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Development and application of IMIS – an Irrigation Management Information System

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IMIS
Irrigation Management Information System

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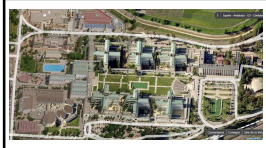

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ETSIAM

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Traditional irrigation (2002)

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Modernization (2009)

- Irrigation efficiency
- flexibility
- Crops diversification
- Automation
- Energy demand

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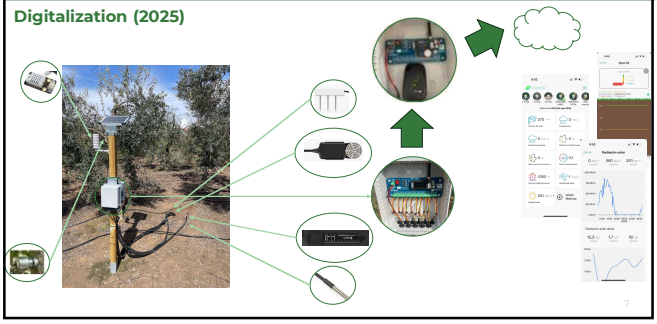
Digitalization (2025)



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EVOLUTION OF AGRICULTURE

TRADITIONAL AGRICULTURE	AGRICULTURE 1.0	AGRICULTURE 2.0	AGRICULTURE 3.0	AGRICULTURE 4.0
Hand tools, manual farming	Mechanization	Green Revolution: Chemical fertilizers, pesticides, hybrid seeds	Precision agriculture: GPS, sensors, variable rate application	IoT, AI, digital twins: Drones, robotics, smart farming

Irrigation 4.0

- IoT sensors
- Drones and remote sensing
- Predictive systems
- Artificial intelligence
- Traceability
- Big Data
- Smart phones and ICTs
- ...

Precision irrigation

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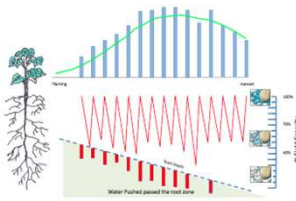
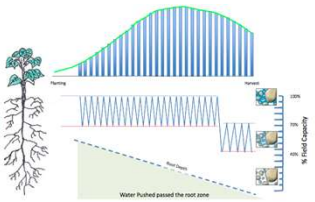
Traditional irrigation



- Data collection and manual control
- Optimization based on observation
- Decision-making using an intuitive method based on farmers' experience

Precision irrigation



- Automatic control and data collection
- Modeling and optimization
- Decision support systems (DSS) and predictive systems

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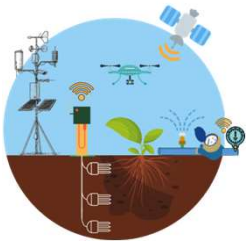
Objectives of precision irrigation

- Improvement of the irrigation efficiency and uniformity
- Costs reduction
- Increase crop profitability
- Reduction of energy consumption
- Use resources more efficiently



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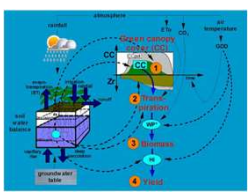
Soil-Water-Plant-Atmosphere models

Mathematical or simulation model that describes the interactions and dynamics between soil moisture (soil water), plant growth, and plant water use over time.



- They have been used for decades.
- Usually with historical climate data.
- They have generally been calibrated in other locations.
- They reproduce crop growth according to complex equations.
- Executed on a personal computer or laptop.
- There is no direct exchange of information with the crop and its development.

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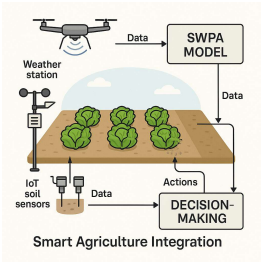
Digital Twin of the Soil-Water-Plant-Atmosphere System



Smart Agriculture Integration

A digital twin is a virtual representation of a physical object, system, or process that mirrors its real-world counterpart in real time through continuous data exchange and simulation.

- It is powered by real-time data collected by IoT sensors.
- It integrates data from various types of sensors into a single platform.
- The real-time calibrated model allows simulations to optimize irrigation.
- Simulates scenarios based on weather forecasts.

IMIS Irrigation Management Information System

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IMIS

IMIS– Irrigation Management Information System

- Digital twin of the crop system
- Simulates crop growth, yield and water needs
- Provide actionable insights to optimize yield, improve water productivity, and reduce risks.
- IoT-enabled: integrates real-time data from any sensor
- Mobile apps (Android & iOS) for easy farmer interaction

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How much water will the crop need today?

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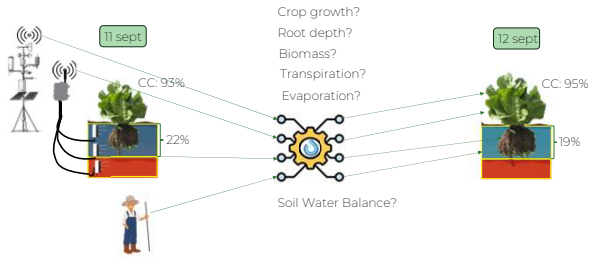
The solution: IMIS



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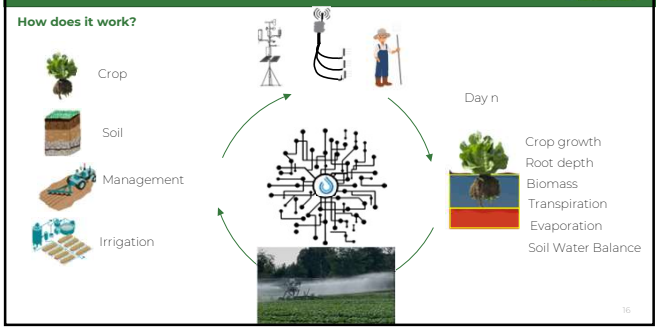
How does it work?



