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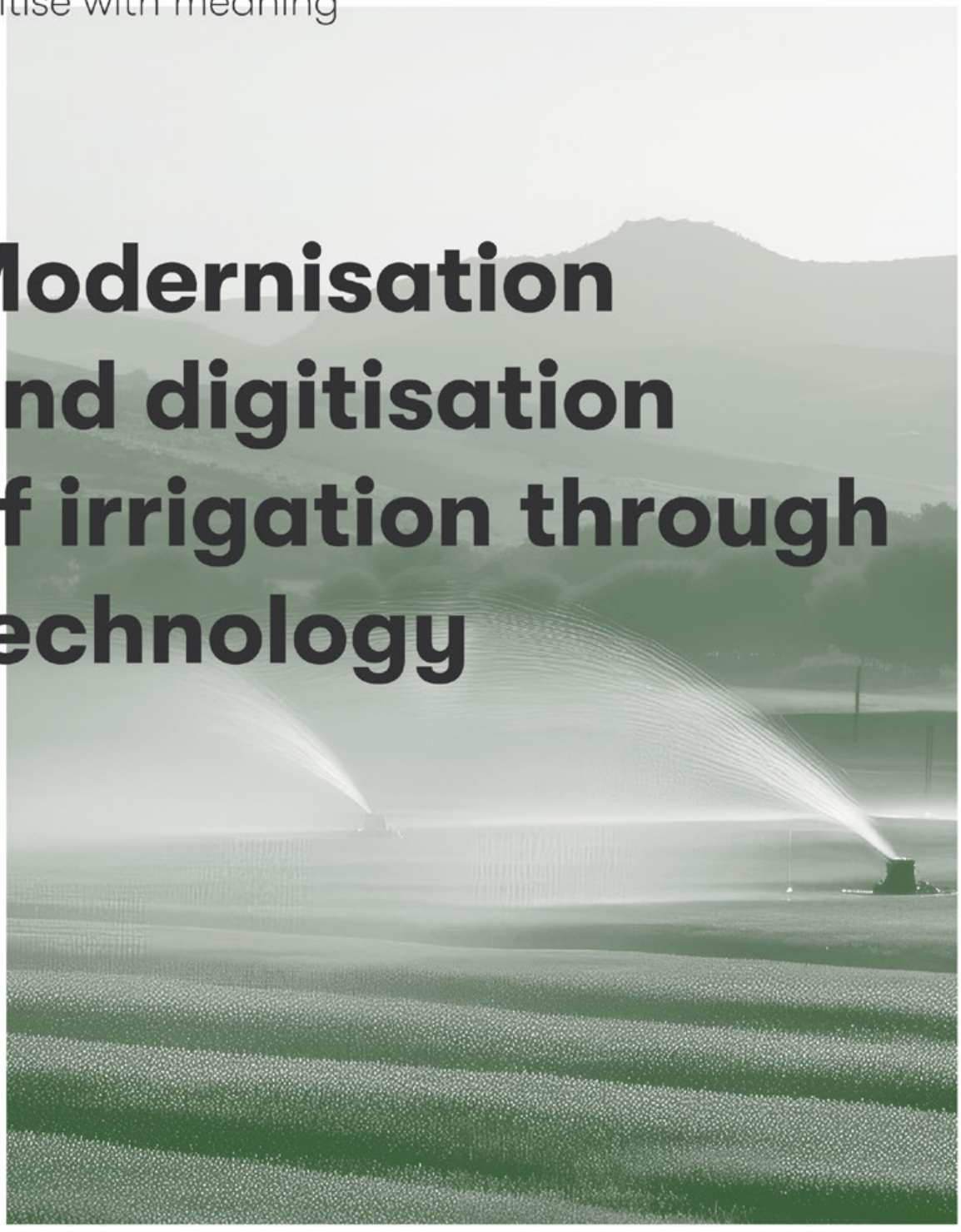
3st WATHER MONOGRAPHIC
IRRIGATION SPECIAL

Digitise with meaning

JUNE 2023

Modernisation and digitisation of irrigation through technology



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ELLIOT CLOUD CEO

FOREWORD

The time for digital irrigation is now

Water is one of the basic and essential life resources, as well as being vital for planet's ecosystems maintenance, and it is also a strategic component of our economy.

According to the data managed by the Ministry for Ecological Transition and Demographic Challenge, the estimated water demand in Spain for 2021 was close to 32,000 hm3/year. Its main use is irrigation and agricultural uses, which accounts for 80.5% of this demand, followed by urban supply, which represents 15.5%. The last one is industrial use.

In a knowledge-based society, there is a lack of complete information on water use, as well as on water losses in distribution networks due to leaks, breaks or seepage.

In this context, aware of the strategic importance of water and the need to strengthen the response to climate change adverse effects, the Spanish Government presents the Strategic Project for Economic Recovery and Transformation (PERTE) Water Cycle Digitalization, which addresses the need to undertake a complete water cycle modernization in the country in order to move towards more efficient and sustainable water management. To this end, this PERTE includes a set of transformative and enabling measures that optimize the economic potential of the sector and put an end to the inefficiencies detected in the system. Many of them will be eliminated through digitalization.

The agricultural sector is at risk due to the drought situation we are experiencing after 2023 first two quarters in which rainfall levels have been 75% lower than last ten years average for the same time period. The consequences of this water crisis for the agricultural sector affect us all, both directly and indirectly. We must act.

We cannot control when it rains, but we can take a step forward to improve water resources efficiency and management, fulfilling sector needs. Because food availability for the population will depend on it. This is a challenge that we must face, and we have an exceptional opportunity to meet it with the call for PERTE aid for the Digitalization of the Irrigation Water Cycle.

Achieving this sector digitalization is essential. At Elliot Cloud we are committed to contributing to the current fight against drought and climate change by proposing technological solutions that help the agricultural sector to meet present and future challenges in water resources efficient management. Technology is a powerful tool at our disposal that we must use to make water use more efficient.

With Elliot Water we not only cover the seven eligible digital solutions, but we also bring data processing added value through advanced analytics and artificial intelligence to build robust, scalable, and secure solutions without losing the focus of meaningful digitalization.

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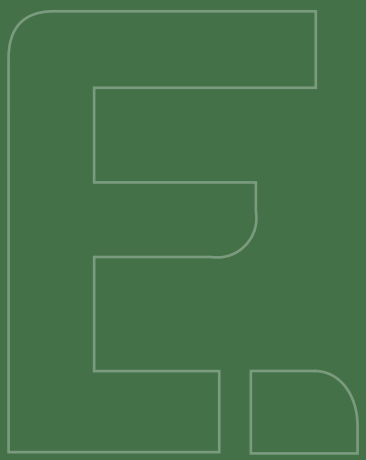


Elliot Cloud, open-source technology for an irrigation efficient management

RUBÉN BARRIUSO, TECHNICAL DIRECTOR OF IRRIGATION SOLUTIONS AT ELLIOT CLOUD

The solution contributes to the modernization of water management not only by pursuing the modernization of water administration but also of various sectors, including urban, irrigation, and industrial.

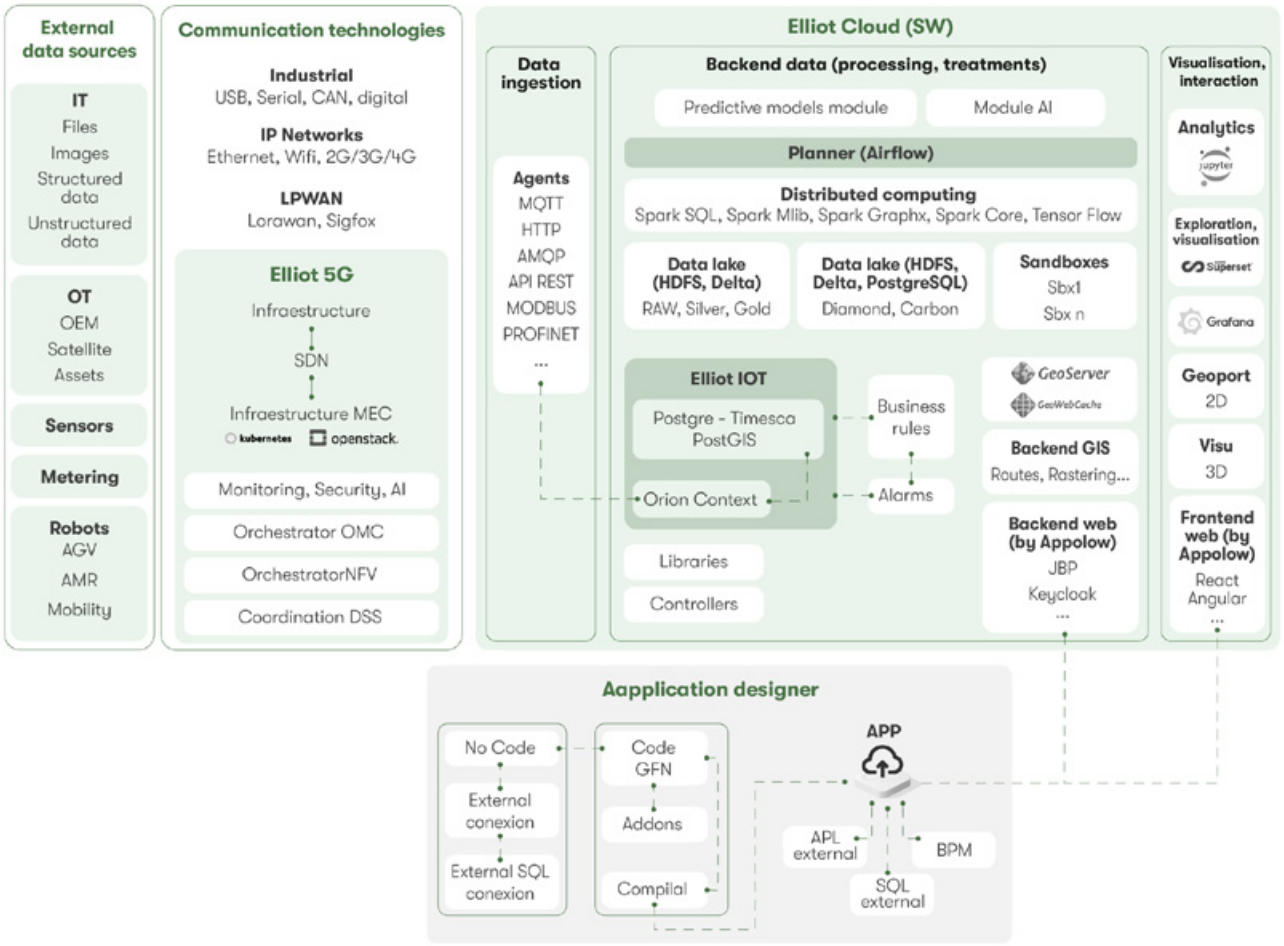
For the digitization of irrigation, Elliot Cloud offers an end-to-end solution that combines hardware and software. This solution, which follows the standard set by Elliot Cloud, combines robustness, reliability, flexibility, transparency, and the use of open-source tools for data ingestion, protocol agnosticism, device control, and an essential advanced analytics component. By utilizing new information technologies in the comprehensive water cycle, water management is improved, efficiency is increased, losses in supply networks are reduced, and progress is made towards meeting the environmental objectives outlined by hydrological planning and international regulations. Elliot Water for irrigation is an advanced hardware and software solution for water management in irrigation communities, utilities, and public administrations, serving as an advanced metering infrastructure (AMI).

