



“Projecte H2020 HYDROUSA: economia circular, destí dels contaminants emergents i avaluació de la seguretat alimentària”

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ICRA, Girona



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III Congrés de l'Aigua a Catalunya



BASIC PROJECT INFO

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



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





HYDROUSA project

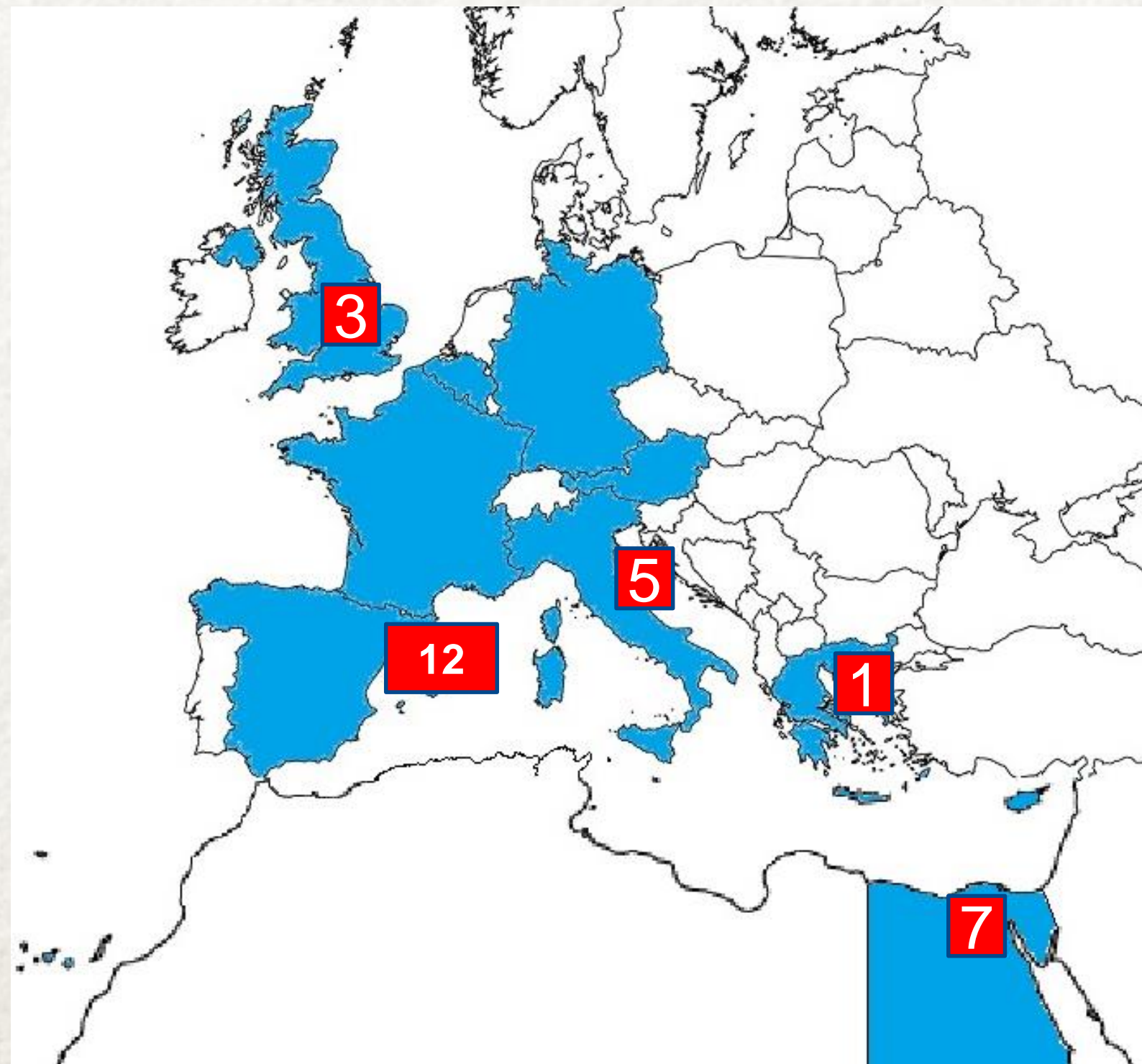
Demonstration of water loops with innovative regenerative business models for the Mediterranean region

Call: H2020-IND-CE-2016-17

Industry 2020 in the Circular Economy

Topic: CIRC-02-2017

Water in the context of the circular economy



27 partners

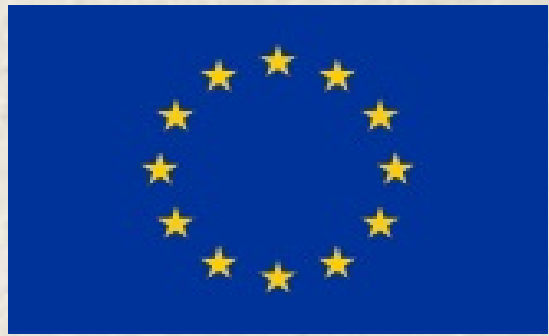
- 13 SME
- 5 University and research centres
- 3 Municipalities
- 2 NGO and 2 NPO

