



CirCLE 2019

Challenges for the Islands in the era of the Circular Economy

*Regenerative & nature-based water solutions:
The H2020 HYDROUSA Project*

Dr. Konstantinos Moustakas

National Technical University of Athens

Under the auspices of



SMile 2019

6th Sustainable Mobility & Intelligent Transport conference





BASIC PROJECT INFO



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776643

Title: Demonstration of water loops with innovative regenerative business models for the Mediterranean region

Acronym: HYDROUSA

CIRC-02-2016-2017: Water in the context of the circular economy, Innovation Action

Total budget: €12,015,448.75; EC contribution: €9,958,706.88

Duration: 54 months

Start date: 01/07/2018

Number of partners: 27





OUR TEAM



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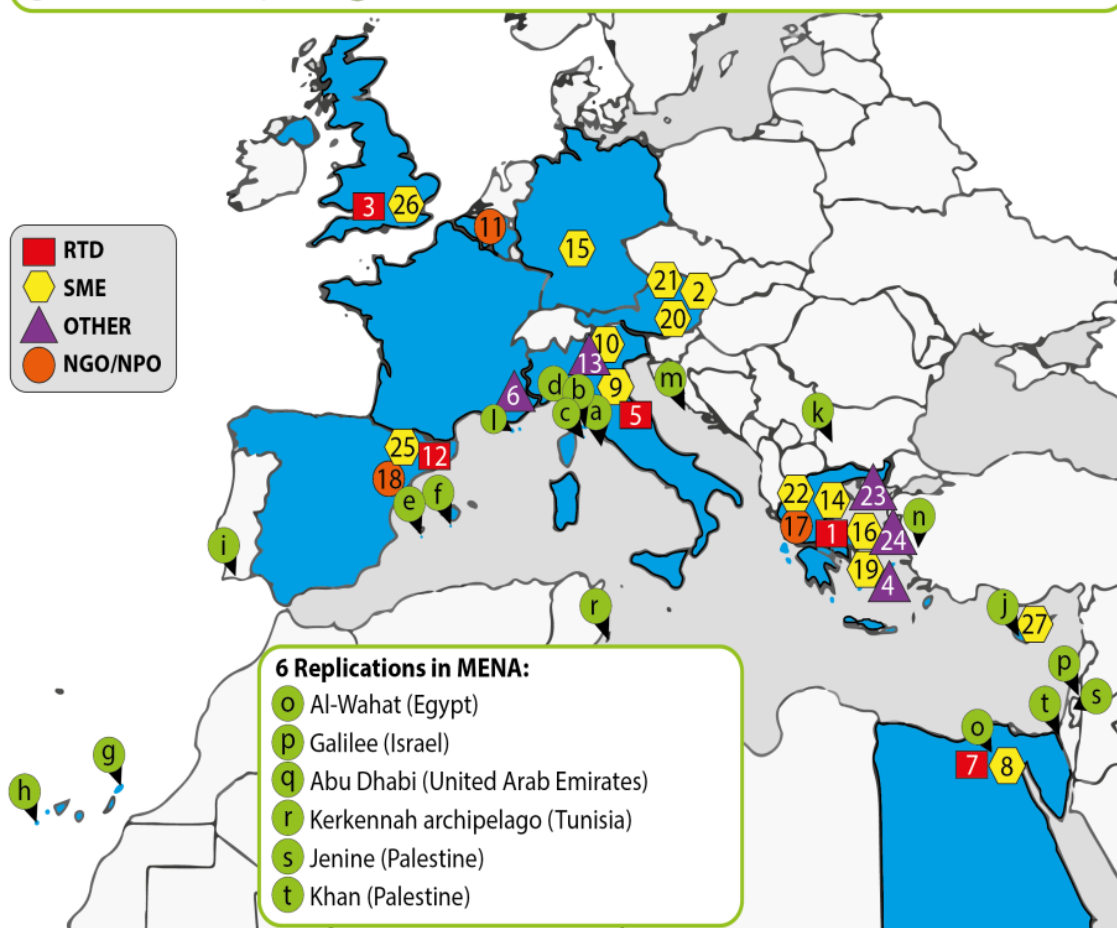
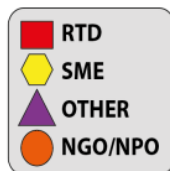
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14 Replications in Europe:

- | | |
|------------------------------|--------------------------------|
| a Elba (Italy) | h El Hierro (Spain) |
| b Capraia (Italy) | i Algarve (Portugal) |
| c Pianosa (Italy) | j Limassol (Cyprus) |
| d Gorgona (Italy) | k Sofia region (Bulgaria) |
| e Formentera (Spain) | l Porquerolles Island (France) |
| f Cabrera (Spain) | m Zlarin Island (Croatia) |
| g La Graciosa Island (Spain) | n Mediterrean area (Turkey) |

5 Replications in Australia, America, Asia:

- Northern China - Shaanxi province (Asia)
- Malaysia (Asia)
- Queensland (Australia)
- Mexico (America)
- Chile (America)



6 Replications in MENA:

- | |
|------------------------------------|
| o Al-Wahat (Egypt) |
| p Galilee (Israel) |
| q Abu Dhabi (United Arab Emirates) |
| r Kerkennah archipelago (Tunisia) |
| s Jenine (Palestine) |
| t Khan (Palestine) |



