IRIDA

Innovative Remote and Ground Sensors, Data and Tools into a decision support system for agriculture water management

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Water JPI
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CONSORTIUM DESCRIPTION

ACRONYM	TOPIC	Coordination	Partners
IRIDA	**2**		
Innovative Remote and Ground Sensors, Data and Tools into a decision support system for agriculture water management		**big-data analysis; evapotranspiration; irrigation scheduling; plant water status; soil water status; weather forecasts**	

PRINCIPAL INVESTIGATOR	INSTITUTION	COUNTRY
Diego Intrigliolo **Juan J. Alarcón**	**Agencia Estatal Consejo Superior de Investigaciones Cientificas - CEBAS**	**Spain**
Daniel Rodriguez Ana Cerezo	Innovati Servicios Tecnologicos, S.L.	Spain
Pablo J. Zarco-Tejada Luca Testi	Agencia Estatal Consejo Superior de Investigaciones Cientificas - IAS	Spain
Simona Consoli	University of Catania	Italy
Giancarlo Roccuzzo	Consiglio per la Ricerca in Agricoltura e l'Annalisi dell'Economia Agraria	Italy
Elena Mateescu	National Metereological Administration	Romania
Johannes Deelstra	Bioforsk- Norwegian Institute for Agricultural and Environmental Research	Norway

Problem analysis

- In Europe, 24% of water abstraction is used by agriculture, and in Southern European Member States, which are often characterized by chronic water scarcity, agriculture accounts for 74% of the total water use.

- There are still uncertainties in correctly determining the components of the water balance and particularly evapotranspiration (ET) in order to:
  - **-improve irrigation efficiency**
  - **-determine the ecosystem water balance** for better prediction of runoff soil erosion, and nutrients leaching to the environment.

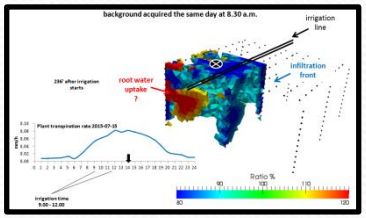
General goal

- The **general objective** is to develop and validate new procedures for determining ET and soil and plant water status. The obtained results will be incorporated into a modular DSS capable to provide end-users recommendations for:
  - 1) on-farm irrigation scheduling in semi-arid and humid regions of Southern and Northern Europe, respectively
  - 2) farming practices and catchment scale water management for the humid Northern Europe mixed agriculture and forestry areas.

Specific objectives (1 to 2)

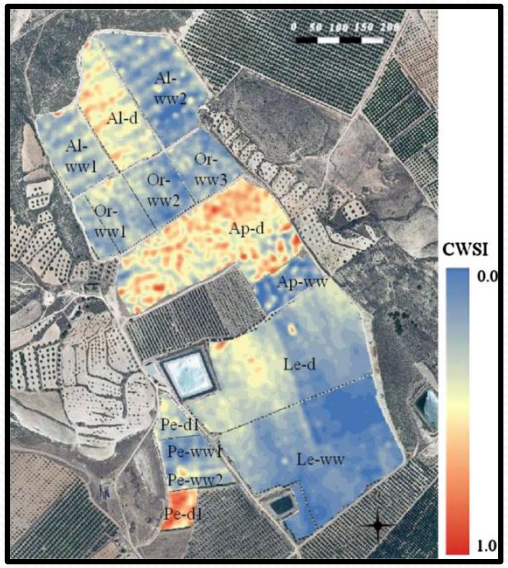
1. To develop a new robust low-cost sap flow sensor equipped with a single thermocouple per gauge able to continuously determine tree water status

2. To determine the usefulness of innovative procedures for determining soil moisture temporal dynamics and soil-plant interactions using minimally invasive 3D micro-electrical and geophysical Electrical Resistivity Tomography (ERT.)

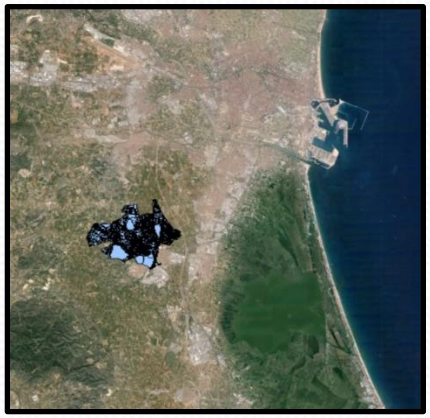


Specific objectives (3 to 4)

3. To design a procedure for mapping the spatial variability of water status and irrigation needs by using high-resolution thermal and hyperspectral imagery acquired by manned aircraft, UAV to detect representative locations for on-the ground sensors installation.



