Policy Brief 1

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UNIVERSWATER

DIGITAL WATER RESILIENCE FOR SUSTAINABLE AGRICULTURE:

Smart monitoring, interoperable data and decision-support for water-smart agriculture

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EXECUTIVE SUMMARY

UNIVERSWATER project is an EU-funded project that aims to adopt a 'system of systems' approach by developing and improving technologies designed to optimise water resources uses in a fully integrated way. This 'system of systems' aims to address growing pressures on water quality and quantity from agricultural activities, including freshwater over-abstraction and pollutant runoff from nutrients and pesticides - pressures that are intensified by climate change - by combining portable and in-situ sensors, Earth Observation (EO), AI techniques, nature-based and technology-based remediation, pricing incentives, and decision-support systems (DSS). These solutions are tested in three case studies: dairy soiled water reuse in Ireland, mitigation of soil salinisation through reclaimed water use in Italy, and optimisation of fertiliser and pesticide application in Greece.

This first policy brief translates early project findings into EU-level recommendations under Task 6.5, which requires the project to develop policy recommendations and best practices. This brief focuses on UNIVERSWATER's contribution to the EU Water Resilience Strategy goals through the agriculture-water nexus, particularly to the upcoming EU Digitalisation Action Plan[1]. It also supports the Vision for Agriculture and Food, the Water Framework Directive, the Water Reuse Regulation, and future policy discussions on monitoring and circular water management.

UNIVERSWATER shows that the EU's water resilience and agricultural transition agendas require a digital operating layer: validated sensors, interoperable data, Earth Observation, and decision-support tools that allow farmers, utilities and regulators to manage water reuse, irrigation efficiency, salinity, nutrients and pollution risks in real time. EU policy should therefore support minimum monitoring datasets, validation pathways for rapid sensors, modular treatment trains, salinity and groundwater safeguards, interoperable data platforms, and incentives for farmers and water managers to adopt circular water solutions.

This policy brief provides six policy recommendations to foster the EU Water Resilience Strategy's goal of enhancing water efficiency and digital water governance in Europe.

1. Make agricultural water reuse a strategic pillar of EU water resilience, not only as a wastewater management option.
2. Define minimum digital monitoring datasets for risk-based agricultural water reuse, as safe water reuse depends on the right and timely monitoring parameters.
3. Create EU validation pathways for rapid water-quality sensors and biosensors.
4. Make salinity and groundwater safeguards mandatory in reclaimed-water irrigation planning.
5. Fund farmer-ready decision-support tools (interoperable DSS tools) through CAP, LIFE, Horizon Europe and Cohesion Policy.
6. Remove adoption barriers through incentives, advisory services and simplified permitting.

[1] More specifically, the Water Resilience Strategy has the goal to "develop an EU-wide Action Plan on digitalisation in the water sector, including an EU-wide initiative on Smart metering for all" by 2026, under the flagship action Digitalisation and Artificial Intelligence to accelerate and simplify sound water management.

INTRODUCTION

Europe is facing a convergence of water, climate, agricultural and pollution pressures. Droughts, irregular rainfall, groundwater over-abstraction, nutrient runoff, pesticide use, salinity risks and wastewater management challenges are already affecting farmers, water managers, regulators and ecosystems.

Agriculture is central to these challenges. It depends on water availability and water quality, but it also contributes to pressures on surface water, groundwater and soils. In water-scarce regions, irrigation can intensify pressure on aquifers. In livestock systems, nutrient-rich effluents can become pollution risks when storage, treatment and spreading are not optimised. In sensitive catchments, pesticide and fertiliser use can affect lakes, rivers, wetlands and groundwater. In coastal regions, groundwater over-abstraction can contribute to salinisation, reducing the suitability of water for irrigation and threatening soil productivity.