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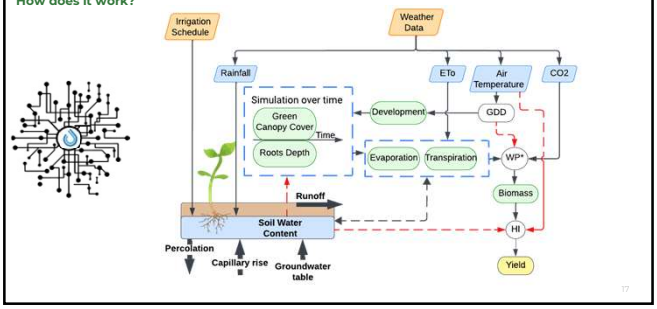
How does it work?



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KPIs

System Operation

- **Relative Water Supply (RWS)** – are crops getting enough water?
- **Relative Irrigation Supply (RIS)** – is irrigation meeting demand?

Agricultural Productivity

- **Water Use Efficiency** (tons/m³) – yield per water used
- **Land Productivity** (tons/ha) – yield per area cultivated

Environmental Performance

- **Blue Water Footprint** (m³/ton) – irrigation water per ton produced
- **Energy Efficiency** (kWh/m³) – energy cost of water delivery
- **Carbon Footprint** (g CO_2/m³) – emissions linked to irrigation

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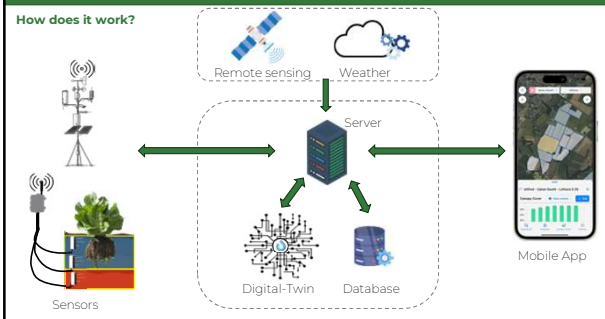
How does it work?



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Benefits

- **Unified Platform** – Integrates all sensor data in one place
- **Data Management** – Secure storage and easy access through centralized databases
- **Smart Crop Modeling** – Simulates growth, water needs, and yield
- **Adaptive Predictions** – Uses real-time data to continuously improve accuracy
- **Irrigation Optimization** – Identifies and recommends the best irrigation strategy
- **Performance Insights** – Generates KPIs for monitoring and decision-making
- **Mobile Access** – Intuitive iOS & Android app for field-friendly use

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Use case – Add a parcel

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Use case - Sensors

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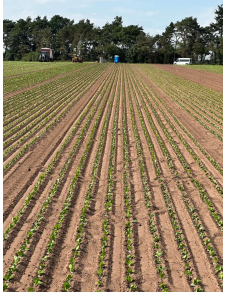
Use case – Add a crop



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Use case - Dashboard

Dashboard 📈 - Comprehensive parcel dashboard with:

- Date navigation from season start to end/current date
- Seasonal data visualization
- Key performance metrics

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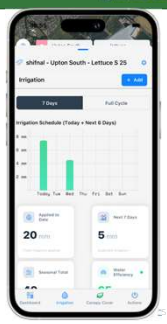
Use case - Irrigation

Irrigation 💧 - Complete irrigation management:

- Future Schedule: Charts showing predicted irrigation (7-day and full season views)
- Metrics Cards: Applied to date, next 7 days prediction, seasonal total
- Historical Chart: Past irrigation events visualization
- Event Management: Add/edit irrigation events
- Smart Analysis: Water efficiency scoring based on deficit, missed opportunities, and over-irrigation



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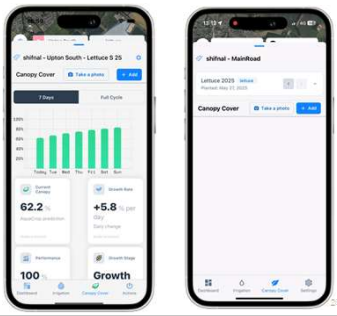
Use case – Crop growth

Canopy Cover 🌱 - Crop growth monitoring

- Future Growth: Predicted canopy development (7-day and full season)
- Growth Metrics: Current canopy %, growth rate, performance, growth stage
- Historical Chart: Model predictions vs manual measurements
- Photo Integration: Camera segmentation for canopy analysis
- Measurement Management: Add/edit canopy cover data



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Use case - Settings

Settings

- App settings
- Farm-Parcel-Crop settings

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Future Vision

- Integration with remote sensing
- Test in more locations and crops
- Integrate artificial intelligence
- Integrate more sensors to the digital-twin
- Diseases, pests and nutritional problems
- Improve the application

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