11-12 FEBRUARY 2025

RABAT, MOROCCO

Institut Agronomique et Vétérinaire Hassan II

BONEX

SURE NEXUS

WEFE NEXUS INTERNATIONAL CONFERENCE

EXPLORING AND BRIDGING NEXUS FOR A SUSTAINABLE FUTURE

PRIMA IN THE MEDITERRANEAN AREA

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

WEFE NEXUS INTERNATIONAL CONFERENCE

Day 2 – 12th February 2025

PILLAR 3: WEFE NEXUS SOLUTIONS

TOOLS AND DECISION SUPPORT SYSTEMS TO SUPPORT WEFE NEXUS IMPLEMENTATION & GOVERNANCE

Nature-Based solutions (NbS) and ancestral hydrotechnologies for water and food security and climate change adaptation

Dr Jordi Morató

Director UNESCO Chair on Sustainability
Universitat Politècnica de Catalunya- Spain

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NbS and ancestral hydrotechnologies for water/food security and climate change adaptation

Jordi Morató Farreras

UNESCO Chair on Sustainability

Universitat Politècnica de Catalunya

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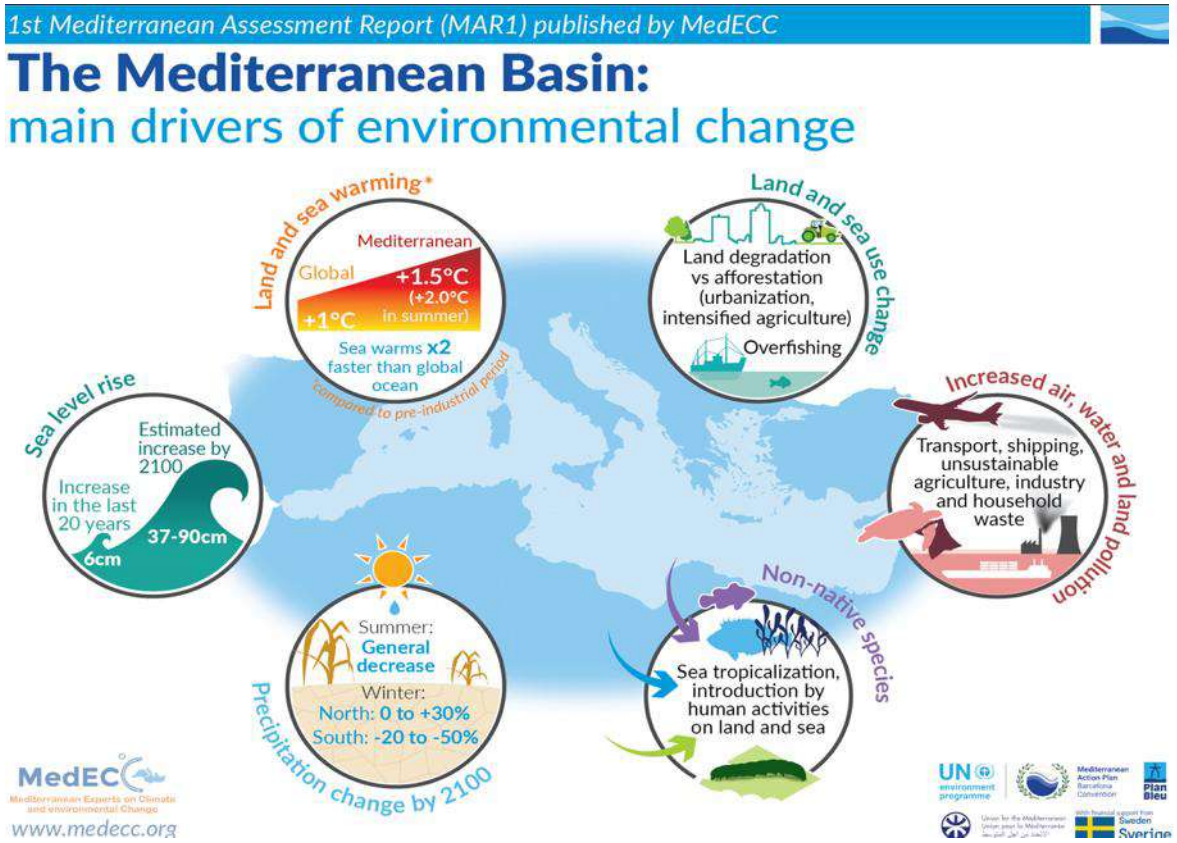
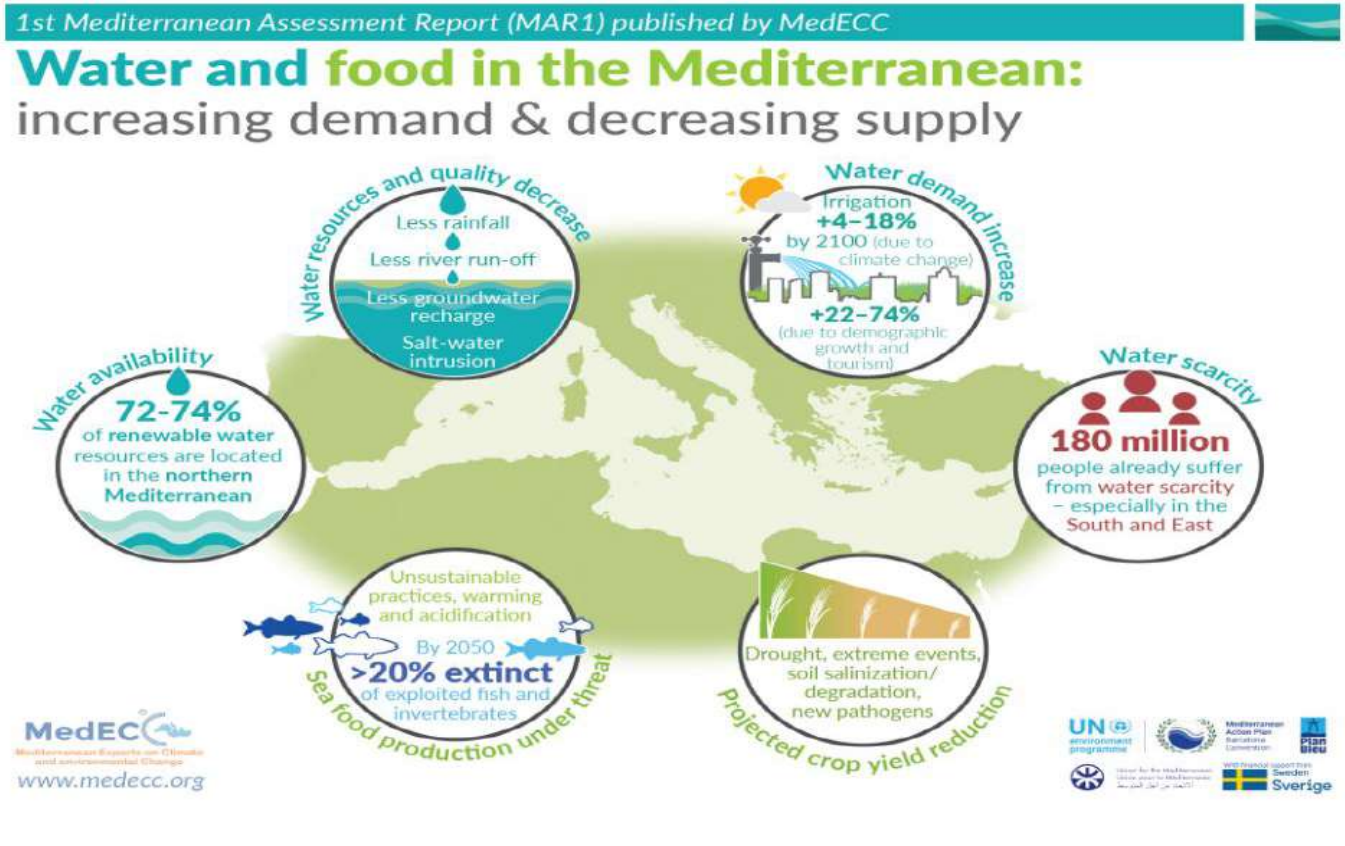
THE CLIMATE REALITY CREATES UNCERTAINTY