Integration and Interoperability in a Unified System

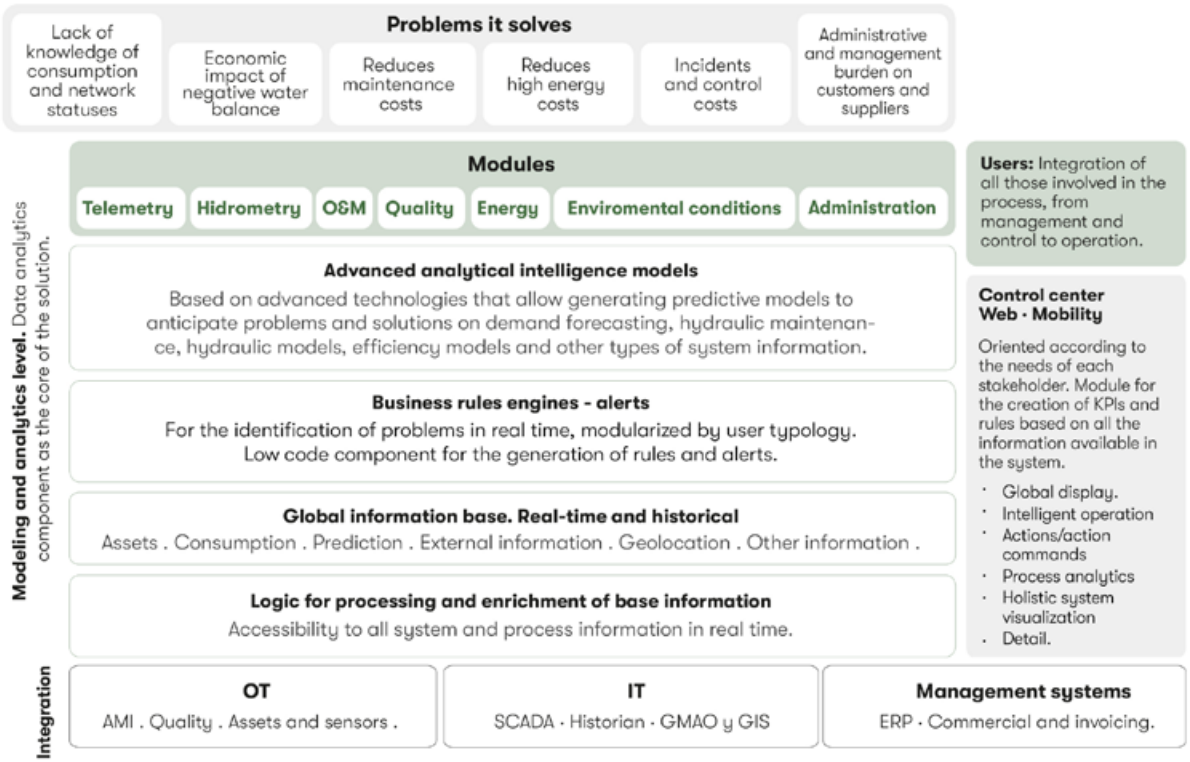
Elliot Water integrates different infrastructures, assets, and systems into a unified solution to encompass all operational processes. This integration leads to cost savings in operations and ensures efficient and high-quality service control.

The solution consists of a robust and flexible technical architecture supported by open-source, transparent tools. Additionally, it includes specific modules to address the problems and requirements of water management in irrigation.

Technical architecture



Functional architecture

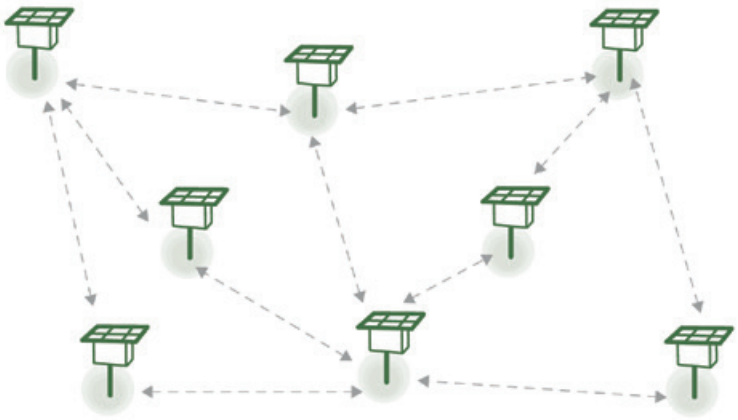


Hardware Network (AMI)

Meter pulse readers, models C-50

Control of irrigation water consumption by irrigators is managed through the installation of a pulse emitter in the meter, as well as a device called C-50, which primarily serves this purpose. The C-50 devices, powered by a lithium battery with a lifespan of up to 10 years, can read up to 4 meters. The frequency of reading transmissions can be configured on a daily, weekly, or monthly basis, providing the option to track consumption over specific time period.

For remote irrigation management, the C-100-IRR units are available. These devices can manage two solenoid valves, two meters, and two digital or analog inputs. They communicate wirelessly with the rest of the system and can also function as repeater nodes within the communication network. The entire system is based on a 169 MHz communications mesh with dynamic addressing, where mesh members connect to the repeater node that offers the best coverage with the fewest number of hops.



The network is configured using gateways and repeaters:

Sub 1 GHz Network Repeater C-100-IRR-DIN:

- Provides independent reading of up to 2 counters (pulses) and up to 2 sensors (digital or analog).
- Offers 2 outputs for actuating latch-type solenoid valves or relays.
- Operates on a DC 9-24V power supply, with solar power availability.
- Features a 12V relay connection and DIN rail mounting.
- Allows for connection expansion of inputs (sensors) and outputs (latch).
- Utilizes ISM 169 communication and functions as a communication mesh node.
- Has a range of up to 8 km (with visual contact between antennas).
- Supports two control networks: irrigator and community/manager.

- Enables data sending with hourly, daily, or monthly segmentation.
- Allows for irrigation programming based on time or volume
- Real-time visualization.
- Includes internal battery backup.
- Monitors supply voltage and notifies of power failures.

Sub 1 GHz network repeater NODE-4214:

- Provides 4 digital inputs for connecting counters or digital sensors.
- Offers 2 analog inputs with ranges of 4-20mA and 0-10V.
- Includes 14 outputs for actuating latch-type solenoid valves or relays.
- Operates on a DC 15-24V power supply, with solar power availability.
- Utilizes ISM 169 communication and functions as a communication mesh node.
- Supports LTE CAT-M communication.
- Has a range of up to 8 km (with ISM communication).
- Enables data sending with hourly, daily, or monthly segmentation.
- Allows for irrigation programming based on time or volume.
- Provides real-time display in repeater mode.
- Features an internal battery with rechargeable options via power supply or solar panel.
- Monitors battery voltage, external power supply, and notifies of power failures or low battery.

Sub 1 GHz MINI-ST-IRR 169MHz GPRS/3G/4G network gateway:

- Acts as a node creating the ISM mesh network.
- Serves as a gateway between the server and the communication network.
- Offers 2 outputs for actuating latch-type solenoid valves or relays.
- Enables point-to-point control loop configuration between different network nodes (e.g., tank control).

Multiple irrigation solutions

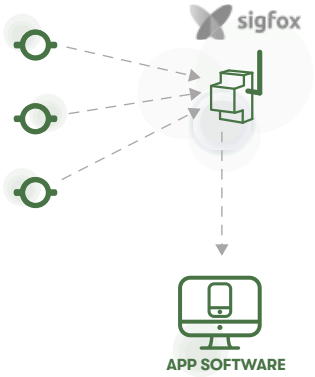
Depending on the scenario, available networks or terrain orography, different solutions are available:

Solution for isolated reading points

Reading with SIGFOX coverage:

For isolated farms:

- Without the need to act on the solenoid valve.
- Without the for hourly or daily dispatches of hourly consumption.
- Battery powered.
- Reading of up to 3 meters for each C-50.

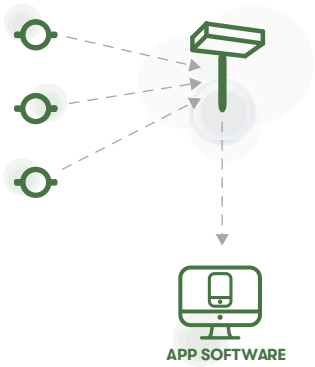


Solution for isolated control points

Protocol GPRS, 3G/4G (MINI-ST-IRR) o LTE CAT-M (N4214):

For isolated farms:

- Without SIGFOX coverage.
- With the need to act on the solenoid valve.
- With the need for hourly or daily dispatches of hourly consumption.
- Power supply, external power supply with rechargeable battery or internal battery (non-rechargeable).



Mesh grid solution

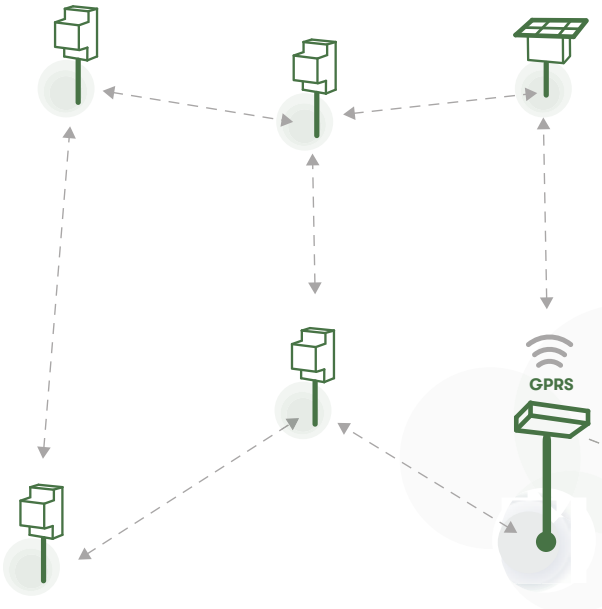
A dynamic communction mesh is created with C-100-IRR nodes:

· **Connected to each other**, they act as repeater nodes.

· Powered externally or by solar panel plus battery.

· Communication distance greater than 8km.

· Meter reading and actuation in latch type solenoid valves or relays.

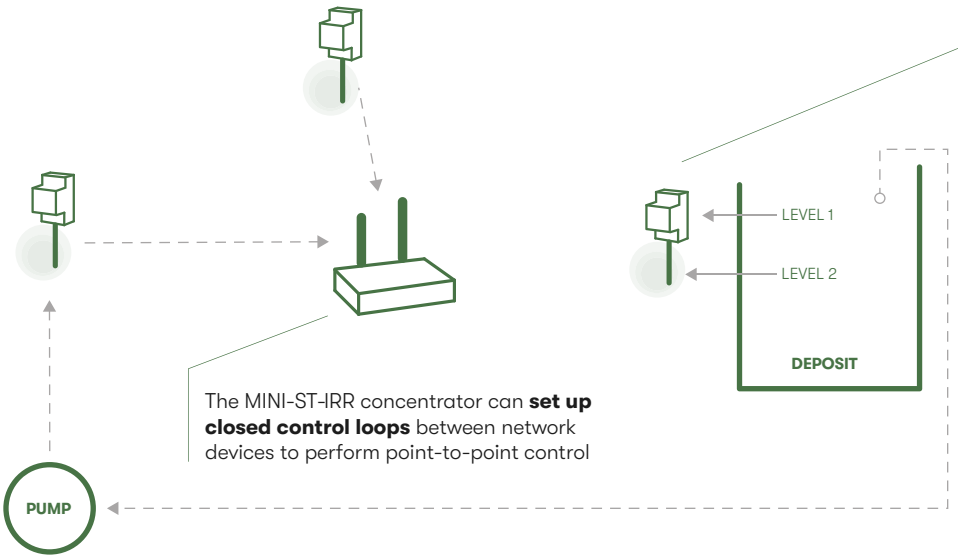


Solar panel powered version: Installed next to the meter, it can also activate solenoid valves.

