

11-12 FEBRUARY 2025

RABAT, MOROCCO

Institut Agronomique et Vétérinaire Hassan II



WEFE NEXUS INTERNATIONAL CONFERENCE

**EXPLORING AND BRIDGING NEXUS FOR
A SUSTAINABLE FUTURE**



These projects are part of the
PRIMA programme supported
by the European Union.

WEFE NEXUS INTERNATIONAL CONFERENCE

Day 1 – 11th February 2025

PRESENTATION OF BONEX AND SURENEXUS PROJECTS



Dr Jordi Morató

Director UNESCO Chair on Sustainability
Universitat Politècnica de Catalunya- Spain



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EXPLORING AND BRIDGING NEXUS FOR
A SUSTAINABLE FUTURE

SureNexus PRIMA Project

Jordi Morató Farreras

UNESCO Chair on Sustainability
Universitat Politècnica de Catalunya



UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH
UNESCO Chair on Sustainability

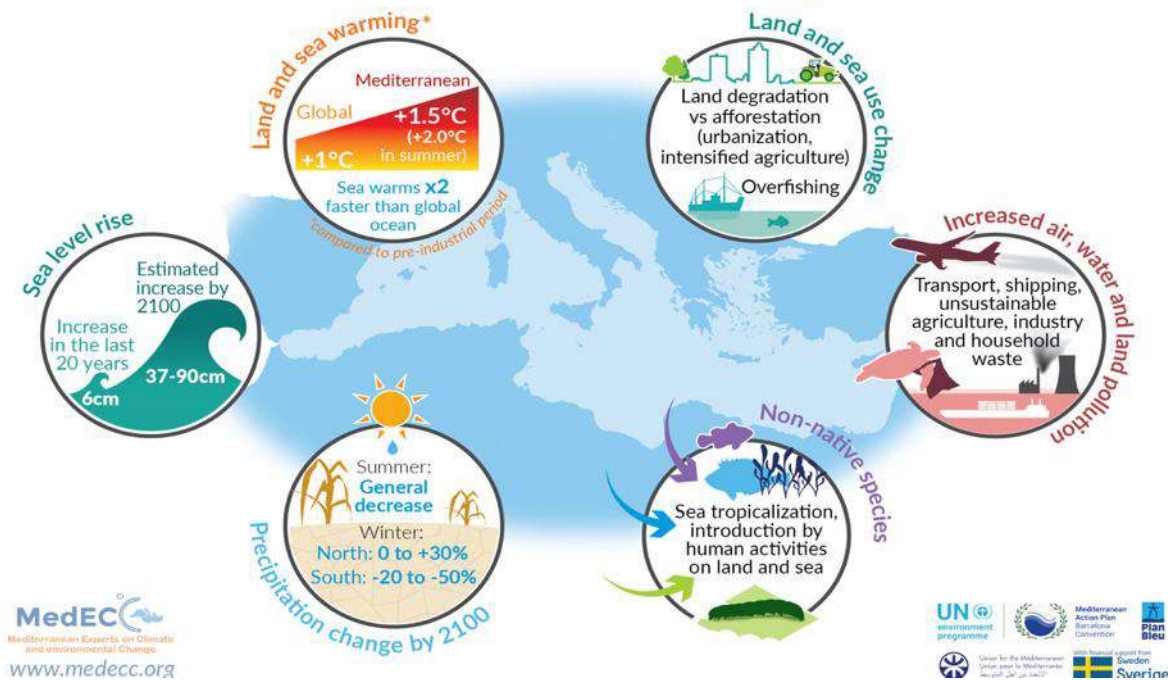


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THE CLIMATE REALITY CREATES UNCERTAINTY

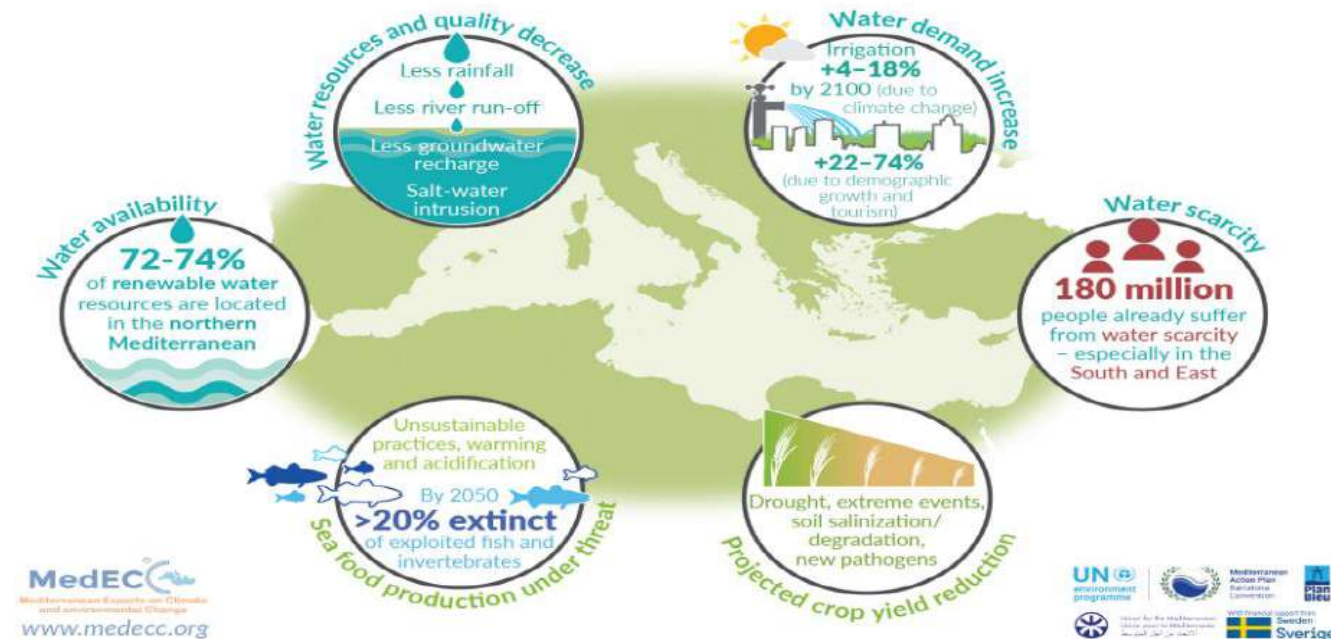
1st Mediterranean Assessment Report (MAR1) published by MedECC

The Mediterranean Basin: main drivers of environmental change



1st Mediterranean Assessment Report (MAR1) published by MedECC

Water and food in the Mediterranean: increasing demand & decreasing supply



Accelerated Climate & Water Scarcity in the Mediterranean

1

Accelerated climate change (CC) has exacerbated existing **socio-environmental problems** in the Mediterranean (MED) Basin.

2

Regional **temperature increase** will be 2.2°C in 2040.