4. To study relations between continuous on-the ground ET measurements and actual ET obtained by SEBAL model from thermal and hyperspectral images

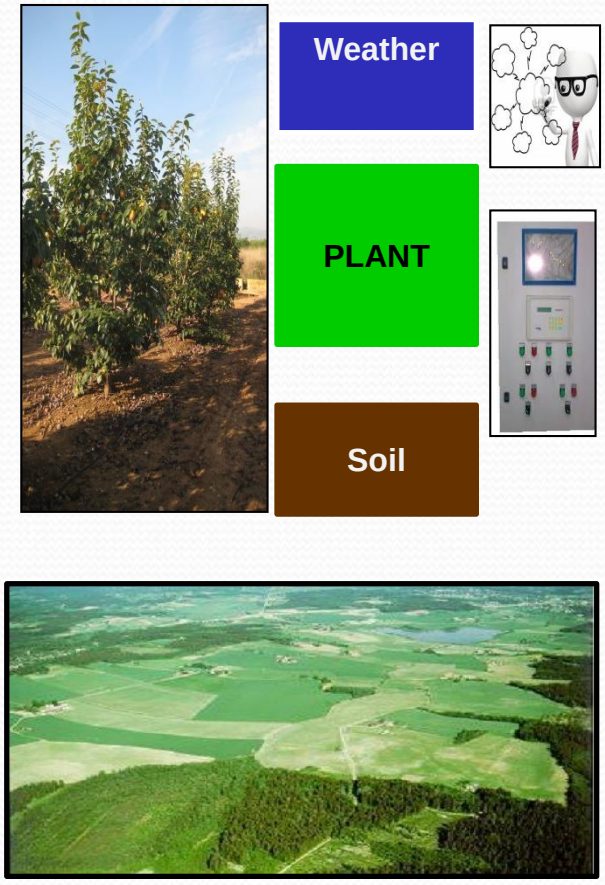


Specific objectives (5)

5. To integrate the obtained sensors data and model predictions into a modular DSS able to:

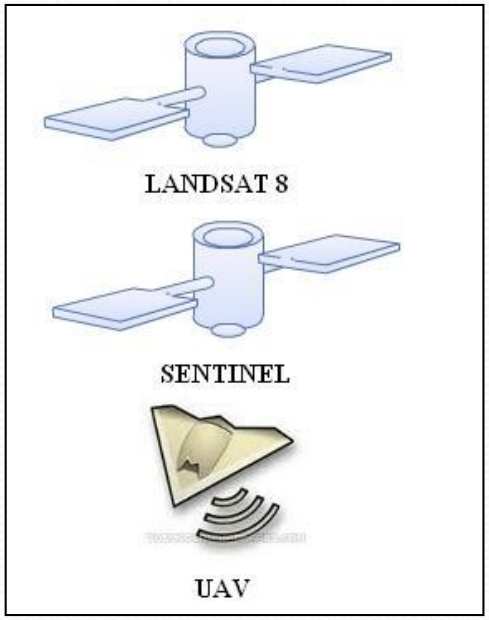
   1) delivering recommendations for on-farm irrigation scheduling from either measured or modelled ET,

   2) determining and visualizing ET from the plot to the catchment scale in order to estimate potential soil erosion and nutrient pollution risks.



