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

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PRIMA programme

- **Partnership for Research and Innovation in the Mediterranean Area** "will devise new R&I approaches to improve water availability and sustainable agriculture production in a region heavily distressed by climate change, urbanisation and population growth"
- **Call: Section 2 Multitopic 2020**
- Thematic Area 1-Water management
  - Low cost, lean solutions for enhancing irrigation efficiency of small-scale farms
- Thematic Area 2-Farming systems
  - Re-design the agro-livelihood systems to ensure resilience.
- Thematic Area 3-Agrofood chain
  - New optimization models of the agro food supply chain system to fair price for consumers and reasonable profit share for farmers

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Consortium

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

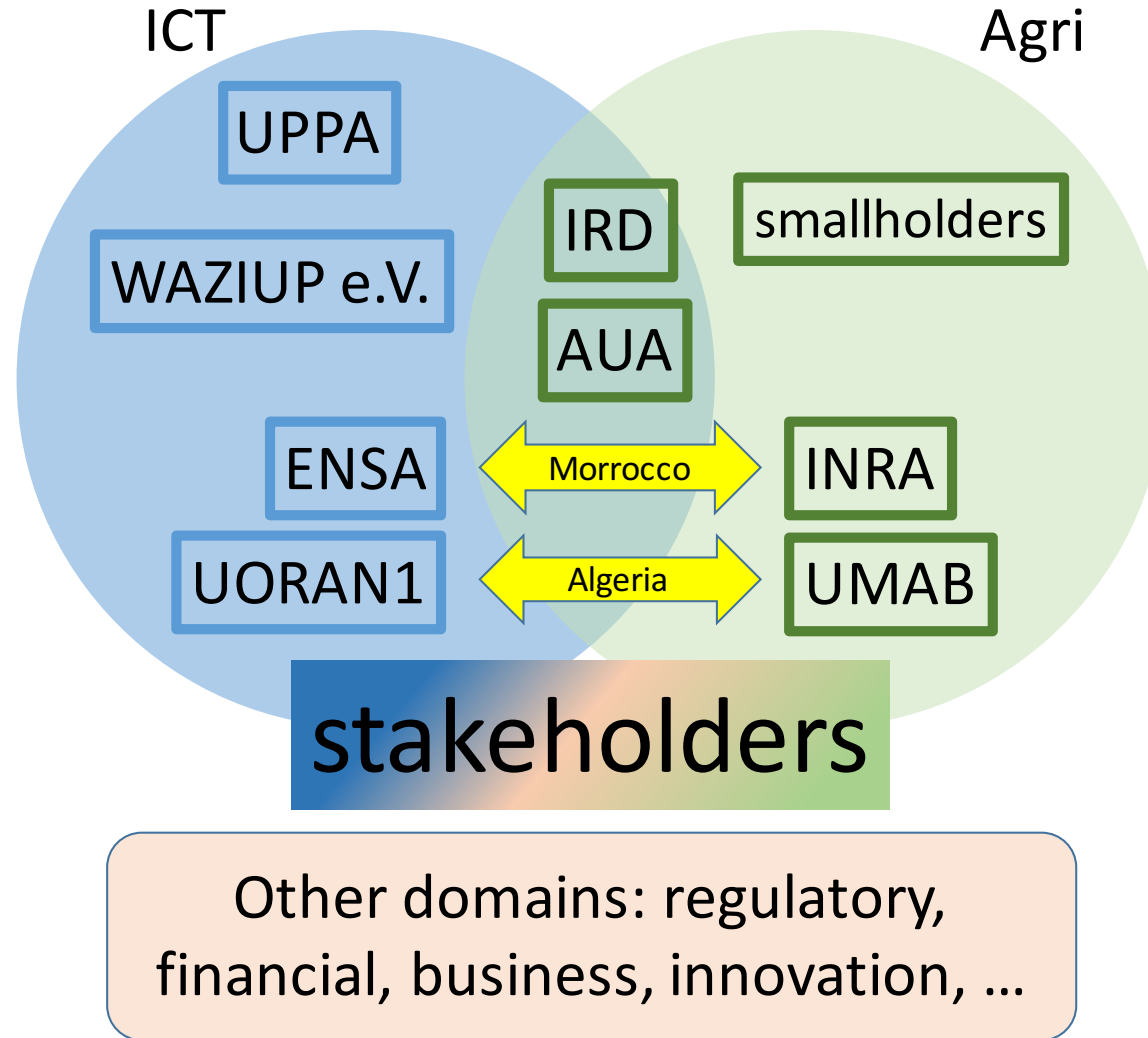**UPPA**: University of Pau & Adour Country