3

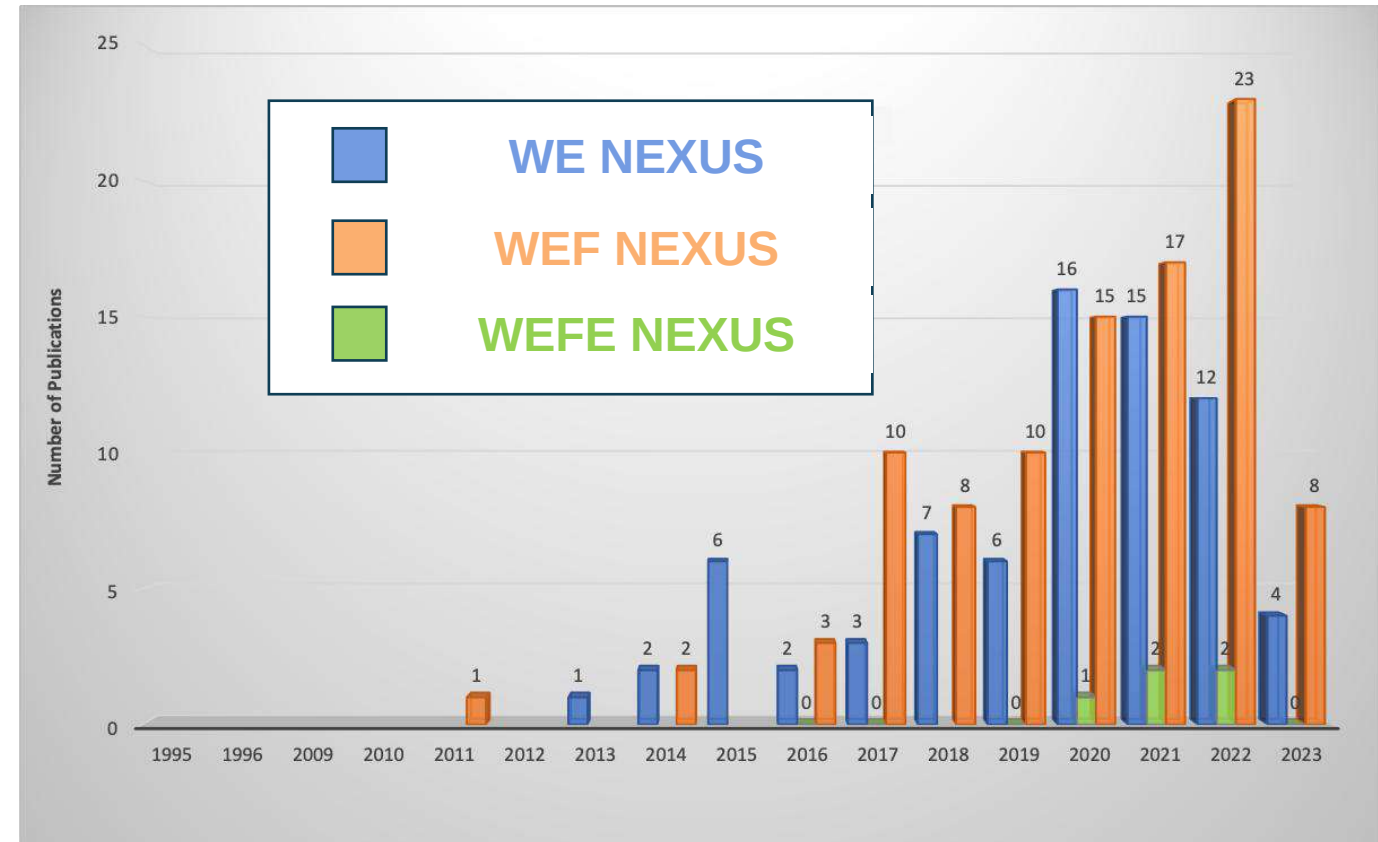
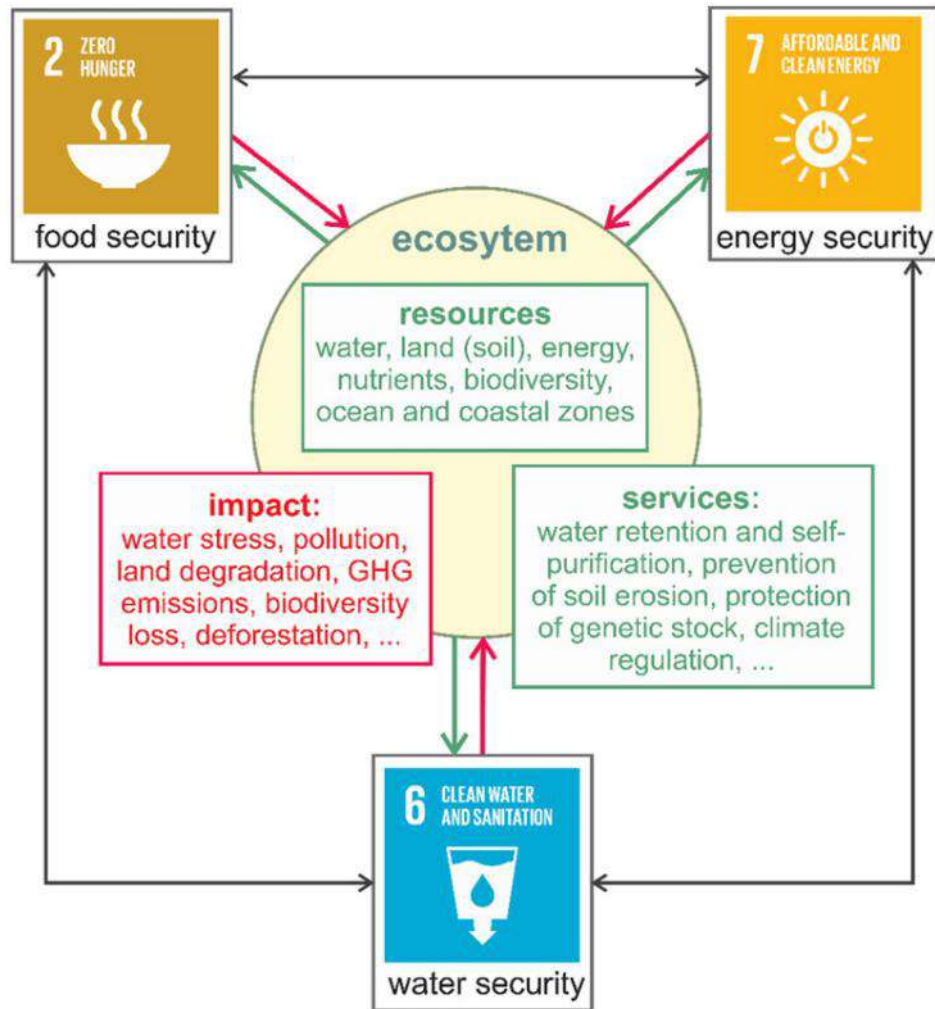
For each degree of global warming, mean **rainfall will likely decrease by about 4%** and **evaporation increase near 7%**.

4

Drought is increasing and consequently **food productivity will be reduced by 17% in 2050**

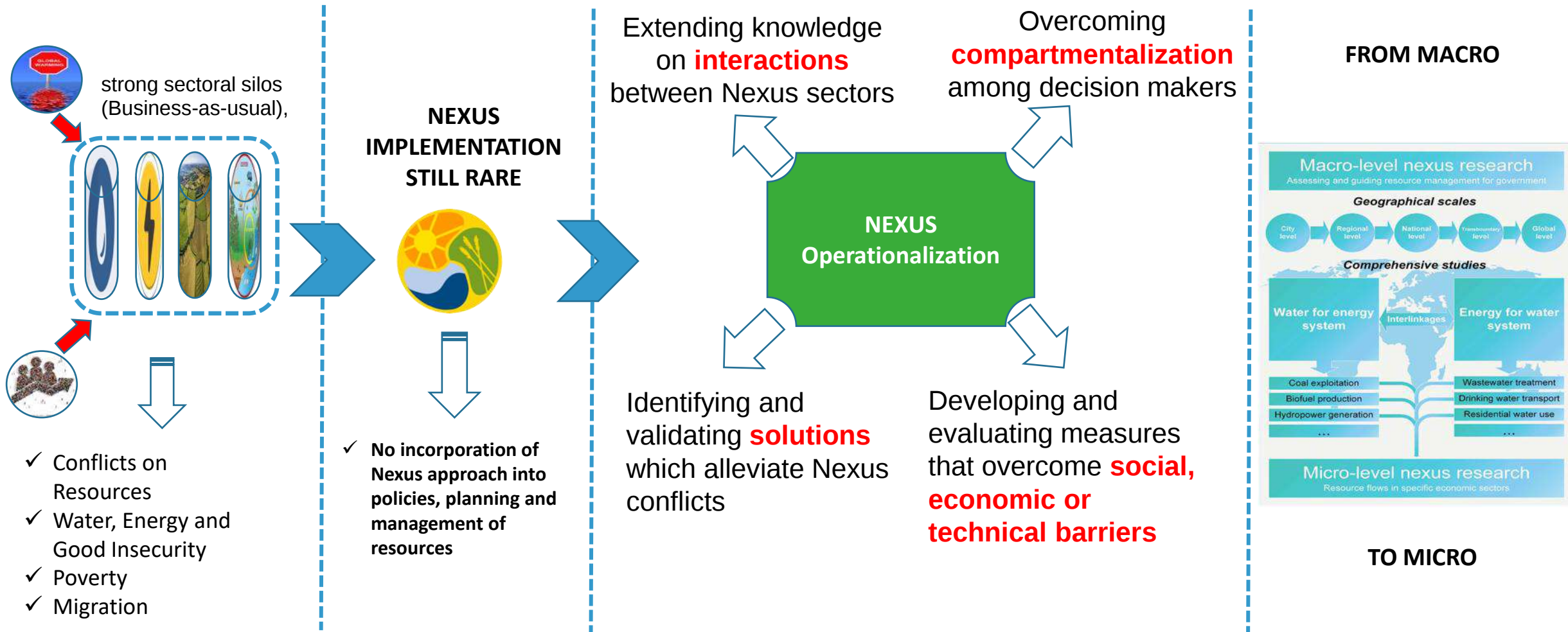


Water – Energy – Food – Environment (WEFE) NEXUS



Modelling + WE NEXUS/WEF NEXUS/WEFE NEXUS (Web of Science, 2023)