Innovative aspects

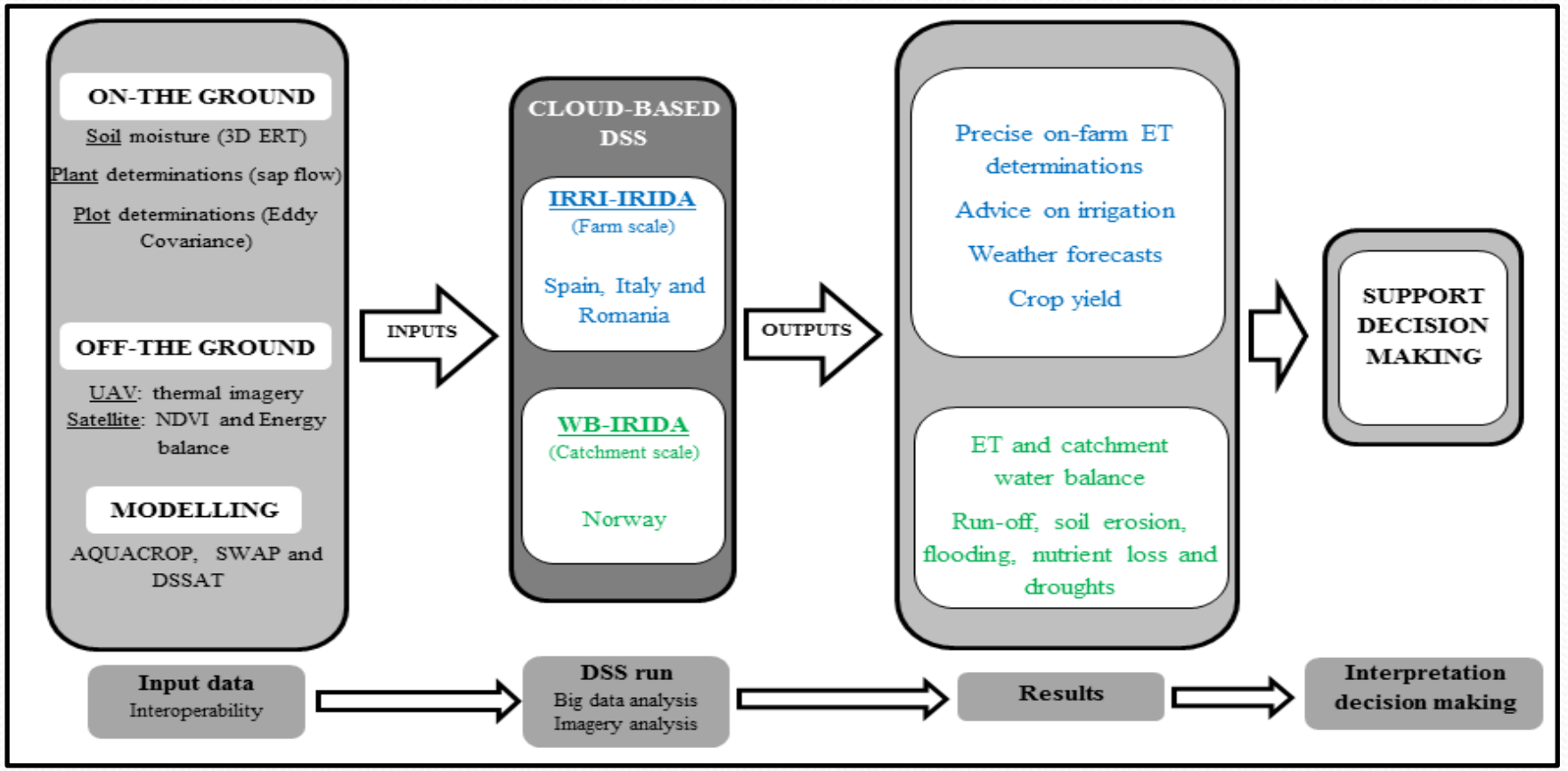
- IRIDA will relate isolated plant and soil ET measurements provided by lower spatial resolution methods with the analysis of images provided by UAV, or Landsat to solve the upscaling problem. This will increase the accuracy of ET and water balance tasks such as weather predictions, analysis of hyperspectral and thermal imaging or derived needed indicators data to be used in water consumption models.