- 9 Greece
- 4 Italy
- 3 Spain
- 3 Austria

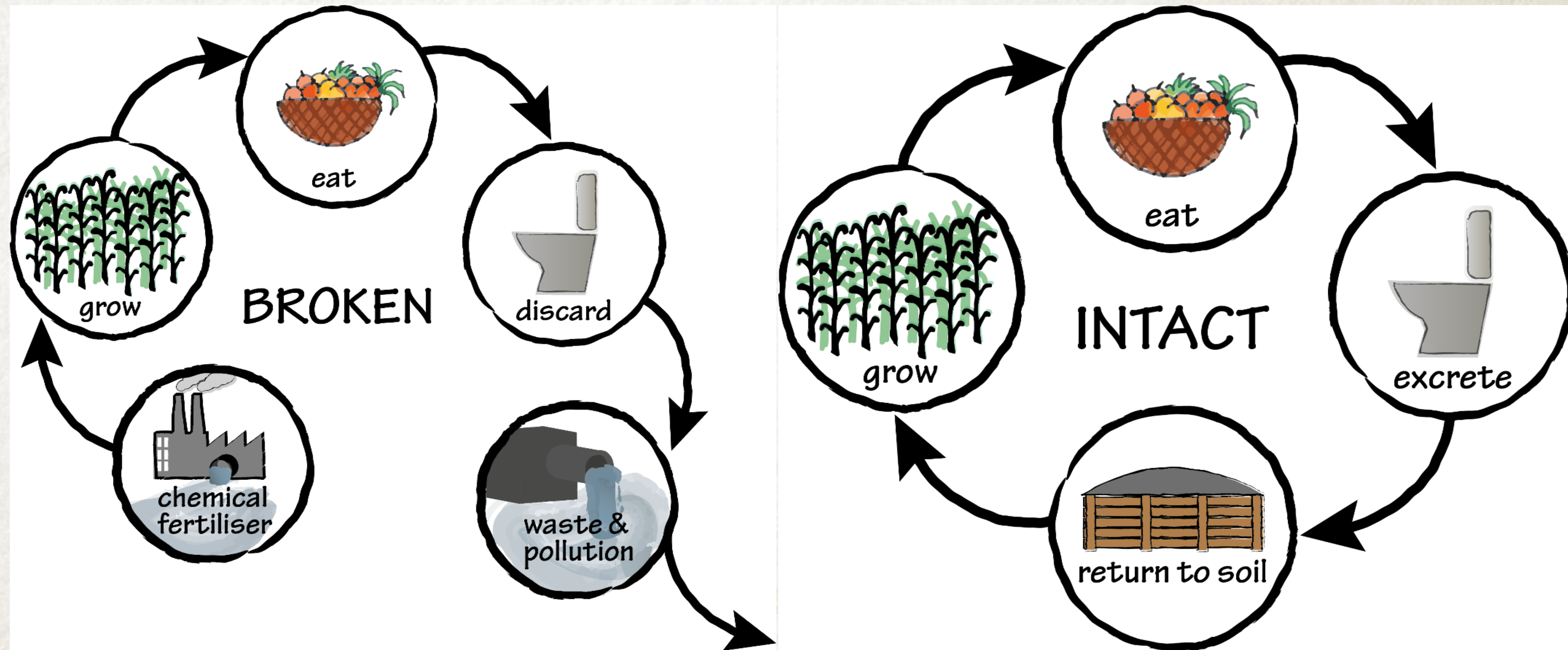
Total project budget: 12.02 M€ (funded 9.96 M€)



BROKEN VS INTACT



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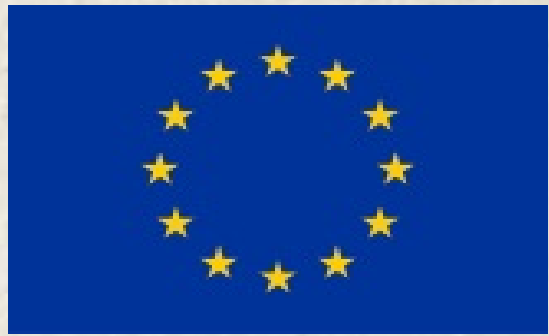


The central challenge of HYDROUSA is to close broken nutrients

- New circular business model, suitable for MED and other water-scarce regions



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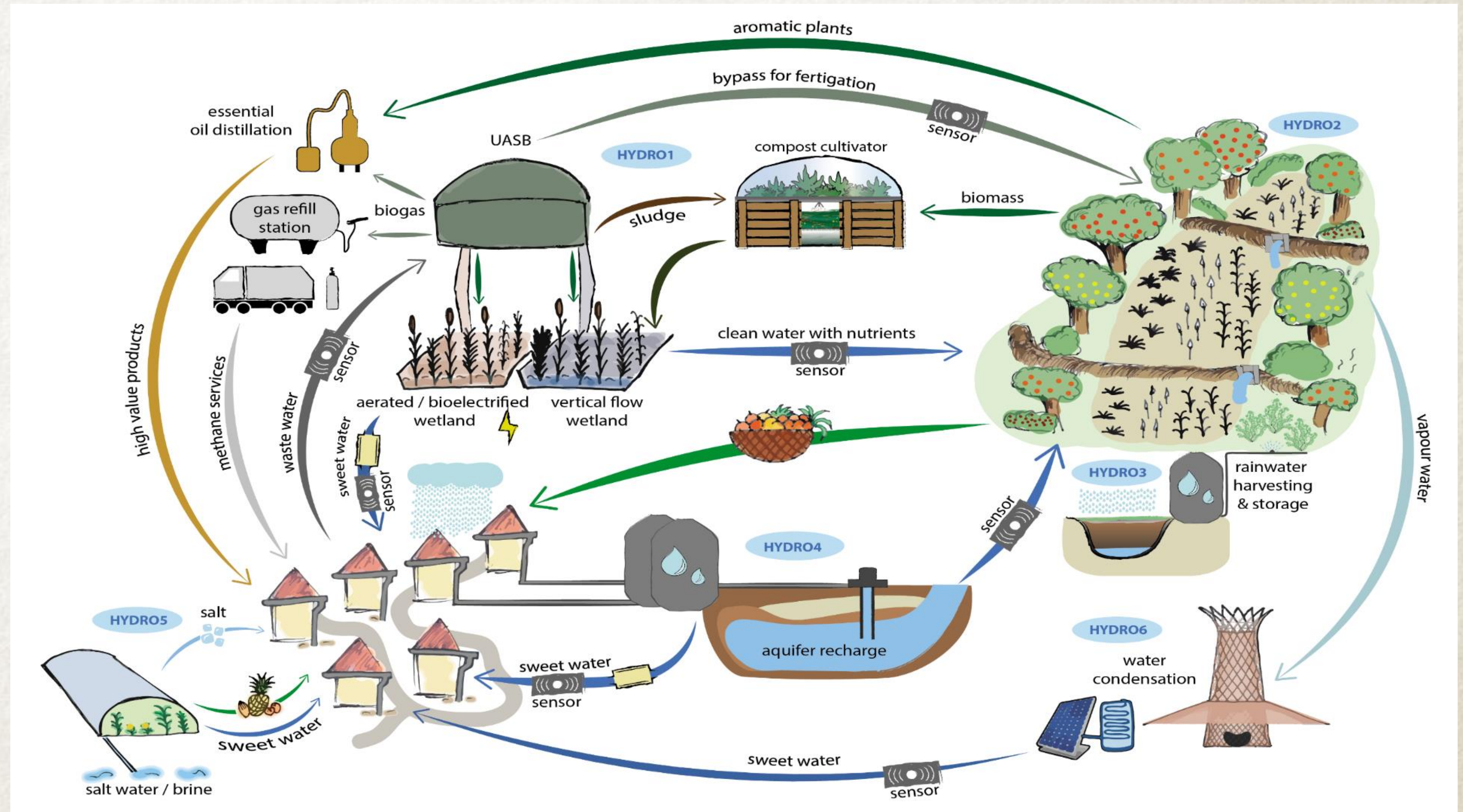
Conventional systems