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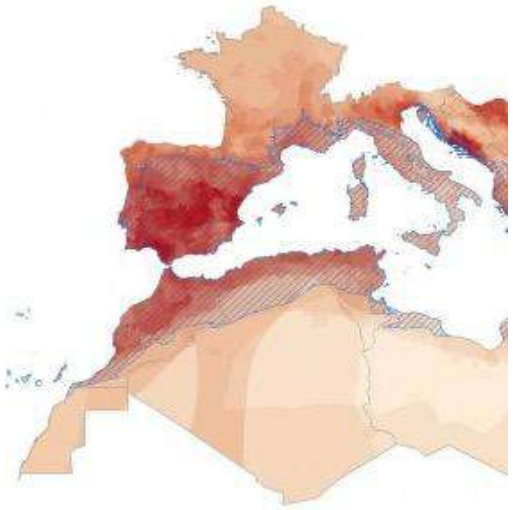
Accelerated Climate & Water Scarcity in the Mediterranean

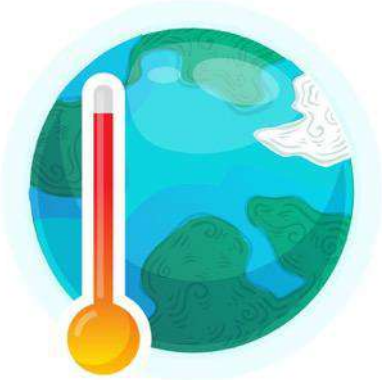


1

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

2

Regional temperature increase will be 2.2ºC 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**

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Co-funded by the European Union

7 countries / 15 institutions

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

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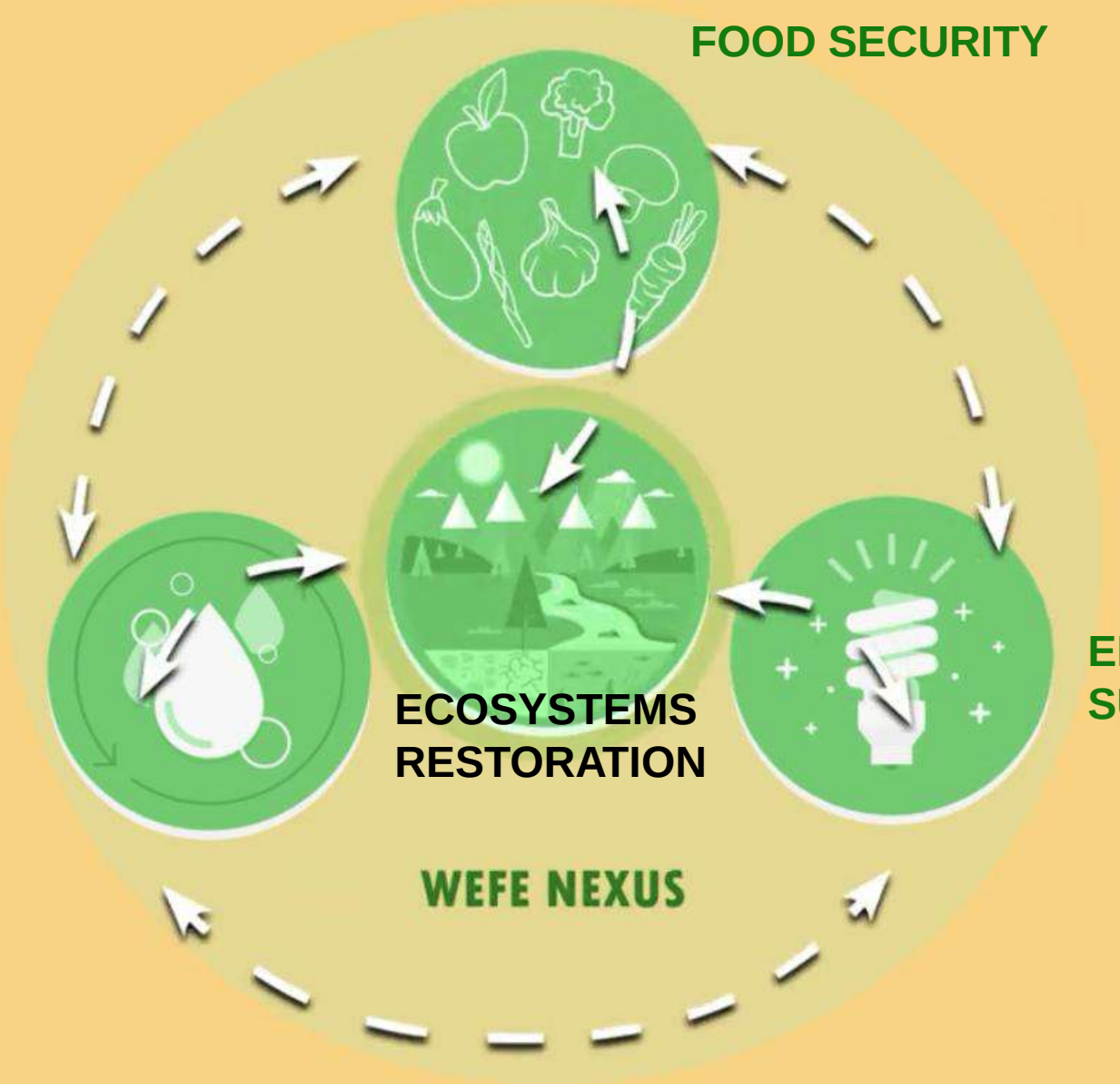
CLIMATE RESILIENCE FUTURE IN THE MEDITERRANEAN REGION



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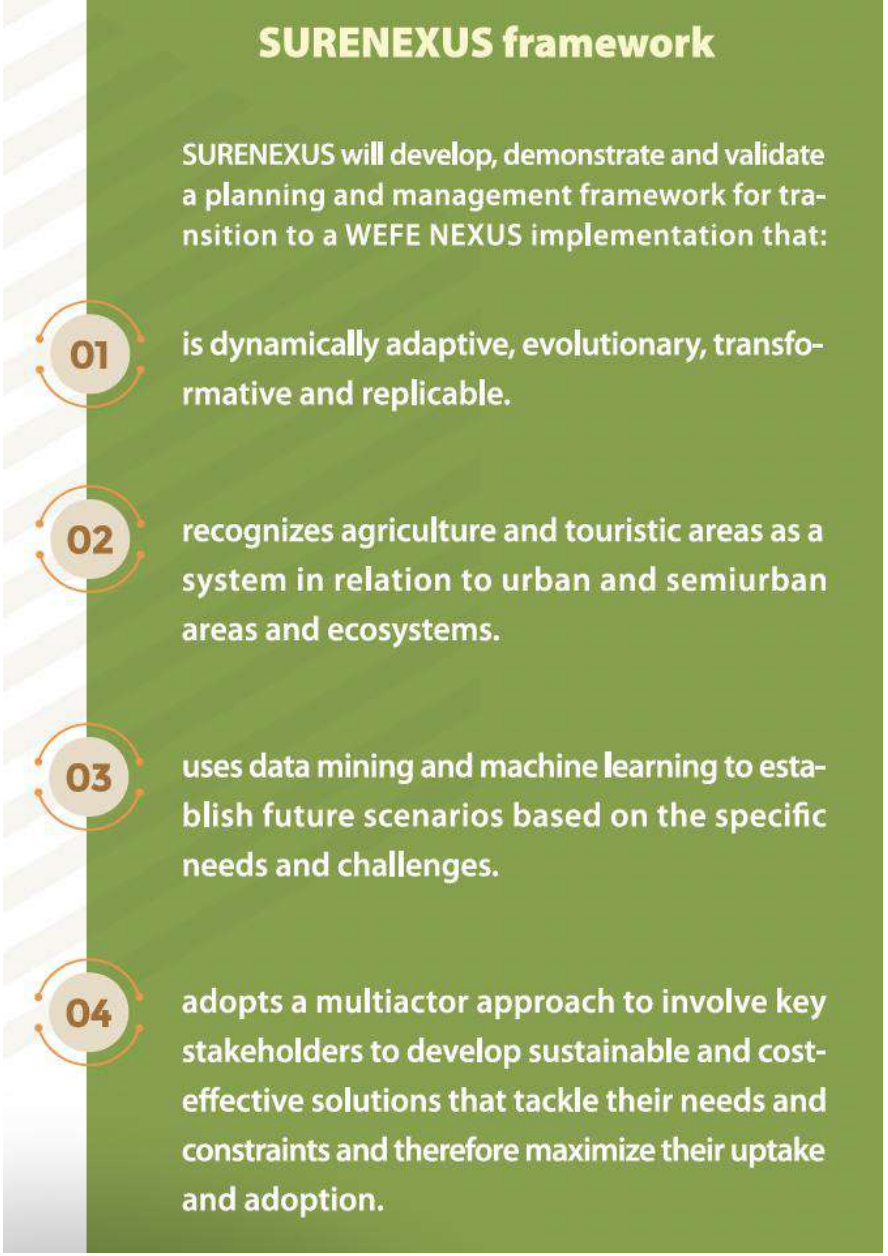
To deploy **small-scale innovative solutions as demonstrators of Socio-Ecological and Technical systems (SETs)** based on:

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.