All data are fed to a MINI-ST-IRR concentrator in which the network is generalised and enables **communication with the software application.**

- MINI-ST-IRR concentrator powered electrically or by solar panel.

Closed loop control solution

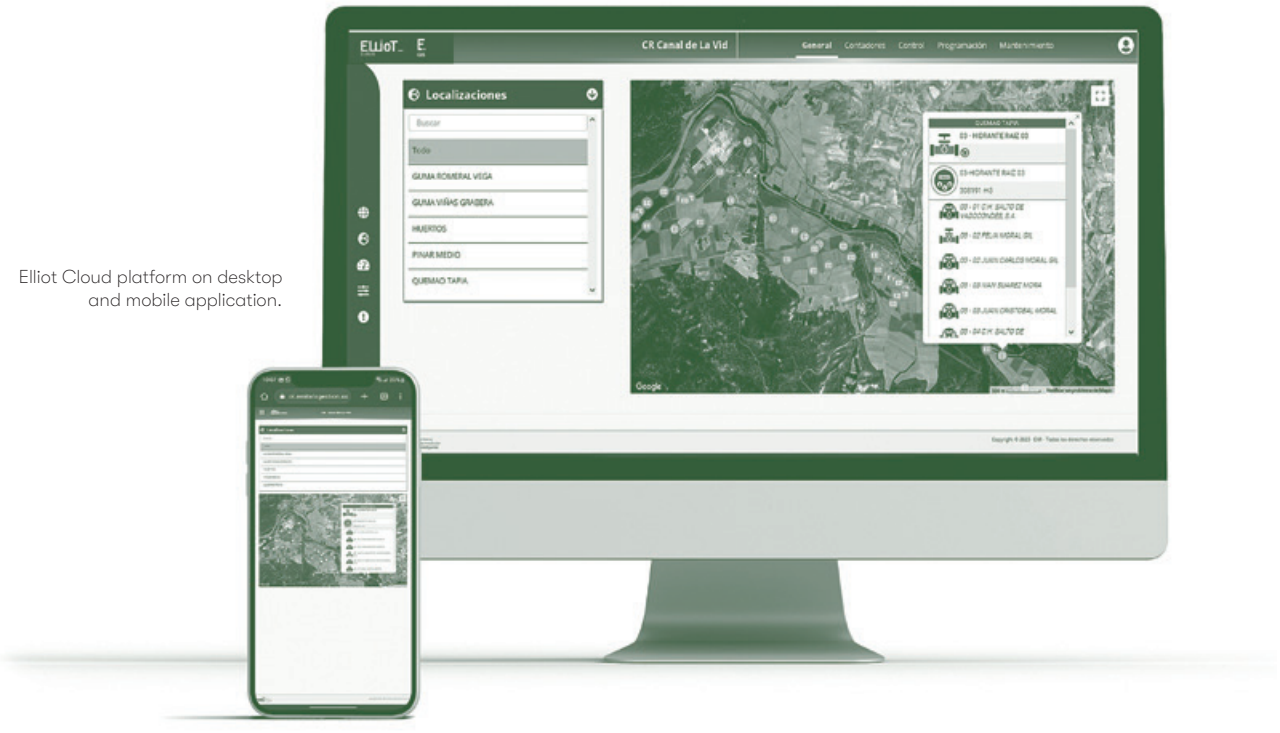


Any change of **sensors connected to network** equipment can produce open/dose or start/stop events.

• Ideal solution for tank control.

The MINI-ST-IRR concentrator can **set up closed control loops** between network devices to perform point-to-point control

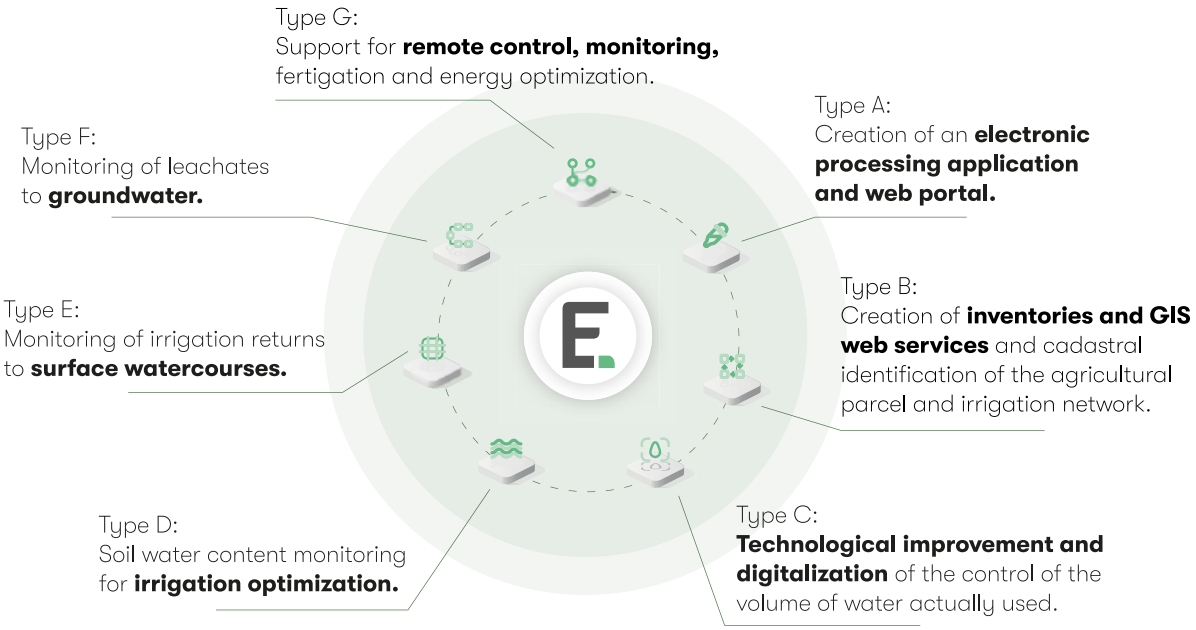
All the equipment is managed through the Elliot Cloud platform on desktop or mobile application. This platform allows the control, automation, and remote control of irrigation installations from anywhere in the world, at any time of the day or night. We can, for example, start or finish an irrigation operation with real-time visualization.

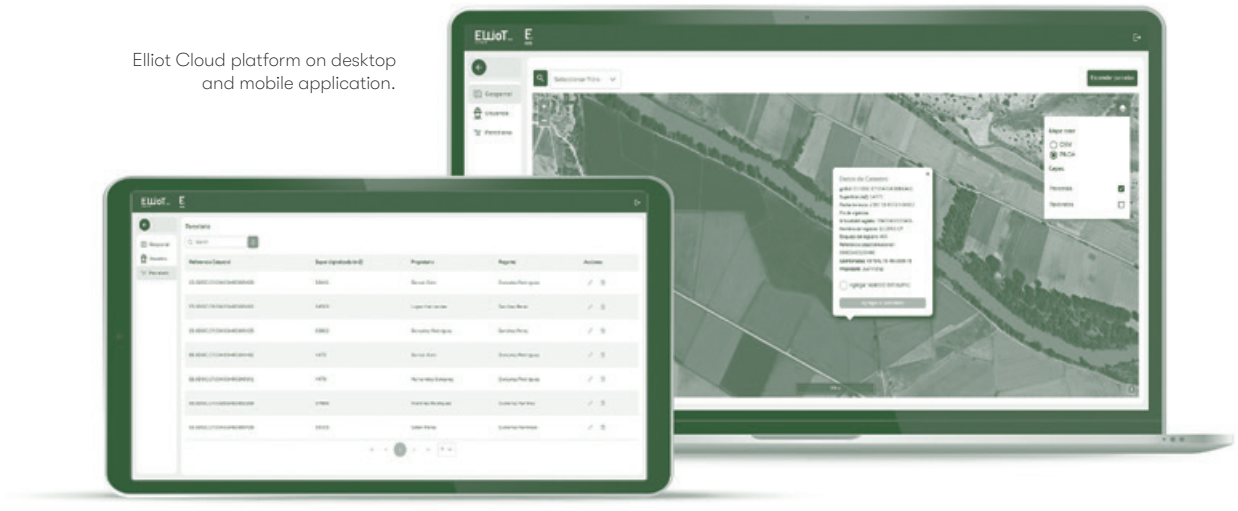


Elliot Cloud platform on desktop and mobile application.

Elliot Cloud: A Comprehensive Solution for PERTE

Elliot Water has solutions to fully or partially address the seven digital solutions funded by PERTE.





Elliot Cloud platform on desktop and mobile application.

The faces of water

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Modernisation of irrigation systems, a decisive step towards guaranteeing agricultural activity and food sovereignty

La Rioja es una región eminentemente rural, de 5.000 km2, con un fuerte contraste paisajístico y cultural entre la Sierra y el valle del Ebro, que diferencian gradualmente los grandes espacios del agro riojano. El paisaje agrario incluye, no solo las tierras labradas, que suponen un 30 por ciento del territorio, sino también los espacios forestales, prados y pastizales que alcanzan casi los dos tercios de la región.

EVA HITA, REGIONAL MINISTER OF AGRICULTURE, LIVESTOCK, RURAL WORLD, TERRITORY AND POPULATION. GOVERNMENT OF LA RIOJA

La Rioja

La Rioja is a predominantly rural region, spanning 5,000 km2, with a notable contrast in landscape and culture between the Sierra and the Ebro valley, which gradually distinguishes the vast agricultural areas of La Rioja. The agricultural landscape encompasses not only arable land, accounting for 30 percent of the territory, but also woodlands, meadows, and pasturelands, covering nearly two-thirds of the region.

Agricultural activity primarily centers around the Ebro corridor, where a series of changes have occurred since the second half of the 20th century, harmonizing the landscape, and transforming the traditional agricultural system into a modern, competitive, diversified, and market-based system adapted to contemporary needs.

This transformation has been facilitated by technological advancements and the crucial role of water in agriculture, sourced from seven rivers that originate in the Sistema Ibérico and flow into the Ebro.

The estimated irrigated area in the region is approximately 50,700 hectares, representing 10 percent of the total regional area and about 18 percent of the Useful Agricultural Area (285,920 hectares of arable land, meadows, and pastures).

Approximately 50 percent of the irrigated area is dedicated to woody crops, with around 23,600 hectares, of which vineyards account for approximately 15,110 hectares. Grain cereals constitute 26 percent (approximately 13,414 hectares), while fruit trees make up 10 percent, around 5,300 hectares, primarily consisting of pear trees. The remaining area is predominantly allocated to horticultural crops such as irrigated broad beans, beans, and poplar trees.