- **Water extraction** from ground or surface water resources
- **Fertiliser imports** from non-European countries for use in agriculture
- **Fresh water production** in isolated areas often with **energy-intensive reverse osmosis**
- **Storm water** needs to be **drained away from sealed surfaces**
- **Conventional WWTPs** have **high energy footprint** due to aeration requirements
- **Supply chain** in water industry **involves many intermediates** decreasing the profit margin
- **Exploitation** is targeted towards maximising benefits for **large companies** in **centralised systems**

HYDROUSA approach

- **Wastewater** use as **valuable water source**; **water stored in aquifers**; **rainwater harvested and used**;
- **Nutrients** in wastewater used in **fertigation regime**
- **Solar desalination**, **water condensation from air humidity**, **tropical fruit** and **salt production**
- **Storm water** after treatment used as **freshwater** or stored as groundwater
- Take advantage of plants to depollute wastewater through engineering CWs; **implement anaerobic treatment solutions**
- **Create local circular supply chain** minimising the number of intermediates
- **Dual exploitation** of untapped resources benefits **water companies, local organisations** and **SMEs** through **decentralisation**

The logo for Hydrousa is a circular emblem. A thick green arrow curves clockwise around the perimeter. Inside the circle, at the top, are three blue wavy lines representing water. In the center, the word "HYDROUSA" is written in a green, stylized, sans-serif font. Below the text is a horizontal blue bar with a brown base, resembling a cross-section of water or a container. At the bottom of the circle is a large green leaf with two smaller leaves branching off it.



ICRA

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de Recerca de l'Aigua

Instituto Catalán
de Investigación del Agua

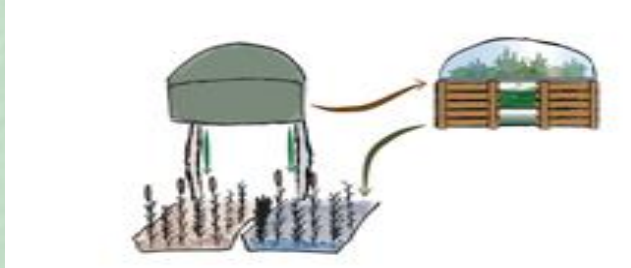
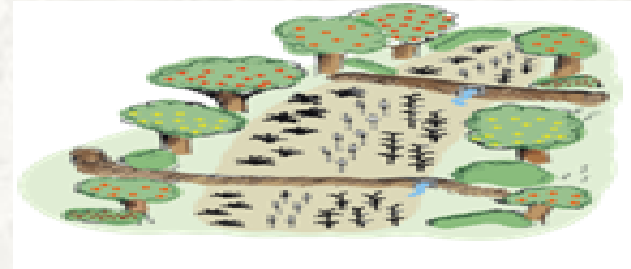
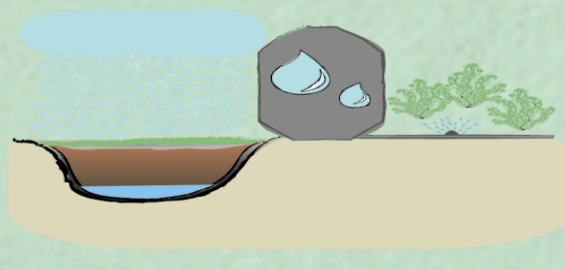
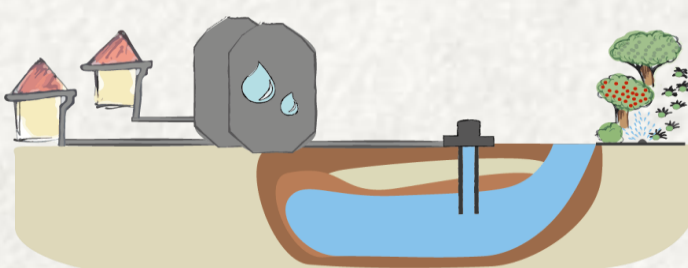
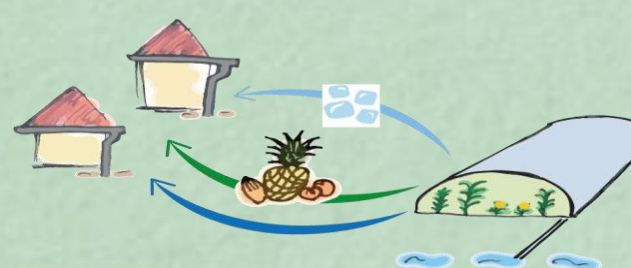
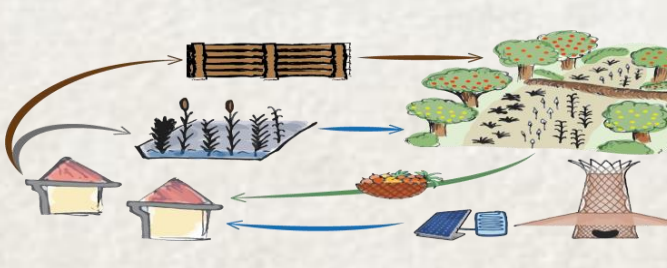
Catalan Institute
for Water Research