NEXUS Challenges





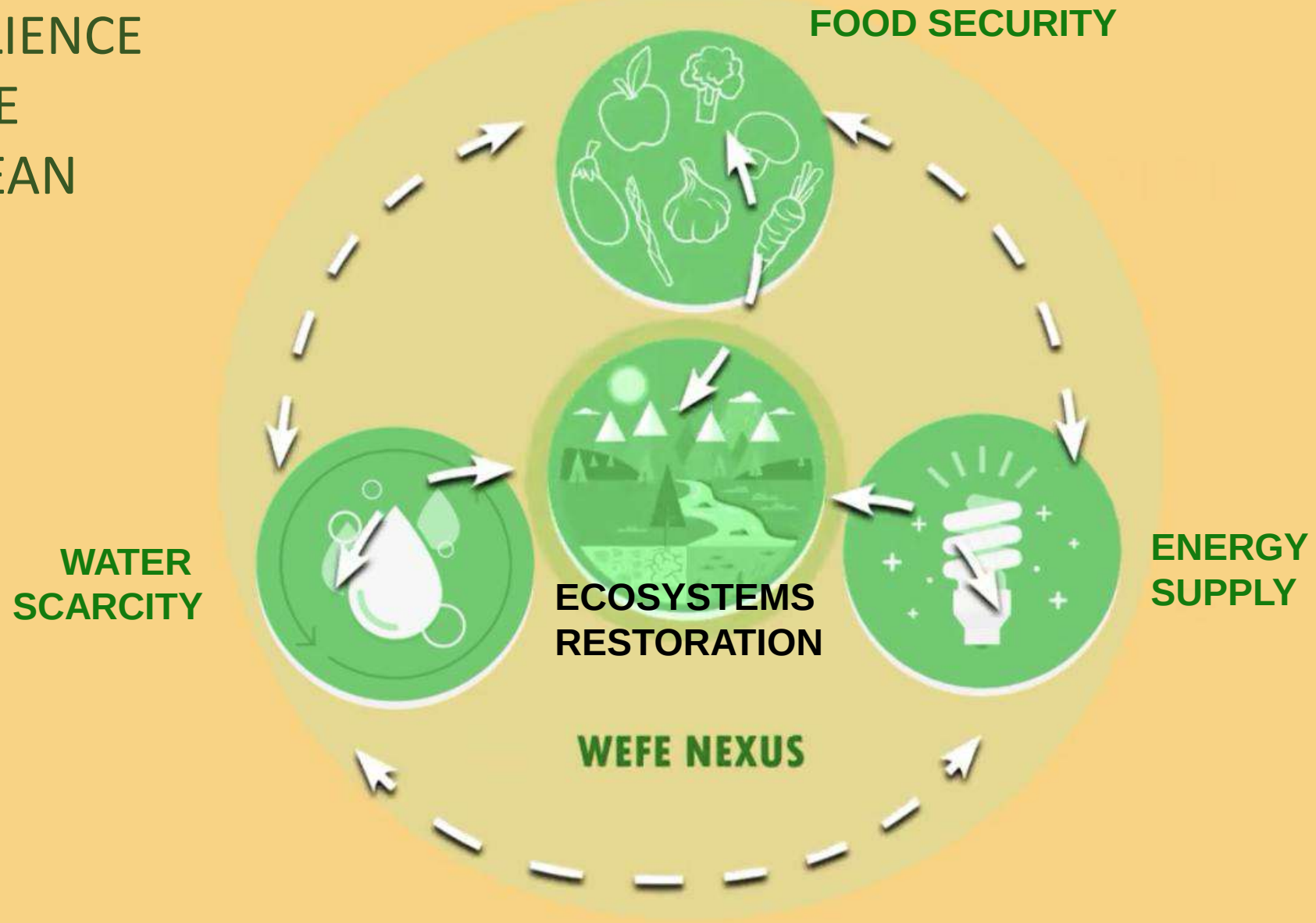
7 countries / 15 institutions

Ensuring fair WEF E NEXUS transition for Climate Change Adaptation and Sustainable Development implementation, based on coupled Nature-based Systems and Bioeconomy



These projects are part of the PRIMA programme supported by the European Union.

CLIMATE RESILIENCE FUTURE IN THE MEDITERRANEAN REGION



To deploy **small-scale innovative solutions as demonstrators of Socio-Ecological and Technical systems (SETs)** based on:

- 1) **Bioeconomy solutions (BES)**
- 2) **Nature-Based Solutions (NbS)**

for WEFE NEXUS, and evaluate their **productivity and value to the local community**, although the concepts of productive and consumption must also be evaluated in alignment with food market, driving technology acceptance and **mentality change**.

SURENEXUS framework

SURENEXUS will develop, demonstrate and validate a planning and management framework for transition to a WEFE NEXUS implementation that:

- 01 is dynamically adaptive, evolutionary, transformative and replicable.
- 02 recognizes agriculture and touristic areas as a system in relation to urban and semiurban areas and ecosystems.
- 03 uses data mining and machine learning to establish future scenarios based on the specific needs and challenges.
- 04 adopts a multiactor approach to involve key stakeholders to develop sustainable and cost-effective solutions that tackle their needs and constraints and therefore maximize their uptake and adoption.



SURENEXUS WEF E NEXUS STRATEGIC PROCESS



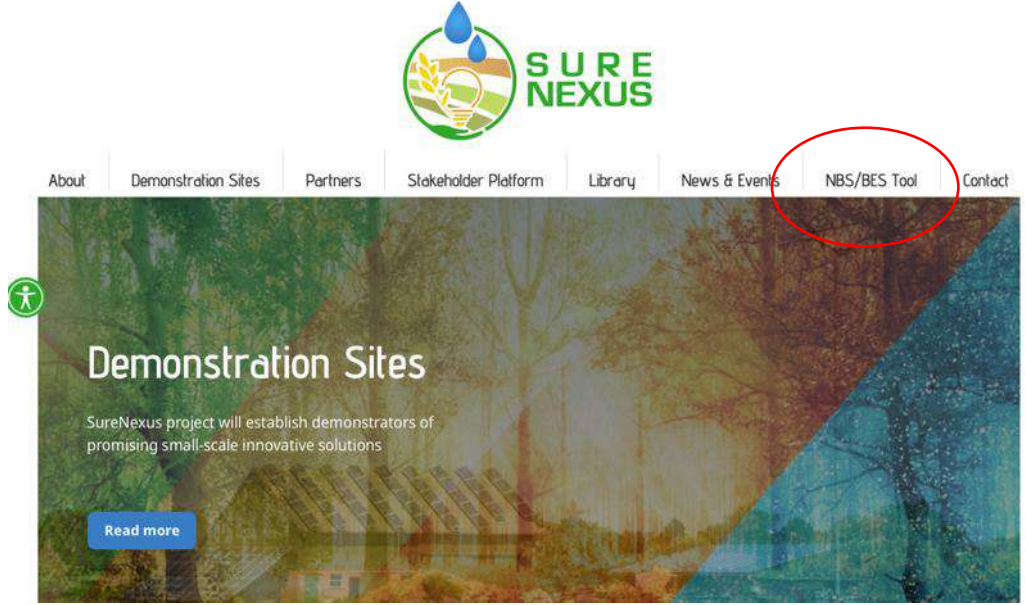


After Mapping, SureNexus aimed to **select technologies with the help of SH Multi-criteria Assessment (MCA) tool**

- Implementation of a Best Practices (BP) selection process was carried out including **cross-cutting goals** related to working directly with stakeholders through a MAA.
- Development of a **BES / NbS Best Practices selection tool** using a **Multi-Criteria Assessment (MCA) methodology** by NTUA and UNIVPM.
- Customization of the tool for each DS, by DS leaders.
- **Application of the tool at 3 DS (Greece, Israel, Catalonia) through participatory all-day workshops with local stakeholders** (in conjunction with Task 8.3 and WP5).



The user interface of the SureNexus MCA tool



Multi-criteria Assessment (MCA) tool Workshops

1) Presentation of **SureNexus** project and the **WEFE nexus** concept; 2) Individual exercise, groupwork and plenary discussion about the **local context**: SWOT, barriers and enabling factors for sustainability and climate resilience, 3) Presentation of / tour around the **Demonstrator**, 4) Introduction to the **MCA tool**, 5) List of **solutions** and **criteria** and open discussion, 6) Individual exercise: selection and scoring of solutions (using the **MCA tool**), 7) Presentation of **draft compiled results** and group discussion



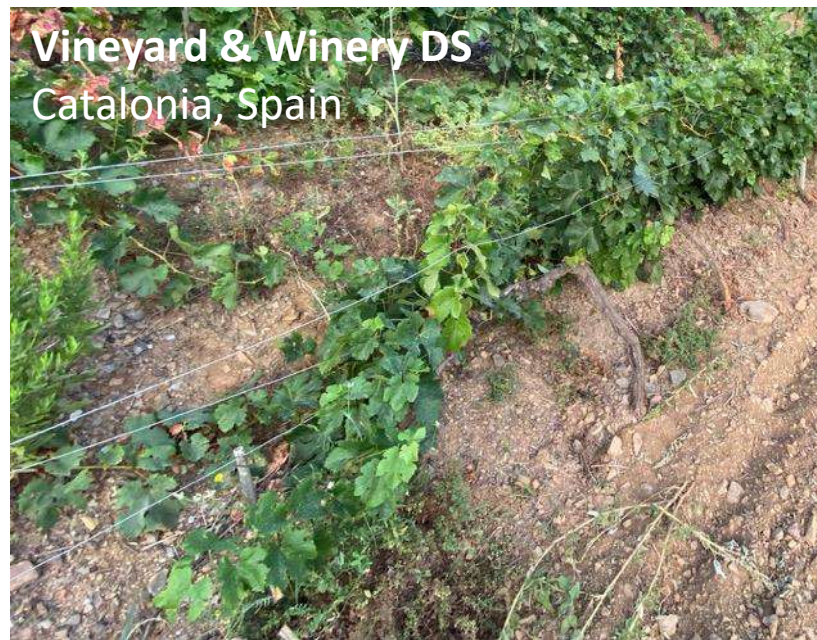
Stakeholder workshops in Greece (left) and Israel (right). The workshops included the WP5 exercise on barriers / enabling conditions.

validate the selected

**NbS and bioeconomy (BES)
practices**

**following WEF E Nexus
approach**

**in specific environments FROM
Mediterranean
area**



Vineyard & Winery DS
Catalonia, Spain



Agrovoltaic DS
Emek HaMaayanot, Israel



Digital Citrus DS
Kenitra INRA, Morocco



Ecolodge DS
Tinos Island, Greece



CATALONIA, SPAIN

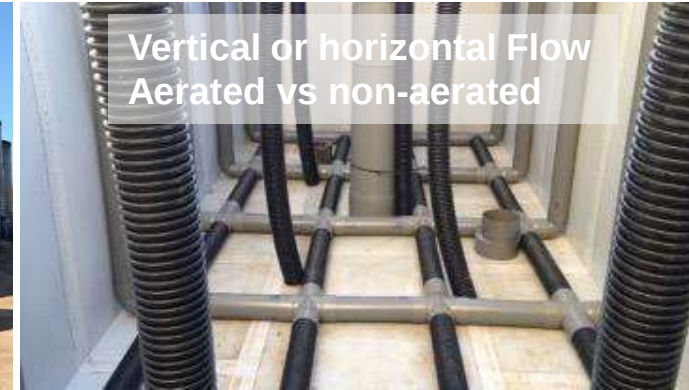


Wastewater treatment using NBS

Shipping Containers (mobile treatment wetland)