UNIVERSWATER responds to these challenges through a "system of systems" approach, integrating sensors, IoT, Earth Observation, AI, decision-support systems and water treatment solutions across three use cases in Ireland, Italy and Greece. UNIVERSWATER demonstrates that the EU response should not separate water reuse, water efficiency, digitalisation and agricultural sustainability.
The policy response must therefore connect agendas that are often treated separately: water resilience, agricultural competitiveness, water reuse, digitalisation and pollution prevention. The Water Resilience Strategy, the upcoming EU Digitalisation Action Plan for the water sector, the Water Framework Directive, the Vision for Agriculture and Food, all point towards the same need: Europe must manage water more intelligently, prevent pollution earlier, and support users in making better decisions.

The policy gap addressed by UNIVERSWATER is not simply the lack of data. It is the lack of connected, trusted and actionable data. Agricultural water management still too often relies on fragmented monitoring, delayed laboratory results, separate management of water quantity and quality, and insufficient integration between farm decisions and water policy objectives. UNIVERSWATER demonstrates how this gap can be closed through digital, risk-based and user-oriented systems.

Policy gaps identified by UNIVERSWATER	UNIVERSWATER added value
• Agricultural water reuse is still treated mainly as a compliance issue, not as a digital risk-management challenge. • Water efficiency policy often focuses on infrastructure, while underplaying data, water quality and decision support. • Digital water policy risks focusing on utilities and smart metering while overlooking farms and agricultural catchments. • Farmers need tools that reduce uncertainty and support compliance, not additional administrative burden.	• Connects water reuse, irrigation, nutrients, pesticides, salinity and treatment performance. • Tests digital water tools in three agricultural contexts. • Combines in-situ monitoring, EO, IoT, AI-ready datasets and DSS. • Grounds technology development in farmer, utility and regulator needs.

UNIVERSWATER IN PRACTICE

UNIVERSWATER contribution to the Water Resilience Strategy

The Water Resilience Strategy[2] aims to enable Europe to anticipate, withstand and recover from water stress, while protecting aquatic ecosystems and ensuring water availability, a water-smart economy, food production and economic activities. UNIVERSWATER contributes to the Water Resilience Strategy in three ways:

1. Moving from reactive water management to risk-based water management: The project shows that safe water reuse and water efficiency require more than compliance at the final point of use. They require risk management across the full chain: source water, treatment, distribution, soil, crop, irrigation method, pollutants and end-user practices. This is particularly visible in Italy, where reclaimed-water stakeholders identify microbial contamination, suspended solids, salinity, chlorine, emerging contaminants and long-term ecological effects as risks. Their preferred mitigation measures are risk management plans and continuous sensor monitoring[3].
2. Supporting safe alternative water sources: Reclaimed water and treated agricultural effluents can reduce freshwater and groundwater pressure, but only where salinity, microbial contamination, nutrients and emerging contaminants are monitored and managed through risk-based systems. UNIVERSWATER is developing and testing tools to monitor reclaimed water and treated agricultural effluents more effectively, overcoming monitoring bottlenecks for safe water reuse. Rapid E. coli monitoring, nutrient sensing, glyphosate sensing, pH and dissolved oxygen monitoring all support safer water reuse[4].
3. Linking water resilience with pollution prevention: UNIVERSWATER supports water resilience by linking alternative water sources with digital safeguards, enabling reuse without compromising soil, crop or ecosystem health. The project's sensor and data systems address nitrate, phosphorus, salinity, E. coli, glyphosate, emerging contaminants and water-quality parameters. UNIVERSWATER's sensor platform is designed for real-time environmental monitoring and includes nitrate sensing, glyphosate sensor development and E.coli detection[5].

Case Studies

1. The Irish case shows that on-farm circular water reuse will not scale through technology alone. It requires nutrient testing, clear permitting routes, advisory services and incentives that make reuse economically and administratively feasible for farmers.

2. In Italy, stakeholders view reclaimed water as a potential alternative to saline or overexploited groundwater, but only if quality, salinity and long-term risks are actively managed. This supports the integration of reclaimed water into drought and groundwater resilience strategies.