coordinator

France

WAZIUP eV: WAZIUP association

Germany

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Linking ICT & Agri communities

ICT   Agri

UPPA

WAZIUP e.V.

IRD   smallholders

AUA

ENSA ⟷ Morrocco ⟷ INRA

UORAN1 ⟷ Algeria ⟷ UMAB

stakeholders
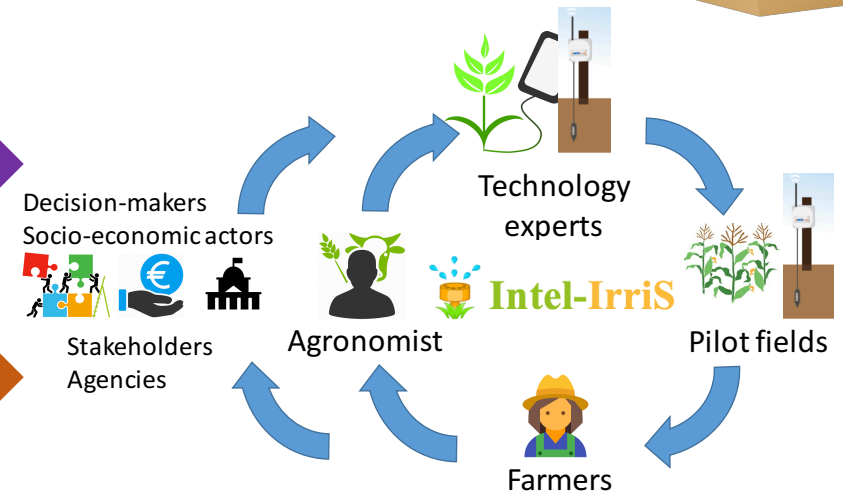
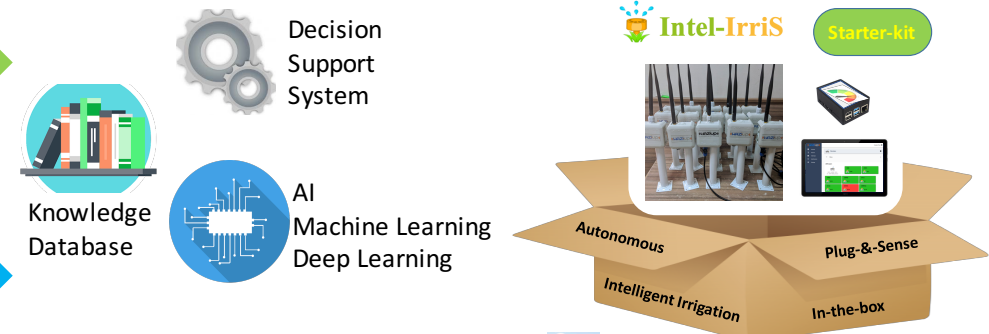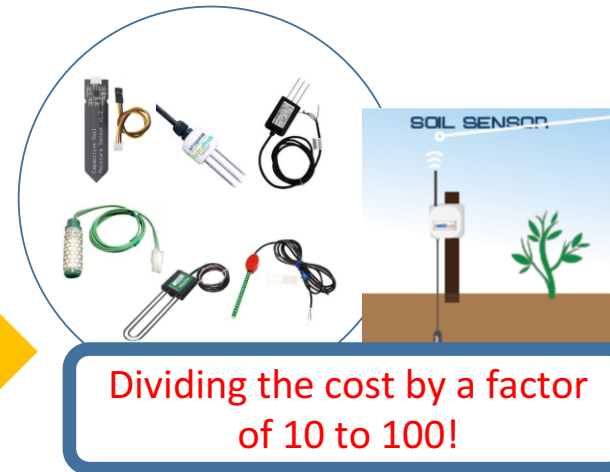Other domains: regulatory, financial, business, innovation, …
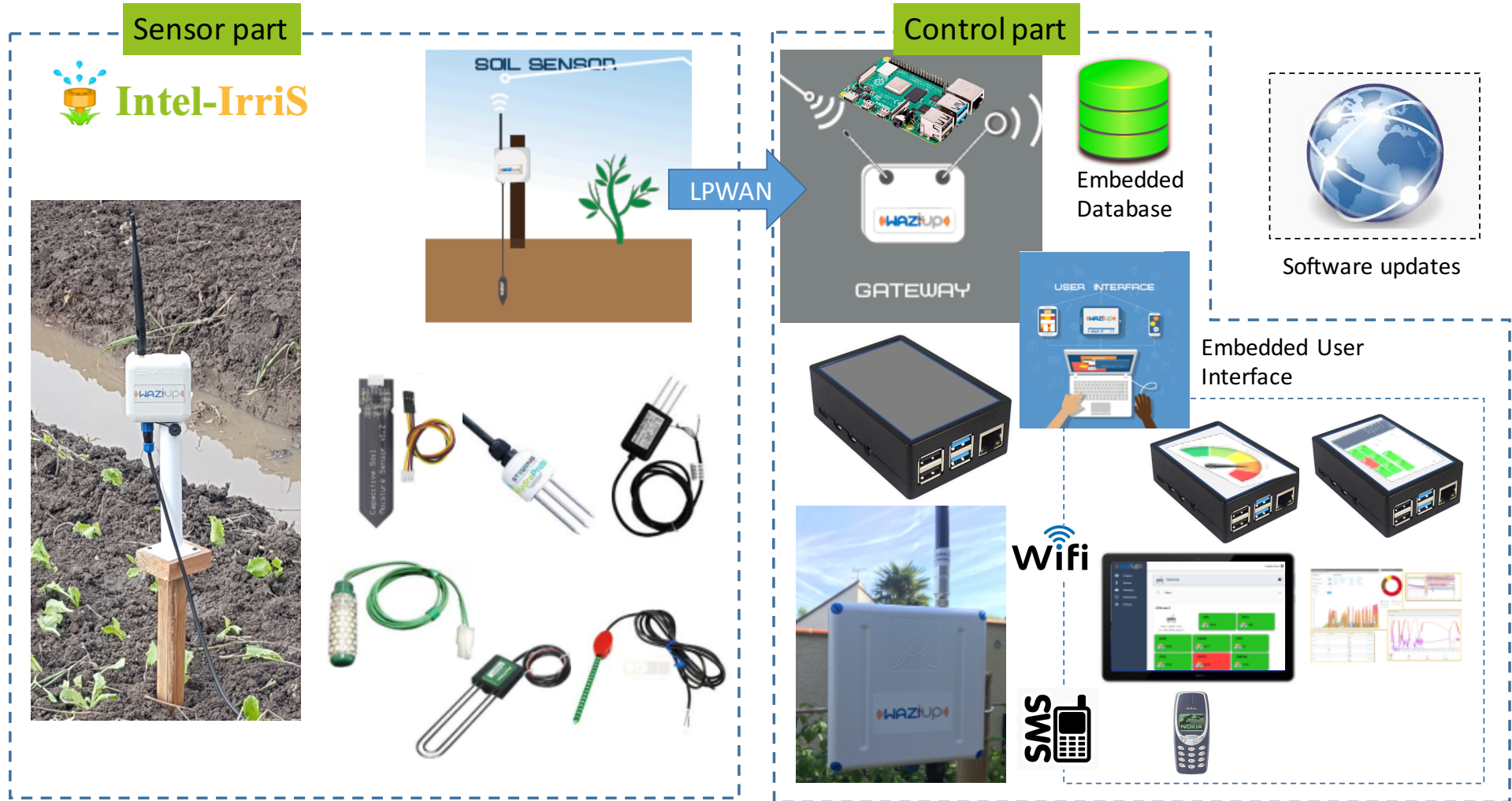
Small-scale farms / Smallholders