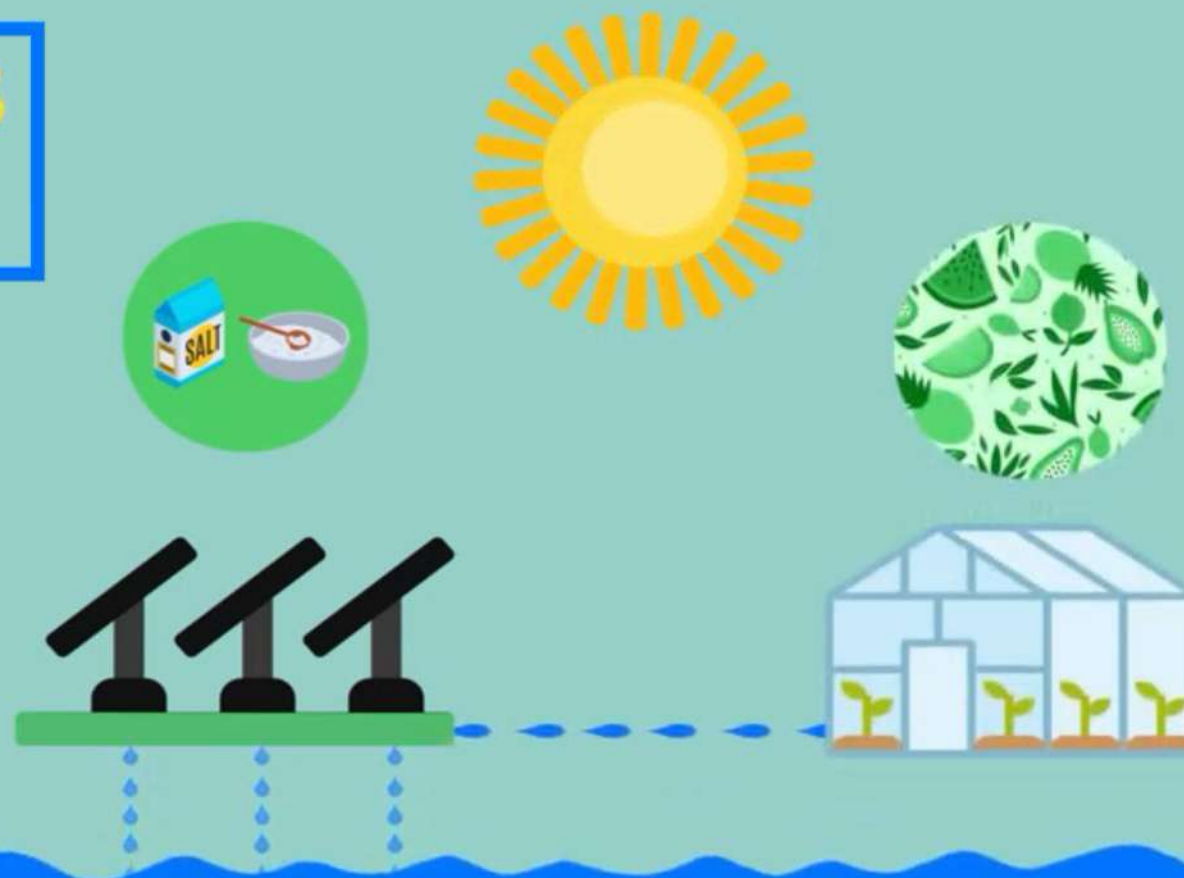


Reduction diffuse Pollution from agriculture (Nitrates)
Use of waste byproducts (cork) for treatment



AGIOS FOKAS POTAMIA

Reduce water,
material and energy
consumption in an
island ecolodge

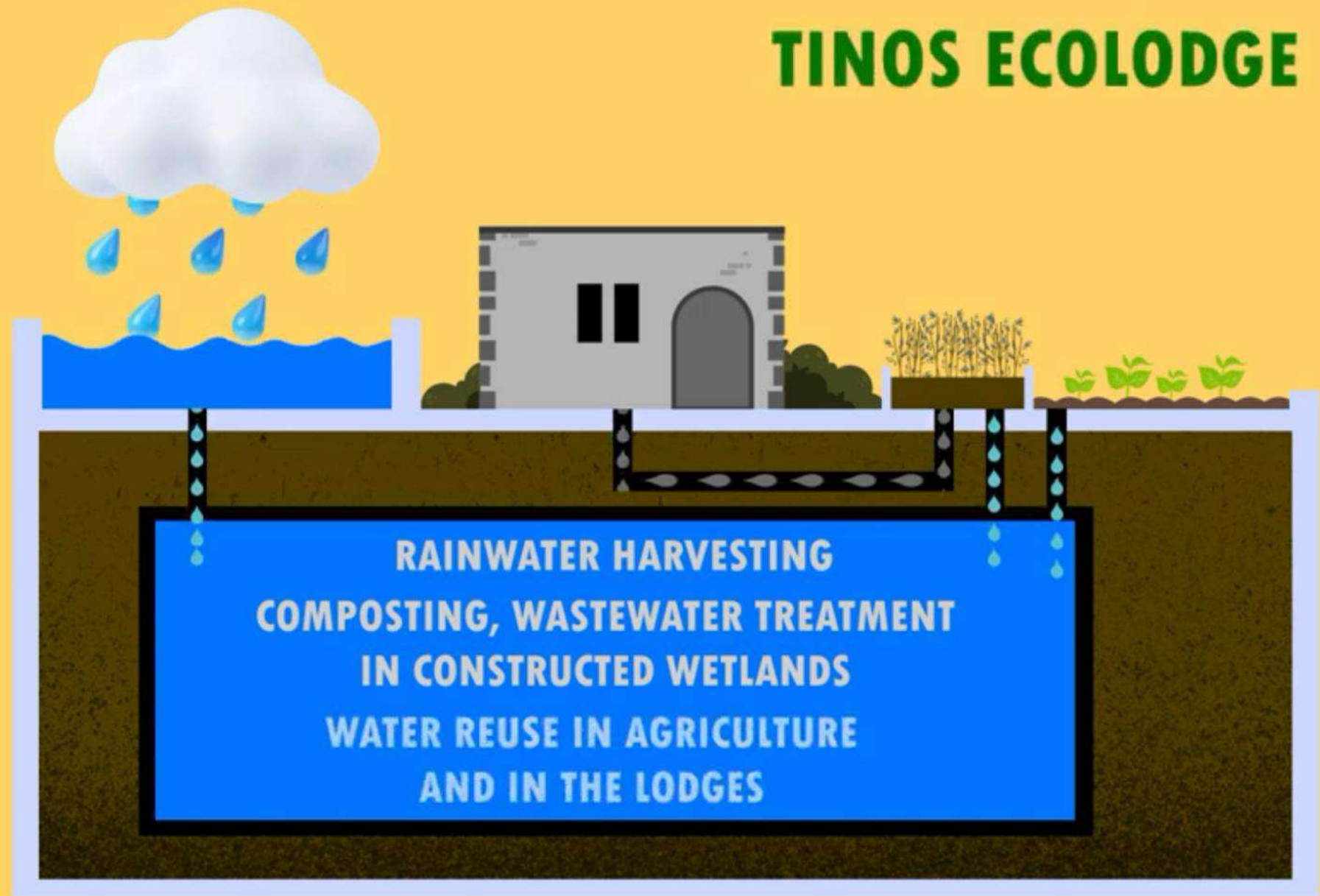


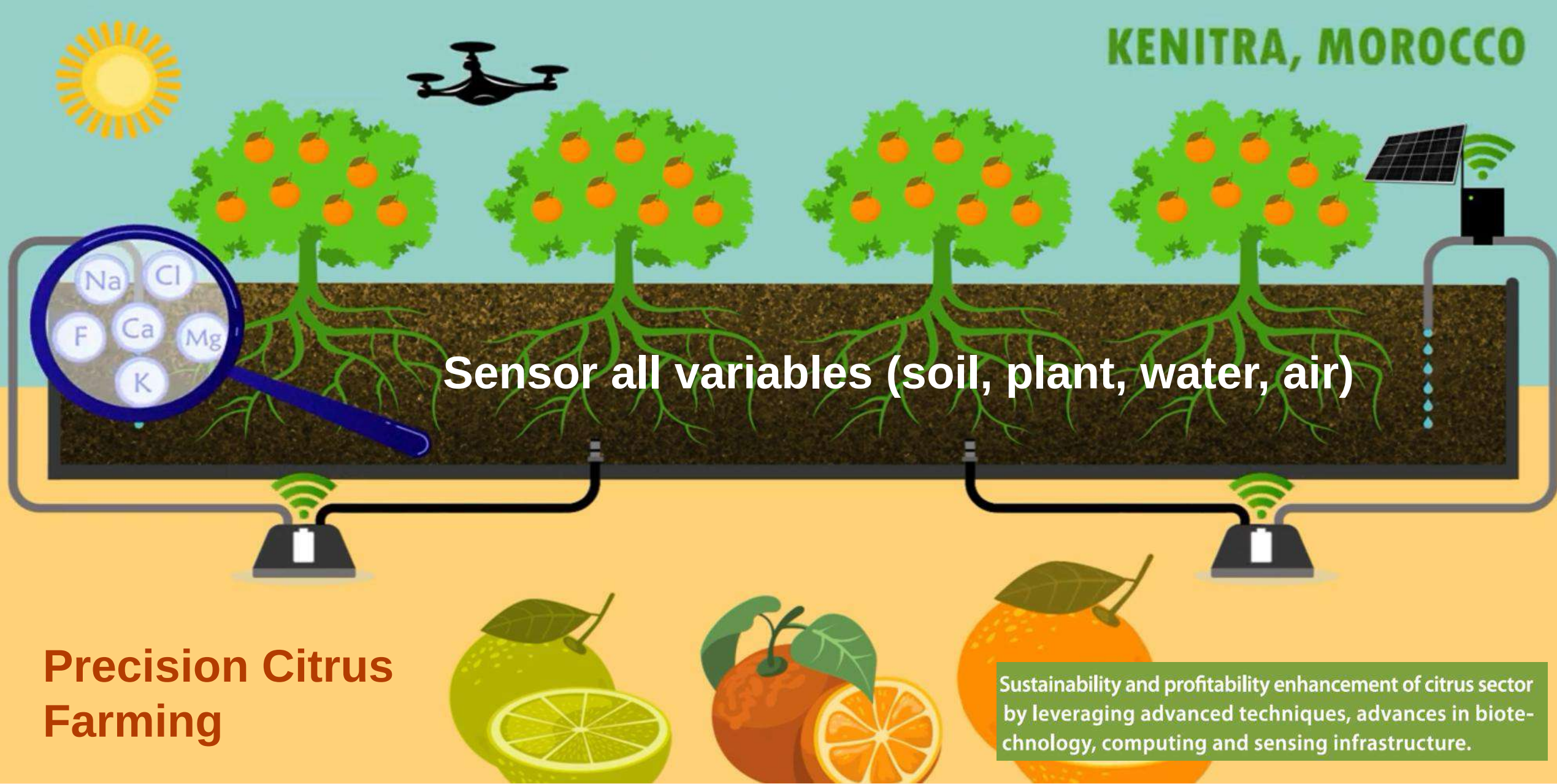
Mangrove Still System - innovative desalination and water purification technology.
Saline agroforestry (*Atriplex sp.*)

Combination of ecotourism and agrotourism



TINOS ECOLODGE







Static



Dynamic

Solar energy production and reuse or/and resell in order
for the community resilience to be strengthened.