Circular Approach

HYDROUSA

DEMOSTRATION SITES

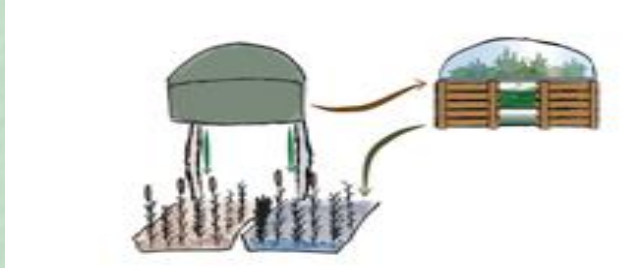
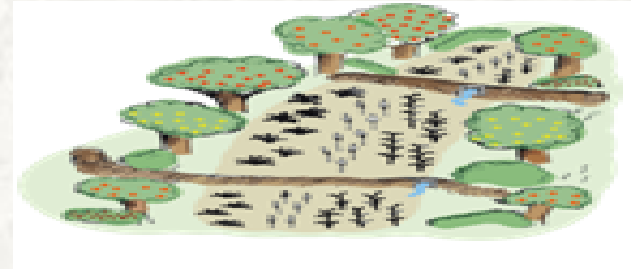
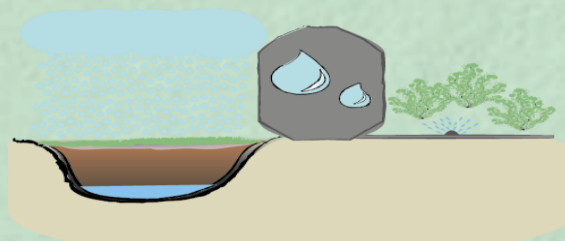
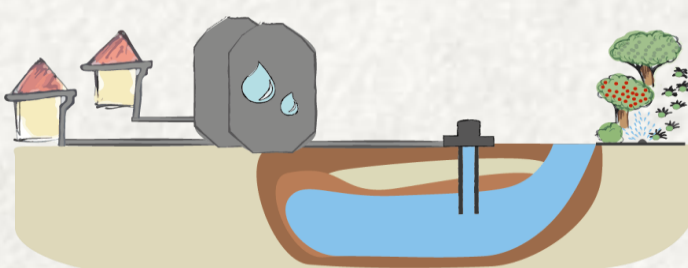
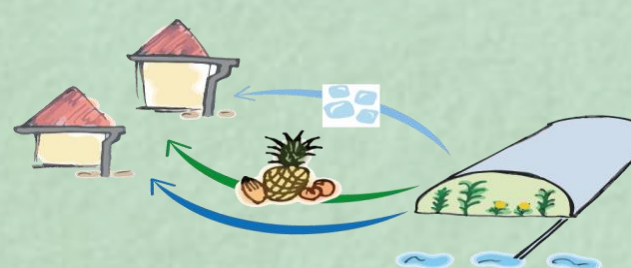
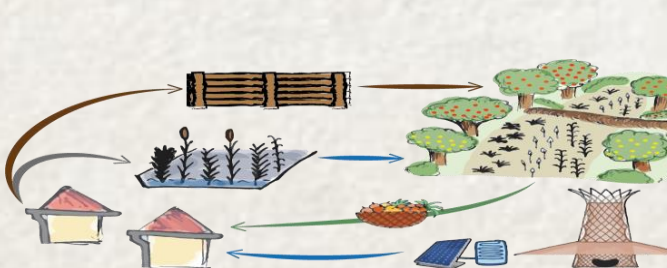


Site	Scheme	Specification	Issue Solved
HYDRO1, Lesvos		Integrated UASB-wetland Anaerobic treatment & sludge composting, water reuse, biogas production	No wastewater discharge in the sea; cheaper production of reclaimed water; increasing water supply; recycling nutrients
HYDRO2, Lesvos		Irrigation of 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

HYDROUSA

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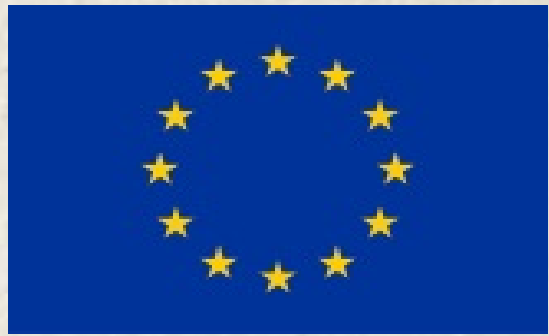


