

CAPABILITIES IRTA – TOPIC NBS

HORIZON-CL6-2024-BIODIV-02-1-two-stage: Demonstrating Nature-based Solutions for the sustainable management of water resources in a changing climate, with special attention to reducing the impacts of extreme droughts.

At IRTA, the research program on Efficient Use of Water in Agriculture believe we can contribute our expertise and capacities to this topic and, accordingly, we are looking for a consortium to join and prepare a competitive proposal.

In 2023 our team has directly faced the management of a severe drought in Catalonia, where we have been requested by the local government to intermediate between water agencies, irrigation districts and farmers. Among the activities undertaken were the precise planning with water agencies and irrigation districts on how to distribute, among different crops and a long time, the severely reduced water availability. Among the successful agronomic solutions that we recommended to farmers were, on annual crops, the choice of appropriate crops for a water-shortage scenario and, on orchards, the application of Regulated Deficit Irrigation strategies and the severe fruit thinning. To deal with the huge amount of information to manage this real crisis at regional scale, we adapted on-the-edge digital technologies that we had developed in previous R+D+I project. For instance, the digital twins for the supervision of irrigation water demand at regional scale (e.g. www.irriter.cat, www.irrilleida.cat)

In the following paragraphs, we highlight our possible contributions to this topic:

- **Topic: The successful proposal should:**
 - a. *Demonstrate innovative, systemic and locally attuned NBS (as single interventions or as a combination of them), for the management of catchment water resources and the reduction of extreme drought risks, in areas that are heavily impacted by temporary or lasting water scarcity and areas that are being increasingly exposed to this risk with the deepening of climate change. Possible agro demo site IRTA on how to face drought. We have several ongoing trials on the mid-term consequences of drought and some practices to alleviate its effects on orchards.*
 - i. **Advise on how and when to remove fruit from trees.**
 - ii. **Knowledge on resistance of trees in extreme droughts.**
 - iii. **Regulated Deficit Irrigation.**
 - b. *Be incorporated into an integrated design concept for land and water management at the appropriate scales (preferably at landscape level, integrating water, soil and ecosystems as a whole), in accordance with WFD objectives, considering longitudinal connectivity of water flows, lateral connectivity with floodplains and adjacent grounds, and connections between surface- and groundwater.*

Working in multidisciplinary consortia is the normal way of working at IRTA.

IRTA can contribute our capabilities to monitor vegetation development and their water state, assimilated in models for regional supervision that can be easily integrated to other systems through our APIs. Our regional-level digital twins can be integrated into other systems using OGC standards through our Geoserver API. Among the variables that we can provide early identification of crops by Earth

Observation and AI (early on the current season), actual crop evapotranspiration, irrigation water demand, expected drainage to groundwater, expected yield, etc.

- c. *Plan, co-design and co-deploy solutions in a transdisciplinary multi-stakeholder and participatory context with due consideration and integration of social and cultural aspects and climate change effects.*

Besides other regional-level or farm-level solutions that may be proposed by other partners, we have a sound experience (demonstrable with peer-reviewed publications) on the effectiveness of management strategies to face extreme drought, such as Regulated Deficit Irrigation and management practices such as fruit thinning and severe pruning.

- d. *Building on the work of Horizon 2020 projects and their taskforces, develop an advanced monitoring programme for the demonstrated solutions and test and further develop as needed the EU Impact Evaluation Framework for NBS to assess the economic, social, and ecological benefits of NBS and provide quantitative evidence, including positive and negative synergies, and analysis of trade-offs, for higher performance.*

Our methodologies, based on Earth Observation and modelling in Digital Twins, facilitates monitoring at regional scale.

- e. *Identify and assess barriers related to: functional conflicts in land-use; NBS technical, commercial, social and cultural acceptance (e.g., farmers perceptions and values, the role of private landowners); and policy regulatory frameworks (e.g., the role of the common agriculture policy, urban, rural and regional development plans) - and propose ways to overcome them (for example through new business cases and governance approaches).*

Actual barriers may be quite site-specific. The experience of IRTA on different areas of Catalonia and our role of mediation among different stakeholders can contribute insights into some already identified barriers.

- f. *Develop methodologies and tools, adapted to end-users (e.g., farmers, forest owners, local authorities, engineers, spatial planners), enabling the replication and up-scaling of NBS.*

Our working experience in monitoring, counselling and technology application in Catalonia can be ported to other regions.

Etc.

More Information:

- **IRTA is an Institute of Agrifood Research and Technology** that contributes to modernising, improving, boosting competitiveness, and fostering sustainable development in the sectors of agriculture, food, agroforestry, aquaculture, and fishing, as well as in all areas of activity directly or indirectly related to the supply of healthy, high-quality foodstuffs to end consumers, while also contributing to food safety and safe processing of foodstuffs and in general enhancing the health and well-being of the population. Its general objectives are to promote research and technological development in agri-food, to facilitate the transfer of

scientific advances and to evaluate its own technological advances whilst seeking the utmost coordination and collaboration between the public and private sectors.

- **Efficient use of water in agriculture is a research program** of the plant production area in IRTA that is interested in joining with other partners to submit a proposal in this topic. This program is aimed at producing knowledge and technology to improve efficiency in the use and productivity of irrigation water under water scarcity conditions. Wide experience has been gained in designing irrigation management strategies in a broad range of crops (such as almond, vines, olive, apple, peach, cherry, maize, etc.). As a scientific basis for precision irrigation, special emphasis has been placed on the analysis of spatial and temporal variability in irrigation needs and in the sensitivity of yield to water stress. Practical application of this knowledge at farm and regional levels is enhanced with the development of smart tools based on the synergies between plant and crop sensors, crop modelling and remote sensing. Specifically:
 - Expertise on the use of remote sensing (satellite and UAV) to estimate crop evapotranspiration, to improve irrigation efficiency and productivity.
 - Use of digital twins to monitor in real-time and forecast crop water demands of irrigation districts, for instance: www.irriter.cat, www.irrilleida.cat
 - Improve the state-of-the-art of remote sensing for evapotranspiration modelling approaches, and field-phenotyping applications, particularly for woody row crops.
 - Numerical modelling of global processes using climate GIS-based modelling and multiplatform satellite data to analyse extreme events, such as droughts, as well as the effects of global change on the water cycle.
 - Development of algorithms for irrigation control based on sensor integration, remote sensing and crop simulation, especially aimed at drip-irrigated woody crops.
 - Application of artificial intelligence to the interpretation of soil moisture sensors, the characterization of the vegetative canopy of plantations, and their integration into irrigation decision-making.
 - Assimilation of different data sources into digital twins for automated irrigation scheduling (www.irridesk.com).
 - Development and evaluation of strategies for efficient fertilization and its interaction with irrigation and other agronomic practices.
 - Knowledge on plant physiology, soil-plant-atmosphere relations, and regulated deficit irrigation (RDI) strategies in different crops and for the determination and characterization of seasonal sensitivity of crops to water deficit.
 - Application of artificial intelligence and compute vision for: 1) fruit detection and sizing, for yield prediction and mapping; and 2) crop-type satellite-based classification, for agricultural water demand forecasting.

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