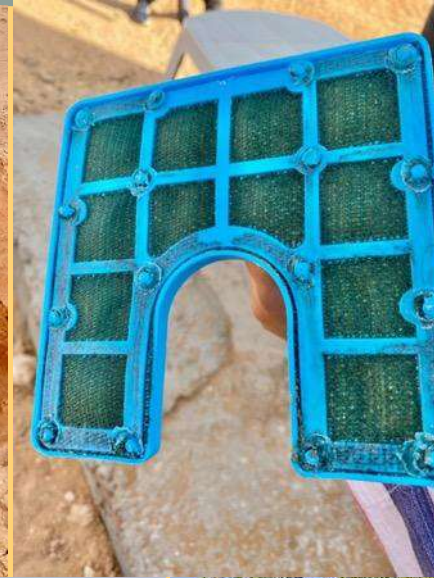
Construction on-site, September 2023



SureNexus tour & workshop on the Israel DS with Stakeholders, September 2023



Comp DS (Tunisia): Underground irrigation for olive crops (Bir Ami. Tunisia)



**Tunisian
Innovation
Patented**



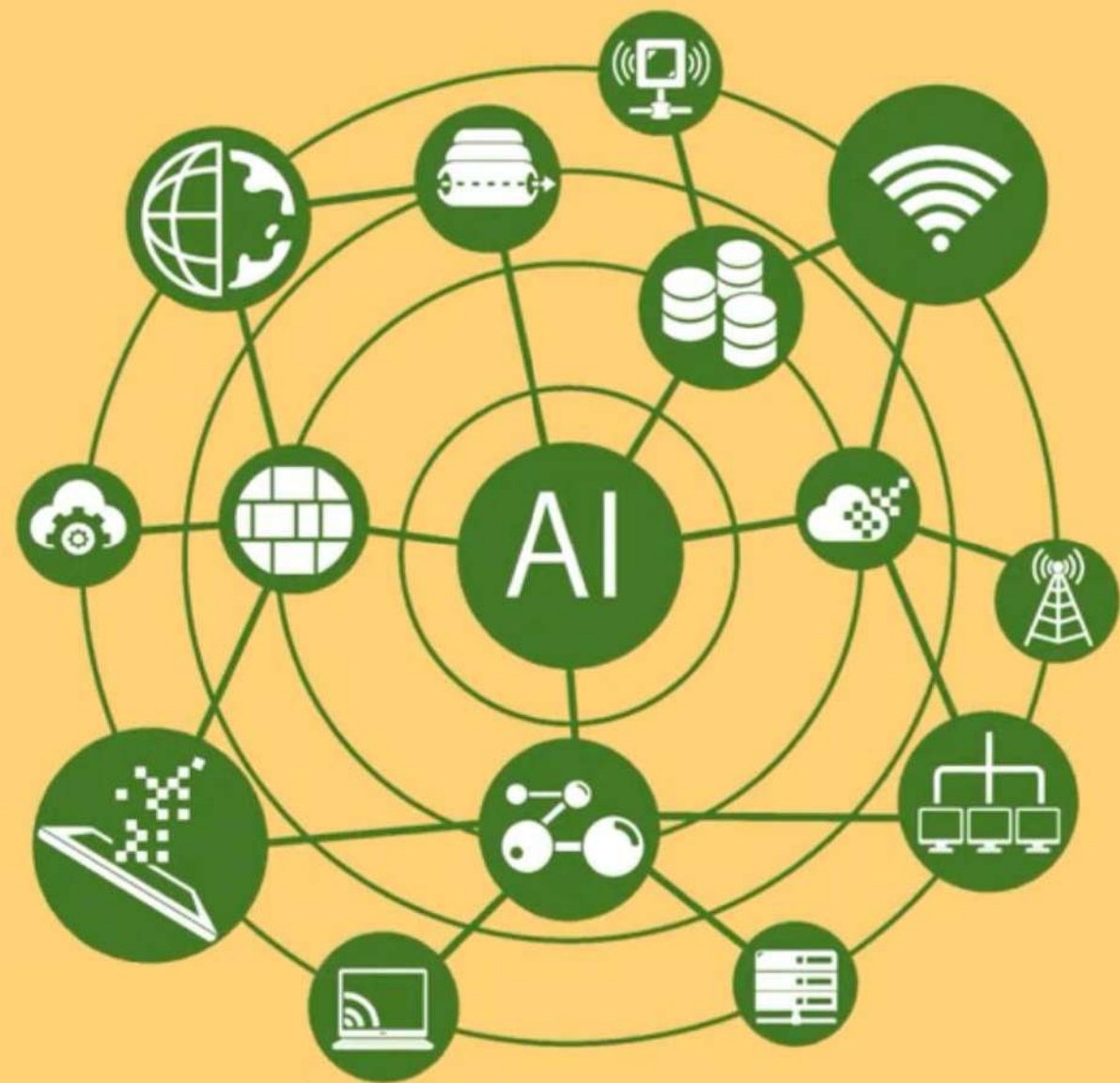
Conventional drip irrigation



Underground irrigation

**NATURE BASED SOLUTIONS
&
BIOECONOMY PRACTICES**

**IMPLEMENT
MONITOR
OPTIMIZE**



Arid / Semiarid Environments

To demonstrate, validate and quantify the **performance of alternative bioeconomy practices and nature-based solutions** for conserving and restoring ecosystem services and biodiversity.

Replication of **practical solutions in the Mediterranean region in a context of climate emergency and water scarcity.**



Complexity

WEFE Nexus / Social / Environmental / Economic

Multi-transdisciplinary

Participatory Co-design / SHP / Governance

Selection Technologies

W – E – F – E

Different Scales

Local / Regional / Mediterranean / MENA

Different Demo-sites

DS1/DS2/DS3/DS4/CompDS

Qualify SETs

Resilience / Vulnerability / Risk Assessment



1. Data Analysis (data bases, IoT, literature)

2. Predictive Modelling for:

2.1. Water Management

NBS/Technologies for Wastewater treatment

2.2. Energy Efficiency

Technologies for Energy Recovery

2.3 Waste Management

Circular Bioeconomy : Added Value Chain Products

Environmental

Circularity

Economic

Social

Governance

Use of AI for NEXUS WEFE Management



KEY AREAS OF AI APPLICATION WITHIN SURENEXUS PROJECT

Role of Computational Modelling

Identification and qualification best practices, including specific technical and policy solutions adapted to the Mediterranean.

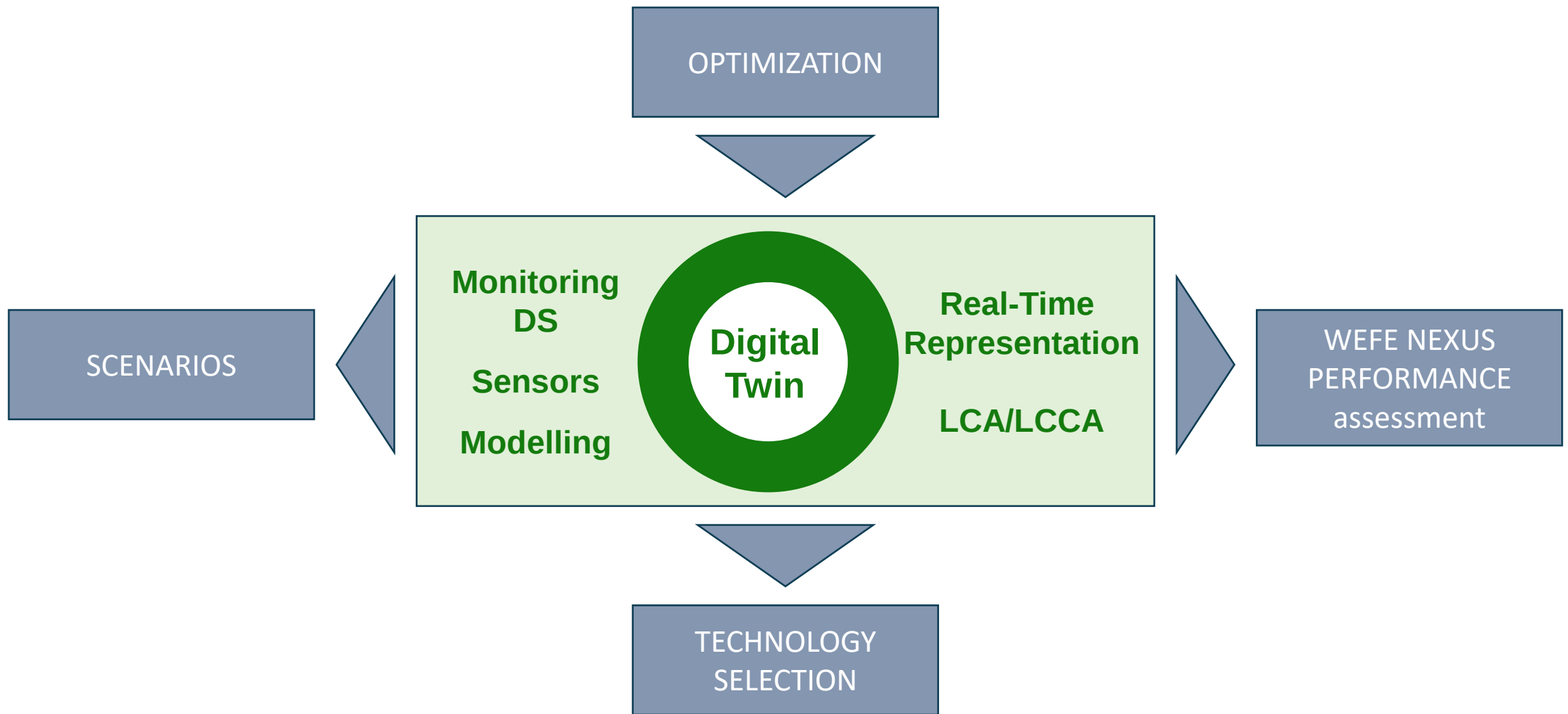
Helping find **suitable SETs for each context/scale** by evaluating **social, economic (cost-effectiveness) and environmental perspectives** together with safety aspects, adaptability to change.