- According to FAO, small-scale farming has an enormous contribution to food security and to rural economy

- Water resource is one of the major constraints and the situation is foreseen to worsen

- A smart irrigation process can adapt water usage (i) for a particular crop, (ii) at a particular moment and (iii) for a given soil type and condition

- BUT, adoption of solutions enhancing irrigation efficiency has not reached the small holder farmers, primarily due to the high initial cost and high skills requested to master the technology

- **Intel-IrriS will reduce the cost of smart technologies for smallholders, increase adoption and long-term smallholders' sustained production and income**
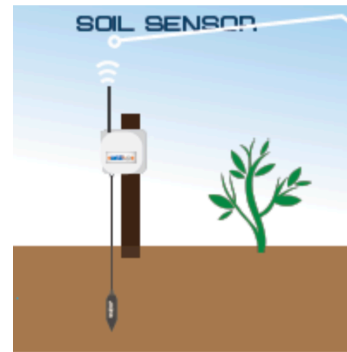
Objectives

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

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

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

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

Dividing the cost by a factor of 10 to 100!

Knowledge Database

Decision Support System

AI Machine Learning Deep Learning

Intel-IrriS   Starter-kit

Autonomous   Plug-&-Sense
Intelligent Irrigation   In-the-box

Decision-makers
Socio-economic actors

Stakeholders
Agencies

Agronomist

Intel-IrriS

Technology experts

Pilot fields

Farmers

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Technology components

Low–cost sensors

Sensor part

- Build on low-cost, low-power IoT expertise
- Increase accuracy of low-cost sensors by automatic and remotely controlled procedures for advanced calibration
- Enable deployment of several complementary low-cost sensors
- Include agricultural models / knowledge with corrective & predictive analytics

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Smart embedded control

- Build on low-cost embedded & open IoT gateway expertise
- Implement the "Intelligent Irrigation in-the-box" with "plug-&-sense" approach
- Model complex water-soil-plant interaction
- Embed Decision Support System (DSS) and disruptive Artificial Intelligence (AI)
- Integration of various knowledge streams
- Fully autonomous