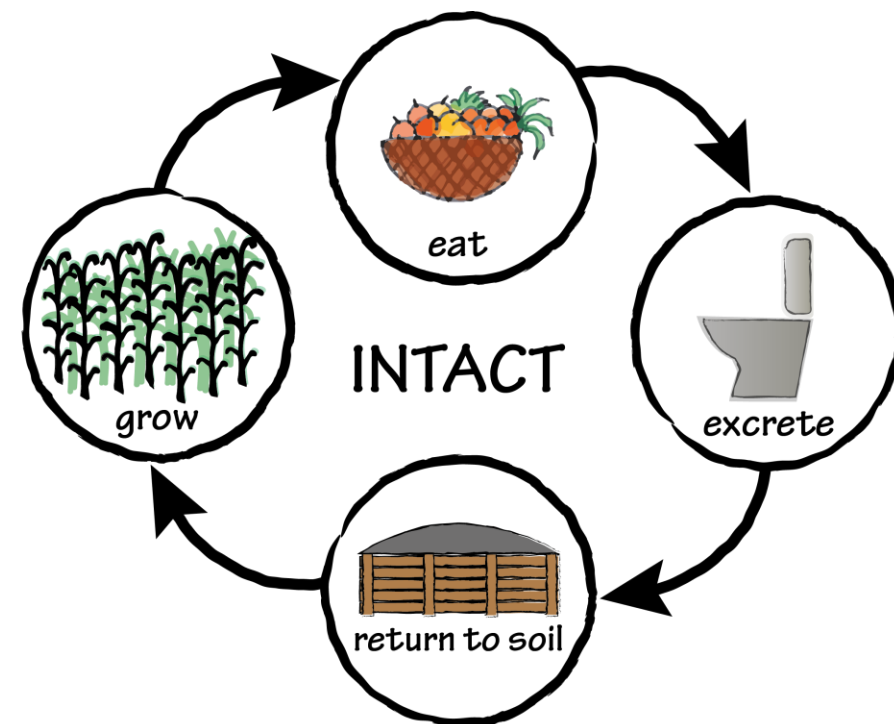
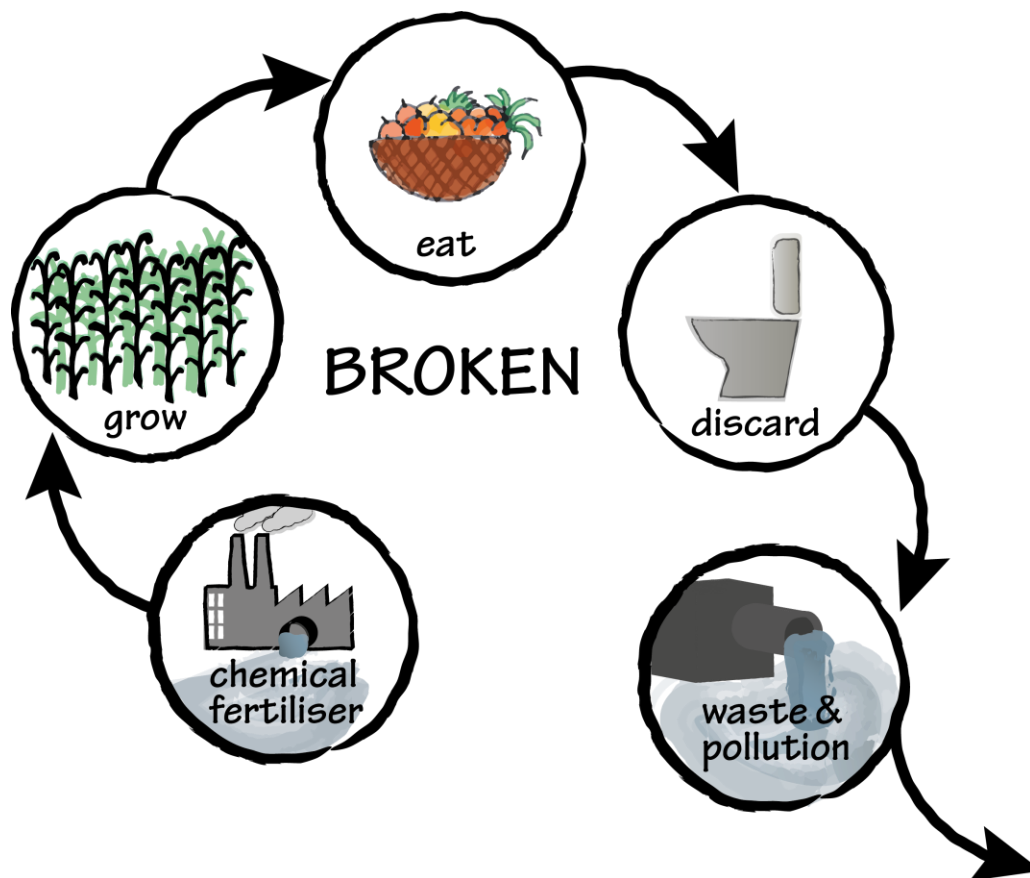
Country map of participants

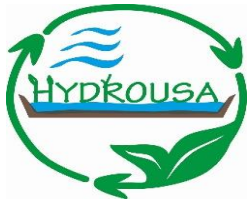


BROKEN VS INTACT



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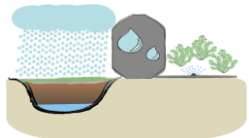

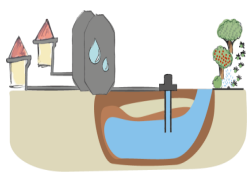

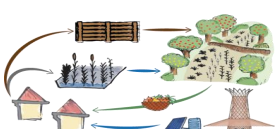
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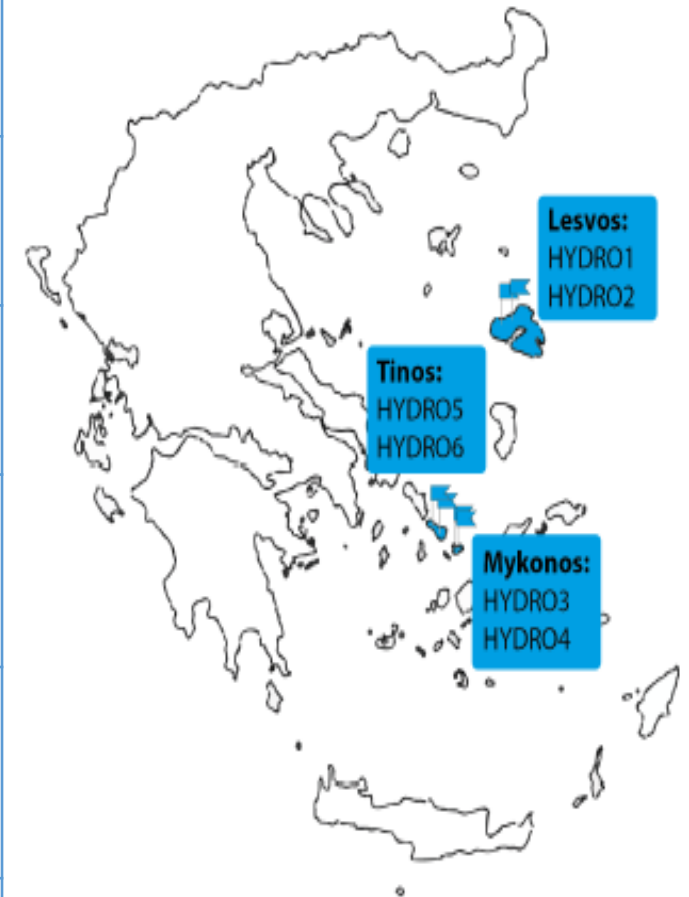
HYDROUSA Concept



