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"Water relations and irrigation of fruit crops: from science to policy and practice“

Naoussa (Greece), 16-18 June, 2025

Establishing a science-policy-practice nexus transforming water management for climate-resilient fruit orchards

Theo Zacharis Greek Scientists Society

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

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The Urgency of Water Resilience in Fruit Orchards

Why we must act now

Fruit orchards across Europe, particularly in the **Mediterranean**, are under increasing pressure from **climate variability**. Water stress, erratic rainfall, and rising temperatures are already affecting yields and profitability. Our response must go beyond technology or policy alone. What is needed is an **integrated framework—a Science-Policy-Practice (SPP) nexus**—that connects innovation, governance, and real-world implementation.

Key Issues:

- Traditional irrigation methods are inefficient under climate stress.
- Research often fails to translate into field-level impact.
- Policies and on-farm practices remain disconnected.

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Policy-Driven Irrigation Strategies

Aligning Policy Incentives with Sustainable Irrigation

The EU's Common Agricultural Policy (CAP) and Green Deal offer unprecedented opportunities to promote climate-smart agriculture, yet their uptake depends on effective alignment with regional water realities. **CAP eco-schemes** and **conditionality mechanisms** can **incentivise smart irrigation technologies**, **water reuse**, and **soil conservation**—but only if these are made actionable for **fruit growers** on the ground.

Key Points:

- Policy incentives (e.g. eco-schemes) must reflect real irrigation constraints.
- CAP funding can support water-efficient systems, but awareness is low.
- Local adaptation of EU rules is critical for orchard viability.

What's Needed:

- Practical guidelines for orchard-specific water-saving practices.
- Stronger communication between policymakers and grower communities.
- Monitoring systems that link CAP compliance with on-farm water data.

From Models to Decisions

Turning complex science into daily farm tools

Hydrological models, seasonal forecasts, and soil data offer valuable insights—but are often **too complex** or **disconnected** from daily farm decisions. Decision-support tools (DSTs) can help growers optimise irrigation based on real-time conditions, but uptake remains limited.

Key Issues:

- Most DSTs are **designed for researchers, not end-users**.
- Fragmented data sources hinder integrated recommendations.
- Growers need **timely, localised,** and **crop-specific** advice.

What's Needed:

- User-friendly dashboards with clear irrigation recommendations.
- Integration of remote sensing, IoT, and weather forecasts.
- **Co-design of tools** with farmers to boost trust and usability.
- Use of **knowledge graphs** to connect sensor data, climate models, and orchard-specific practices.

Collaborative Water Governance

Putting farmers at the centre of adaptive solutions

Effective water management goes beyond infrastructure and technology—it's about **governance**. Local engagement and trust are essential for building systems that reflect both **policy goals** and **on-farm realitie**s. Top-down approaches often miss the mark without farmer participation.

Key Issues:

- Farmers are rarely involved in irrigation planning or policy dialogues.
- Governance is often **fragmented** across agencies and sectors.
- Lack of ownership leads to low compliance or rejection of new practices.

What's Needed:

- **Participatory** water user associations and advisory councils.
- Joint design of irrigation calendars, reuse schemes, and monitoring tools.
- **Capacity building** for both farmers and policymakers to engage meaningfully.

Sustainable Irrigation Infrastructure

Going beyond hardware to ecological solutions

Traditional irrigation infrastructure often focuses **on delivery**, **not sustainability**. As climate extremes intensify, fruit orchards need systems that combine efficiency with resilience—integrating nature-based solutions and circular water use.

Key Issues:

- Infrastructure investments overlook ecological design.
- Water reuse is underutilised due to legal or cultural barriers.
- **Soil degradation** undermines irrigation efficiency.

What's Needed:

- **Retention ponds, bioswales, and agroecological water buffers**.
- On-farm water recycling using treated greywater where safe.
- Practices that enhance soil moisture retention (e.g. mulching, cover crops).