These figures reflect the significance of irrigation for the competitiveness and sustainability of agriculture in the Autonomous Community of La Rioja. The region is undertaking an unprecedented commitment to irrigation by implementing numerous irrigation modernization and conversion projects. These initiatives are made possible through the support of funding from the Spanish Government, the European Union, and the regional government.

The Next Generation Fund opportunity

The Next Generation Fund opportunity has been a significant driver for investment. Primarily backed by the Plan for Efficiency and Sustainability in Irrigation of the Recovery, Transformation, and Resilience Plan, this initiative is co-financed by Next Generation funds from the European Union. Public contributions cover up to 80 percent of the eligible expenses.

To date, the Ministry of Agriculture, Fisheries, and Food (MAPA), through the Sociedad Mercantil Estatal de Infraestructuras Agrarias (SEIASA), has allocated an investment of 35.75 million euros from the funds of the Recovery, Transformation, and Resilience Plan to four irrigation modernization projects in La Rioja. Agreements have been signed between SEIASA and the Irrigation Communities to execute these projects in the Najerilla river basin, benefiting over 7,453 irrigators across more than a dozen municipalities and encompassing over 13,000 hectares of cultivated land.

"La Rioja is demonstrating an unprecedented dedication to irrigation by embarking on a substantial number of irrigation modernization and transformation projects"

This support recognizes the decisive efforts of the Autonomous Community of La Rioja and the Irrigation Communities in promoting sustainability and digitalization through the modernization of irrigation. These projects have been meticulously developed through collaboration between the administration and irrigators.

In La Rioja as a whole, the regional government has been actively promoting ten irrigation modernization projects since 2019, covering a total of 18,880 hectares of agricultural land, with a planned investment of 165 million euros.

Funding is provided by European funds, the Rural Development Programme, the General State Budget, and funds from the Autonomous Community of La Rioja.

Both the administration and the irrigation communities that have embraced modernization share the vision that sustainable irrigation is crucial in tackling the challenges posed by climate change in agriculture. It also plays a vital role in fostering a food production model that meets the demands of the population while ensuring an adequate and high-quality food supply.

Investing in irrigation modernization is investing in the present and future of agriculture and the agri-food system. It signifies a commitment to promoting generational renewal, addressing demographic challenges and depopulation, mitigating the effects of climate change, and preserving the landscape and food sovereignty. Moreover, it entails investing in sustainable territories at the forefront of innovation.

Our agricultural policy is dedicated to promoting a competitive, profitable, innovative, digital, sustainable, egalitarian, and cohesive rural environment in the 21st century. In this vision, the modernization of irrigation stands as a key pillar of the agricultural policy of the Government of La Rioja. Its aim is to optimize water efficiency, transforming it into an optimized asset that enhances the competitiveness and sustainability of agricultural activity.

"Investing in irrigation modernization translates to investing in the present and future of agriculture and the agri-food system."

Modernized irrigation improves water usage efficiency, enhances farm productivity and profitability, ensures on-demand water availability, facilitates adaptation to climate change, increases the value of agricultural assets, promotes entrepreneurial activity and generational transition, reduces environmental impact by lowering water consumption and diffusing nitrate pollution, and ultimately enhances the quality of life for farmers through the incorporation of new technologies and customizable irrigation practices.

Sustainable territories

Sustainable territories are a priority for the Government of La Rioja, which has supported various models of irrigation modernization tailored to specific territorial needs. For instance, in the Sierra de La Rioja Baja, around Cornago, the administration has promoted the modernization of an irrigation system as a crucial element in combating depopulation by creating opportunities for local agriculture. This project covers 100 hectares of intensive crops, including fruit trees, vegetables, and olive groves, benefiting a hundred irrigators in the Alhama-Linares river basin, with a total budget of 2.6 million euros.

Irrigation pond in Cornago

Drip irrigation in Valle de Iregua.

In La Rioja Alta, specifically in the area around San Asensio, the regional government has supported the modernization of irrigation by replacing the existing irrigation ditches with a piped irrigation system in the Acequia de San Asensio. This action will benefit 433 irrigators and cover a total area of 1,591 hectares. Vineyards dominate this area, and the notable aspect is the young age of the members of the Irrigation Board, who are committed to a professional life dedicated to quality, competitive, profitable, and sustainable viticulture. This work is part of the irrigation modernization and consolidation projects of general interest planned by the Ministry of Agriculture, financed by the General State Budget, and promoted by the Spanish Government in collaboration with the Autonomous Communities.

In the middle-lower Iregua river, which extends to the city of Logroño in La Rioja media, we are actively fostering the continuity of agricultural activity in this agricultural valley. The irrigation area of the lower-middle Iregua river valley encompasses the irrigated land in nine municipalities, involves nine irrigation communities, and covers 10,518 hectares of vineyards, cereals, and fruit trees.

The Government of La Rioja has spearheaded the strategic project of common irrigation in the Iregua basin, which includes the development of the Iregua Irrigation Master Plan and the modernization project entrusted to Tragsa. Regional funds amounting to 830,000 euros have been invested to lay the foundations for this initiative.

The Iregua irrigation modernization project is a decisive action for the present and future of the valley. It ensures water conservation, allows for more efficient resource utilization, enhances the competitiveness of agricultural activity in the area, and improves the quality of life in rural areas.

"The modernization of irrigation would facilitate the upgrade of infrastructures and the implementation of irrigation systems that enable effective control and management of resources, as well as the development of efficient and automated irrigation facilities."

Currently, only 5% of the crops in the Iregua valley have modern irrigation systems with consumption volume control, while the rest rely on blanket irrigation. By modernizing irrigation infrastructures and implementing efficient and automated irrigation systems, we can improve control and management of resources, ensuring their sustainable utilization. Undoubtedly, the commitment to irrigation modernization, within the framework of European recovery efforts, promotes the sustainable development of our rural environment. It guarantees water savings and energy efficiency in irrigation, aligning with the Spanish Government's conviction that sustainable irrigation, together with digitalization and generational renewal, forms the foundation of the future agricultural activity model.

Irrigation increases agricultural productivity sixfold, generates four times more income for farmers, and creates three times more employment compared to other crops. Sustainability entails optimizing and conserving our natural resources today to secure tomorrow's needs. It is time to prioritize efficient and sustainable irrigation as it provides greater stability and ensures food production. With climate change, the demand for water resources has increased while their availability has decreased. Therefore, it is crucial to embrace efficient and sustainable management of water, which is a precious resource, to bring a prosperous future to our agricultural activity.

Hidroconta: Possibilities for Irrigation Digitalization

Water scarcity poses a significant challenge in resource management, disrupting established norms and necessitating actions and improvements to optimize crop profitability through efficient and sustainable water usage an essential element for life and food production.

ALFONSO CORBALÁN, HIDROCONTA CEO

hidroconta metering technology

At Hidroconta, we are actively engaged in developing innovative technologies for the digitalization of the water sector, encompassing both domestic water and water used for food production, where irrigation accounts for 80% of the planet's available water.

The objective of Hidroconta's digital advancements is to collect data generated within hydraulic systems, enabling analysis and informed decision-making. Through data analysis, we provide notifications and process alerts, fostering greater operational efficiency and aiming to achieve enhanced productivity and profitability.

Hidroconta offers various telemetry and remote-control technologies, equipping our equipment with data communication capabilities. We embrace innovation by incorporating cutting-edge communication technology into our water meters, manufacturing intelligent water meters that are entirely Spanish made. These water meters can record daily consumption data, transitioning from the traditional practice of 2 or 3 annual readings to approximately 9,000 readings per year.

We provide comprehensive support to our clients in their irrigation digitalization projects, tailoring our developments to address their unique

challenges. Over the past 8 years, Hidroconta has successfully executed multiple irrigation digitalization projects worldwide.

One notable project on the international stage involves controlling water extraction through deep boreholes for irrigation purposes, covering an area of over 40,000 hectares in Saudi Arabia, employing approximately 800-meter diameter pivots. The primary objective of this Saudi Arabian project is to accurately measure and automatically record the flow rates extracted from the boreholes. The project necessitates precise flow rate measurements, a continuous connection for remote reading equipment, an all-in-one module solution, easy installation, weather resistance in extreme desert conditions, including temperature fluctuations, sandstorms, and solar storms.

Visualization on the Demeter platform of the Project in Saudi Arabia

"There are several reasons why digitalization is a significant commitment for irrigation communities, a commitment reflected in the PERTE on digitalization by the Ministry for Ecological Transition and the Demographic Challenge (MITECO)."

This project addresses two key aspects: the accurate measurement of flow rates and remote reading, historical data recording, and data visualization. Hidroconta Hidromag electromagnetic flowmeters, with separate converters powered by 220 V AC, are employed for flow rate measurement. For remote reading and data logging, the project incorporates the Hidroconta Demeter System, utilizing Demeter 4H GPRS terminals.

The Demeter 4H is a remote management and monitoring device for hydrants and metering equipment related to water consumption and distribution.

Digitized water meters with Iris at the Irrigation Association Consortium Cota 400

By deploying autonomous Demeter GPRS terminals, we can monitor water abstractions from aquifers, providing accessible real-time information accessible from anywhere worldwide via the internet.

At the national level, Hidroconta implements projects and supplies equipment for irrigation digitalization, remote reading, and remote control of consumption. Several factors contribute to digitalization becoming a significant commitment for irrigation communities, a commitment reflected in the PERTE (Program for Territorial and Economic Resilience) for digitalization initiated by the Ministry for Ecological Transition and the Demographic Challenge (MITECO). Remote reading of water meters stands out as a key technology promoted within this program, enabling real-time water consumption monitoring and improved water resource management.

The PERTE presents a significant opportunity for the irrigation sector. It raises awareness regarding the need for efficient resource utilization and

encourages Irrigation Communities, Central Water User Boards, Groundwater User Communities, and others to digitize their farms.

The Cota 400 Irrigation Community, located in the southern region of the peninsula, has already commenced the digitalization of its supply network. Motivated by structural changes in plot distribution, which led to the installation of new individual water meters, the number of control points multiplied, posing challenges for staff control. In response, the Community adopted Hidroconta's IRIS system, enabling control and measurement of individual meters through a remote management system.

"We manufacture water meters capable of recording daily consumption data, transitioning from 2 or 3 water consumption readings per year to around 9,000 readings per year"

IRIS is a communication module that integrates with conventional water meters, enabling direct communication with a server that records, visualizes, and compares flow rate and water volume data through a mobile app or web platform. To date, 420 units of the Iris remote management system have been installed in the Cota 400 Irrigation Community.

In summary, digitalizing flow recording equipment such as water meters or flowmeters represents the solution to the new scenarios emerging in the field of irrigation due to water scarcity. Tailored solutions can be adapted to any situation, imbuing irrigation networks with intelligence. Additionally, the ongoing PERTE initiative, supported by European Funds, presents a remarkable opportunity for implementation.

The presence of an intermediary entity between technology and the end user, the farmer, is crucial as it facilitates the expedited transfer of knowledge

José Mª González

PRESIDENT OF SPANISH ASSOCIATION FOR IRRIGATION AND DRAINAGE (AERYD)

José Mª González is an Agricultural Engineer with a PhD in Hydraulic Engineering from the Polytechnic University of Madrid. He currently serves as the President of the Spanish Association of Irrigation and Drainage (AERYD), an organization established in 1985 with the objective of enhancing information exchange and increasing the involvement of Spanish irrigation professionals in the activities of the International Commission on Irrigation and Drainage (ICID).