- Demonstrate the feasibility of **innovative, nature based technologies** to **recover** and **preserve** valuable materials and energy from different types of water
- Demonstrate innovative supply chain within the concept of the circular economy
- **Decrease water acquisition cost**
- Applicability in **coastal areas** and in **islands**, particularly suitable for medium-small and decentralized regions
- Integrating within the supply chain **citizen and farmer** based **activities**
- Promote **novel agricultural practices and precision irrigation** within the water-food-energy nexus

Nature-based solutions for Smart water management in MED areas

Site	Scheme	Specification	Issue Solved
HYDRO1 Lesvos		Anaerobic treatment & sludge composting, water reuse, biogas production	No wastewater discharge into the sea; cheaper production of reclaimed water; increasing water supply; recycling nutrients
HYDRO2 Lesvos		Irrigation of agroforestry system with nutrient-rich reclaimed water	Wastewater use for fertigation; no fertilizer import; product diversity; creating resilient ecosystems
HYDRO3 Mykonos		Remote rainwater harvesting system and irrigation of oregano	Cheap water supply in remote areas; create business case with little input
HYDRO4 Mykonos		Domestic rainwater harvesting, aquifer storage and watering of local crops	Increase water supply; production of drinking water; aquifer recharge to reduce saltwater intrusion
HYDRO5 Tinos		Seawater and brine treatment to recover salt and water, produce tropical fruits	Produce sweet water from saltwater/brine; decrease import of tropical fruits; salt production
HYDRO6 Tinos		Water loops in eco-tourist facility	Ecotourist facilities which are self sufficient in terms of water, energy and food production



