Digital and Agroecological Innovations for Sustainable Berry Production

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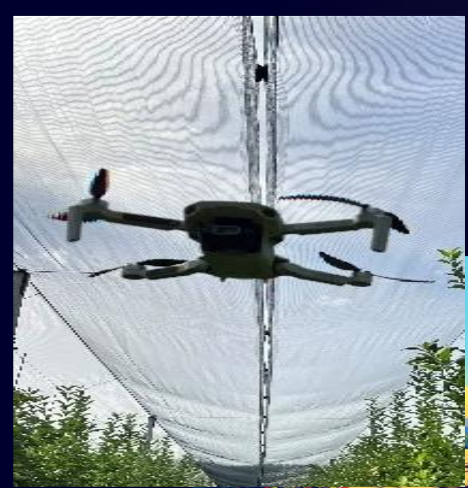
Evaluating integrated strategies for resilient, productive, and environmentally sound horticultural farming systems across Europe.

AGROECOLOGY | SUSTAINABLE HORTICULTURE | DIGITAL AGRICULTURE | BERRY PRODUCTION



Study Objective

Integrating Digital Tools with Agroecological Practice

This study evaluates how combining **digital agriculture technologies** with **agroecological farming practices** can improve sustainability, resilience, and economic performance in berry production.

Digital Monitoring
Assess real-time monitoring tools in farm decision-making

Agroecological Practices
Evaluate biodiversity and soil health outcomes

Integrated Outcomes
Analyse environmental and economic performance together

The Challenge

Berry Farming Under Pressure

Berry production systems across Europe face compounding pressures that threaten long-term viability:

Climate Variability
Erratic weather patterns disrupt crop cycles and increase production risk.

Soil Degradation
Intensive input use undermines long-term soil fertility and ecosystem function.

Biodiversity Loss
Declining pollinator populations and reduced habitat threaten yields and resilience.

Economic Pressure
Farmers must maintain profitability while meeting stricter sustainability requirements.

Study Sites

Four Countries, Four Agro-Climatic Contexts

Lithuania
Continental climate; strawberry and currant systems

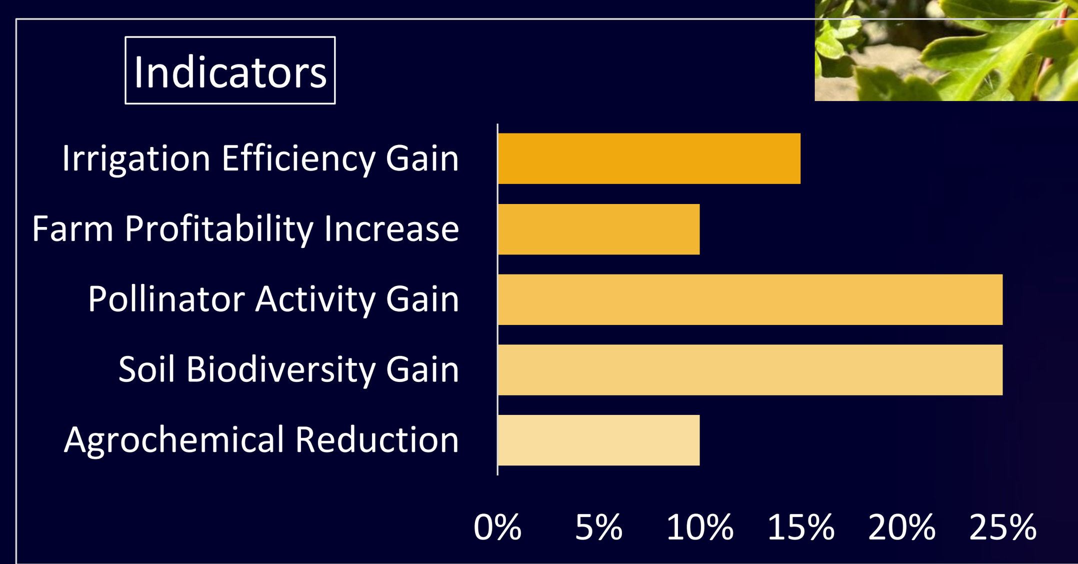
Poland
Mixed climate; intensive berry production landscapes

France
Atlantic climate; diverse horticultural systems

Slovenia
Alpine-continental; smallholder farm settings

Results in Detail

Environmental and Economic Performance



Materials & Methods

A Multi-Technology, Multi-Site Approach

Digital Technologies Deployed

AI Decision Support
Smart advisory systems for crop management

IoT Sensors
Real-time environmental and soil monitoring

UAV Monitoring
Drone-based crop health imaging

Agroecological Practices Applied

Biological Soil Management
Promoting soil microbiome health

Pollinator Habitats
Wildflower strips and habitat corridors

Alternative Weed Control
Reducing herbicide dependency

Data were collected via sensor networks, drone imagery, and field observations. Analysis applied **multi-criteria decision analysis (MCDA)** and **scenario modelling** to evaluate trade-offs across productivity, environment, and economics.

Discussion

Why This Combination Works

The study demonstrates a clear synergy between digital precision and ecological stewardship. Neither approach alone delivers the same breadth of outcomes.

Digital Tools Sharpen Decisions
Real-time data on soil, crop, and environment enable optimized irrigation, fertilization, and pest response — reducing input overuse without sacrificing yield.

Agroecology Builds Resilience
Biodiversity-enhancing practices strengthen ecosystem services essential for long-term productivity — soil fertility, pollination, and natural regulation.

Together: A Sustainable Bioeconomy
Integration supports efficient use of biological resources, linking productivity gains with environmental performance at farm and landscape scales.

Conclusions

A Viable Pathway to Resilient Berry Farming

Integrated digital and agroecological approaches offer a practical, scalable pathway for improving sustainability across European berry production systems.

Agrochemical Dependency
Precision monitoring reduces unnecessary input application

Biodiversity & Soil Health
Ecological practices restore ecosystem function on-farm

Resource Efficiency
Smarter use of water, nutrients, and biological inputs

Farm Profitability
Economic gains accompany environmental improvements

These findings support the case for scaling digital-agroecological integration as a cornerstone of climate-resilient agriculture and the transition to a sustainable European bioeconomy.

Key Results

Measurable Gains Across All Dimensions

10%
Reduction in Agrochemical Inputs
Achieved through precision monitoring and targeted application

25%
Increase in Soil Biodiversity & Pollinators
Driven by habitat creation and biological soil management

10%
Increase in Farm Profitability
Net economic benefit from integrated management approaches

500+
Stakeholders Engaged
Training events, field demonstrations, and knowledge-exchange activities

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