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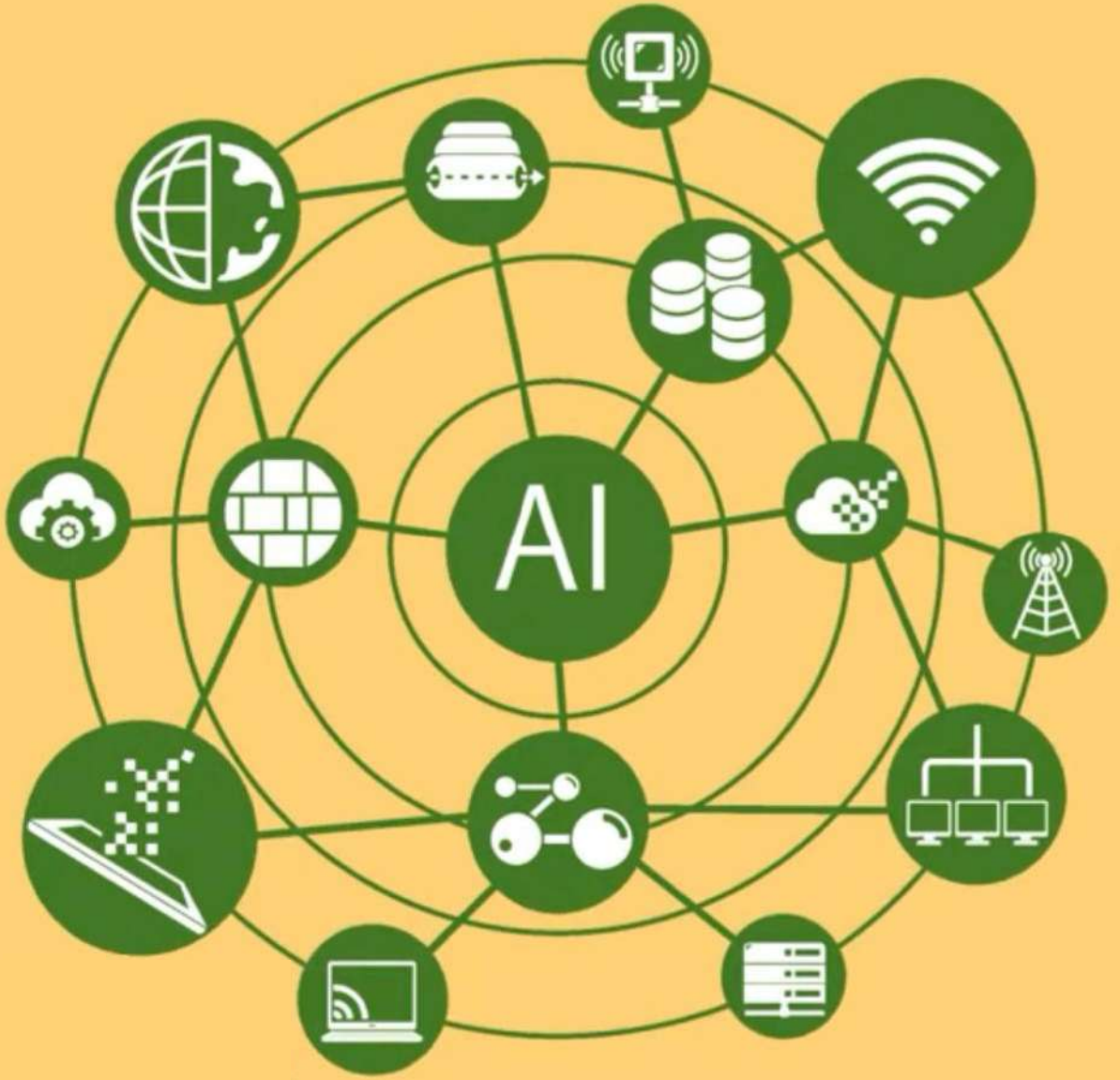
NATURE BASED SOLUTIONS

&

BIOECONOMY PRACTICES



IMPLEMENT
MONITOR
OPTIMIZE

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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/ConpDS

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

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validate the selected

NbS and bioeconomy (BES) practices

following WEFE Nexus approach

in specific environments FROM Mediterranean area

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TECHNOLOGIES FOR WATER TREATMENT AND EFFICIENCY IMPROVEMENT

NBS

TREATMENT WETLAND

UNDERGROUND IRRIGATION

MANGROVE SOLAR DESALINATION

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Biomimicry – NATURE INSPIRING