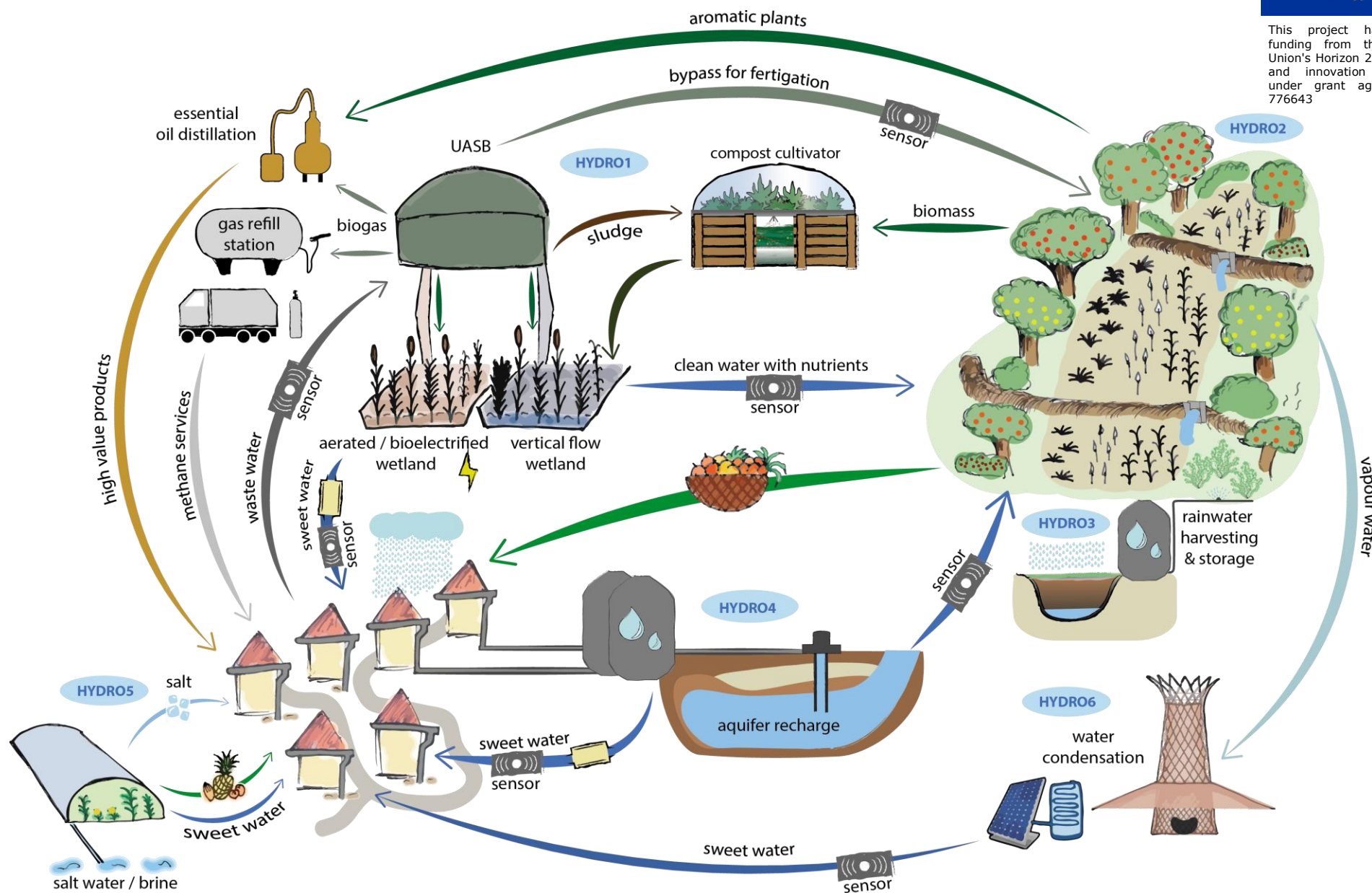
Map of pilots



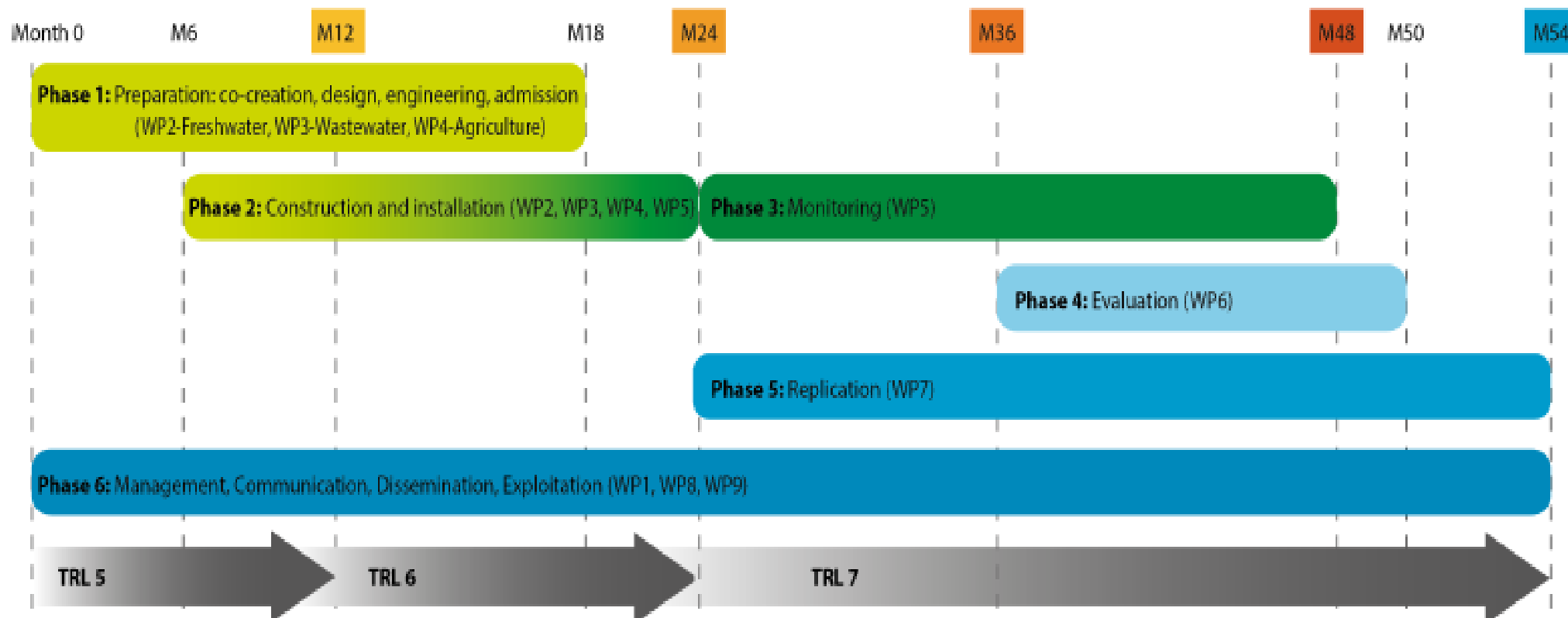
HYDROUSA IN ONE PICTURE



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How it will be achieved?



HYDROUSA Methodology



IMPACT & EXPLOITATION



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HYDROUSA's Regenerative Model