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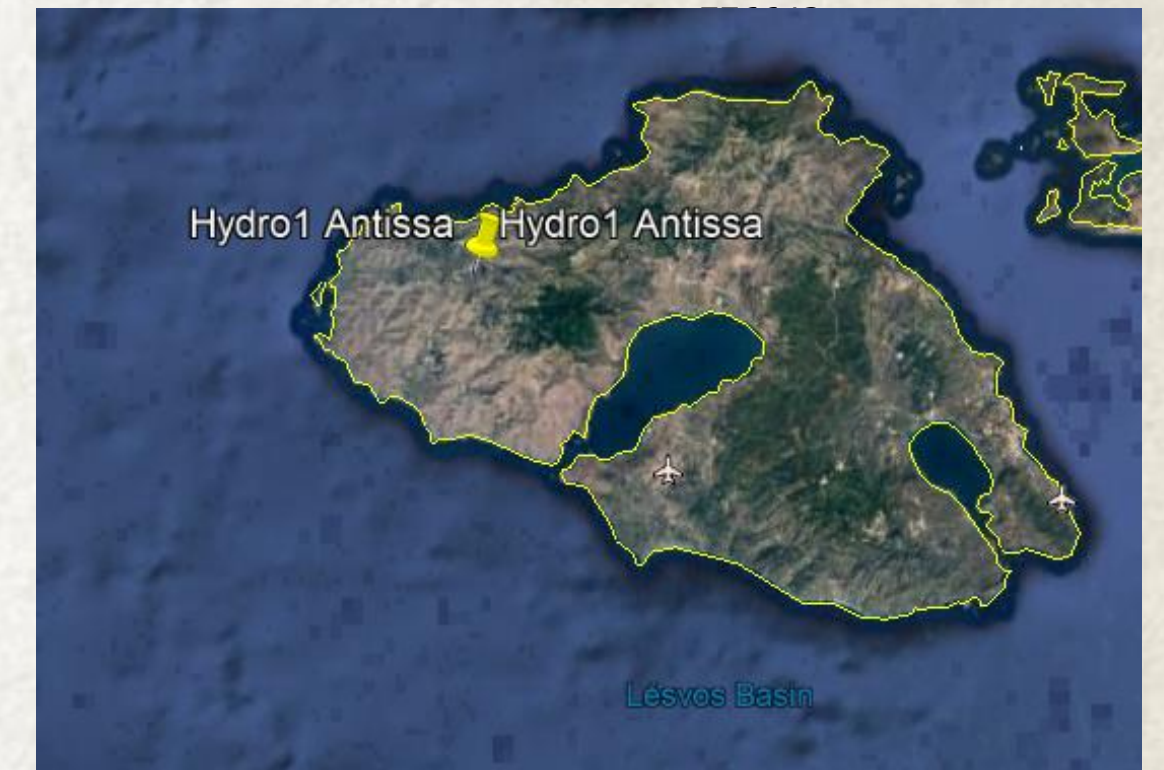
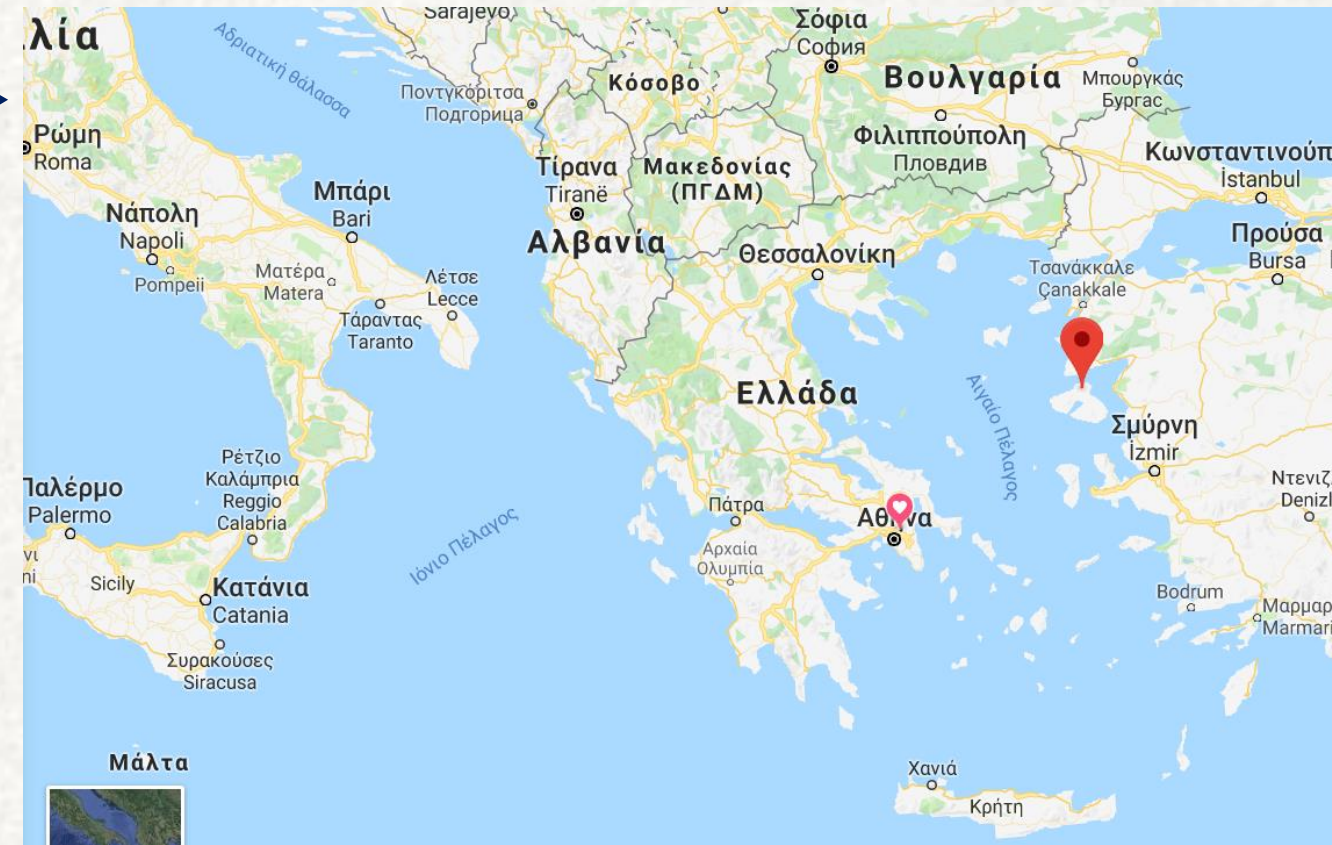
HYDRO 1 Antissa, Lesvos