[2] European Commission, European Water Resilience Strategy, COM/2025/280 final, June 2025
[3] UNIVERSWATER, D1.1. Climate and Health threat and requirements, February 2026
[4] UNIVERSWATER, D2.12. Public Summary of sensor development, February 2026
[5] UNIVERSWATER, D2.12. Public Summary of sensor development, February 2026

UNIVERSWATER contribution to the Digitalisation Action Plan

UNIVERSWATER provides a practical use case for the EU Digitalisation Action Plan by showing how sensors, IoT networks, Earth Observation, FAIR data and DSS tools can be combined to support real-time agricultural water management. Its contribution is particularly relevant because agriculture is a high-pressure interface between water scarcity, pollution, food production and climate adaptation.
The project operationalises digitalisation through a chain of actions and an interoperable data architecture:

- Measure: UNIVERSWATER develops and deploys portable and in-situ sensors, IoT networks, wireless sensor networks, Smart Gateways, Earth Observation and UAV-derived data. UNIVERSWATER shows that the IoT platforms collect weather, water, soil and crop data from the field and transfer them to cloud-based systems for DSS use[6]. These measurements are essential for operational decisions on irrigation, water reuse, nutrient management and contamination risks.
- Connect and integrate: UNIVERSWATER provides a sensor readout layer with integrated and interoperable electrochemical sensors into the UNIVERSWATER architecture, supporting water and soil parameter measurement across use cases. UNIVERSWATER also uses data integration, AI mechanisms, modelling and DSS tools to transform monitoring data into early warnings, recommendations and operational insights, providing a data-governance and validation layer to its architecture and aligning the project to the FAIR principles.
- Decide and act: The integrated system supports decision-making on irrigation scheduling, fertiliser application, pesticide management, reclaimed water use, salinity prevention and treatment performance. In a water reuse context, delays in detecting contamination can limit the ability of operators and users to act preventively. Rapid monitoring does not need to replace formal compliance methods, but it can complement them by supporting early warning, operational risk management and decision-support systems.

Water data are often dispersed across utilities, public authorities, farmers, laboratories, research organisations and technology providers. Legacy systems, incompatible formats, insufficient metadata and unclear governance rules limit the value of digital tools. UNIVERSWATER shows that the water sector needs digitalisation that is integrated from the start: sensor-to-platform design, common data flows, validation, metadata, FAIR principles, interoperability and user-oriented tools.

[6] UNIVERSWATER, D2.6. Prototype IoT platforms, April 2026
[7] Findable-Accessible-Interoperable and Reusable data

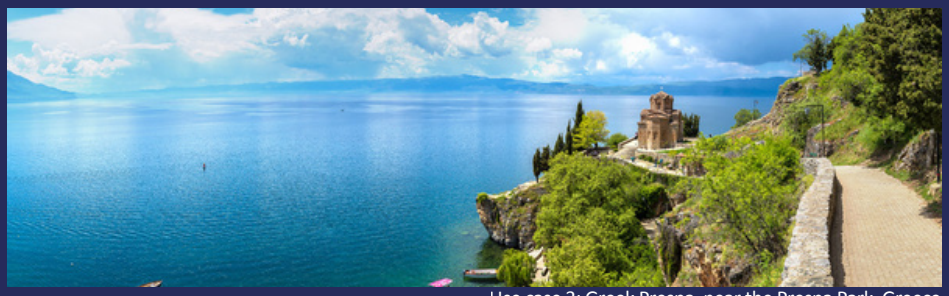
UNIVERSWATER contribution to water efficiency

UNIVERSWATER reframes water efficiency as a data-driven management challenge. Efficient agricultural water use requires more than modern irrigation equipment: it depends on real-time information about soil moisture, water quality, weather, crop needs, salinity and reuse options. This is particularly relevant in regions where farmers still rely on fixed irrigation schedules or lack information on irrigation-water quality. Such an approach is supported by integrating technologies into local DSSs and scaling them up into a modular, extensible and holistic universal DSS adaptable to different situations and local factors.