Appropriate Technologies

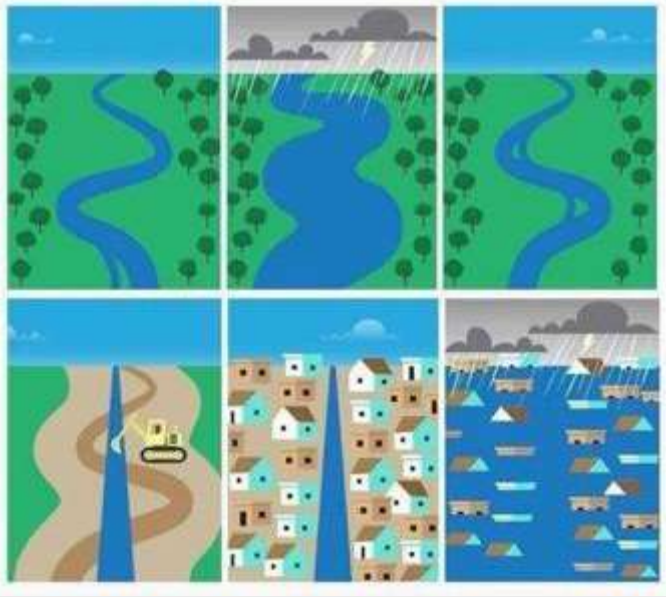
Nature-Based Solutions

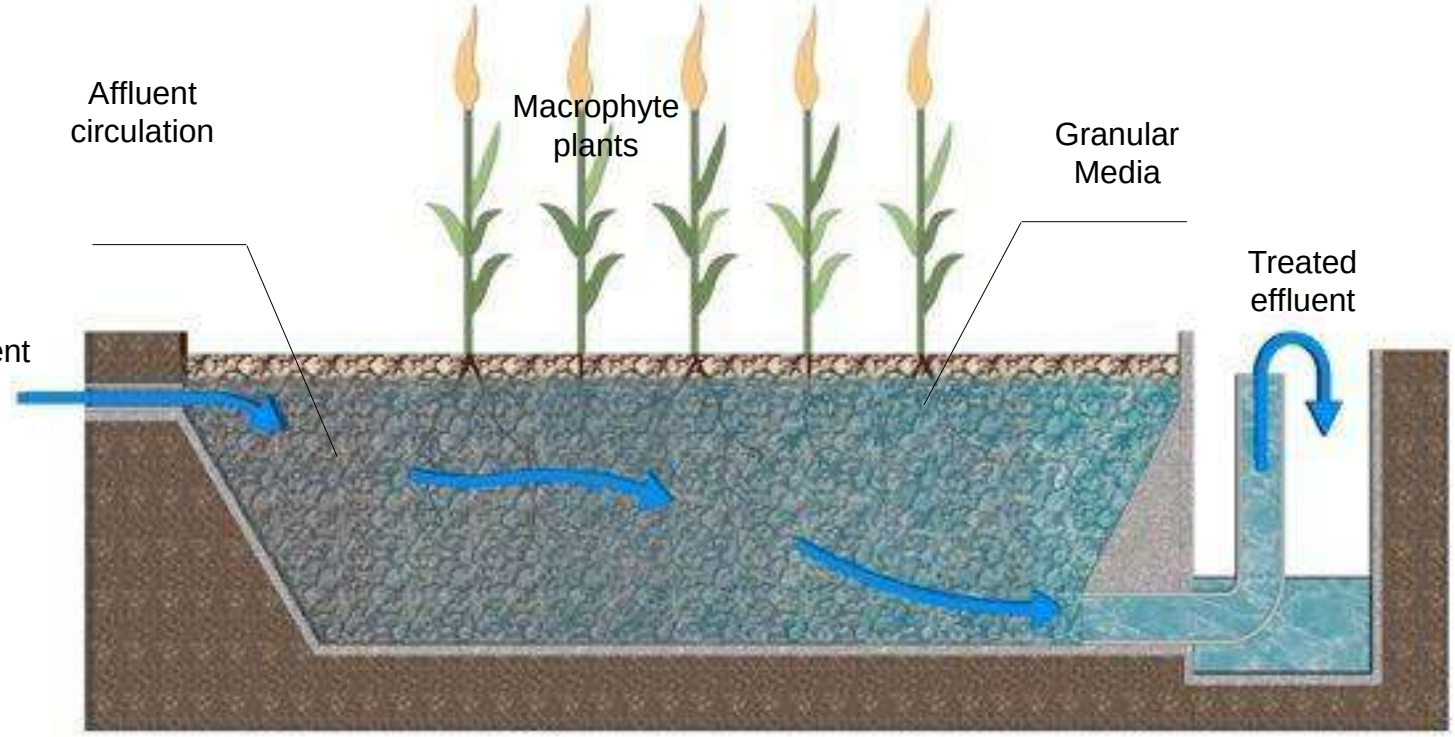
Ecohydrology

Ecotechnologies

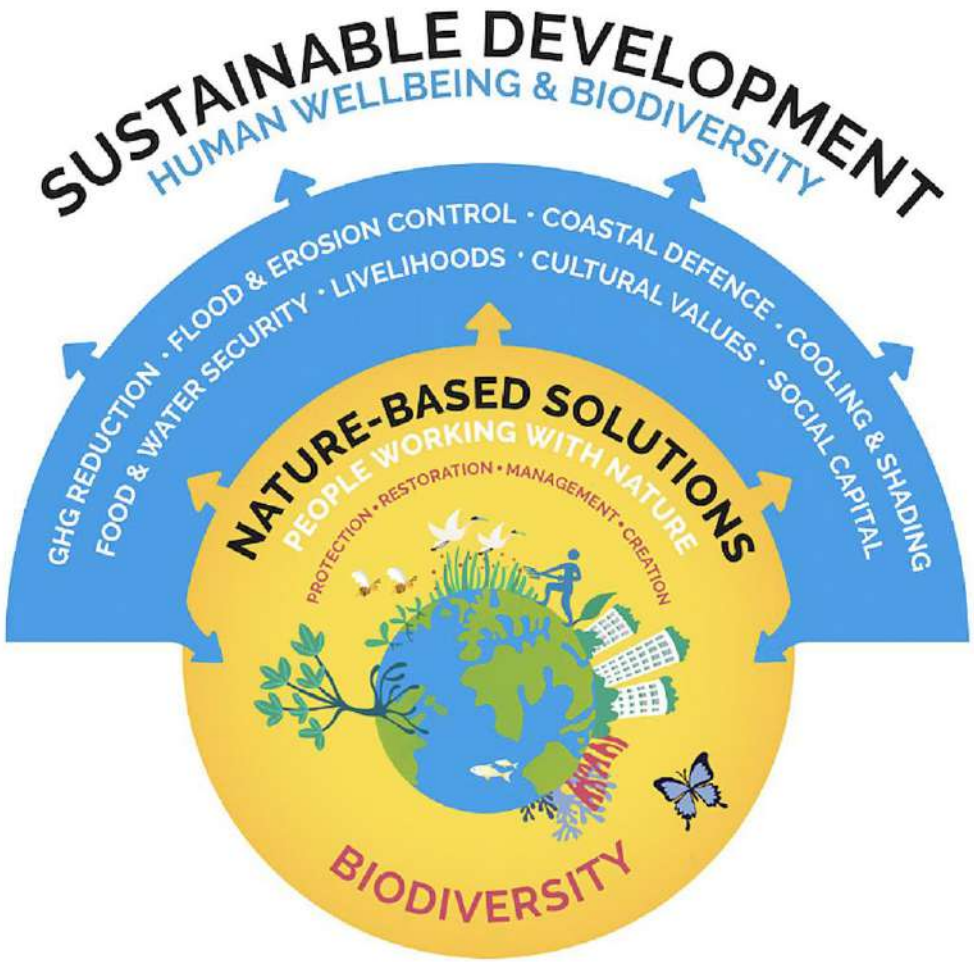
Phyototechnologies

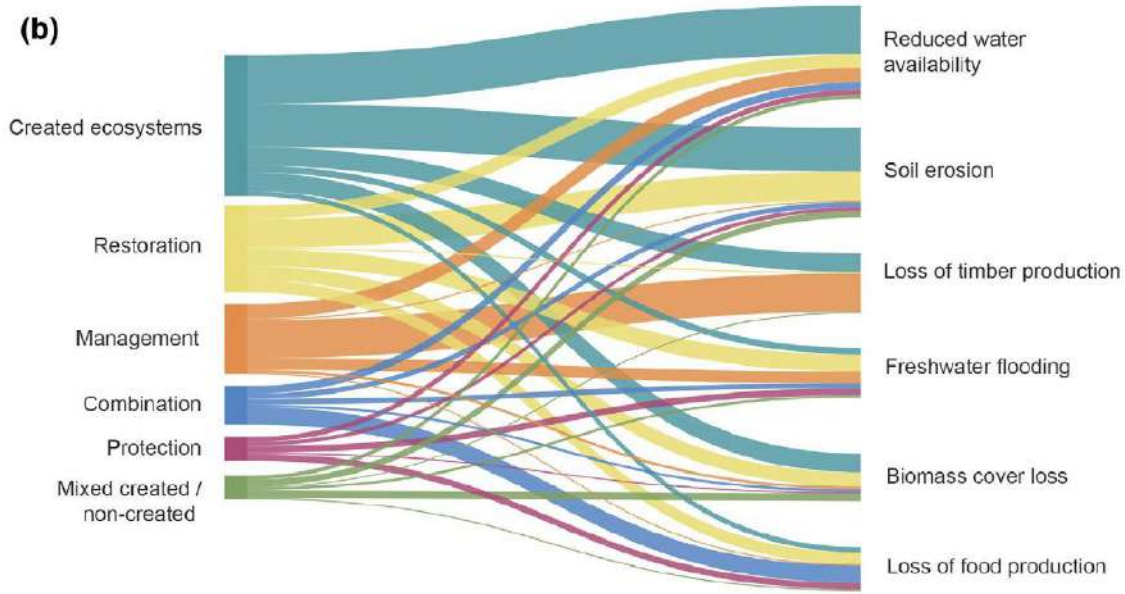
Bioengineering





TREATMENT WETLANDS FOR POLLUTED EFFLUENT TREATMENT





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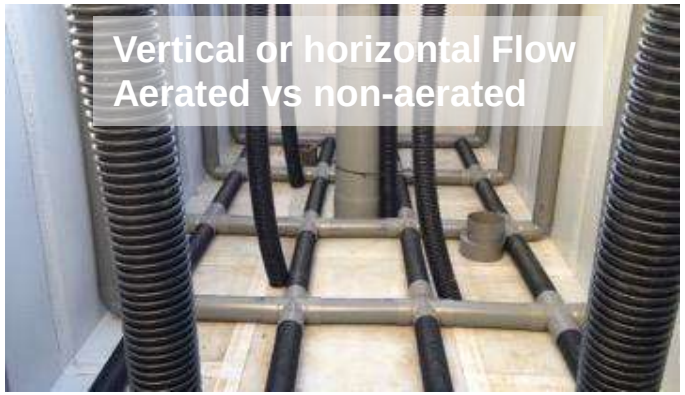
Reduction diffuse Pollution from agriculture (Nitrates)
Use of waste byproducts (cork) for treatment