Integrated UASB-CW treatment at community level



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Location



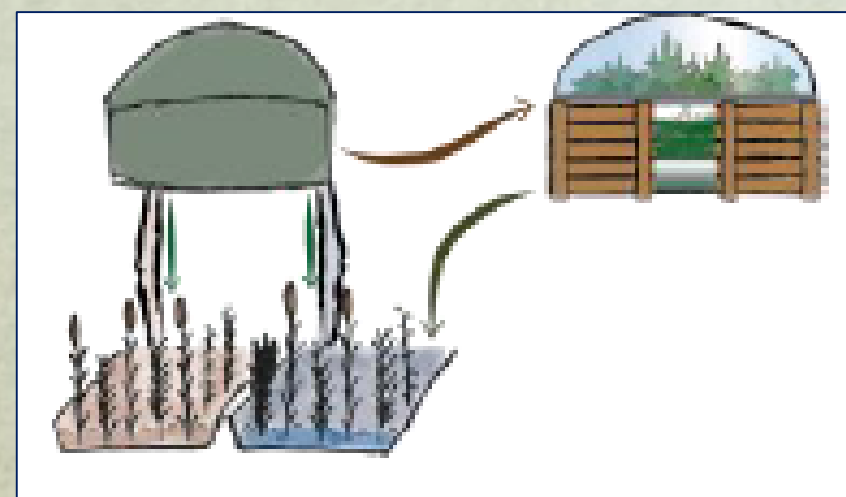
Biogas upgrade

UASB

Constructed Wetland

Filter and Disinfection

Agroforestry



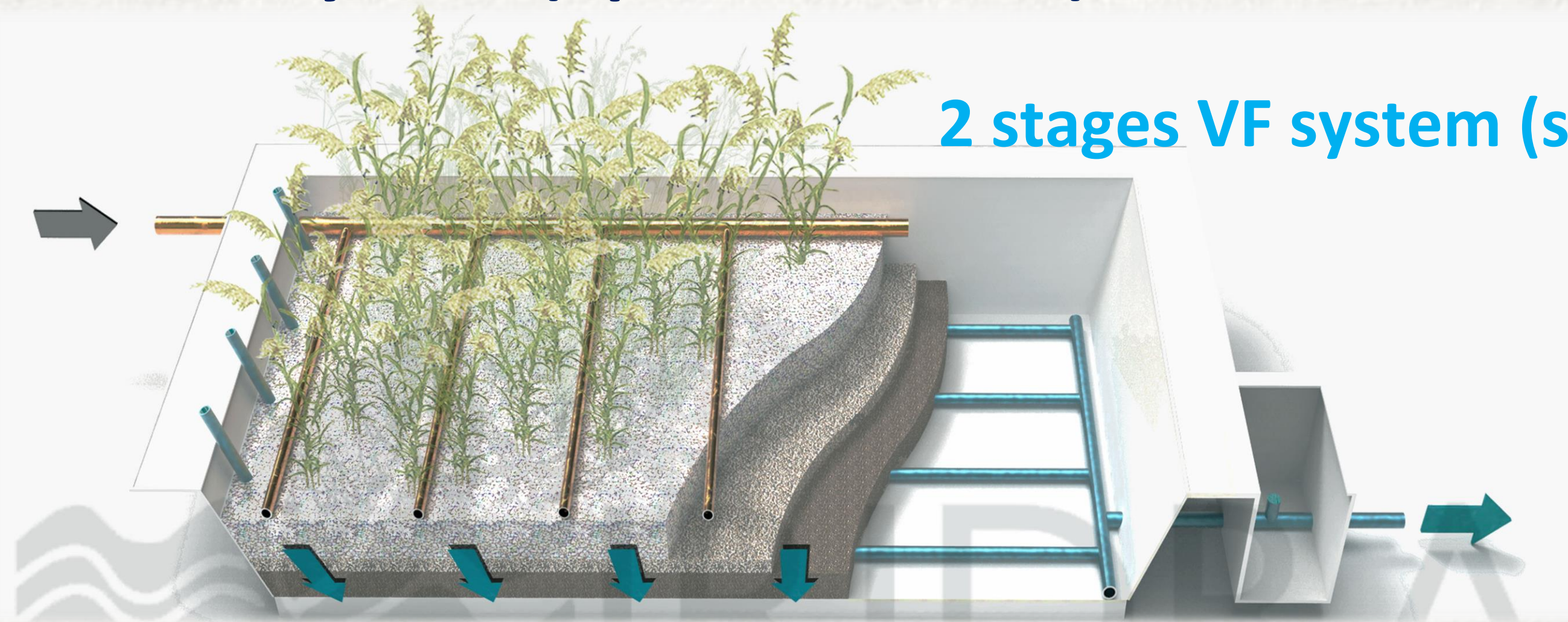


HYDRO 1 Constructed wetlands



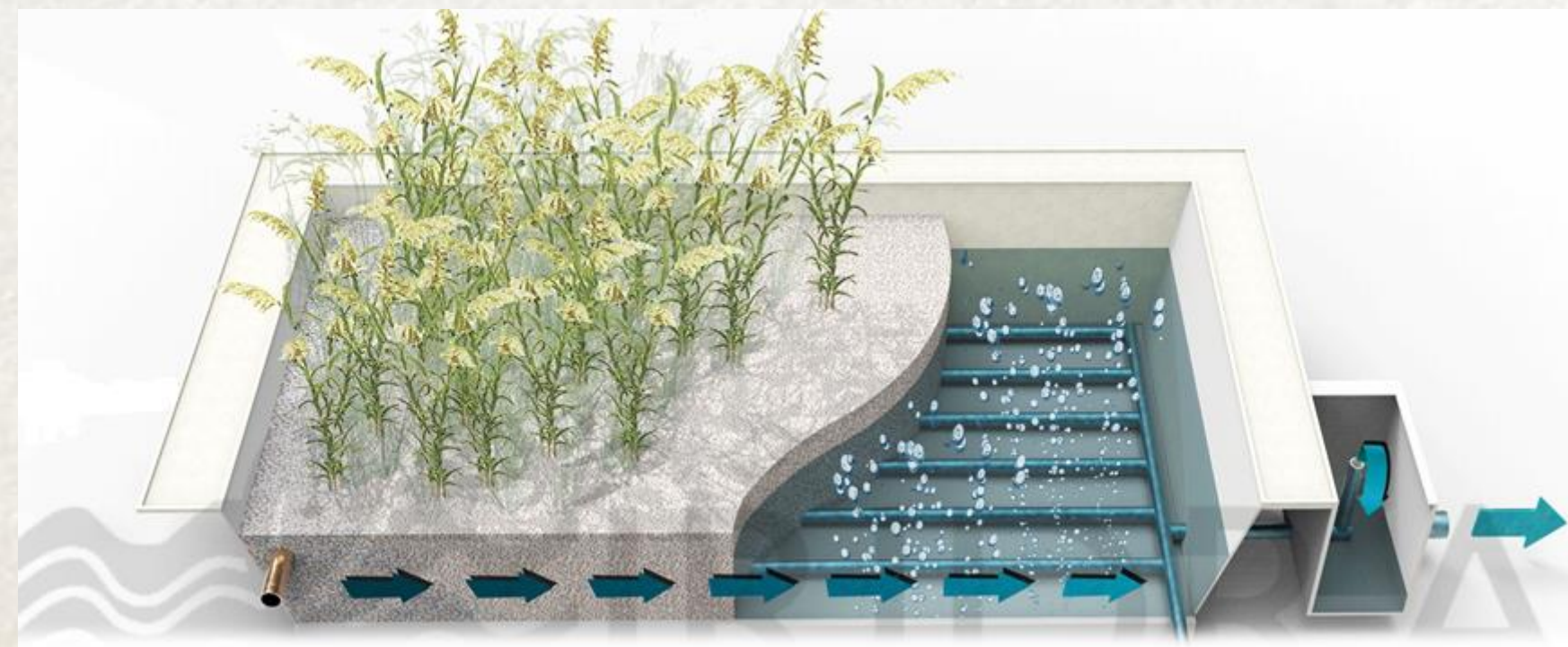
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Full scale system (up to 100 m³/d): Classical CWs