Throughout his professional career, González has directed, executed, and participated in numerous projects primarily related to hydraulic engineering, including dams, reservoirs, canals, and irrigation systems. He has also been involved in river engineering, such as watercourse protection works and flood mitigation actions.

On the international front, he has undertaken assignments and prospecting missions in various countries, including Jordan, Saudi Arabia, Qatar, United Arab Emirates, Egypt, Tunisia, Colombia, Croatia, Mali, and Angola, among others.

Additionally, González has served as an adjunct lecturer at the Polytechnic University of Madrid and has been actively engaged in numerous master's and postgraduate courses, both as a module director and as a lecturer in subjects primarily focused on dam and reservoir engineering and river engineering.

He has authored several technical publications and made numerous contributions to national and international congresses and technical conferences. Currently, he works as a Water Engineering expert at Tragsatec, where he previously held the position of Water Engineering Area Manager for 8 years.

González is also a collaborating member of the Spanish National Committee for Large Dams (SPANCOLD) and a member of the Spanish Society of Dams and Reservoirs (SEPREM).

"The digitalisation of the irrigation sector represents an opportunity to integrate the knowledge and progress developed in technological areas, providing solid tools for the management and handling of water in Spanish irrigation"

INTERVIEW

What is the role of the Spanish Association of Irrigation and Drainage (AERYD)?

AERYD is a non-profit association dedicated to promoting irrigation in Spain through collaboration between the scientific, technical, business, institutional sectors, and irrigation water users. Its mission is to generate ideas that strengthen and enhance the irrigation sector by fostering collaboration among stakeholders and contributing to the progress and well-being of society. The main objectives include facilitating connections and interactions among different sector agents, promoting knowledge generation and dissemination, and fostering the sector's capacity and experience.

What does digitalization mean for AERYD?

For the Spanish Association of Irrigation and Drainage, digitalization in the irrigation sector represents an opportunity to integrate technological advancements into the management and use of water in Spanish irrigation. AERYD welcomes the involvement of stakeholders working on various digitalization aspects such as sensors, decision support systems, and artificial intelligence, as it aims to improve irrigation practices in Spain.

What is the current state of digitalization in the irrigation sector in Spain?

In the irrigation sector, particularly within the Irrigation Communities, the digitalization process is progressing alongside the Irrigation Modernization plans led by the Ministry of Agriculture, Fisheries, and Food with the support of European funds. Notable advancements

include the increasing adoption of remote-control systems for hydrants, sophisticated equipment for catchment and pressurization management, and the implementation of an Agro-climatic Information System for Irrigation (SiAR). SiAR complements the digitalization efforts of the Irrigation Communities, facilitating more efficient irrigation management.

How has digitalization unfolded, and why are there differences in the sector?

Digitalization in the rural and irrigation fields has been a gradual introduction of technology to farmers, enabling successful adaptation to new practices. In the early 2000s, the process of assimilating remote-control systems in modernized irrigation areas took approximately three years for farmers to become acquainted with the control system, external operation, and collective irrigation practices. Today, farmers quickly adapt to smartphone apps and are familiar with web-based tools. However, there are still significant areas in Spain where irrigation modernization and digitalization have not yet been implemented, resulting in differences within the sector.

¿What have been the phases or milestones in the digitalization of the sector, and why have they occurred?

The digitalization process in the irrigation sector has advanced as pumping station control and management systems became technologically outdated. Additionally, there was a need to reduce water consumption and transition from gravity/sprinkler irrigation systems to more efficient localized irrigation systems in terms of water use and energy requirements.

Obsolescence of installations played a key role in modernizing irrigation networks constructed in the 20th century, incorporating digital elements like telecontrol, SCADA EEBB, and sensors. Farmers' growing technological literacy and their inclusion of irrigation monitoring and control elements on their plots have also contributed to this process.

What are the major benefits of digitalization?

Digitalization allows for optimized decision-making and actions in irrigation, improving efficiency, sustainability, and profitability. By applying only the necessary quantities of water, nutrients, and phytosanitary products, traditional treatments become more efficient. In the medium term, these developments should increase the overall efficiency of irrigation production systems while reducing their environmental impact.

Which solutions have had the biggest impact on the sector?

The installation of GPS devices on tractors has significantly benefited farmers, as it enabled optimized passes and avoided overlaps. This not only saves resources such as fertilizers and fungicides but also improves work quality. The use of sensors to measure plant water stress on farms, integrated with agronomic knowledge, has led to

smart irrigation. Smart irrigation automates key decisions like when, where, and how much to irrigate and apply fertilizers. Artificial intelligence, combined with humidity probes, nitrate levels, satellite images, and environmental predictions, ensures irrigation occurs at the most suitable times, preventing water stress.

What difficulties hinder progress in digitalization?

Experts agree that the irrigation sector is at a critical moment in terms of digitalization. While technology is available, there is a lack of knowledge, training, and discussion. Communication technologies are advancing rapidly, and sensors are becoming more affordable, but there is a need for more training to introduce these technologies to technicians first, who can then pass them on to farmers. The ultimate goal is for farmers to recognize the usefulness of technology in their farms. Initiatives and work are still required, especially in less advanced areas, to facilitate the definitive transition. An intermediate entity bridging the gap between technology and end-users (farmers) is crucial for accelerating knowledge transfer.

"The new modernisation irrigation actions have the aim to reduce water consumption in agriculture, to consolidate a sustainable and competitive aliments production an to improve energetic eficiency"

How can institutions support digitalization, and does the PERTE provide the right incentive?

The main objectives of new irrigation modernization actions are to reduce water consumption, enhance sustainable and competitive food production, and improve energy efficiency. The investment of 563 million euros in irrigation modernization included in the Recovery, Transformation, and Resilience Plan represents a significant public injection into the sector. When combined with contributions from irrigation communities, the total investment amounts to around 700 million euros. These investments are crucial for consolidating progress in the sustainability, efficiency, and technification of Spanish irrigation, as well as enhancing productivity and profitability in agriculture.

What does AERYD foresee for the future of digitalization in the water cycle?

AERYD believes that various digitalization techniques applied to agriculture offer multiple opportunities to improve productivity and sustainability. In the coming years, significant advancements are expected, including increased use of sensors for monitoring plant water stress and the integration of digital information with agronomic knowledge. This integration will lead to smart irrigation, automating key irrigation and fertilization decisions. Digitalization will optimize irrigation-related decisions and actions, improving efficiency, sustainability, and profitability by using only the necessary quantities of water, nutrients, and phytosanitary products. Ultimately, these developments should enhance overall efficiency and reduce the environmental impact of irrigation production systems.

Irrigation, a crucial ally for sustainable water management

Irrigation plays a vital role as one of the fundamental pillars of the agri-food system and rural development in our country. Sustainable water management and the application of new technologies toward this objective have been a long-standing priority for irrigators.

ANDRÉS DEL CAMPO, PRESIDENT OF FENACORE

FENACORE
Federación Nacional de Comunidades de Regantes de España

At the National Federation of Irrigation Communities of Spain (FENACORE), we represent 700,000 irrigators and practically two million hectares, which accounts for over 80% of the irrigated land. Our sector serves as a benchmark for modernization across the country and is recognized internationally. We are an essential partner in the journey towards sustainable water management.

Spain boasts one of the most competitive and internationally acclaimed models in this regard. There is no doubt that the sustainable management of water resources is essential for meeting food demands with maximum security and promoting sustainable development. Sustainable development, by definition, places two conditions upon us: satisfying the food requirements of the present generation and utilizing production methods that are environmentally friendly, safeguarding natural resources to ensure the well-being of future generations.

The Sustainable Development Goals (SDGs), based on the 2030 Agenda for Sustainable Development, clearly emphasize these points. FENACORE is firmly committed to these 17 Goals, which can be grouped into two overarching categories that deeply resonate with us. The first category pertains to improving people's living standards and well-being, encompassing the eradication of poverty and hunger, as well as enhancing access to water, healthcare, and energy for the growing global population. The second category is linked to the preservation of nature and the environment, including efforts to mitigate the effects of climate change.

It is important to recognize that irrigation is a key activity within this context, and we must respond to the anticipated increase in resource management with sustainable practices, as we have been doing for many years. Irrigation also plays a vital role in territorial structuring and maintaining a population base in rural areas. Moreover, it provides fundamental environmental

benefits such as preventing soil erosion, contributing to carbon dioxide absorption, and preserving biodiversity.

To address the growing demand for food, an increase in available water for irrigation is necessary. In the face of water scarcity, which is exacerbated during periods of drought like the present one, it becomes imperative to explore alternative and supplementary resources alongside conventional methods.

A critical situation

Currently, our country is facing an extremely challenging period due to drought. Rainfed crops (such as cereals and oilseeds) in the southern half of the peninsula have already been lost, resulting in virtually no harvest. In irrigated crop areas, basins like the Guadalquivir are allocating only 700 m3/ha, which is sufficient to irrigate just over 1 in 10 hectares, leading the sector toward complete ruin.

"There is no longer any doubt that sustainable management of water resources is essential to meet food needs with utmost security and promote sustainable development."

Similarly disastrous conditions exist in the Internal Basins of Catalonia and areas of the Ebro, while the Guadiana and Segura basins are also expected to face significant irrigation restrictions. In other basins, the situation is worsening, and the lack of rain in the upcoming weeks will exacerbate these challenges.

In this context, irrigated farmers are urging for both short-term measures to alleviate the severe impacts of drought on crops and long-term structural measures to prevent and enhance the sector's resilience to drought.

Now more than ever, we need a State Pact for Water as one of the necessary structural measures to combat drought and prevent the continued surge in food prices, which have reached historic highs. Additionally, we propose a series of urgent and essential actions within a coordinated action plan that the government must implement to stabilize prices and ensure food production.

It is crucial to emphasize that irrigation is the driving force behind feeding the world, and if the government continues to neglect this issue, the viability of numerous crops will be seriously jeopardized due to widespread water scarcity. This will result in unprecedented losses for farmers and an unprecedented surge in food prices for the general public. FENACORE represents a vital sector for the economy, employment, and rural development. We guarantee a secure supply and serve as a model, thanks to significant efforts and multimillion-euro investments in modernization over the past decades.

The challenge of transitioning towards sustainable and efficient management of our most precious resource, which is the foundation for life, food, and the planet's sustainability, unites us all. We have extensively demonstrated our leadership as an example and an indispensable ally.

Given all these reasons and our proven track record in water management, we hold a prominent position as a major stakeholder, and it is crucial that our voice is heard. We speak not only from the standpoint of a successful model but also from an ethical imperative that binds us and commits us to future generations and the future of our country.

Digital technologies enable the optimization of water and energy use through real-time monitoring and precise control of irrigation, treatment, and distribution systems"

Rafael Prieto

CANAL DE ISABEL II FORMER CEO, H2SOLAR ENERGY CEO, SENIOR ADVISOR AND BOARD MEMBER

H2SOLAR

Rafael Prieto, CEO and founder of H2 Solar Energy, has experience in finance, commercialization, marketing, and strategic management in European and LATAM business units, as well as global marketing in the private sector.

