6 **Improve local innovation capacity and facilitate technology appropriation**

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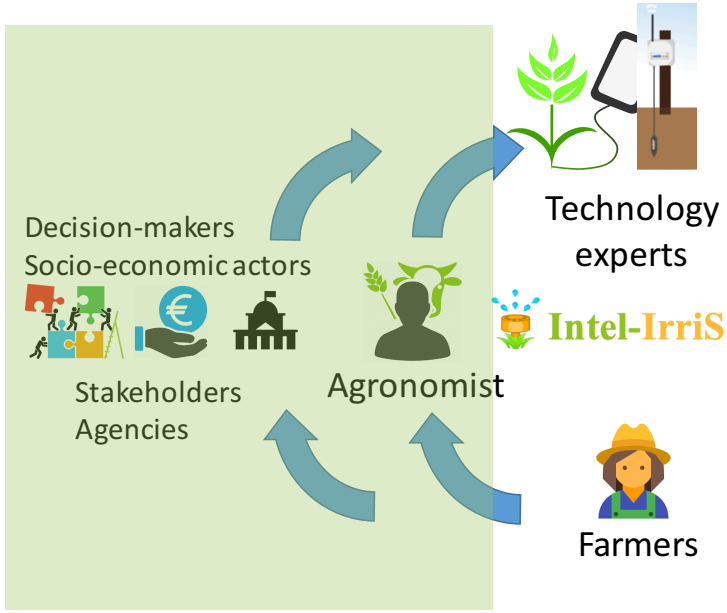
http://www.univ-pau.fr/~cpham

Collaboration with local actors

- **INSID** (Institut National des Sols et de l'Irrigation et du Drainage, Algeria)
- **INRAA** (Institut National de la Recherche Agronomique, Algeria)
- **National Institute of Vegetable Protection** (Institut National de la protection des végétaux, Algeria)
- **Direction of Agricultural Services of Oran** (Direction des Services Agricoles d'Oran, Algeria)
- **Direction of Agricultural Services of Mostaganem** (Direction des Services Agricoles de Mostaganem, Algeria)
- **Chamber of Agriculture of Mostaganem** (Chambre d'Agriculture de Mostaganem, Algeria)
- **National council of vegetable crop farmers** (Conseil National Interprofessionnel de la Filière des Cultures Maraîchères, Algeria)
- **ORMVAT** (Office Régional de Mise en Valeur Agricole du Tadla, Morocco)
- **ONCA** (Office National du conseil Agricole, Morocco)
- **Association of Irrigation Water Users** (AUEA, Association d'Usagers de l'Eau Agricole, Morocco)



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

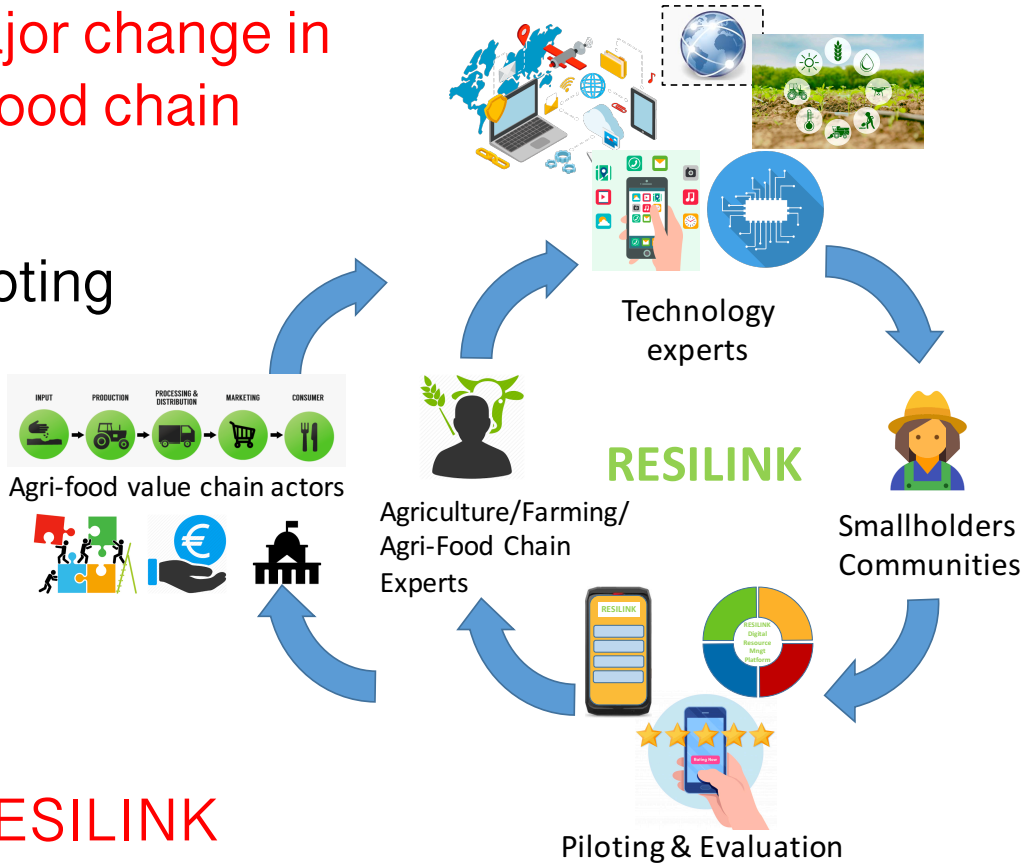
UMAB farm #1, Algeria

INRA farm #1, Morocco

INRA farm #2, Morocco

Living-Lab piloting program

- RESILINK's approach is a major change in smallholder's traditional agri-food chain
- The RESILINK "living-lab" piloting program will maximize smallholder's acceptability of these new technologies that may imply radically new practices & interaction model
- The sharing principle & the RESILINK mobile app user interface will be extensively tested for more than 2 years



Conclusions

Transdisciplinary research for a healthy planet

- 2 projects targeting smallholder farmer communities with digital platforms and embedded AI
- Although different objectives, some issues are recurrent
  - Technology readiness
  - Technology cost
  - Technology simplicity
  - Technology acceptability & trust
- Transdisciplinary research needs a lot of meetings & discussion!
  - May be obvious remarks but was definitely taking much more time than expected!
- Transdisciplinary research may lead to frustration!
  - Tradeoff in complexity & accuracy
  - Tradeoff in results & impacts

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http://www.univ-pau.fr/~cpham

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WAZIUP

IoT – from idea to reality

WAZIHUB

HUBiquitous

Paving for the next 10 years of innovation in IoT and AI

Intel-IrriS

RESILINK

Advanced and disruptive IoT/AI technologies targeting the smallholder community for increased resilience