Control part

GATEWAY

Embedded Database

Software updates

USER INTERFACE

Embedded User Interface

Wifi

SMS

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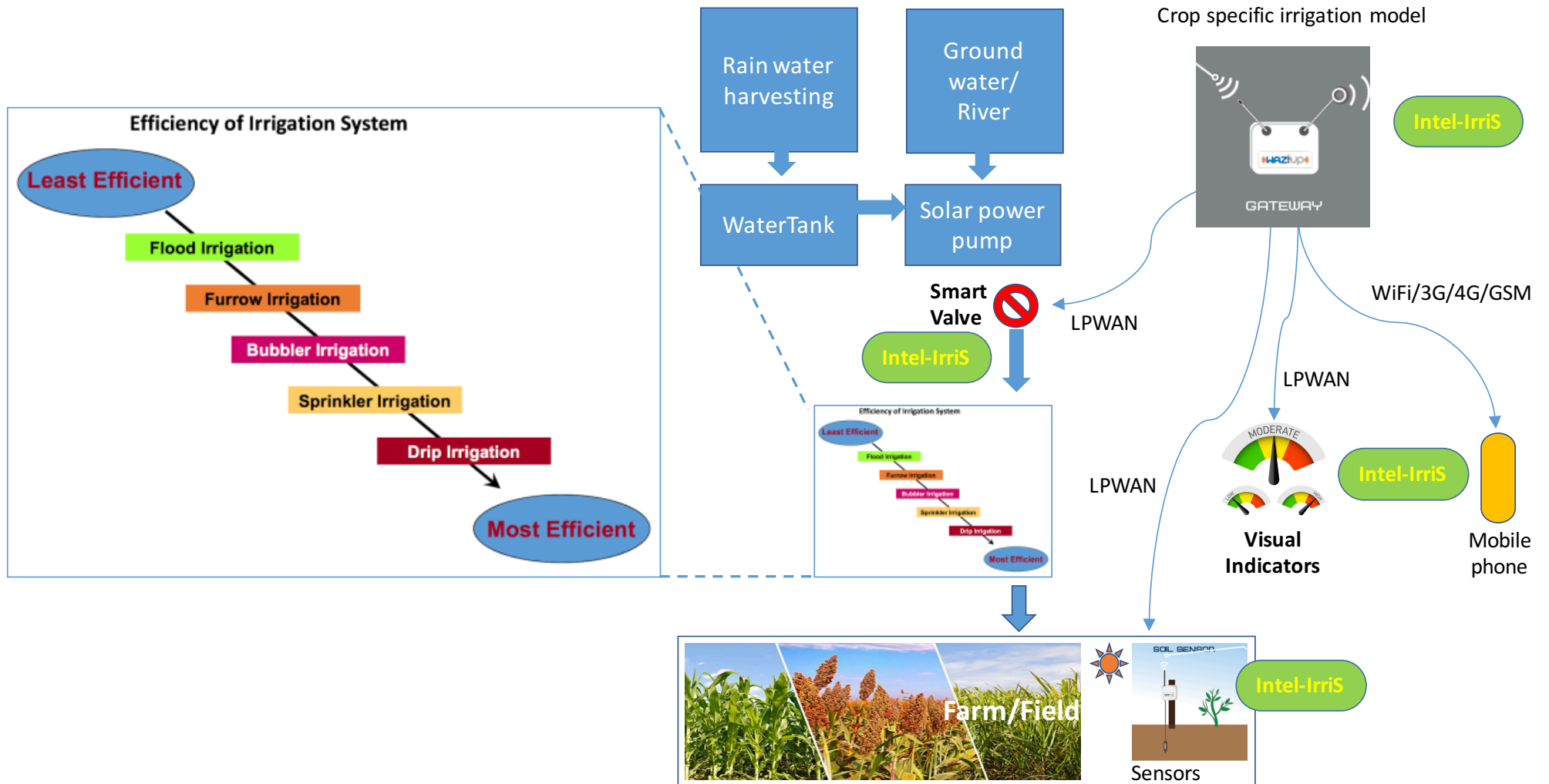http://www.univ-pau.fr/~cpham

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Starter–kits

- "Intelligent Irrigation in-the-box", "plug-&-sense"
- At least 100 starter-kit will be distributed

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Seamless integration

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It is NOT ONLY about technology!

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

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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

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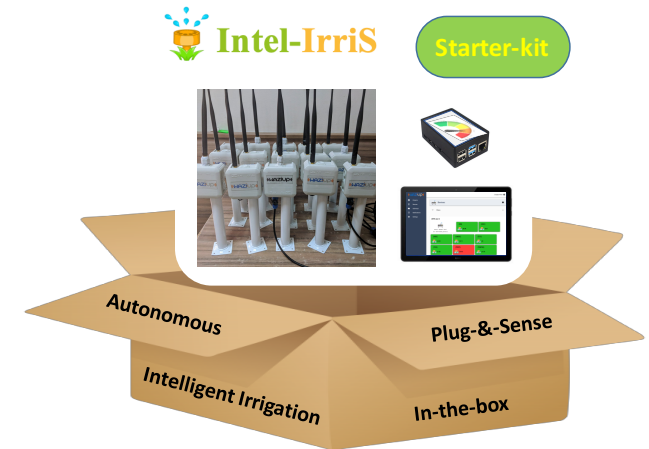
Dissemination Events