Water efficiency is not only a question of irrigation hardware; it requires real-time information on water quality, soil moisture, weather, crop needs and reuse options. EU water efficiency measures should support digital monitoring and DSS tools, not only physical irrigation modernisation. Smart irrigation requires data, sensors, advisory support and interoperable platforms.

Case Studies

In Greece, farmers often rely on fixed irrigation schedules rather than real-time soil moisture, weather or sensor data. It also shows that farmers identify water-use efficiency, crop yield and regulatory compliance as expected benefits from decision-support systems.



Use case 3: Greek Prespa, near the Prespa Park, Greece

UNIVERSWATER contribution to the water-agriculture nexus

UNIVERSWATER shows that agricultural water reuse should not be treated only as a wastewater management option or as an end-point compliance issue. It should be treated as a risk-management system that covers the full chain: source water, treatment, storage, distribution, soil, crop, irrigation method, pollutants and end-user practices.

- Making water reuse usable for farmers: Farmers are open to innovation but need practical tools, simplified guidance and financial incentives[8]. Irish farmers expressed strong interest in on-site reuse and technologies for nutrient-management decisions. Italian farmers and stakeholders support treated wastewater reuse but remain concerned about natural resource contamination, long-term effects and microbiological risks. Greek farmers are open to DSS technologies but uncertain about water treatment technologies unless supported by incentives. UNIVERSWATER connects water reuse policy with farmer realities: cost, risk, trust, usability and compliance.

[8] UNIVERSWATER, D1.1. Climate and health threat and requirements, February 2026

- Supporting sustainable agricultural productivity: The project supports farmers in maintaining production while reducing environmental pressures. Nitrate sensors support fertiliser optimisation; pesticide monitoring supports safer crop protection; water-quality monitoring supports safer irrigation; IoT and DSS tools support more precise use of water and inputs, reducing uncertainty and supporting more efficient management.
- Protecting soils, groundwater and sensitive ecosystems: UNIVERSWATER shows that agricultural water management must account for cumulative impacts on soils, aquifers and protected ecosystems, not only immediate water availability. By combining Earth Observation, in-situ sensor data, field observations and laboratory validation, UNIVERSWATER supports earlier detection of salinity, nutrient and pollution risks, enabling farmers and regulators to adjust irrigation, reuse and input-management decisions before degradation becomes irreversible[9].

Case Studies

1. In the Italian case, the project addresses the risk that groundwater over-abstraction and the use of saline irrigation water can accelerate soil salinisation, reduce crop productivity and place additional pressure on coastal wetlands.

2. In the Prespa region, in Greece, the project focuses on the need to protect lake water quality in a sensitive transboundary ecosystem where irrigation, fertiliser and pesticide practices can affect nutrient loads, pesticide residues and ecological status.



Use case 2: Torre Guaceto, Southern Adriatic coast, Italy

[9] UNIVERSWATER, D5.1. New data collection campaigns, September 2025

RECOMMENDATIONS

Building on the insights from UNIVERSWATER, we recommend considering certain policy foster the EU Water Resilience Strategy's goal of enhancing water efficiency and digital water governance in Europe:

1 Recognise agricultural water reuse as a strategic measure for water resilience

And not only as a wastewater management option. Policies should support reclaimed water, treated agricultural effluents and on-farm circular water systems where they are safe, risk-assessed and locally appropriate.

- Develop guidance on agricultural water reuse as part of water resilience implementation.
- Promote water reuse in rural and farming contexts, not only in urban wastewater treatment settings.
- Encourage Member States to integrate water reuse into river basin management, drought management, agricultural advisory services and climate adaptation plans.
- Support water reuse in both crop and livestock systems, including treated dairy soiled water were safe and technically feasible.