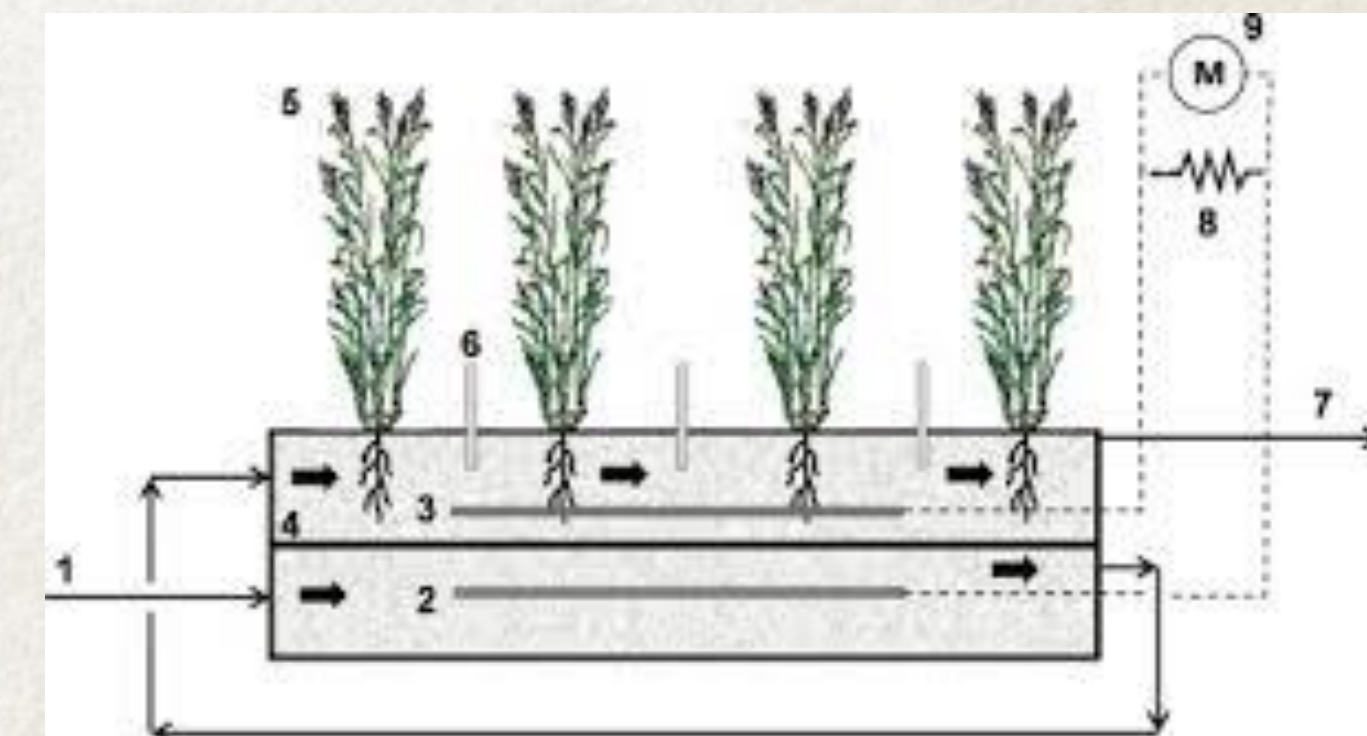


2 stages VF system (saturated+ unsaturated)