- Create/raise awareness about the smart low-cost irrigation system technologies & innovations to a large variety of audience
    - smallholders, farmers/rural communities
    - specialized audience, local technology actors (tech-enthusiasts, startups/entrepreneurs), FabLabs, Digital Innovation Hubs/TechHubs
    - economic multipliers, stakeholders, government agencies, policy makers, agri/water-related agencies/institutes & regulatory bodies
    - non-specialized audience, general public
    - research communities
- At least 10 dissemination events to showcase technologies, show opportunities and stimulating synergies between various local actors
- Recruit for Smallholder Piloting Program and distribution of starter-kits

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Farmer Training Program

- Run in parallel to the Smallholder Piloting Program

- Increase smallholders' knowledge so that they can familiarize with the proposed technologies, tools and practices

- Specific training materials will be created for that purpose and dedicated training sessions will be organized in coordination with the Smallholder Piloting Program

- Increase engagement of final users

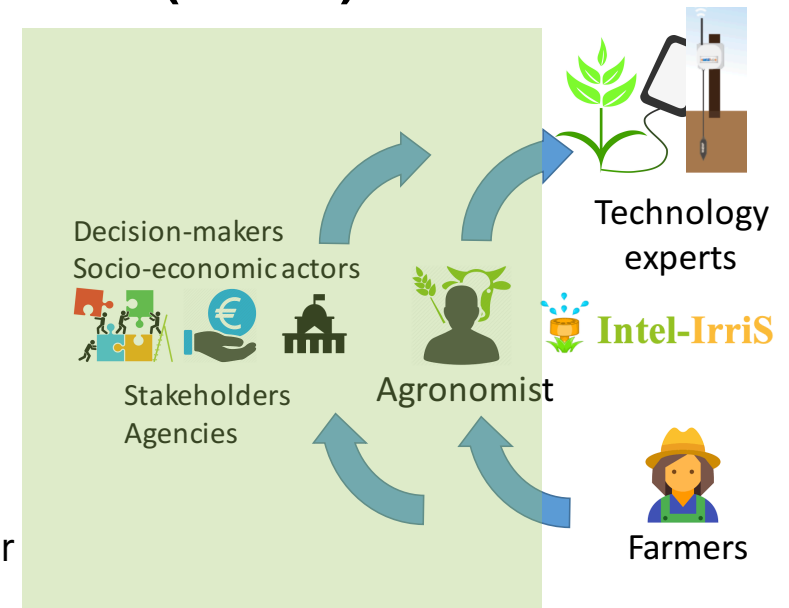- Recruit for Smallholder Piloting Program and distribution of starter-kits

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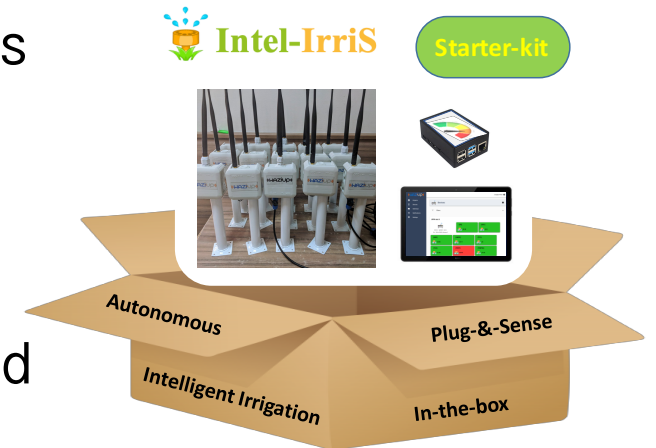
Competitions & Challenges

- Increase awareness and engagement from the local Tech Community
  - tech-enthusiasts, hobbyists,
  - entrepreneurs, startups, …
- on key technologies implemented by Intel-IrriS
  - IoT, data science,
  - AI, MachineLearning, DeepLearning
- Datasets provided by the Smallholders Piloting Program
- Contribute to capacity building and scaling-up
- Objective to reach the whole African tech community