Build a Water-Resilient Economy



Create Jobs



Build Green Infrastructures



Market Development

Mitigate Climate Change



Sequester Carbon



Rebuild Flourishing Ecosystems



Turn a Problem into a Solution

Reimagine the Food System



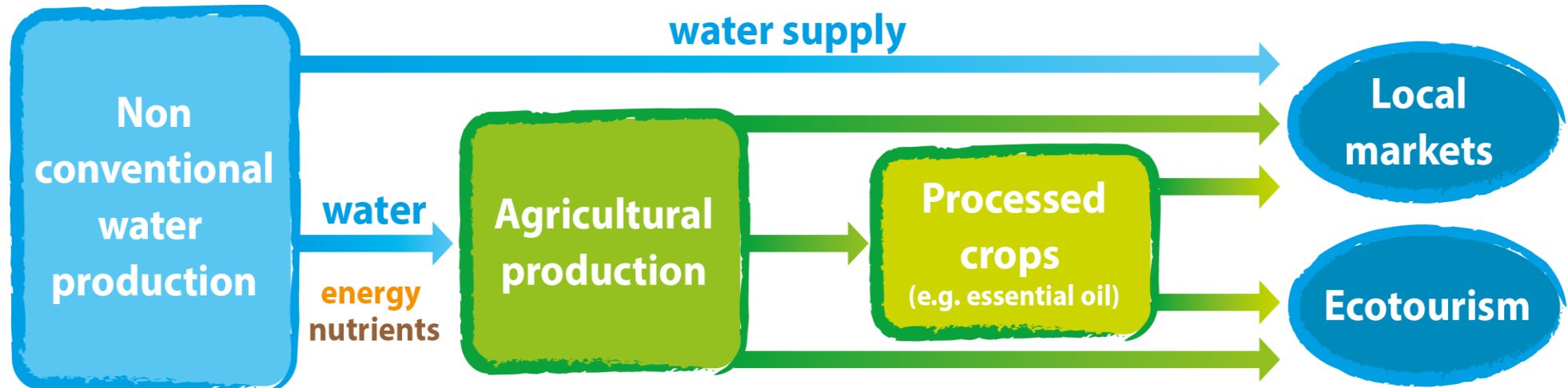
Rearrange Local Food Production



Zero km Farming



Establish Diversity as Commons



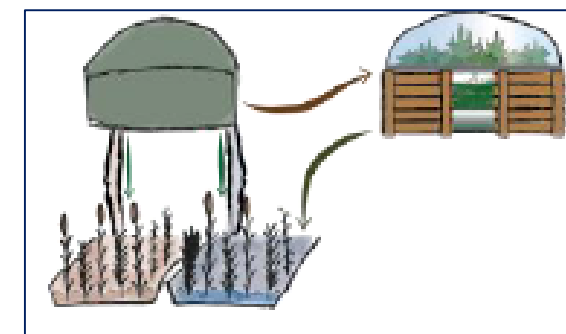
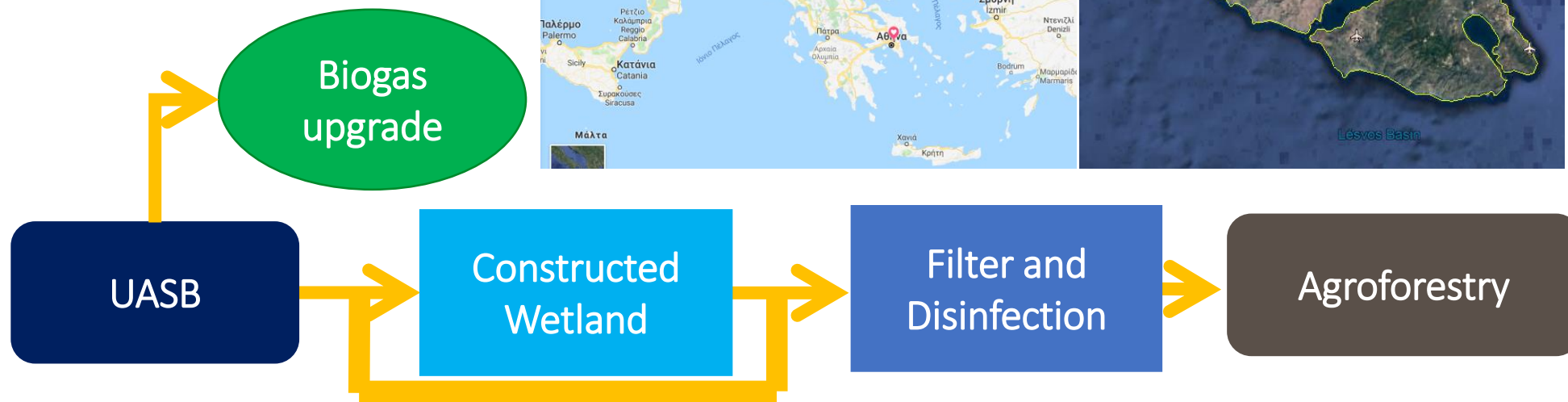
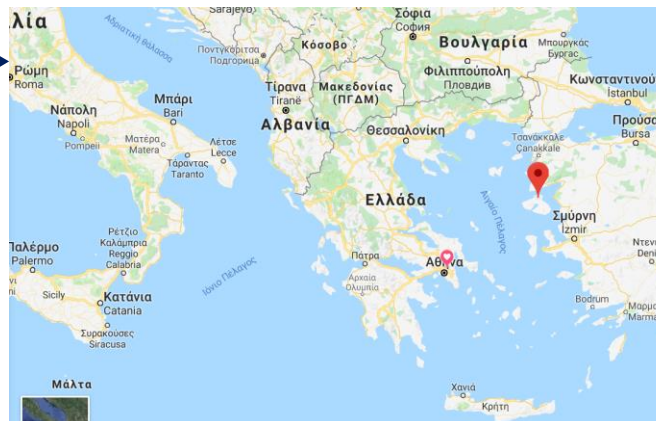