He currently leads H2 Solar Energy, a company focused on developing renewable energy solutions for self-consumption, primarily in the agricultural irrigation sector. They specialize in designing, constructing, and operating floating photovoltaic plants on irrigation pond water surfaces.

INTERVIEW

What does digitalization mean for Rafael Prieto?

LDigitalization of a sector entails integrating digital technology into processes and activities to enhance efficiency and productivity. By digitizing an industry, companies and individuals can work more efficiently, compete better, and offer improved services to customers. This entails transforming work methods, organizational structures,

and business practices. Digitalization involves adopting tools such as data analytics, artificial intelligence, the Internet of Things, cloud computing, and advanced communication networks. It also requires changes in work practices, internal organization, business models, and collaboration between companies and partners. Digitalization is occurring across various sectors, including industry, agriculture, education, health, transportation, and financial services, presenting new opportunities and challenges for all.

To what extent do you think this sector needs to differentiate itself and what are its digitalization and energy and water efficiency requirements?

Digitalization and energy and water efficiency are crucial for the water sector's transition into a 4.0 sector. These factors can help address challenges like climate change, increasing water demand, and the conservation of natural resources. Some key areas where digitalization and efficiency can make a difference in the water sector include real-time monitoring and control. Implementing sensors and real-time monitoring systems enables accurate data collection on water use and quality throughout purification, distribution, treatment, and reuse processes. This empowers companies and authorities to identify potential issues, optimize water usage, and make data-driven decisions.

Another significant aspect is reducing non-revenue water. Digitalization can help detect leaks, reduce fraud, and prevent water losses in distribution systems. Leveraging technologies like data analytics and artificial intelligence enhances leak identification and repair efficiency. Digitalization in the water sector can also improve energy efficiency in water treatment and pumping plants. Process optimization and the use of efficient technologies reduce energy consumption, resulting in reduced greenhouse gas emissions.

Regarding demand management, digitalization allows better control and management of water demand in residential, industrial, and agricultural domains. Adoption of smart technologies and promoting responsible water usage awareness can decrease consumption and ensure future water resource availability. The development of digital twins for treatment plants (potabilization or purification) and industrial or agricultural facilities will enable significant advancements in water resource management. Additionally, integrating renewable energy sources such as solar energy, particularly through floating photovoltaic systems on reservoirs and irrigation ponds, and wind energy to reduce desalination plant energy costs can enhance sustainability and decrease reliance on fossil fuels. Furthermore, biogas generation, derived from water purification processes, can be incorporated into electricity and heat generation processes, remaining CO2 neutral.

In summary, digitalization and energy and water efficiency are essential for ensuring sustainable and responsible use of water resources. The water sector must embrace these technologies and approaches to meet present and future challenges.

With your extensive experience in this sector, how do you view the current state of water digitalization in Spain, especially in irrigation?

Spain has made progress in water digitalization, including irrigation, in recent years. Increased awareness of the importance of water efficiency and the availability of digital technologies have driven the adoption of innovative solutions. Some notable developments in water digitalization in the field of irrigation in Spain include:

- Precision agriculture: Implementing technologies like soil moisture sensors, weather stations, and remote sensing systems for monitoring environmental conditions and plant needs. This allows farmers to make informed irrigation decisions and improve water use efficiency.
- Smart irrigation systems: The adoption of sectorized, automated, and remotely controlled irrigation systems have increased in Spain. These systems enable more efficient and precise irrigation by adapting to soil conditions and plant requirements, thereby minimizing water wastage.
- Data utilization and analysis: The collection and analysis of data on water consumption, crop health, and weather conditions have become more common in Spain. This helps farmers optimize their irrigation practices.
- Collaboration and coordination: Digitalization has facilitated collaboration and coordination between farmers, irrigation communities, businesses, and government agencies. Digital platforms and mobile applications enable information sharing, knowledge exchange, and best practices in water management.

Despite these advancements, there is still room for improvement in water digitalization in Spain, particularly in irrigation. Challenges such as limited investment, resistance to change, and regulatory barriers can slow down the process. However, increasing awareness of water efficiency's importance and growing government support, including EU funds, can accelerate the adoption of digital technologies and solutions in the Spanish water and irrigation sector.

What has the progress of digitalization been like? Is it homogeneous, and why are there differences in the sector?

Digitalization in the water sector varies significantly based on factors like economic development level, existing infrastructure, government policies, awareness and education, and geographic and climatic conditions. These differences influence the global adoption and application of digital technologies in the water sector. Recognizing and addressing these disparities is crucial to ensure that all countries and regions can benefit from the opportunities offered by water digitalization.

Some of the most advanced countries in water digitalization are:

- Israel: Renowned for innovations in efficient irrigation, desalination, and wastewater reuse technologies, Israel is a global leader in water management and conservation. Digitalization and cutting-

edge technology adoption have played a key role in addressing water challenges in this arid country.

- Netherlands: Known for its advanced water management systems and flood control efforts, the Netherlands has embraced digital technologies in areas such as water monitoring, treatment, and distribution. Government policies and public-private partnerships have fostered innovation in the water sector.
- Singapore: Singapore has made noteworthy progress in water digitalization through initiatives like smart water management, floating photovoltaic plants, and wastewater reuse. Investments in research and development and the promotion of technological solutions have contributed to Singapore's success in water management.

"There is still room for improvement in the digitalization of water in Spain, particularly in irrigation"

What have been the phases or milestones in the digitalization of the sector, and why have they occurred?

The digitalization of the water sector has evolved through various phases and milestones. These include:

- Automation and information systems: The initial phase involved automating processes and adopting information systems to manage water-related data. Automated control systems and data management software were implemented to monitor and control water systems.
- Remote and real-time monitoring: With advancing technology and sensor capabilities, the water sector started adopting remote and real-time monitoring systems. These systems measure parameters like flow, water quality, and pressure in distribution networks. Telemetry facilitated data transmission from sensors to control stations, enhancing decision-making efficiency and water resource management.
- IoT technologies and connectivity: The adoption of IoT technologies and improved connectivity facilitated greater integration and communication between devices and systems in the water sector. Real-time data collection, analysis, and sharing became more efficient, leading to proactive water management.
- Data analytics and artificial intelligence: The increasing availability of data and advancements in data analytics and artificial intelligence technologies enabled the water sector to improve decision-making, event prediction, and process optimization. AI and machine learning allowed the development of "digital twins" to predict water demand, detect leaks, and enhance water quality and efficiency.

The digitalization of the water sector will continue to evolve in the future as new technologies and approaches emerge to improve water resource management and conservation.

What are the major benefits of digitalization?

Digitalization in the water sector offers several significant benefits, including:

"We need to invest in improving and modernizing water infrastructure, as well as in telecommunications, especially in rural areas, and renewable energy"

- Water and energy use efficiency: Digital technologies enable optimization of water and energy use through real-time monitoring and precise control of irrigation, treatment, and distribution systems.
- Leak detection and prevention: Real-time monitoring and sensor implementation aid in the detection and prevention of leaks in water distribution networks, reducing losses and improving system efficiency.
- Improved water quality: Digitalization facilitates water quality monitoring and enables real-time decision-making regarding treatment and distribution, ensuring a safe and high-quality water supply for consumers.
- Cost savings: The adoption of digital technologies can lead to reduced operation and maintenance costs by enabling more efficient management and process optimization.
- Resilience to climate change: Digitalization helps address challenges like drought, flooding, and water scarcity by enabling better planning, prediction, and management of water resources.
- Informed decision-making: Real-time data availability and analysis empower stakeholders to make informed and evidence-based decisions, enhancing water management and user satisfaction.

What difficulties hinder progress in this regard?

There are several challenges that can hinder further digitalization in the water sector. Addressing these challenges is crucial for continued progress in water sector digitalization and maximizing the benefits of digital technologies. The difficulties include:

- Infrastructure investment: Implementing digital technologies often requires significant investment in infrastructure and equipment, which can be challenging for developing countries or regions with limited resources.
- Digital divide and inequalities: The digital divide and inequalities in access to digital technologies can impede the adoption and uptake of digital solutions, especially in rural or disadvantaged areas.
- Training and education: Successful implementation of digital technologies requires adequate training and education to ensure that employees and end-users understand and utilize digital solutions effectively. Lack of interoperability between systems and devices can also hinder adoption and limit data sharing and collaboration.

How can institutions support this digitalization, and how can they improve?

Institutions, both governmental and non-governmental, play a crucial role in promoting and supporting digitalization in the water sector. They can support this process through:

- Policies and regulations: Implementing policies and regulations that encourage the adoption of digital technologies in the water sector, such as tax incentives, funding, and subsidy programs for research and development projects.

- Infrastructure development: Investing in the improvement and modernization of water infrastructure, as well as in telecommunications and renewable energy, especially in rural areas.
- Research and development: Promoting collaboration between academia, industry, and government agencies to drive research and development efforts in digitalization.
- Collaboration and knowledge sharing: Encouraging collaboration and cooperation among different stakeholders in the water sector, including end-users, utilities, non-governmental organizations, and private companies. This includes sharing knowledge, best practices, and lessons learned in digitalization.

What do you foresee for the future of digitalization in the water cycle?

In the future, we can expect further development and deployment of advanced technologies such as artificial intelligence, machine learning, cloud computing, and the Internet of Things in the water sector. These technologies will enable more efficient and sustainable management of water resources, enhance resilience to climate change and global challenges, and foster transparency and end-user participation in water management. The future of digitalization in the water cycle holds immense potential for optimizing water resource utilization and ensuring its long-term sustainability.

Water Resources Management in 21st Century Agriculture

PATRICIA TERRERO, HEAD OF INNOVATION AT SACYR WATER

sacyr agua

Water is a precious and scarce resource. Drought and the impacts of climate change pose a significant threat to a large portion of the global population (800 million people lack access to safe drinking water, and 3.6 billion lack proper sanitation). Furthermore, the occurrence of disasters like floods and torrential rains exacerbates the situation.

Simultaneously, the United Nations predicts that the world's population will double its food production by 2050, necessitating a corresponding increase in agricultural activity. Agriculture currently accounts for 70% of global water consumption.

Given this scarcity of water, it becomes imperative to explore alternative water resources, including what are known as "non-conventional" sources such as desalination and water reuse. These alternatives are crucial to meet the increasing demands of both the growing population and food production.

While the global use of desalinated water in agriculture is currently negligible, representing no more than 2% of total water use, Spain stands out as an exception, with the highest utilization rate for this purpose, exceeding 21%.

In Spain, the structural water deficit has prompted farmers in eastern regions to incorporate desalination as part of their water resources. They combine surface water from transfers, groundwater, reused water, and

desalinated water (both brackish and seawater), achieving a reasonable cost through this diverse water mix. Additionally, the high profitability of greenhouse crops, which are highly technified and produce off-season products, makes desalinated water costs affordable within the overall production expenses for this sector, known for its high-quality products. It is worth noting that research projects like Sacyr Agua's LIFE Deseacrop have demonstrated that the use of desalinated water in agriculture enhances productivity and product quality.

Likewise, water reuse enables the recycling of water after it has been utilized for municipal, industrial, or agricultural purposes. To facilitate this second use, an additional treatment, known as tertiary treatment, must be applied to the conventional purification process. The complexity of this treatment depends on the quality of the treated water and its intended use.