DS 1A (Spain): Vineyard & Winery Demo Site – Catalonia, Spain

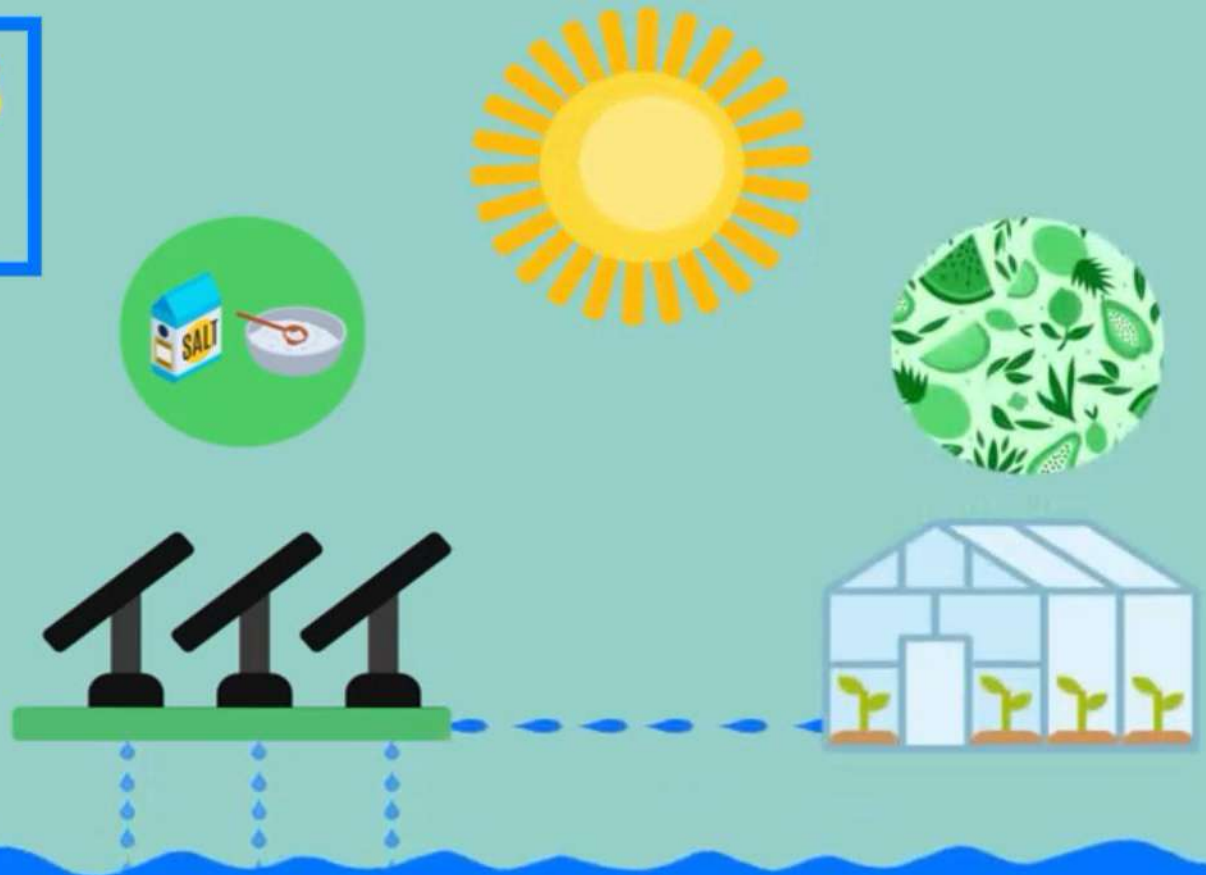
Wastewater treatment using NBS

Shipping Containers (mobile treatment wetland)



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

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.*)

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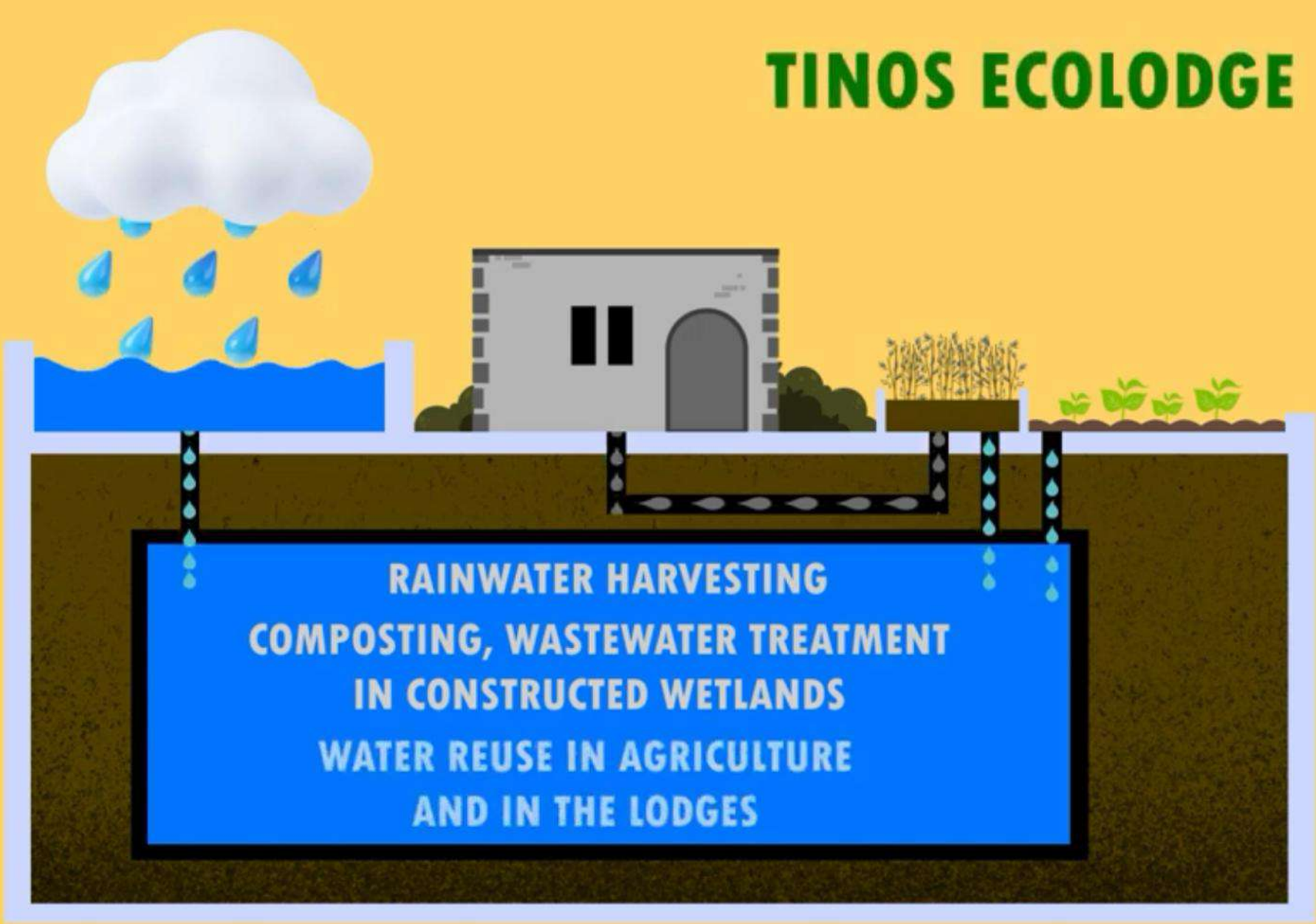
Combination of ecotourism and agrotourism



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TECHNOLOGIES FOR WATER TREATMENT AND EFFICIENCY IMPROVEMENT

NBS

TREATMENT WETLAND

UNDERGROUND IRRIGATION

MANGROVE SOLAR DESALINATION

ANCESTRAL HYDROTECHNOLOGIES

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CAN WE LEARN FROM THE PAST?

Human beings have historically adapted to extreme conditions.

How a **local population has coexisted with extreme events** in the past, **managing their adaptation to the environment - SETs**

Knowledge of the specific socio-cultural and technical system (SETs) of an area is essential - Community experience in the face of different threats and its capacity to confront, recover and adapt.

Recover, understand and transfer the specific socio-ecological-cultural and technical systems (SETs), the **intangible heritage, basic to improve climate adaptation**

WATER HERITAGE

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MEDITERRANEAN AREA **WATER HERITAGE**

Hydro-Technologies (45)

Hydraulic Heritage (21)

Ancestral Water (24)

Ancient Water (24)

EGYPTIAN Water Culture (ca 3150-31 BC)

ETRUSCAN Civilization – Tuscany, Umbria, Latium - Italy (Iron Age, ca 800-100 BC)

ROMAN Period (146 BC-AD 330)

MEDIEVAL Period (5th – 10th Century)

MINOAN Civilization Southeastern Greece (Bronze age, ca 3200-1100 BC)

CLASSICAL AND HELLENISTIC Times Greece (ca 480-100 BC)

INDUS VALLEY Pakistan (Bronze age, ca 3200-1100 BC)

ZENU SOCIETY Colombia (ca 600-400 BC)

PREHISPANIC AMUNAS Peru (XII-XIII Century)

Convergent Evolution

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LESSONS LEARNED FROM WATER HERITAGE

MINOAN CIVILIZATION – Southeastern Greece (Bronze age, ca 3200-1100 BC)

Streets with paved roads including rainwater drains

Advanced water supply and sanitation technologies were practiced in Minoan Greece during the Bronze Age

(a) These civilizations understood the **importance of sanitation, water supply, and drainage and sewer systems for human survival and well-being**, making these aspects an essential part of **urban planning** to achieve the sustainability of water resources.

(b) Water quality and safety were among the critical aspects in the design and construction of their water supply systems.

(c) Use a **combination and balance of small-scale measures (such as cisterns for water collection systems) and large-scale water supply projects** (such as reservoirs for storing aqueduct flows).

(d) Water technologies were characterized by their simplicity, ease of operation, and lack of need for complex controls.

The value and the potential of ancestral hydrotechnologies (AHT) to respond to the current global emergencies (climate, biodiversity, water scarcity, health and food) have been recognized and substantially documented**, through evidence from best practices and case studies.**

50 specialists from 21 countries met in Barcelona, to present 29 best practices.