2 Establish minimum monitoring datasets for risk-based agricultural water reuse,

Safe water reuse depends on the right monitoring parameters.

- Develop minimum monitoring datasets for agricultural water reuse risk management plans.
- Encourage the use of soil and crop monitoring alongside water quality monitoring.
- Promote harmonised data formats and interoperability to allow datasets to feed decision-support tools.
- Support FAIR data practices for publicly funded water reuse and monitoring projects.

3 Create EU validation pathways for rapid and field-deployable monitoring technologies

Innovative sensors and rapid biosensing methods can help farmers and water managers take faster operational decisions. However, regulatory uptake depends on validation, comparability and trust.

- Establish EU-level guidance for validating novel sensors and rapid methods for operational water reuse monitoring.
- Allow validated rapid methods to complement accredited laboratory methods in risk management.
- Support demonstration and intercomparison campaigns across different water matrices.
- Engage standardisation bodies, regulators, water utilities, farmers and technology developers early in the validation process.

4 Integrate salinity and groundwater protection into water reuse planning

Reclaimed water can support irrigation resilience, but it may also affect soil salinity and groundwater quality if not properly managed. Salinity is particularly important in coastal regions, irrigated agriculture and areas facing groundwater overexploitation.

- Support combined monitoring of reclaimed water quality, soil electrical conductivity, groundwater status and crop response.
- Promote digital tools for anticipating salinity accumulation and adjusting irrigation decisions and include salinity risk assessment in agricultural water reuse planning
- Prioritise vulnerable coastal and water-scarce regions for demonstration and advisory support.
- Link reclaimed water uses to groundwater protection and abstraction reduction strategies.

5 Fund farmer-ready decision-support tools (interoperable DSS tools) and advisory services

Digital decision-support systems can help translate complex water, soil, crop and treatment data into actionable recommendations. However, adoption depends on usability, trust, cost, training and integration with existing farm practices.

- Support DSS deployment through the Common Agricultural Policy advisory ecosystem, operational groups and living labs.
- Fund training for farmers, water managers and advisors on water reuse, monitoring and treatment technologies.
- Promote explainable AI and transparent recommendations to increase trust.
- Ensure DSS tools are interoperable with existing farm management, irrigation and water quality platforms.

6 Remove adoption barriers through incentives, advisory services and simplified permitting

By combining EU funding, CAP advisory services, simplified permitting and performance-based incentives for farms and utilities that adopt validated digital water and reuse solutions.

- Create funding windows for scaling validated agri-water monitoring and treatment technologies.
- Use innovation procurement and public-private partnerships to accelerate uptake by utilities, farms and water authorities.
- Promote pricing and incentive mechanisms that make water reuse financially attractive while protecting public health and ecosystems.
- Support regulatory sandboxes for safe testing of novel monitoring and treatment approaches.

CONCLUSIONS

UNIVERSWATER provides early evidence that water resilience, agricultural competitiveness and environmental protection can be advanced together when digital systems are used to connect monitoring, data integration and decision-making.

The project's contribution is not limited to technology development. It demonstrates a policy-relevant model for digital agri-water resilience: validated sensors, interoperable data, Earth Observation, IoT platforms and decision-support tools aligned with farmer needs, regulatory safeguards and EU water objectives.

To maximize policy impact, EU institutions and Member States should treat digital water management as enabling infrastructure for the Water Resilience Strategy, the Digitalization Action Plan, the Vision for Agriculture and Food, the Water Reuse Regulation and the Zero Pollution agenda. This means investing not only in infrastructure, but also in data governance, validation, advisory services, incentives and uptake pathways.

Digital water resilience starts on the farm. Europe should equip farmers, water managers and regulators with tools to monitor, reuse, optimize and protect water resources in real time.



Use case 1: Teagasc Moorepark, Ireland



To address the complex challenges of agri-water management, the UNIVERSWATER consortium will adopt a 'system of systems' approach by developing and improving technologies designed to optimize water resources uses in a fully integrated way.

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