Water reuse contributes to more sustainable water management by expanding available resources, reducing the adverse impact of wastewater discharge into water bodies, alleviating pressure on surface and groundwater sources. It is particularly beneficial in water-stressed coastal areas as it preserves flows that would otherwise be lost when discharged into the sea.

To incorporate water reuse into water planning, several key aspects need to be considered: the applicable legal framework, the reduction or elimination of health risks through regulation, the adoption of best practices and technologies, competitive pricing inclusive of transport to end-users, and conscious acceptance by end-users through effective communication.

Spain deserves recognition as the fifth-largest country globally and the foremost in Europe regarding installed desalination capacity. It also leads European countries in wastewater reuse capacity, signifying a wealth of technological expertise and experience in applying these resources to agriculture. It is worth mentioning that in 2020, the European Union published a new regulation on the reuse of treated water for agriculture, which came into effect in June and necessitated improvements in certain facilities, particularly regarding disinfection.

Recent developments include a press release by the Spanish government on May 11, 2023, through the Ministry for Ecological Transition and the Demographic Challenge (MITECO), announcing a new Royal Decree containing measures to combat drought. The summary of the decree includes:

- Total funding of 2.2 billion.
- Inclusion of tax and fee exemptions for drought-affected farmers.
- Amendment of water laws to increase the utilization of reclaimed water from the current 400 Hm3/year to 1,000 Hm3/year by 2027.
- Investments in decarbonization, such as photovoltaic plants.
- Acceleration of the construction of new desalination plants, including Tordera II, Costa del Sol, and Levante Almeriense.
- Major investments in new large tertiary treatment plants, such as Rincón de León and Monte Orgegia in Alicante.

Furthermore, the extensions of Spain's two largest desalination plants, Águilas and Torrevieja, have already been approved and are expected to be put out for tender this year. Additionally, a new PERTE (Strategic Project for Economic Recovery and Transformation) for the digitalization of the water sector in agriculture has been published. Certain regions, like Murcia and the Valencian Community, have also announced additional tax reductions for desalinated water used in agriculture.

The achievements in technology and water supply through non-conventional resources would not have been possible without the innovative developments in our companies, administrations, and research centers. These entities are global leaders in the water sector, and innovation serves as an essential tool for the advancement of these technologies. Emerging trends in water innovation focus on enhancing sustainability, such as the recovery of valuable components from wastewater or brine (brine mining), promoting the circular economy, improving efficiency, utilizing renewable energies, and embracing digital transformation.

In this regard, the SOS-AGUA-XXI project, "Sustainability, Water, and Agriculture in the 21st century," stands as an exemplary initiative that explores technologies for the future of agriculture, encompassing water quality, digital transformation, nutrient recovery, and other relevant aspects.

"The SOS-AGUA-XXI project, 'Sustainability, Water, and Agriculture in the 21st Century,' exemplifies the development of technologies for the future of agriculture."

SOS-AGUA-XXI Project

The SOS-AGUA-XXI project is a major research initiative with a budget of 6 million euros, funded by the Centre for Technological Development and Innovation (CDTI) through the 2021 Missions call, supported by European 'Next Generation' funds. The project aims to advance 21st-century agriculture. It will be carried out from 2021 to 2024 and involves a consortium comprising Sacyr Agua, Valoriza Servicios Ambientales, Regenera, Bosonit, Tepro, Fora Forest Technologies, Aeromedia, Aquadvise, and a group of universities and research centers (University of Alicante, University of Alcalá de Henares, Polytechnic University of Cartagena, and the Association for Research and Industrial Cooperation of Andalusia (AICIA)).

The overall objective of the SOS-AGUA-XXI project is to research technological solutions that prioritize sustainability and energy efficiency in water resource management and treatment for the agricultural sector.

Development of agriculture in the 21st century. The project encompasses 35 tasks distributed across six lines of research:

- Digitalization and adoption of new technologies in 21st-century agriculture.

Photograph 1: Aerial view of the Águilas desalination plant (Murcia).

Photograph 2: Aerial drone data collection at the experimental farm of the SOS-AGUA-XXI project.

Photograph 3: Experimental plant at the ANECOOP Farm (LIFE Deseacrop project).

ROV used in the reservoir sampling campaign of the SOS-AGUA-XXI project.

Experimental plant for microalgae cultivation for nutrient removal.

"All these achievements in technology and water supply through non-conventional resources would not have been possible without the innovation fostered by our companies, administrations, and research centers."

Planta experimental de la Finca ANECOOP (Proyecto LIFE Deseacrop).

- Enhancements in water quality and the utilization of non-conventional resources for agricultural irrigation, including the detection and treatment of emerging compounds in reclaimed water, identification and reduction of boron in desalinated water, implementation of new disinfection systems, exploration of salt-tolerant crops, and utilization of aerial and underwater drones.
- Recovery of nutrients and valuable compounds from different types of water, involving nutrient recovery using microalgae, salt recovery from brine mining and wastewater, production of green hydrogen from reclaimed water, among others.
- Integrated economic and environmental studies, such as water balance analysis in the study area, evaluation of economic and environmental aspects of proposed measures, assessment of energy efficiency, calculation of water and CO2 footprints, and analysis of socio-economic impacts.

It is essential to highlight the significance of digital transformation in this project. The digitalization line includes tasks such as::

- Predictive modeling of water and energy consumption.
- Development of predictive models for extreme weather events and their impact on infrastructures.
- Design of irrigation models based on new technologies.
- Utilization of aerial and underwater drones.
- Implementation of digital tools and platforms.
- Application of different models to various project tasks, such as microalgae and emerging compounds.

In conclusion, the SOS-AGUA-XXI project aims to promote 21st-century agriculture that efficiently utilizes water and energy resources in a sustainable and resilient manner. The key pillars of the project are:

- Promoting the use of non-conventional resources, such as desalination and water reuse.
- Embracing digitalization and the integration of new technologies.
- Enhancing water quality and implementing circular economy practices for by-product recovery.
- Advancing economically, socially, and environmentally sustainable solutions.

The PERTE for the Digitization of Irrigation represents a significant boost for irrigation water user communities"

Teresa Maestro

HEAD OF THE TECHNICAL SECTION AT HYDROLOGICAL INFORMATION AREA OF THE GENERAL SUBDIRECTORATE FOR WATER PROTECTION AND RISK MANAGEMENT

Since 2018, the Ministry for Ecological Transition and the Demographic Challenge (MITECO) has been promoting environmental sustainability and addressing demographic challenges in Spain. The creation of MITECO reflects the Spanish government's emphasis on environmental protection, the fight against climate change, as well as challenges related to depopulation and demographic distribution in the country.

The ministry is driving the Strategic Projects for Economic Recovery and Transformation (PERTE) to boost the country's economic recovery and facilitate the transition to a sustainable and environmentally friendly model.

INTERVIEW

First and foremost, what is the main objective pursued by the Subdirectorate General for Water Protection and Risk Management?

The primary objective of our Subdirectorate is the protection of water resources, both in terms of quantity and quality. To achieve this, we coordinate measures related to surveillance, monitoring, and control of surface and groundwater bodies, hydrological information, ecological flows, river restoration, and flood risk management. We also promote measures to combat and control point and diffuse pollution in coordination with other competent authorities. Additionally, we manage permits for discharges into the Public Hydraulic Domain falling under the ministry's authority.

How would you describe the current state of irrigation within Spain?

Irrigation is a fundamental pillar of rural development and contributes to food security. The Ministry of Agriculture, Fisheries, and Food currently oversees irrigation management, emphasizing intelligent, sustainable, and inclusive practices.

While the Spanish irrigation sector is highly technified, there is still significant room for improvement. Increased digitization of the sector will contribute to the implementation of modernization strategies, facilitating the transition towards more intelligent, precise, and sustainable agriculture that optimizes production processes. This aligns with the concept of Agriculture 4.0.

What measures is the Subdirectorate General for Water Protection and Risk Management taking to ensure sustainability and energy efficiency in the digitization of irrigation?

The Subdirectorate's key measure is promoting the PERTE for the Digitization of the Water Cycle. As part of this initiative, a call for aid to develop digitization projects for irrigation water user communities will be published in July 2023.

What are the main guidelines of PERTE in the digitization of irrigation?

The grants, awarded through a competitive process, will be provided to projects that contribute to one or more of the following objectives::

- Enhancing knowledge of water use in irrigation and improving transparency in administrative water management.
- Improving understanding of water losses on irrigated farms.
- Enhancing water use efficiency on irrigated farms.
- Improving the use of fertilizers and pesticides.
- Enhancing energy efficiency on irrigated farms and overall productivity.

"The main challenge is motivating irrigation water user communities to apply for this aid, as it aims to distribute the budget and benefit both irrigated agriculture and water protection"

Water user communities engaged primarily in irrigation, such as irrigation communities, groundwater user communities, general communities, central user boards, or similar groups fulfilling all requirements outlined in the regulatory bases and call for applications, are eligible to apply for aid.

Irrigation digitization projects must include one or more digital components from the following catalog, with some being mandatory:

- Digital Solution A: Development of an e-processing application and a web portal.
- Digital Solution B: Creation of inventories and web services for geographic information systems and cadastral identification of agricultural parcels and irrigation networks.
- Digital Solution C: Technological improvements and digitization of systems for monitoring actual water usage volume.
- Digital Solution D: Monitoring soil water content for irrigation optimization.
- Digital Solution E: Monitoring water quality in irrigation runoff to surface watercourses.
- Digital Solution F: Monitoring leachate to groundwater.
- Digital Solution G: Support for remote control, monitoring, and assistance for fertigation and improved energy efficiency.

Additionally, there will be allocated reserves for projects sourcing water from bodies with a status worse than good according to the existing river basin management plans.

What challenges do you anticipate in implementing these guidelines?

This aid will facilitate compliance with current water legislation, particularly in measuring the volume of water collected and returned to the Public Water Domain, thereby contributing to water protection. However, these grants have been designed to be attractive to user communities by offering many other actions that can improve water management.

The primary challenge lies in motivating irrigation water user communities to apply for these grants since the main objective is to distribute the budget and benefit both irrigated agriculture and water protection.

What advantages does PERTE offer in irrigation digitization?

The PERTE for the Digitization of Irrigation represents a significant boost for irrigation water user communities in their digitization efforts. It will foster the acquisition and management of data at the community level, facilitating decision-making processes. This, in turn, promotes more efficient agriculture in terms of resource utilization, including water, fertilizers, and pesticides, thereby positively impacting farm profitability and the environment. The aid can

cover up to 100% of the expenses, subject to certain limits, with the condition that the installations are maintained for five years following the project's completion.

Do you believe that data management can contribute to the modernization of irrigation, and if so, why?

Data management is crucial as it provides precise information on plant needs, enabling smarter and more innovative farming practices. Additionally, monitoring water usage can lead to greater efficiency in water utilization, helping achieve better yields despite the limited resources available to us.

Lastly, could you highlight any specific projects carried out in recent years that have contributed to improving irrigation systems and optimizing water usage?

Within our subdirectorate, projects under the PERTE for irrigation will be the first to contribute to the improvement of irrigation systems.

Spanish irrigation, a sustainable and modern model

The future of the agri-food sector in our country relies on modern and sustainable irrigation. Irrigation is undoubtedly the cornerstone of Spanish agriculture, leading the way in innovation, sustainability, digitalization, and the use of non-conventional water. Moreover, it generates added value, employment opportunities, and ensures the supply of healthy, safe, and quality food to citizens at reasonable prices.