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WATER MUSEUMS GLOBAL NETWORK

unesco

International Conference

Ancestral Hydrotechnologies as a Response to Climate, Health and Food Emergencies

16-17 Feb 2023

Barcelona

Good practices in the Mediterranean and Latin America

"Use of Cultural Heritage to Rescue the Future"

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Programa Hidrológico Intergubernamental

Buenas prácticas sobre Hidrotecnologías Ancestrales

como respuesta a la emergencia climática, sanitaria y alimentaria. Casos de estudio en América Latina

Cooperación Española

Scodia

Red Iberoamericana Redes Ibero-Americana

PHI - IX / Documento Técnico
América Latina y el Caribe

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ANCESTRAL HYDROTECHNOLOGIES (AHT) & NBS

NATURE BASED SOLUTIONS (NBS). Ancestral hydrotechnologies are based and inspired by nature, coupling **traditional knowledge and management of ecosystems**, therefore ancestral hydrotechnologies can be fully considered as nature-based solutions.

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ANCESTRAL HYDROTECHNOLOGIES (AHT)

KEY PROPERTIES OF AHT

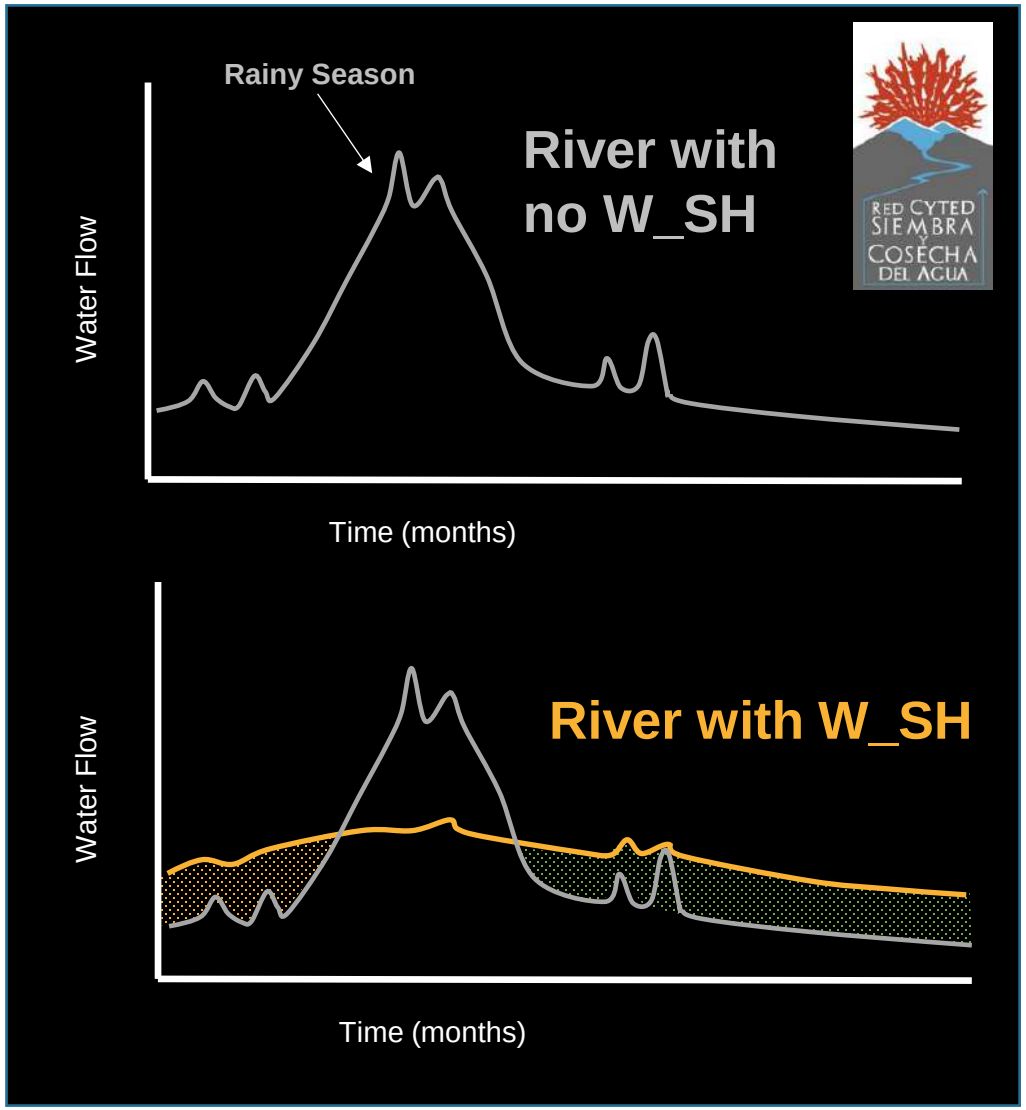
Water Sowing & Harvesting Systems

Humans collect and infiltrate (sow) rainwater and runoff underground

to recover (harvest) downgradient at some later time.

Amunas (Perú)

Acequias de Careo (Granada, Spain)



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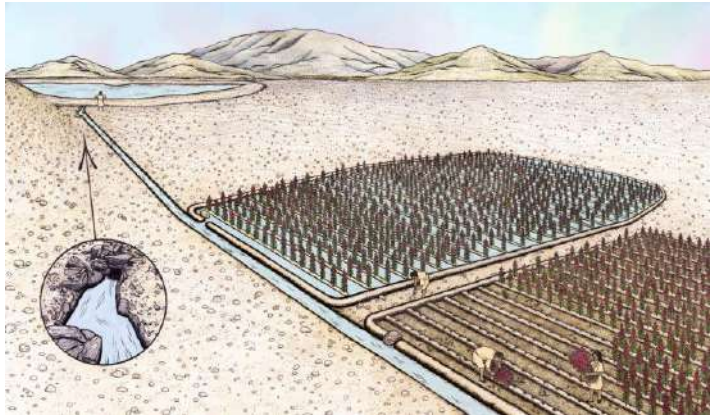
KEY PROPERTIES OF AHT

1. Sustainability & Ecological Integration – Ancestral hydrotechnologies have a **low energy, resources and carbon footprint.** Designed in harmony with natural water cycles, these **systems minimized environmental disruption and ensured long-term resource availability.**



Grana, Gasparotti, Sentinelli y Arévalo; 2025

Alfredo Durán Núñez del Prado, 2025

2. Adaptability to Local Conditions – Tailored to specific geographic and climatic contexts, AHT **optimized water use in arid, mountainous, or flood-prone regions.**

Bernardo Arcos Mijailidis/Archivo:Arcos-Alcaraz

3. Efficiency in Water Conservation – Many techniques, such as terraced irrigation, qanats, and amunas, prioritized water infiltration, storage, and controlled release to reduce losses and maximize usage.

4. Decentralized & Community-Based Management – Operated through local knowledge and collective governance, ensuring equitable distribution and maintenance.

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KEY PROPERTIES OF AHT

5. Resilience to Climate Variability – Designed to **mitigate droughts, floods, and seasonal changes**, these technologies provided stable water access in extreme conditions.

6. Beneficial for Biodiversity Restoration. Ancestral hydrotechnologies can be instrumental to **preserve and restore biodiversity and strengthening ecosystem services' provision**.

7. Low-Tech, High-Impact Design – Simple yet effective engineering principles made these systems **durable, cost-efficient, and easy to maintain** over centuries.

8. Integration with WEFE NEXUS - Ancestral hydrotechnologies serve for the further integration of WEFE NEXUS at local and regional scale for their transfunctionality, and contribution to the Sustainable Development Goals (SDGs).

(The Nature Conservancy; 2025)

9. Multifunctionality – Often served multiple purposes, such as irrigation, drinking water supply, flood control, and soil conservation, contributing to overall ecosystem stability.