Define **future scenarios for a resilient transition** of agri-food, water and energy systems towards sustainability

**NATURE BASED SOLUTIONS
&
BIOECONOMY PRACTICES**

**IMPLEMENT
MONITOR
OPTIMIZE**





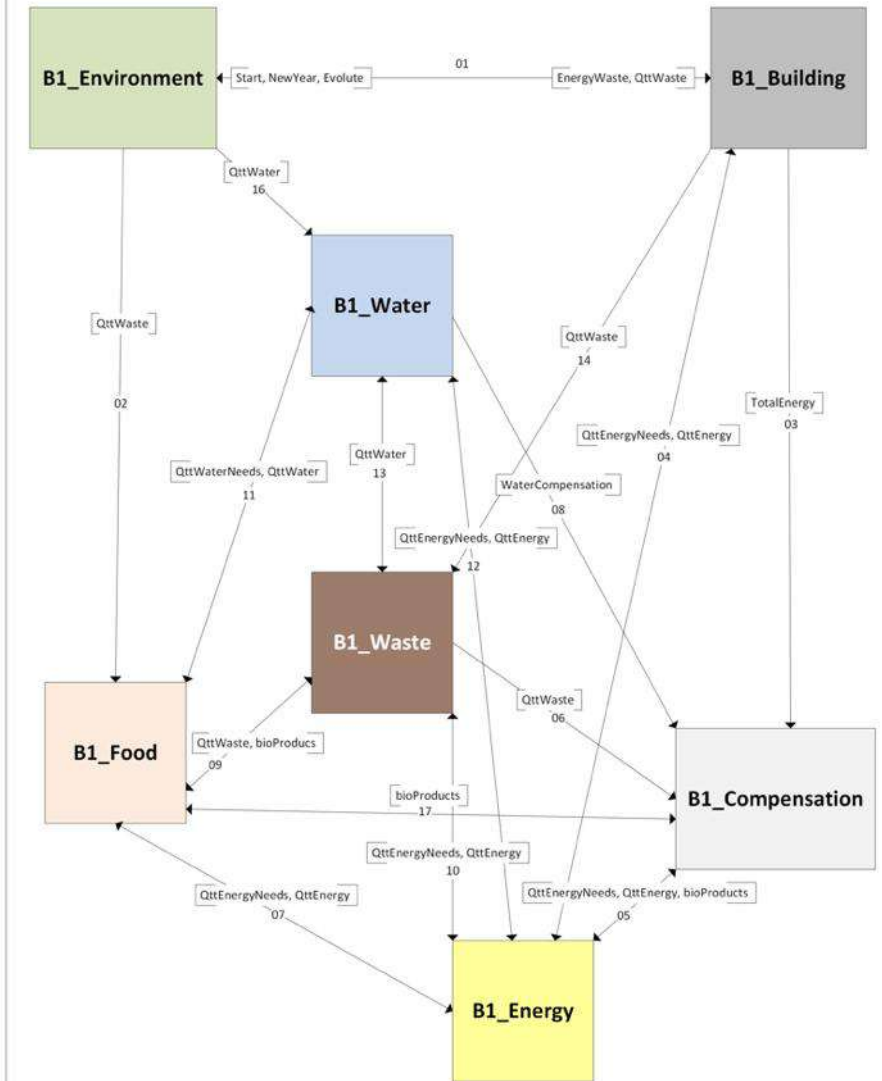
**Step 1 - Define System (Transdisciplinary approach)
Conceptual Model (SDL)**

**Step 2 – Model Validation
by/with Stakeholders**

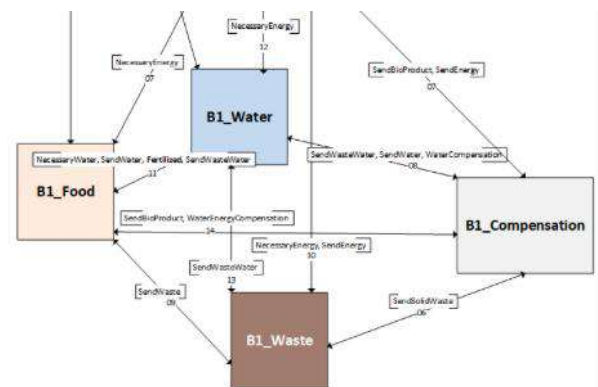
**Step 3 - Implementation
Computerized Model (SDLPS)**

**Step 4 : WEFE Nexus
Metrics Evaluation**

**Step 5 : Technology selection
by compensation block**



System With Blocks

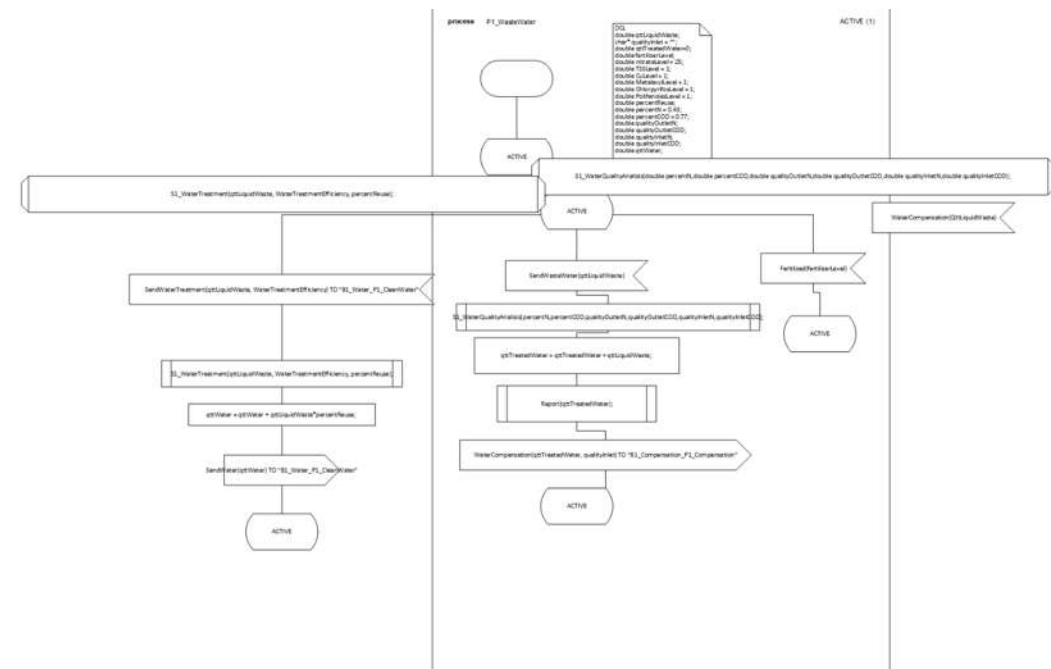


CodorniuDemoSite_1.png

Process (P1)

- B1_Water.vsdX
 - P1_CleanWater.vsdX
 - S1_GetEnergyNeeded.vsdX
 - S1_GetWater.vsdX
 - **P1_WasteWater.vsdX**
 - S1_WaterQualityAnalysis.vsdX
 - S1_WaterTreatment.vsdX
- B1_Energy.vsdX
 - P1_Energy.vsdX
 - S1_AlternativeSupply.vsdX
 - S1_DayliEnergy.vsdX
- B1_Compensation.vsdX
 - P1_Compensation.vsdX
 - S1_EnergyRecoveringTechnologies.vsdX
 - S1_CircularBioproductRecovering.vsdX
 - S1_SelectBioProductTypeTreatment.vsdX
 - S1_SelectWaterTypeTreatment.vsdX