HYDRO1 Antissa, Lesvos

Integrated UASB-CW treatment at community level



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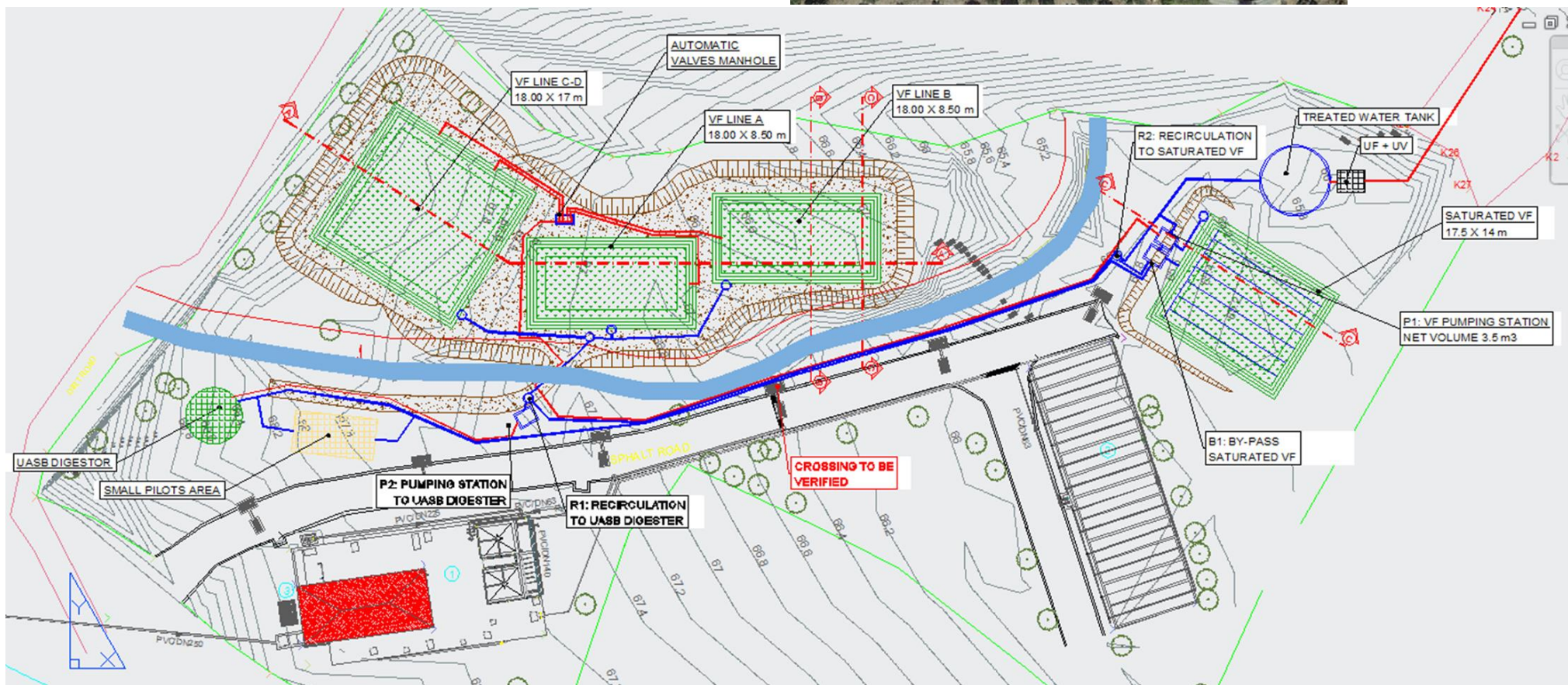
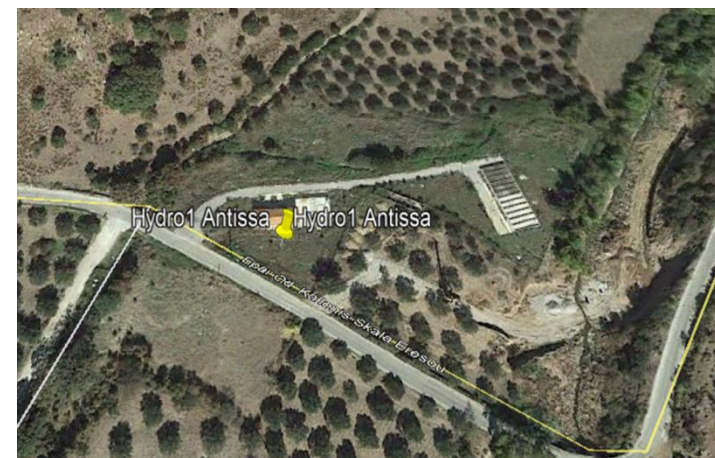




HYDRO1 - Scheme



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HYDRO1 - Effluent Requirements



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- The UASB+CW+UF+UV pilot plant is designed **to respect the Greek effluent water quality regulation** for unrestricted agricultural reuse
- **Versatile enough to meet other water reuse criteria**

Parameters	Limit
BOD ₅ (mg/L)	10 for 80% of the samples
TSS (mg/L)	10 for 80% of the samples
Turbidity (NTU)	2 (median)
E. Coli (EC/100 mL)	5 for 80% of the samples 50 for 95% of the samples





HYDRO2- Agroforestry



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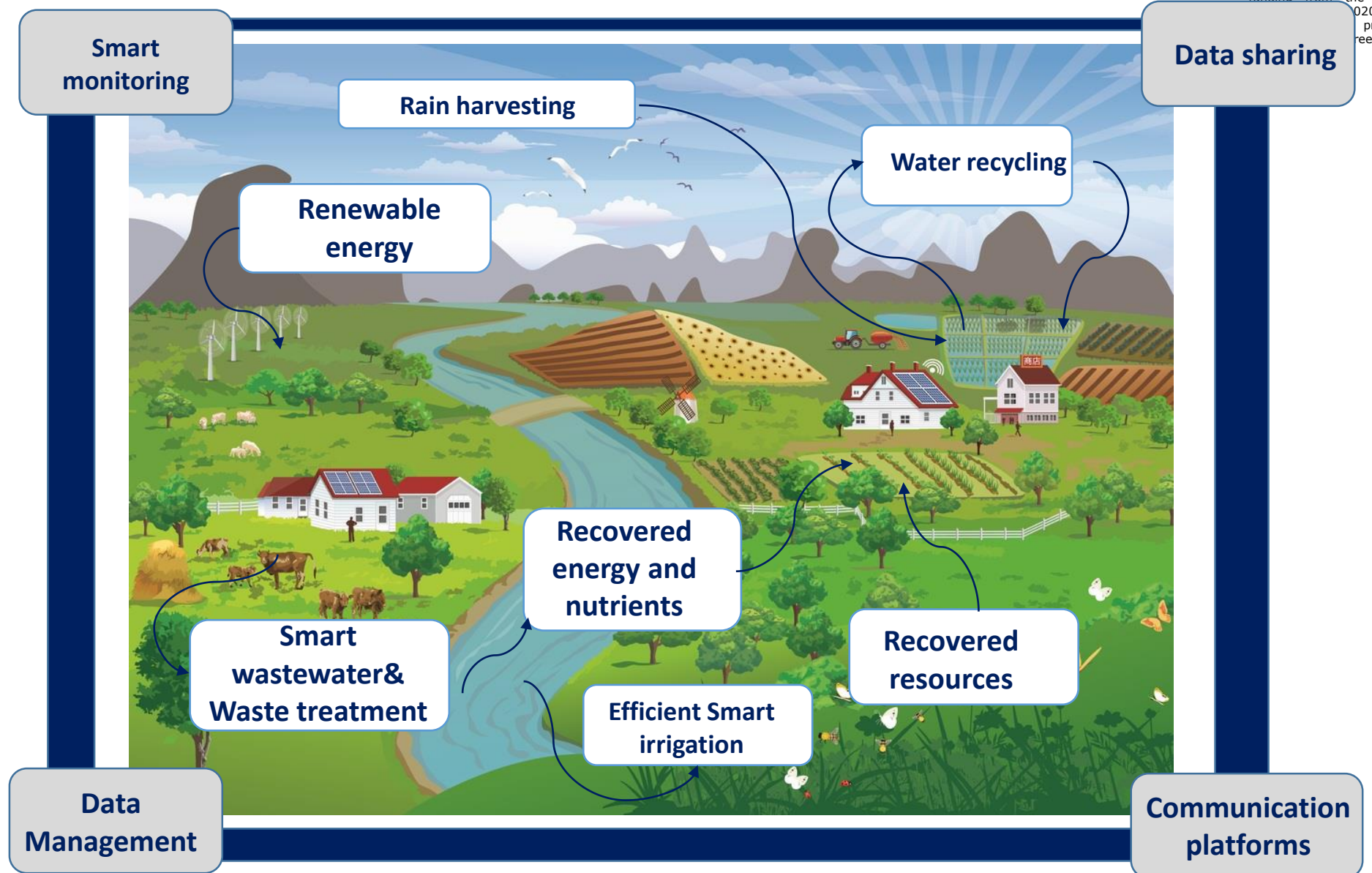