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ANCESTRAL HYDROTECHNOLOGIES (AHT)

Enhance provision of Ecosystem Services

Low Resources Footprint

Low Energy Footprint

Preserve & Maintain Water Resources

Low Carbon Footprint

Manage Drought

MULTIFUNCTIONALITY

instrumental to Preserve & Restore Biodiversity

Contribute to Disaster Risk Reduction

Control Flooding

Support Climate Change Adaptation

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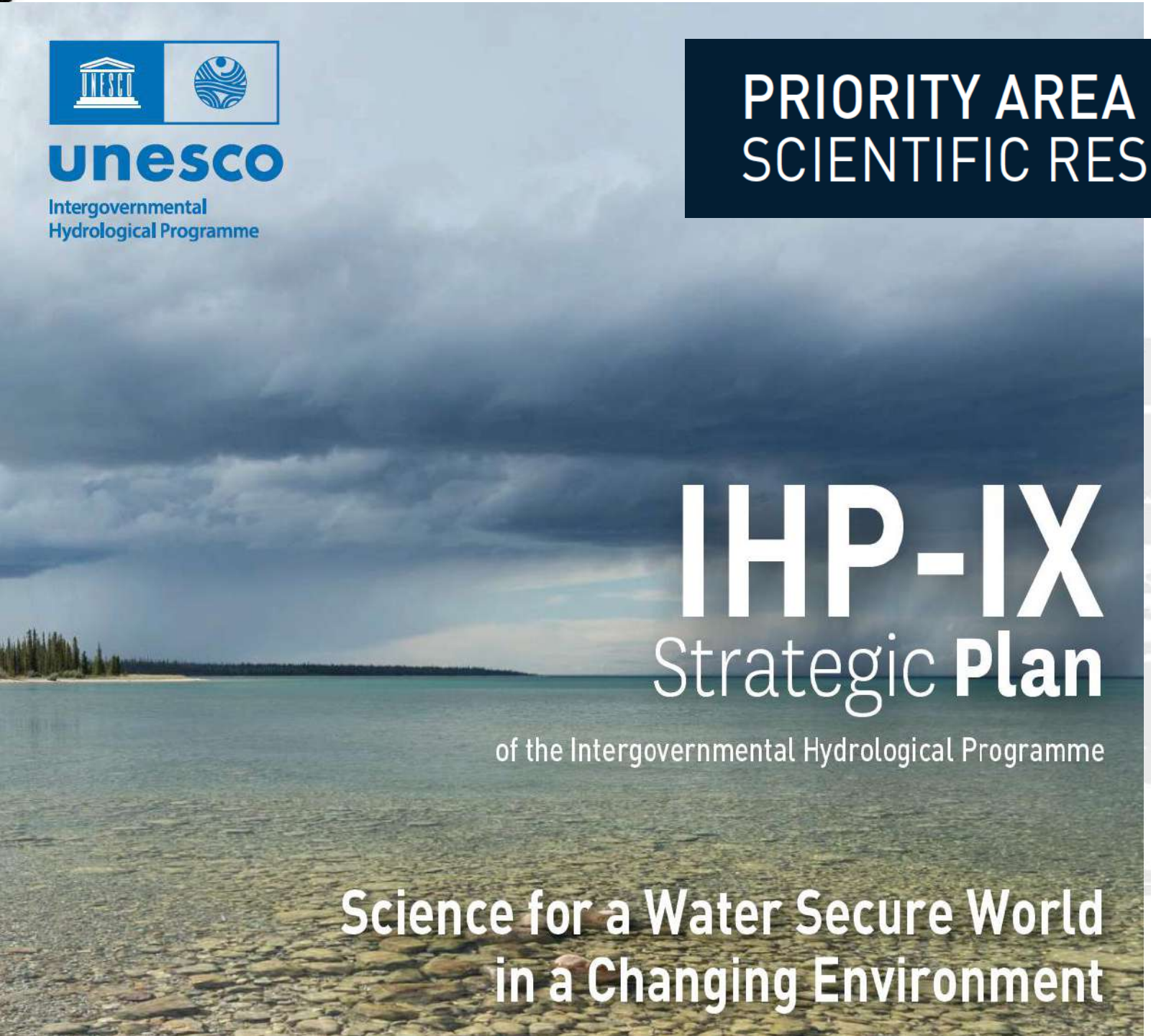
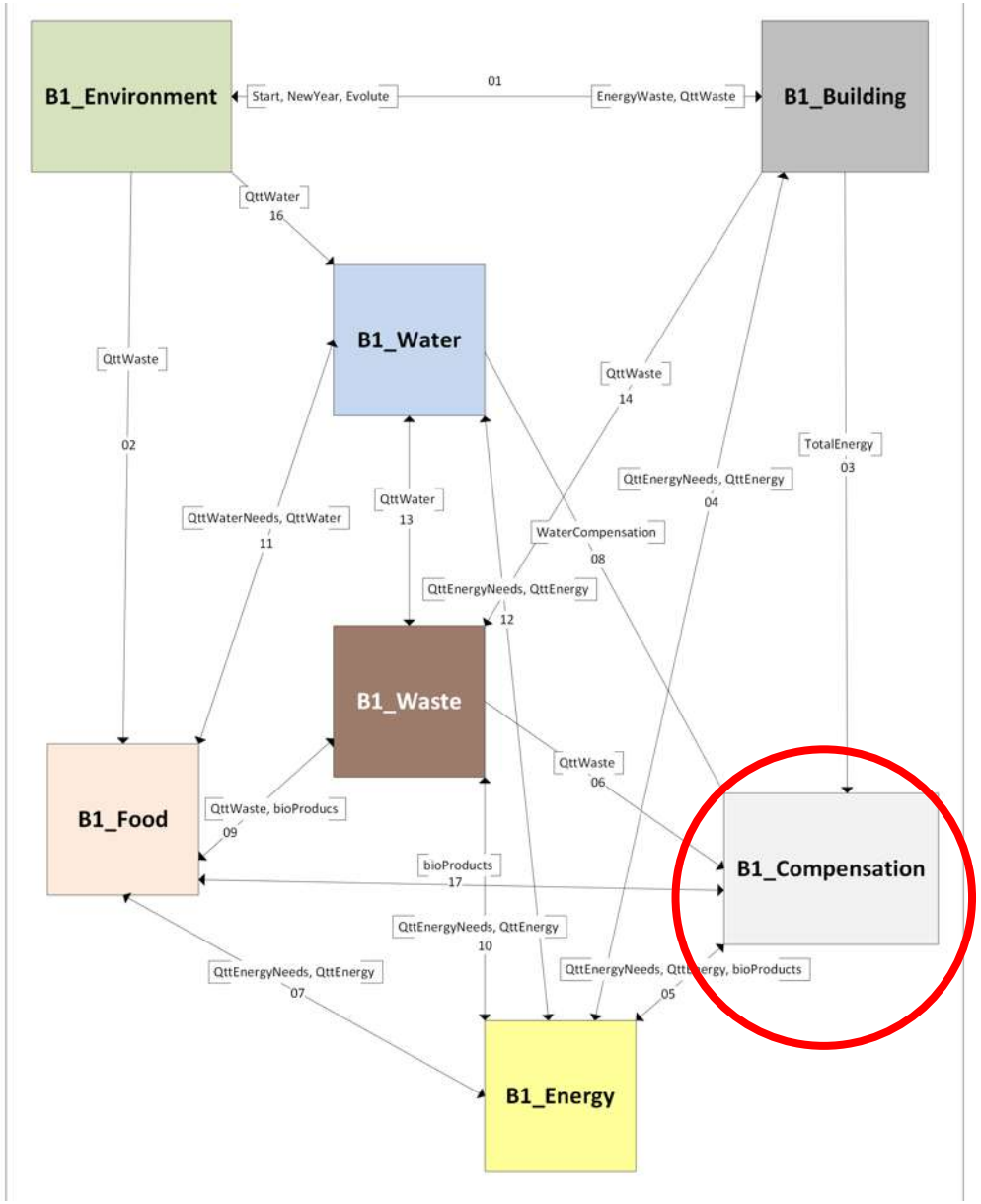


PRIORITY AREA 1:
SCIENTIFIC RESEARCH AND INNOVATION

1.10 Conducting and sharing of research on **integrating citizen science in the hydrological discipline by the scientific community and other stakeholders** supported, to improve understanding of the water cycle enabling science based decision making.

IHP-IX will create the enabling environment and assist citizens and scientists, through enhanced water
knowledge and education programmes to ensure scientific methods are used when participating in and reporting their findings to increase the contribution of citizen science to hydrology research. Training, in particular, will contribute to enhancing accuracy and validity of data.
Additionally, scientific tools should be developed to encourage citizen participation and other social applications that can improve water management, such as **integrating modern science with ancestral, indigenous and local knowledge.**



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.