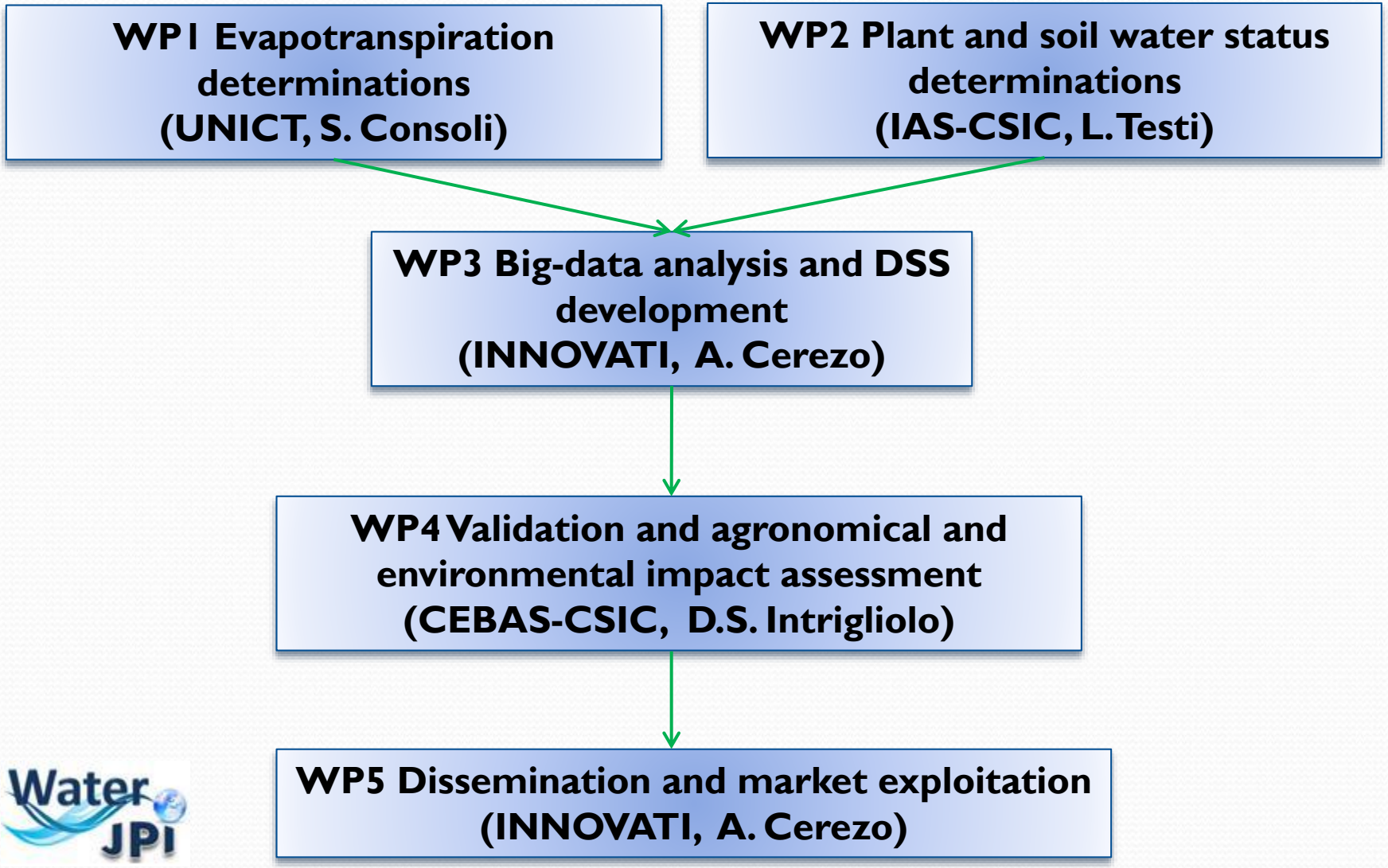
Innovative aspects

- IRIDA will use communication based on M2M protocols for transmission of information. This includes the possibilities that 5G brings to the Internet of Future and Things combined with wireless sensor networks for distributed information communication and for data processing considering Big Data Technologies to support the four V's: Variety, Volume, Velocity and Value.

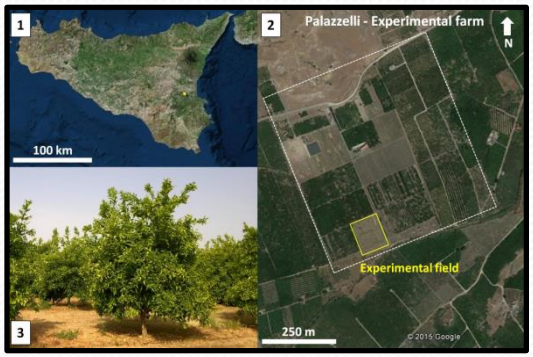
Work flow and approach

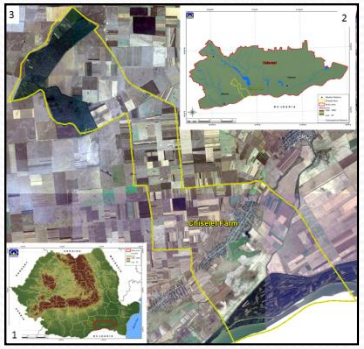


Work flow and approach



Demo areas





Southern Europe)
(citrus and peach orchards and irrigation districts)

Eastern Europe
(Cereal crops)

Northen Europe
(Agro-forestry systems)

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Main deliverables

WP1 Evapotranspiration determinations

- D1.1 New low-cost sap flow sensor. 3 set of gauges, specification and user manual.
- D1.2 Procedures for using sap flow for determining ET in fruit and forest trees.
- D1.3 Algorithms for upscaling ET measurements from on-ground measurements to field or small catchment scale using remote sensing and modeling.

Main deliverables

WP2 Plant and soil water status determinations

- D2.1 Protocols for determining the soil water balance using the 3D Electrical Resistivity Tomography technology.