A paradigm shift towards a sustainable - circular farm system



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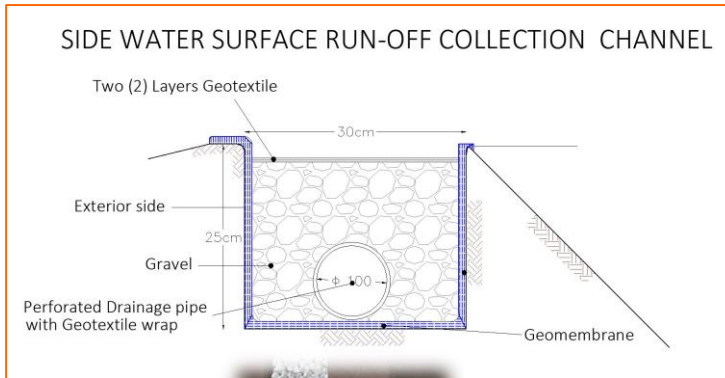
HYDRO3 - Mykonos Island

Shallow subsurface rainwater collection system

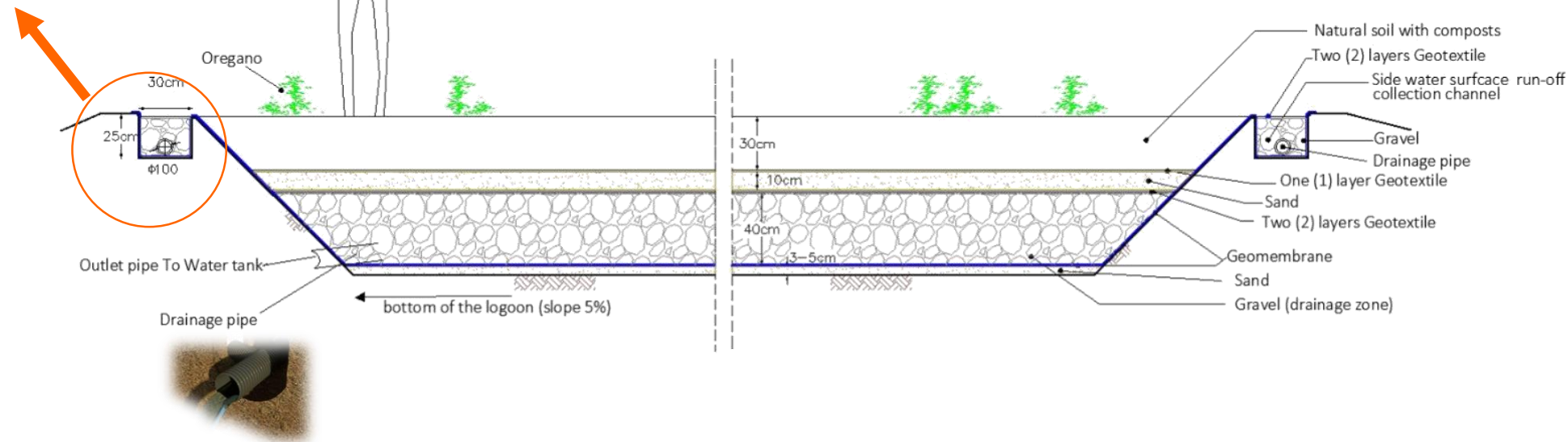


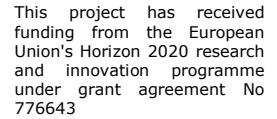
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- Geomembrane to seal the water from penetrating into the soil
- Gravel
- Geotextile at the top to allow the passage of water but not of soil
- Soil (top) to avoid visual intrusion.
- Rainwater use for the irrigation of oregano.



SUB-SURFACE RIANWATER COLLECTOR (drainwater Lagoon) ≈ 350 m²

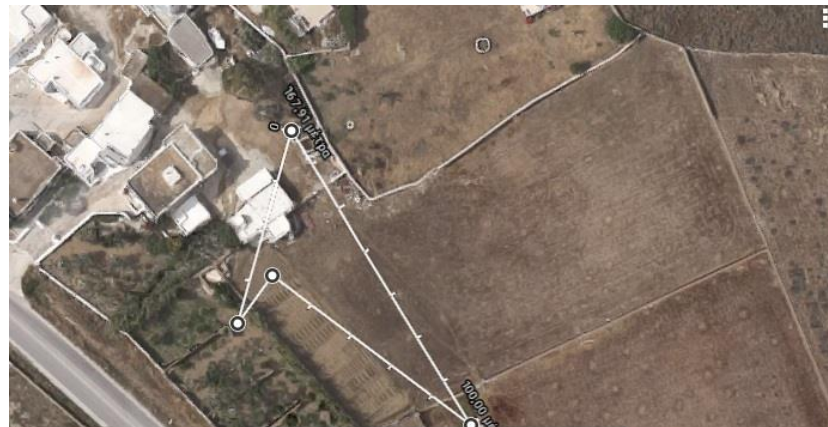




Rainwater harvesting & aquifer storage system

Rainwater harvesting and aquifer storage and recovery system

- Harvested rainwater from residential roofs will be reserved in tanks for domestic use
- Surface runoff from road collected, filtered and stored into the aquifer to be used for irrigation purposes (lavender) (Aquifer Storage and Recovery)
- Limitation: Need impervious layer at the bottom to be able to store the water into the aquifer