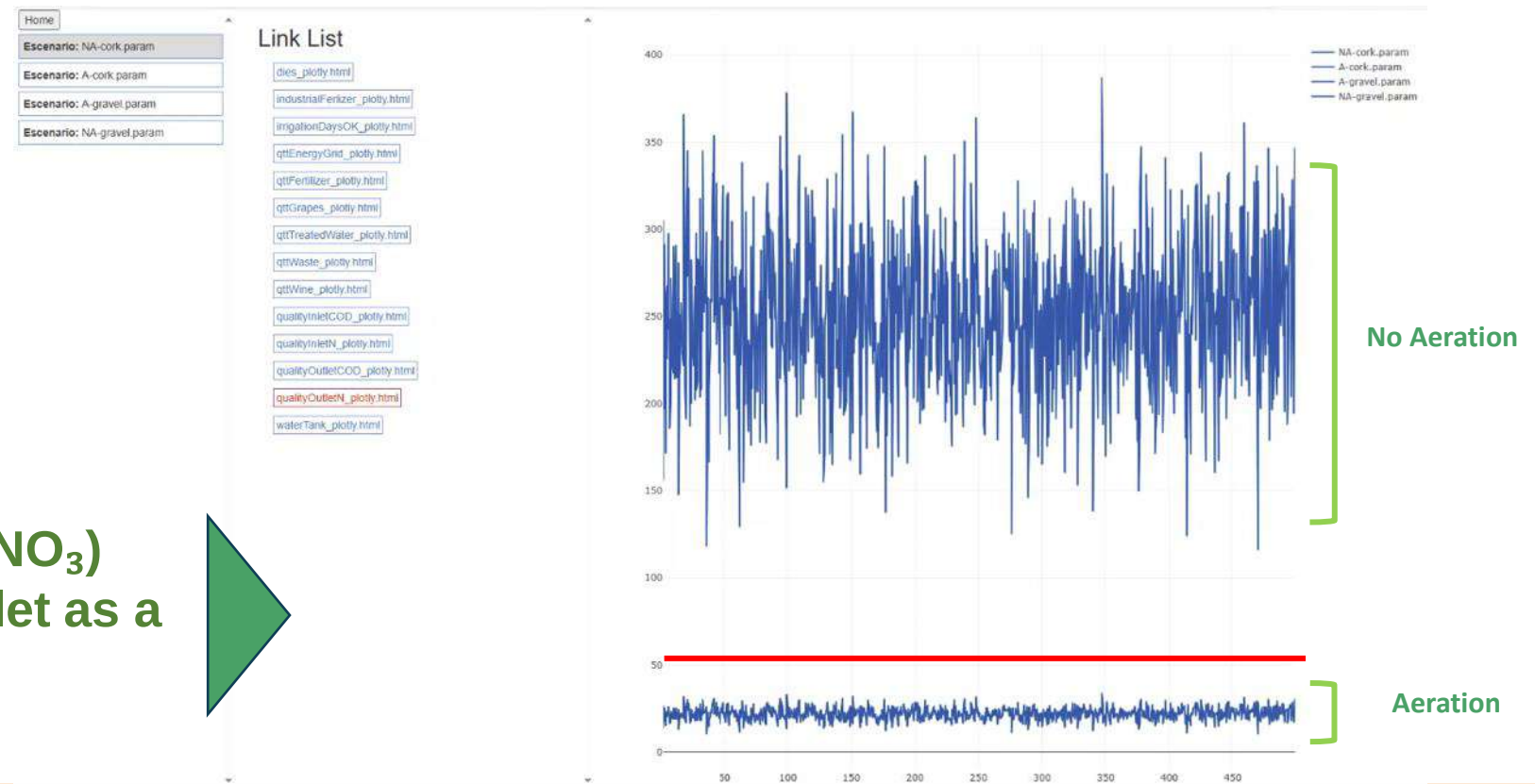
Procedures (S1)



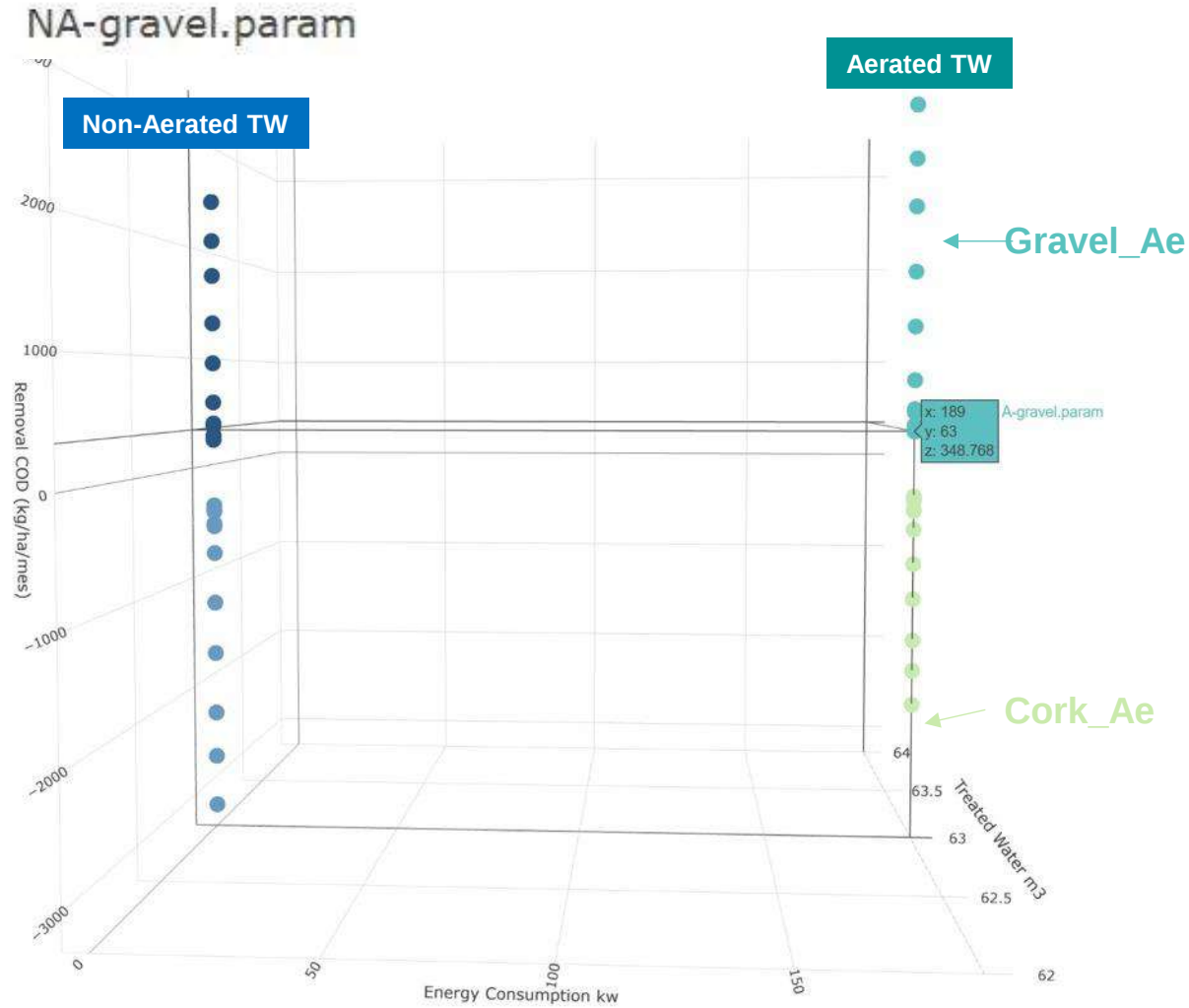


Innovative aerated vertical flow subsurface treatment wetland (TW)
Recycled cork as filter medium
Removal of Nitrate pollution

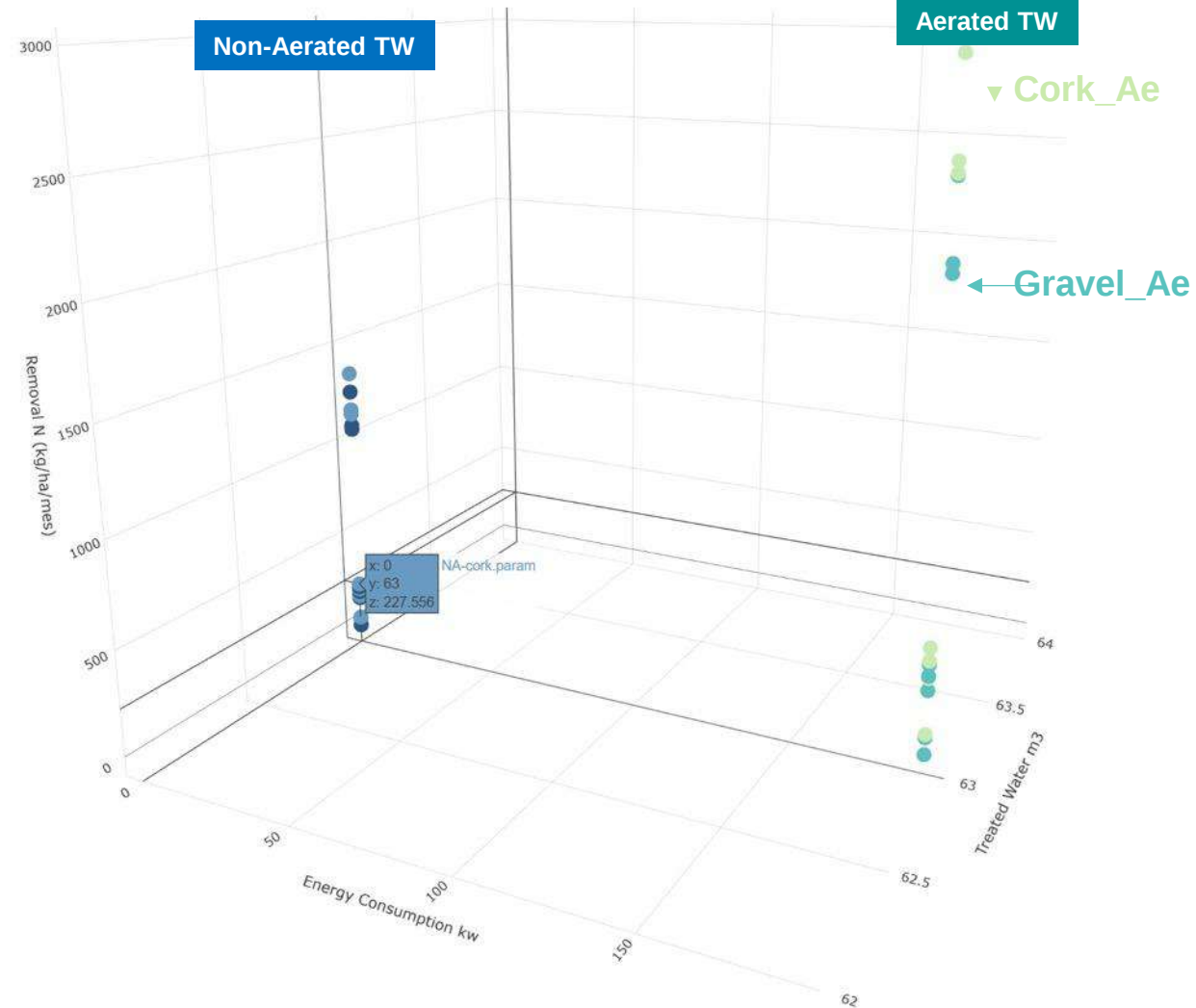
Evolution of Nitrate (NO_3) Levels at the TW Outlet as a Function of Aeration