ISABEL BOMBAL, GENERAL DIRECTOR FOR RURAL DEVELOPMENT, INNOVATION AND AGRI-FOOD TRAINING

GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, PESCA Y ALIMENTACIÓN

In the 21st century, Spanish agricultural production has already witnessed a remarkable 36% increase, primarily attributed to the advancements in irrigation. Spain currently dedicates approximately 23% of its cultivated area, covering 3.8 million hectares, to irrigation. This sector generates two-thirds of the value of crop production and significantly enhances agricultural productivity, increasing farmers' income fourfold and tripling employment rates within the sector.

This existing potential becomes even more crucial in the face of challenges such as depopulation and climate change that will shape the coming years. As rainfall becomes increasingly irregular and scarce, water resources are projected to diminish by 12% to 40% before the end of the century. To address this situation, it is imperative to take action and modernize water management in agriculture, ensuring efficient and effective utilization despite the anticipated water scarcity. Water reuse and treatment, renewable energy utilization, digitalization, and irrigation technology are the key instruments to tackle this issue. Spain is an international leader in the development of these areas and even exports its successful practices.

In the context of a global food security crisis partly caused by climate change, efficient and sustainable irrigation is the primary guarantee for food production. Particularly in Spain, where more than half of the irrigated area is concentrated, irrigation plays a pivotal role in combating depopulation. Thus, promoting sustainable irrigation aligns with European policies, including the Green Pact and strategies like "From Farm to Fork" and "Biodiversity." To achieve these goals, a series of investments are necessary, and our country is already making significant progress in this regard.

The Path to Sustainable Irrigation

Sustainable irrigation must encompass economic, social, and environmental perspectives. The Ministry of Agriculture, Fisheries, and Food is committed to sustainable irrigation to ensure the efficient use of water, energy, and other inputs like fertilizers and pesticides, while minimizing the impact on natural resources.

To this end, the government has planned an investment of 2,130 million euros for the period of 2021-2027. This investment represents the highest economic volume of this century and will be dedicated to sustainable irrigation actions, tripling the average annual investment of recent years. The investment includes the "Plan for the Improvement of Efficiency and Sustainability in Irrigation," which receives over half of the budget from the Recovery, Transformation, and Resilience Plan (PRTR) managed by the Ministry of Agriculture, Fisheries, and Food (component no. 3). This plan involves 563 million euros of public investment, which will be supplemented by contributions from irrigation communities, surpassing 700 million euros in total. These funds will support the implementation of more than 80 actions. Furthermore, the investment volume is expected to increase with additional funds from the recovery plan linked to the PERTE Agroalimentario.

Regarding irrigation works, the General State Administration focuses on areas designated as of general interest according to national regulations. For the funds allocated to the "Plan for the Improvement of Efficiency and Sustainability in Irrigation" within the PRTR framework, the infrastructures are selected from those proposed by the Autonomous Communities. The proposed actions are categorized into different groups based on the predominant type of modernization: use of non-conventional water (reclaimed or desalinated water instead of surface or groundwater), substitution of fossil energy sources with renewable energy (especially photovoltaic), utilization of pumping techniques such as natural level or level ponds to achieve energy and water efficiency, adoption of new technologies and digitalization, modernization through the integration of renewable energy using electrical components, and traditional modernization.

Additionally, the ministry will undertake investments co-financed by the European Agricultural Fund for Rural Development (EAFRD) as part of the new Common Agricultural Policy 2023-2027. These investments contribute to the specific objective of the CAP Strategic Plan (PEPAC) in "promoting sustainable development and efficient management of natural resources such as water, soil, and air." As part of this plan, the ministry plans to implement further irrigation modernization infrastructures.

"So far in the 21st century, Spanish agricultural production has increased by 36%, thanks in particular to the significant boost provided by irrigation."

"In a context of a global food security crisis, which is partly attributable to climate change, efficient and sustainable irrigation serves as the primary safeguard for food production."

It is worth noting that the ministry is also executing regular investments in irrigation transformation funded by the General State Budget, amounting to 419 million euros. Furthermore, investments entrusted to the Sociedad Estatal de Infraestructuras Agrarias (SEIASA) reach nearly 500 million euros, forming part of the long-standing agreement between the ministry and this state trading company. These investments go beyond the funds linked to the recovery, transformation, and resilience plan.

With the available funds, the Ministry of Agriculture, Fisheries, and Food aims to modernize more than 200,000 hectares of irrigated land as a first phase, as well as improve an additional 500,000 hectares that have already undergone modernization in the past but require further enhancements. These actions will result in water savings of at least 10% compared to the current situation, while promoting energy efficiency. This underscores the Spanish Government's political and economic commitment to achieve the program's primary objective: establishing a sustainable irrigation system.

Other Initiatives for Innovation and Development in the Agri-food Sector

However, the actions of the Ministry of Agriculture, Fisheries, and Food in the field of irrigation extend to other areas as well. One notable area is the support for entrepreneurship and the development of new business models within the agri-food sector and rural environments. Many companies in this sector serve as catalysts in irrigation due to their knowledge and experience.

The strength of the agrotech sector and Spanish SMEs and startups also deserves recognition. Many of these entities not only provide solutions to irrigation challenges in our country but also contribute to the creation of added value and economic activity. In fact, the ministry continues to work on the Agroinnpulso program, facilitating access to credit for agri-food SMEs to promote and solidify their technology-based business models. The recently approved Startups Law offers advantages and opportunities to these emerging companies, considering the unique realities of rural environments.

Moreover, the Ministry of Agriculture, Fisheries, and Food will establish a Digital Innovation Hub in the coming months. This digital innovation center, located in San Fernando de Henares (Madrid), will primarily focus on issues related to irrigation technology and water efficiency. Additionally, the ministry collaborates with the Secretary of State for Digitalization and Artificial Intelligence of the Ministry of Economic Affairs and Digital Transformation to develop data spaces for the agri-food sector. These spaces will facilitate secure information sharing, enabling farmers and irrigators throughout Spain to make informed decisions based on Big Data. This initiative also expands the application scope of the SIEX system and the agro-climatic information system for irrigators (SiAR).

To achieve these objectives, training and skills acquisition in this area are crucial. The ministry has implemented several initiatives in learning, counseling, and skills acquisition. One of these measures is the Centre for Digital Competences, established in collaboration with the University of Cordoba and the Polytechnic University of Madrid in 2021. This center offers access to specialized training through free courses on the digital transformation of the agri-food sector. Among the topics covered, precision irrigation and efficient water management are highly relevant, including aspects such as climate data handling and needs calculation, application of artificial intelligence for water demand prediction and irrigation management, utilization of environmental and crop sensors, and the technology of pressurized irrigation units for uniform applications.

At the Ministry of Agriculture, Fisheries, and Food, we firmly believe that modern irrigation contributes to a better future. Sustainable irrigation serves as the foundation for the future of agricultural production in our country, employing efficient and precision systems that conserve water and integrate alternative energies.

In this context, the Spanish Government remains committed to more efficient, digital, and innovative irrigation systems that incorporate the best available techniques and technologies. These systems should be adaptable to climate change, contribute to reduced input consumption in agricultural production, and help sustain rural populations while generating wealth in these areas.

5 Conclusions

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CONCLUSIONS

A pressing concern for all of us

The current situation demands an urgent and comprehensive response through a collaborative approach. Climate change and its consequences require collective action to overcome demographic challenges.

Sustainable management of water resources is essential to ensure food security and promote sustainable development. The digitalization of irrigation can enhance people's quality of life and well-being by contributing to improved health, water access, and energy efficiency.

Given the increase in life expectancy, water scarcity, and the ongoing drought issue, it is imperative to take action in this field. Technology and digitalization offer highly satisfactory solutions.

Leveraging technology to combat climate change through irrigation

Spanish irrigation has emerged as a sustainable and modern model crucial for the future of the country's agri-food sector. It has successfully increased agricultural productivity, improved farmers' incomes, and generated employment opportunities within the sector. Given the scarcity of water resources and the challenges posed by climate change, there is a need for more modern and efficient water management approaches, including water reuse and treatment, utilization of renewable energy sources, and digitalization.

Recognizing the strength of the agrotech sector and Spanish SMEs and startups, which provide innovative solutions and add value to the irrigation domain.

Currently, the establishment of a digital innovation center is underway, focusing on irrigation technology and water efficiency. The ultimate goal is to promote more efficient, digital, and innovative irrigation practices that adapt to climate change and foster wealth generation in rural areas.

Attainable benefits through irrigation modernization

Efforts to modernize irrigation systems reduce water consumption in agriculture, foster sustainable and competitive food production, and enhance energy efficiency.

By digitally managing water resources in 21st-century agriculture, we can prevent soil erosion, reduce CO2 emissions, and contribute to biodiversity preservation. Moreover, it significantly boosts agricultural productivity, saves energy, and promotes efficient water use through sustainable practices.

Through the modernization of infrastructure and integration of advanced irrigation systems, we can effectively control and manage resources while ensuring the efficient and automated development of irrigation facilities. This digitalization optimizes irrigation decisions and actions, allowing for precise application of water and nutrients and improving the sustainability, efficiency, and profitability of traditional uniform treatments.

Digitalization of irrigation and rural regions: the path to sustainability

Due to water scarcity and the repercussions of climate change, we find ourselves amidst a global food security crisis. In response to the imperative for modern and efficient water management, we are implementing techniques such as water reuse and treatment, utilization of renewable energy sources, and digitalization.

Efficient and sustainable irrigation serves as the foremost guarantor of food production. In Spain, it has become a sustainable and modern model that is pivotal for the future of the country's agri-food sector. It has successfully boosted agricultural productivity, improved farmers' incomes, and increased employment rates within the sector.

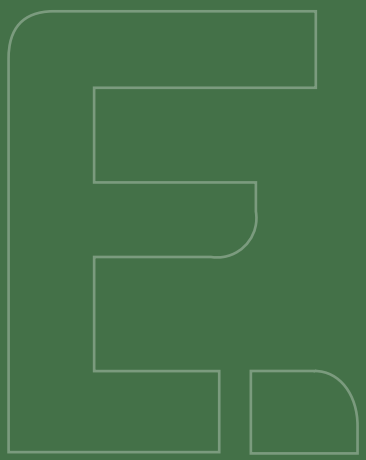
The agrotech sector offers innovative solutions and adds value to the field of irrigation. We must champion more efficient, digital, and innovative irrigation practices that can adapt to climate change and stimulate wealth generation in rural areas.

The PERTE for irrigation to address water cycle modernization for agricultural use

We are confronted with a significant challenge. Climate change-related problems have resulted in a drought crisis, pushing the agricultural sector into a critical position where immediate actions must be taken to reverse the water resource scarcity.

Against this backdrop, the introduction of the PERTE for the Digitalization of the Irrigation Water Cycle enables transformative measures for countryside modernization and digitalization. It addresses a crucial challenge of unlocking the economic potential of the agricultural sector by addressing system deficiencies and achieving comprehensive digital water management.

This is not a minor challenge, and it is the collective responsibility of all of us to resolve this crisis, progress, and build a digitized, modernized, adaptable agricultural sector that can effectively address future challenges that may arise.



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