Creating synergies
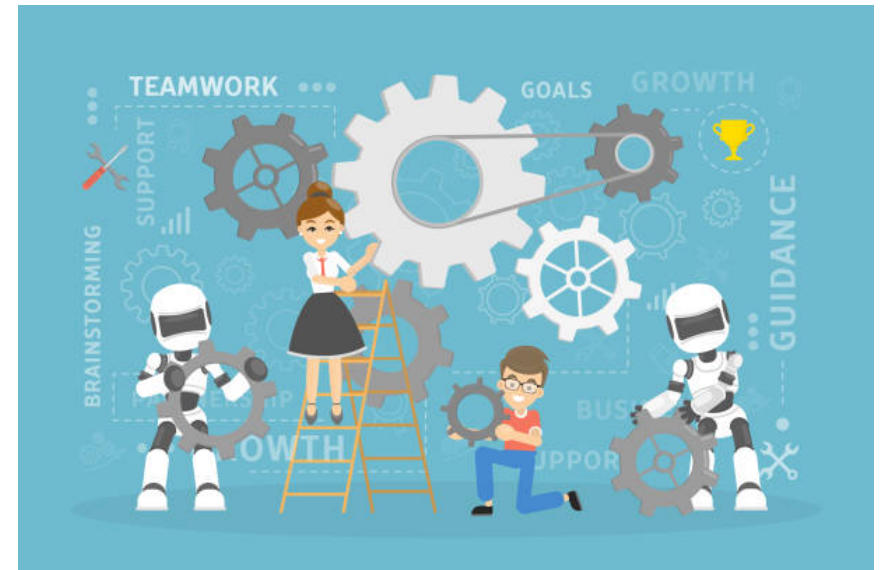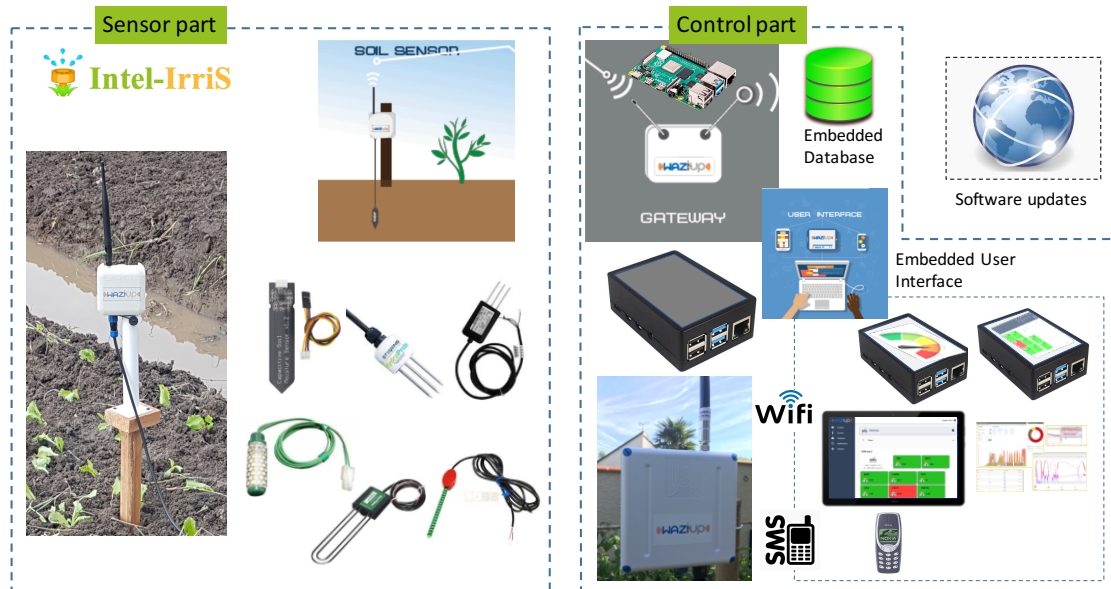
- Stakeholders, government agencies, decision/policy makers, agri/water-related agencies/institutes & regulatory bodies, economic multipliers