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Identifying most effective strategies for

Water Security
Energy Security
Food Security
Ecological Resilience

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

- Best **NBS** Treatment
- Find **Energy** Recovery
- Find **Bioproduct** Recovery

SURE NEXUS
Compensation Block DB

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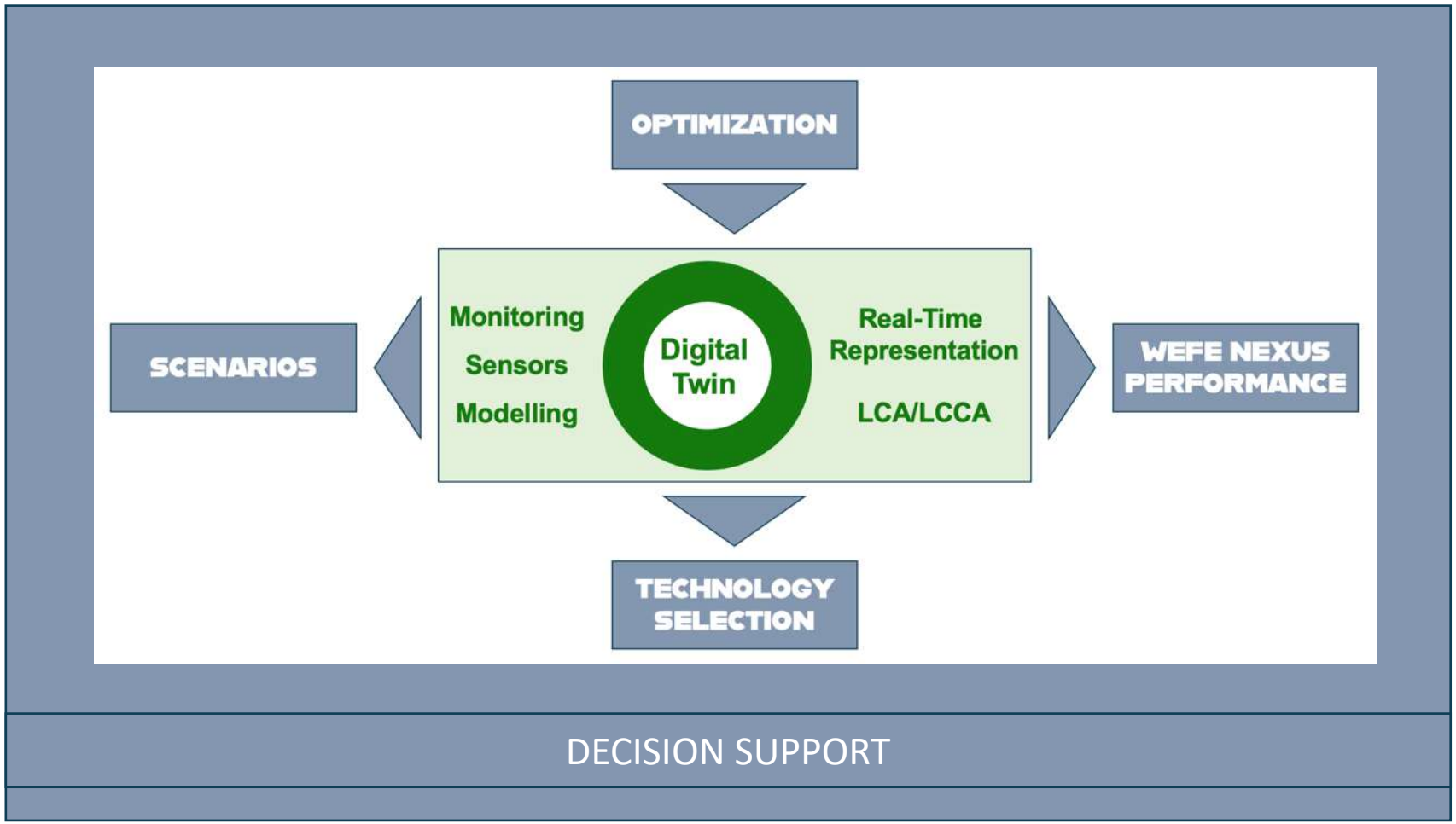

Enhanced Resilience

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Boosting Resilience in the WEFE Nexus Framework

- 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 ancestral hydrotechnologies.

Many ancestral hydrotechnologies have the full potential to be recovered and/or scaled up to contribute to the transformative change needed for responding to the global challenges in the wide framework of sustainable development.

In order to fully enable the scale up ancestral hydrotechnologies, we need:

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POLICY RECOMMENDATIONS

- **Integrate ancestral hydrotechnologies into national and regional water policies** by promoting them as nature-based solutions for climate adaptation and water security. This can be achieved through regulatory frameworks, incentives for implementation, and alignment with existing environmental and agricultural policies.

- **Support capacity development and knowledge exchange** by creating training programs, community workshops, and interdisciplinary research initiatives that bridge traditional knowledge with modern science, ensuring the sustainable management and adaptation of these systems.

- **Establish financial mechanisms and incentives** such as subsidies, grants, or public-private partnerships to encourage the restoration, maintenance, and scaling of ancestral hydrotechnologies, particularly in drought-prone and water-stressed regions.

- **Strengthen multi-level governance and stakeholder engagement** by fostering collaboration between local communities, governments, researchers, and private sector actors to co-develop strategies for implementing these technologies at different scales.

- **Enhance monitoring and data integration** by incorporating ancestral hydrotechnologies into water management planning through remote sensing, hydrological modeling, and participatory data collection, ensuring evidence-based decision-making and long-term sustainability.

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Olga Lucía Sánchez

Luis David Díaz

Brent Villanueva

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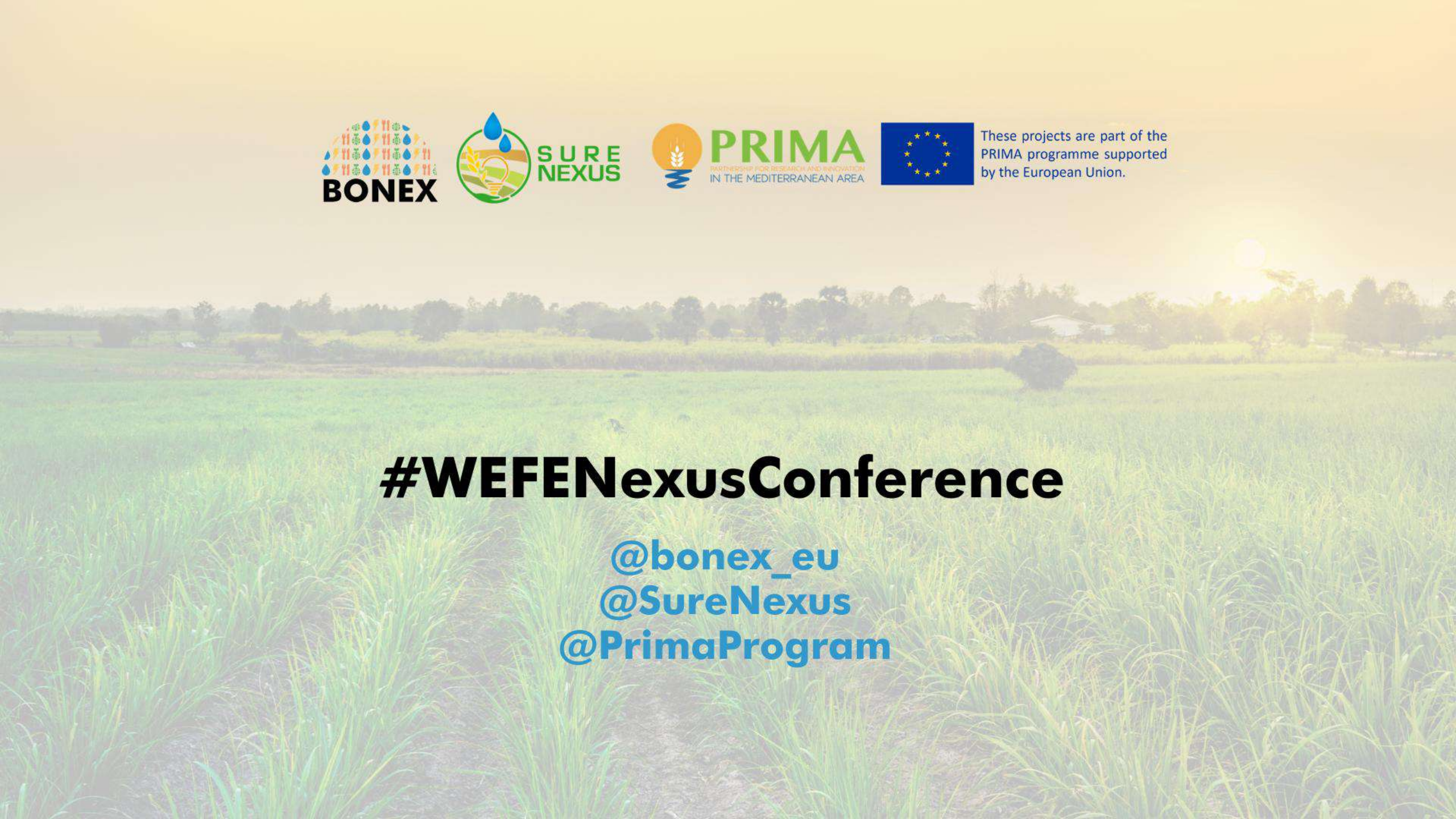
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