Smart Irrigation for Precision Agriculture

Tech-enabled water efficiency at tree level

Smart irrigation technologies offer the potential to optimise water use with precision—matching irrigation to the specific needs of each crop and even individual trees. Yet adoption remains uneven, particularly in smaller orchards.

Key Issues:

- High upfront costs deter smaller growers.
- Data overload without clear guidance reduces usability.
- Integration with existing farm systems is often poor.

What's Needed:

- **Scalable, plug-and-play sensor systems** for orchards.
- **AI-powered apps** that simplify decision-making, not complicate it.
- Demonstration sites showing real benefits in yield, cost, and sustainability.

Stakeholder Engagement & Water Governance

Putting farmers and policymakers on the same side

Water management must be **collaborative** to be effective. Stakeholder engagement isn't a checkbox—it's how resilient, accepted, and adaptive systems are built. Without co-creation, even the best-designed interventions fail.

Key Issues:

- Disconnect between scientific recommendations and grower realities.
- Water decisions are often made without local consultation.
- Power asymmetries prevent equitable dialogue.

What's Needed:

- **Multi-actor platforms** to co-develop irrigation plans.
- **Empowerment** of farmer associations in regional water governance.
- **Feedback mechanisms** linking growers to policy and science.

Nature-Based & Smart Infrastructure

Nature-Based & Smart Infrastructure

Irrigation is no longer just about efficiency—it must support **ecological resilience**. Combining smart technologies with nature-based design offers a pathway to sustainable water use that adapts to climate realities.

Key Issues:

- Conventional infrastructure ignores landscape-scale resilience.
- Smart tech alone can’t solve degraded ecosystems.
- Nature-based options often lack technical or policy support.

What’s Needed:

- Hybrid systems integrating smart irrigation with bioswales, hedgerows, and retention ponds.
- **Policy incentives** for circular water systems and biodiversity-enhancing designs.
- **Infrastructure planning** that considers hydrology, soil, and orchard ecosystems.

The Centre of Excellence

Where science meets policy—and turns into practice

The **Med Smart Agri-CoE** is the operational core of the science-policy-practice nexus. It transforms research outputs and policy frameworks into **real-world applications**—piloted, tested, and scaled in orchards. It ensures that innovations don't just stay in labs or reports but take root in the field.

Key Features: **Practice-oriented innovation hub** for irrigation, plant science, and climate adaptation (and more).
Hands-on training environment for farmers, startups, and extension agents.
Policy advisory function to align CAP instruments with orchard-level needs.
Commercialisation pipeline to turn research into tools, services, and market-ready solutions.

Why It Matters:

- Bridges fragmented efforts across research, governance, and farm practice.
- Anchors best practices in a trusted institutional platform.
- Scales successful solutions through exchange programmes and industry links.

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Call to Action

Co-create the future of climate-resilient fruit farming

The Centre of Excellence

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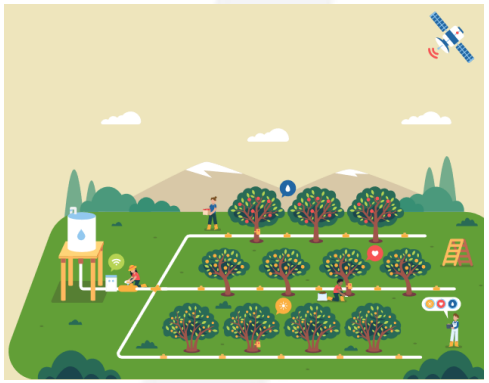
We don’t need more isolated projects—we need lasting systems that translate research into field-level impact. The Med Smart Agri-CoE offers a **strategic model** tailored for Mediterranean regions, a model to **integrate policy, innovation, and practice** through a collaborative, scalable approach.

Our aim:

- The Med Smart Agri-CoE offers members of the Action a shared platform to integrate research, policy alignment, and field-based innovation across Mediterranean orchard systems.
- Help transform water management from a technical challenge into a shared mission across sectors.

Final Thought:

It’s time to move from fragmented solutions to focused action.
Let’s make this **CoE** not just a centre—but a catalyst.



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Thank You

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