COD Removal



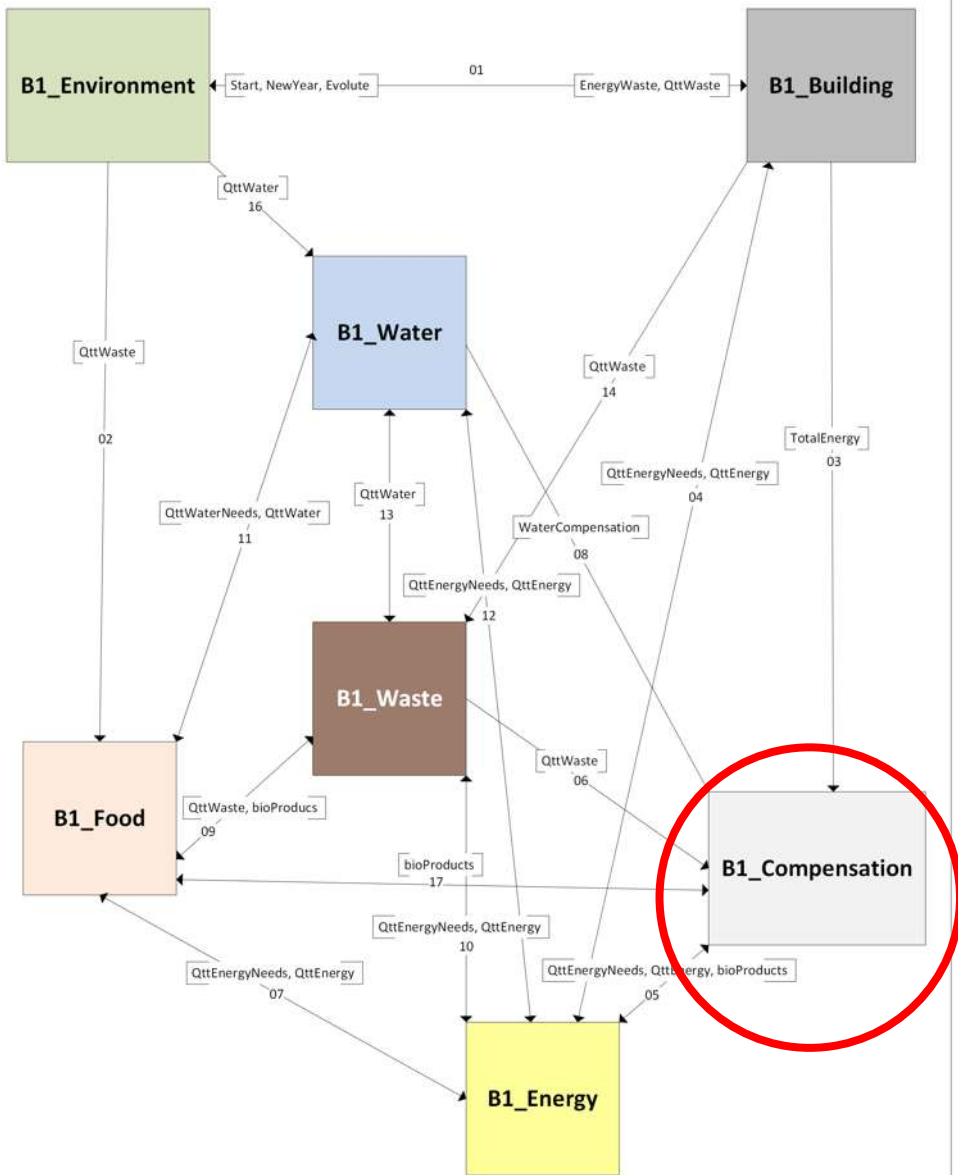
Nitrate Removal



How artificial Intelligence (AI) can help to select best technologies for WEFE NEXUS?

TECHNOLOGY SELECTION BY COMPENSATION BLOCK

AI analyzes **WEFE Nexus interactions and trade-offs** using a “compensation module” with semi-automated technology selection to optimize water, food, and energy security while reducing ecological impact.



Identifying most effective
strategies for

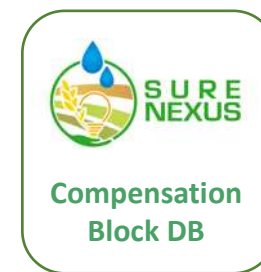
Water Security
Energy Security
Food Security
Ecological Resilience

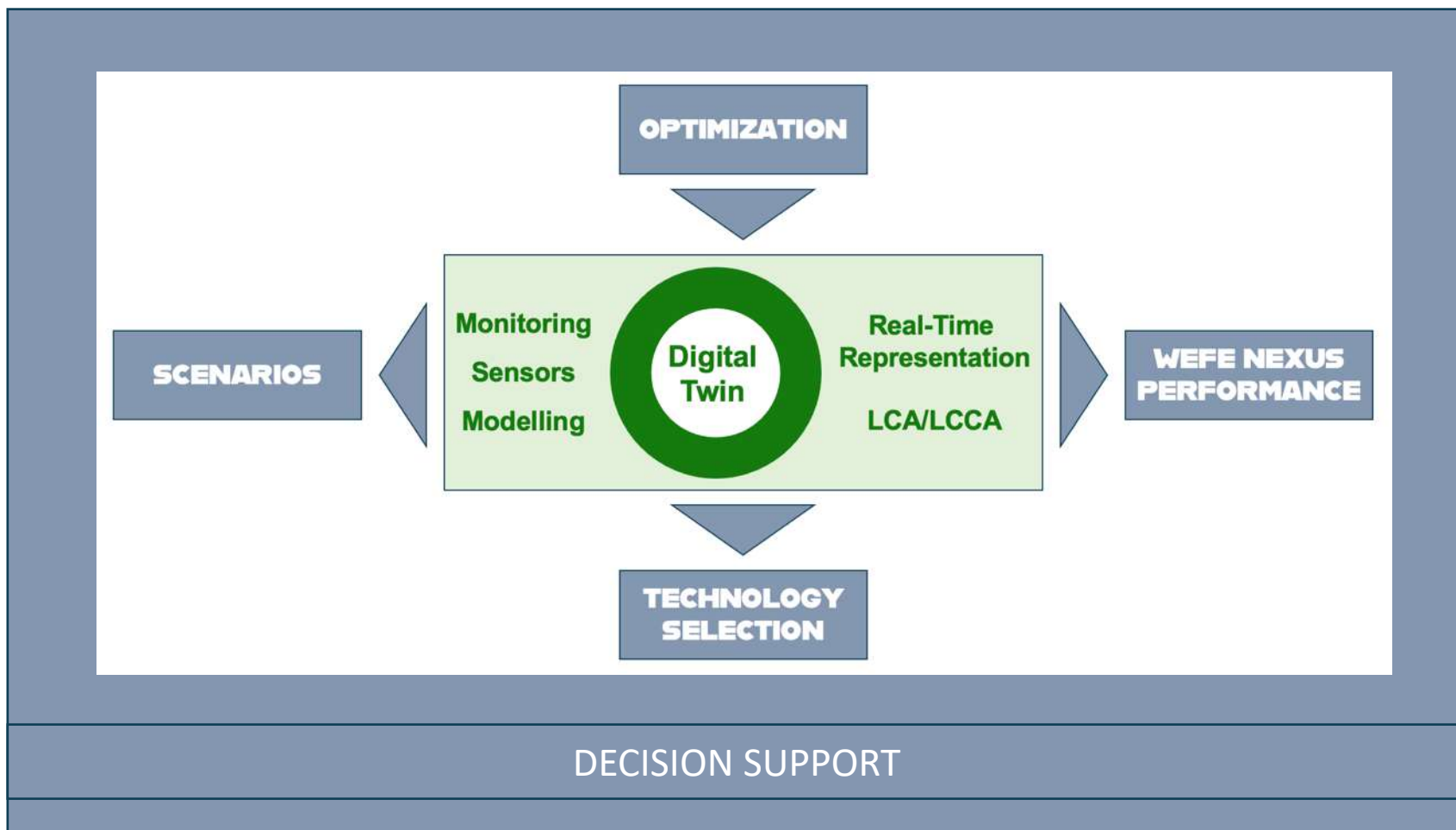
The SureNexus WEF
Nexus AI Tool is designed
to support technology
selection for:

Best **NBS** Treatment

Find **Energy** Recovery

Find **Bioproduct** Recovery





Enhanced Resilience

- **A novel AI model enhances WEF E Nexus evaluation and decision-making processes.**
- **The conceptual model, co-designed with input from all relevant stakeholders, integrates a transdisciplinary approach to develop the model assumptions document and a graphical SDL-based digital twin, fostering teamwork by visually representing the real system's behavior.**

- **A compensation block aids semi-automated technology selection for better WEFE strategies.**
- **The Artificial Intelligence (AI) WEFE Nexus tool is designed to assist in selecting the most effective technologies for water and wastewater treatment, energy recovery, and bioeconomy waste valorization.**
- **The AI WEFE Nexus tool facilitates the comparison between conventional technologies and NBS and other more appropriate technologies.**

CAPACITY BUILDING

**STAKEHOLDER
ENGAGEMENT**

**KNOWLEDGE
BROKERAGE**

POLICIY INTEGRATION

DEFINE BEST KPI

WORKSHOPS / CO-PRODUCE KNOWLEDGE

SPECIALIZED/GENERAL COURSES

POLICIY BRIEFS

WEFE NEXUS AWARD

AI ON-DEMAND CONSULTANCY

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