- **Stakeholders & Experts Advisory Committee (SEAC)**
  - At least 15 local actors
  - **ORMVAT** (Office Régional de Mise en Valeur Agricole du Tadla, Morocco),
  - **ONCA** (Office National du conseil Agricole, Morocco),
  - **INSID** (Institut National des Sols et de l'Irrigation et du Drainage, Algeria),
  - **INRAA** (Institut National de la Recherche Agronomique Algérie),
  - **Filaha Innov** (Innovative idea catalust in Maghreb for Agriculture, Agrofood and Aquaculture, Algeria)
  - **Direction of Agricultural Services of Oran** (Direction des Services Agricoles d'Oran)

Decision-makers
Socio-economic actors

Stakeholders Agencies

Agronomist

Technology experts

Intel-IrriS

Farmers

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Exploitation & Sustainability

- Exploitable project outcomes
  - hardware and software building blocks for low-cost, low-power and long-range connected generic IoT
  - a suite of open-source and modular components to build a complete sensor-gateway system with a fully customizable embedded web user interface
  - an embedded Decision Support System and AI-based processing framework to locally process collected data
  - a multi-level, multi-stream agricultural data framework for integration into advanced decision support system
  - advanced soil-water-plant interaction models to increase accuracy of low-cost sensor systems
- Adaptation to a larger variety of application domains
- Access to technology ➡ **SolutionLab**

Intel–IrriS's SolutionLab

- Provide access to technologies developed by Intel-IrriS
- SolutionLab = FabLab + Intel-IrriS's technologies
- Hardware + all software frameworks
- Learn, Prototype, Develop, Improve, Innovate, Tests & Demonstrators

KPIs

KPI_1 (COST): Low-cost generic smart irrigation system	Obj.1 Obj.2 Obj.3	The cost of a connected sensor ready to be deployed does not exceed 25€. The cost of the smart control system able to handle hundredth of sensors to start at about 55€. **A starter-kit to start at about 80€.**
KPI_2 (WATER): Water efficiency	Obj.2 Obj.3	**Reduce water usage by at least 15%**
KPI_3 (EFFICIENCY): Number of environments/conditions	Obj.2 Obj.3	Validate efficiency with at least **8 different combinations of plants variety, soil types, climatic, irrigation techniques**.
KPI_4 (PILOT): Number of small-scale farms engaged in piloting program	Obj.2 Obj.3 Obj.4	Engage at least **20 small-scale farms in the piloting program** to test in various environments and conditions (different soils types, crops, irrigation practices) the low-cost smart irrigation control system to provide feedbacks for co-design and adaptation.
KPI_5 (ENGAGEMENT): Number of smallholders willing to test the Intel-IrriS solution	Obj.4	Raise interest from at least **100 smallholders for testing** the low-cost smart irrigation system.
KPI_6 (STARTER-KIT): Number of "starter-kit" distributed during events	Obj.4	Distribute (free of charge) at least **100 "starter-kit"** demonstrating low-cost smart technologies for smallholders during dissemination events.
KPI_7 (SYNERGY): Number of external stakeholders/actors	Obj.4 Obj.5	Bring at least **15 local/regional/international actors** (scientists, experts, stakeholders, companies, decision-makers, water & irrigation planners, etc). A *Stakeholders & Experts Advisory Committee* (SEAC) will be formed to drive discussions and create synergies.
KPI_8 (DISSEMINATION): Number of dissemination events	Obj.4 Obj.5	Schedule and animate at least **10 communication & dissemination events** to create awareness on new smart technologies for low-cost irrigation systems to demonstrate the smallholders approach.
KPI_9 (INNOVATION): Number of entrepreneurs/startups interested in exploitation	Obj.4 Obj.5	Raise interest from at least **10 entrepreneurs/startups** to further adapt the Intel-IrriS platforms for further innovations and commercialization purposes, possibly in other domains than irrigation.
KPI_10 (COLLABORATION): Number of actions with local actors	Obj.5	Initiate at least **5 actions with local actors** on water-related issues.

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