HYDRO 5- Agios Fokas, Tinos

Mangrove Greenhouse



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- ✓ Modular Desalination system based on **solar still technology** (evaporation/condensation process).
- ✓ Production of **distilled water** for **land regeneration practices** and **food production** in arid, semi-arid areas.
- ✓ Production of **salt for commercial use**
- ✓ Inspired by the way Mangrove trees function
- ✓ Smart operation via Internet of Things sensors system

Initial pilot test in Cyprus
10 Desalination units

Current performance:
• **2.5-5 liter/day/m²**



Activities Within HYDROUSA

- Design and system up-scaled
- Feed saline water from local Desalination Plant (seawater and brine)
- Embed "Salt factory"
- Optimize Integration with Greenhouse to produce tropical fruits and other fruits/vegetables



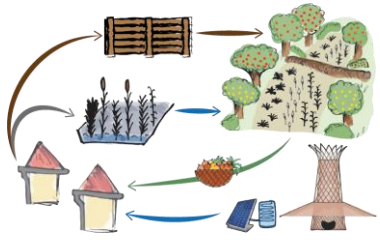


HYDRO 6 – Steni, Tinos

Water loops in eco-tourist facility

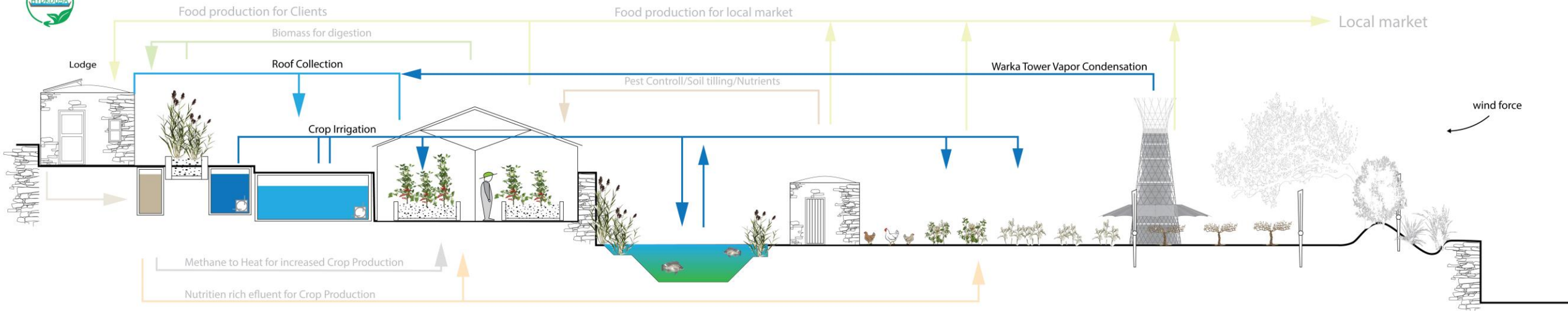


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- Rainwater and vapour water collection
- Onsite reed bed
- 100% reuse of all non-conventional water streams

Hydrousa: Rainwater catchment and storage



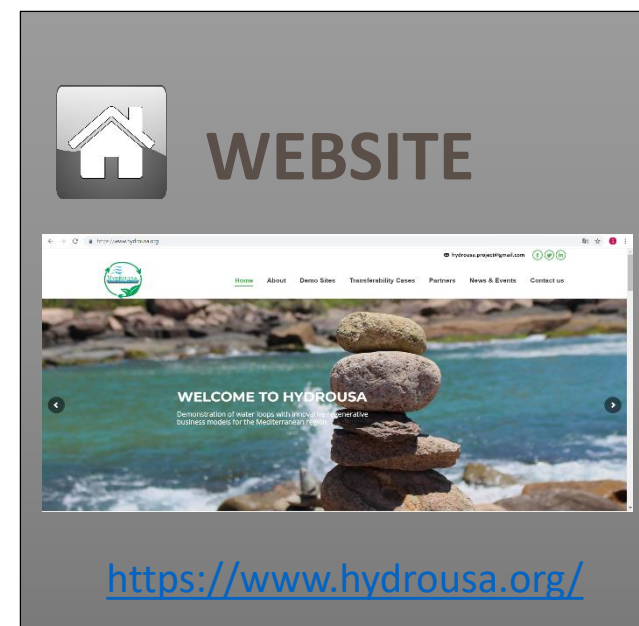
Sewage Water	Biodigester	Water Treatment	Treated Water Cistern	Rain Water Cistern	Greenhouse	Open Cistern/Pond	Chicken Coop	Artichoke P. & Caper plantation	Grape P.	Wind brake hedge Fog Catcher
	Produced Methane could be used for direct burning for heat or stored and transformed into electricity	natural system with excess production of biomass, could be used for biodigestion	water quality control by sensors, if quality low, re-pass by reed bed or increase oxygen level in cistern, UV disinfection Unit	collection of rainwater from roof areas during winter months and storage of excess natural stream water in order to irrigate in summer	Increase productivity and variety of crop production. Excess biomass could be digested	increased water retention from cistern overflow, rainwater and stream water. Possibility of Aquaculture for increased food production and enriched irrigation water	food production and pest control for cultivation. Good source of natural fertilizer and soil tilling	high value crop if organic, low maintenance and very adapted to local climate conditions	high value crop if organic, low maintenance and very adapted to local climate conditions	Wind brake hedges can protect areas that couldn't be cultivated otherwise. In combination with fog catcher nets sufficient water and wind shielding could be provided for fast growth.



We are social!



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Thank you for your attention



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Thursday 28 - Friday 29 March 2019, Nicosia, Cyprus

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