- D2.2 Procedures for determining representative location within a field when measuring soil and plant water status.

Main deliverables

WP3 Big-data analysis and DSS development

- D3.1 Report on routines and algorithm for big-data analysis and image processing.
- D3.2 IRIDA DSS available in cloud server with demo facilities available.
- D3.3 Smartphone Apps for android and iOS.

Main deliverables

WP4 Validation and agronomical and environmental impact assessment

- D4.1 Agronomic validation of the IRIDA protocol for scheduling precise full and deficit irrigation based on plant and soil water status information.
- D4.2 Agronomic validation of the IRIDA protocol for scheduling precise full irrigation based on crop modelling and weather forecasts.
- D4.3 Environmental assessment of the IRIDA protocols based on water balance predictions for mitigating impacts of extreme weather in mixed agro-forestry systems.

Main deliverables

WP5 Dissemination and market exploitation

- D5.1 Project web page fully operative and functional
- D5.2 Report on potential targeted market for IRIDA DSS exploitation and commercialization plan including pricing strategies
- D5.3 Report on the open-day carry out at the 4 demo sites in Spain, Italy, Romania and Norway with a list of first potential customers
- D5.4 After project life plan including identification of R&D project calls of interest

Impact

Country	Agro-ecosystem	Current and expected water applications after applying the IRIDA protocols.	Economic impacts due to water savings, and environmental impacts. Environmental impacts
Spain 	• **Deciduous fruit trees** • Irrigated area is 260.922 ha. • Production value of 684 M€	• Current: 5.000 to 6.500 (m^3/ha) • Expected after IRIDA: 4.250 to 5.525 (m^3/ha)	• -225 to 292 €/ha (considering water prices of 0.30 €/m^3). • - 10% Fertilizers use • -8% in Pruning and harvesting operation • Higher under-ground water table. Lower risks of salt sea intrusion. More water available for surface water bodies
Italy 	• **Citrus** • Irrigated area is 161.616 ha	• Current: 5.500 to 7.000 (m^3/ha) • Expected after IRIDA: 4.950-6.300 (m^3/ha)	• -138 to 175 €/ha (considering water prices of 0.25 €/m^3). • -15% Fertilizers use. • -12% in Pruning and harvesting operation

Impact

Country	Agro-ecosystem	Current and expected water applications after applying the IRIDA protocols.	Economic impacts due to water savings, and environmental impacts.
Norway 	• **Mixed land use** (forest and agriculture, mainly cereals)	• Natural conditions, rainfall	• Unchanged, potentially supplementary irrigation under climate change • Improvement of soil /water quality. • economic benefit = payment for environmental services = government subsidies
Romania 	• **Cereals crops** (winter wheat, barley, rape and maize). • Irrigated area is 2.900 ha	• Current: 3.650 to5.500 (m^3/ha) • Expected after IRIDA: 3.250 to (4.950 m^3/ha)	• -216 to 270 €/ha (considering water prices of 0.36 €/m^3). • -12% fertilizers use

Transnational added value

- Citrus and deciduous fruit trees are two major water demanding crops both in **Italy** and **Spain.** The knowledge gained in Italy with Citrus and in Spain with deciduous fruit trees will be adopted in both countries due to the similarities in agriculture water distribution systems.
- The knowledge on irrigation water management of the **Italian and Spanish** teams, where irrigation has been applied from decades ago, will be transferred to **Romania and Norway** where irrigation being a newer technology, could potentially be required due to climate change.
- In **Norway** there is a general concern about agriculture and forestry effects on water bodies. Indicators for water quality control and contamination derived from the long-term experience gained by the NIBIO partners could be then incorporated by the Southern and Eastern European partners.
- The experience on weather forecast by NMA in **Romania** will be transferred to the remaining partners and used to predict several environmental variables.
- The experience from the **company INNOVATI** in terms of data analysis will be useful to the rest of the research partners for improving their data analysis.

After-Life IRIDA Plans

- To expand the research activities by means of the **Life** and the **H2020** programs, S 2 or 5, where similar problems tackled by IRIDA could be applied to other continents such as Africa and Asia in the new collaborative H2020 and possibly **PRIMA** calls focused on those continents and dealing with food security issues
- In the new **H2020** calls addressing **circular economy,** there is also the possibility that the approach followed by IRIDA could be translated for waste water systems.
- An after-life plan has been developed including:
  - maintenance and update of the website for at least five years after the end of the project,
  - communication and dissemination activities like; presentations, press releases, papers, events attendants
  - dissemination of the project result by each partner network.

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