Pilot systems (1 m³/d): Intensified CWs



Aerated systems



CW-MFC





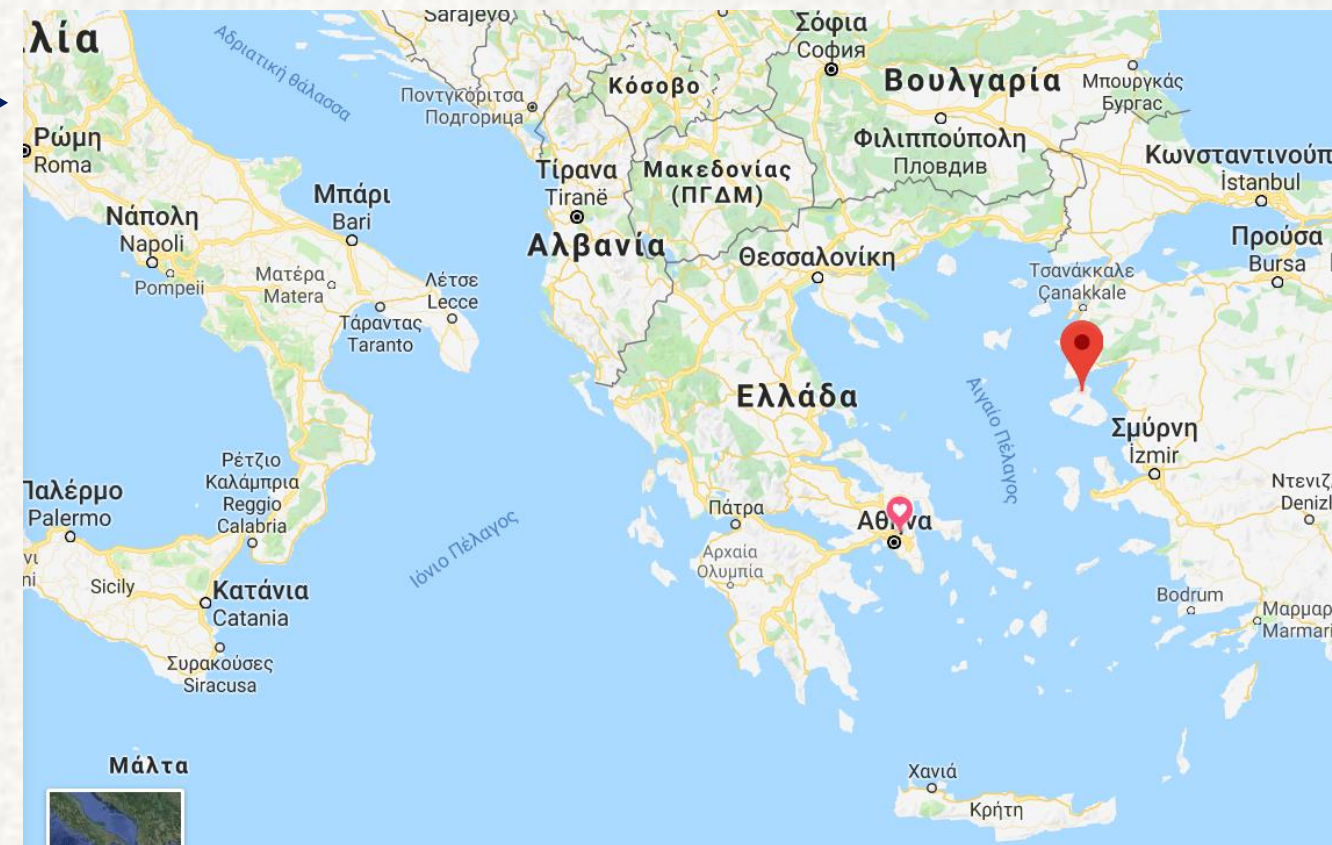
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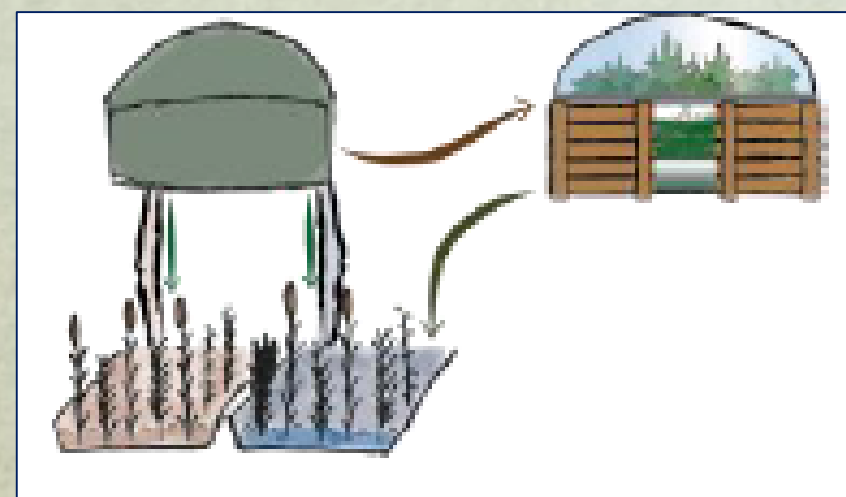
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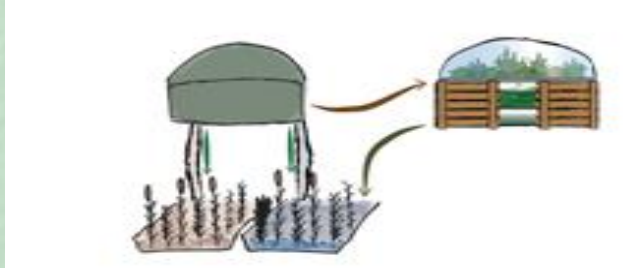
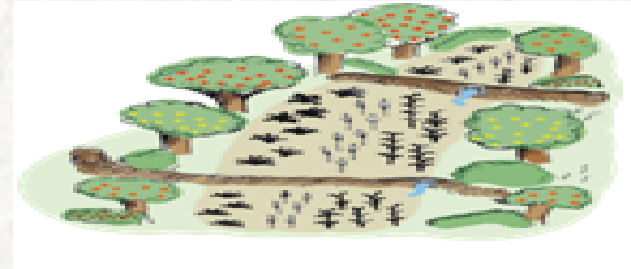
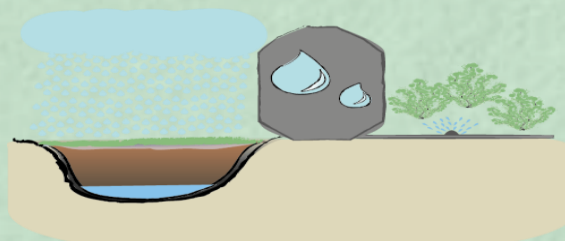
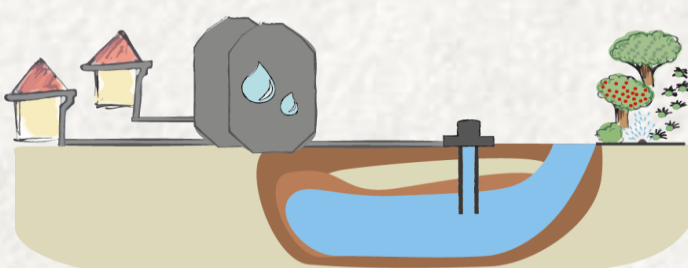
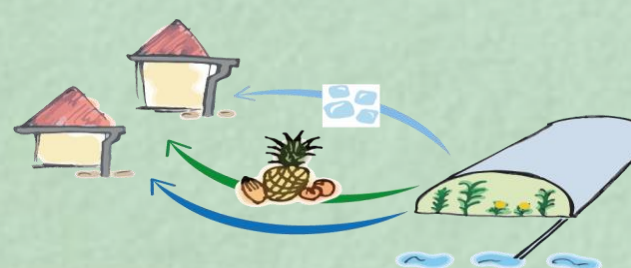
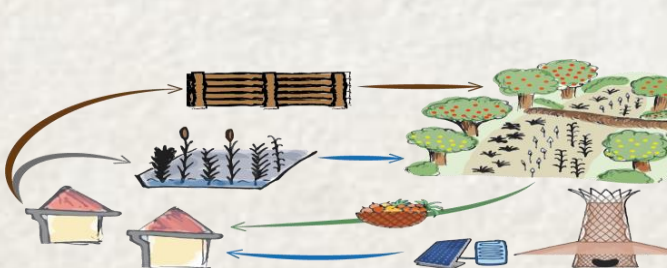
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HYDROUSA

DEMOSTRATION SITES

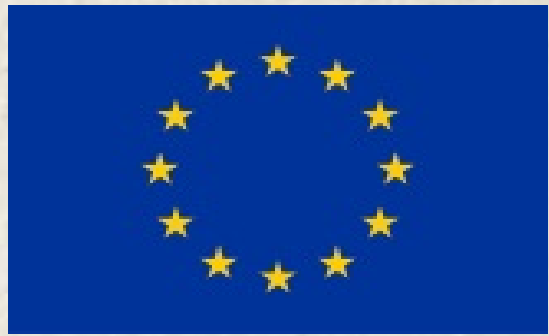


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HYDRO 2, Lesvos

Agroforestry site of Lesvos



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Community engagement and citizen science to adapt the design to regional circumstances



Co-creation Workshop in Antissa

- a. #30 participants (farmers, students, elderly, teachers, local authorities)
- b. Introduction of HYDROUSA to the local community
- c. input on designing the agroforestry system
- d. inputs on regional plants, old water catchment techniques, agroforestry's design



Interview with #8 local stakeholders



Old fencing technique on Lesvos



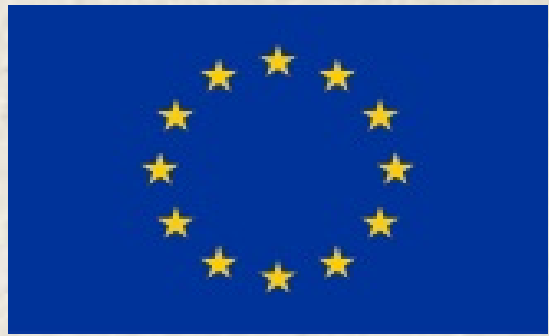


HYDRO 2, **Lesvos**

Agroforestry site of **Lesvos**

Agrobiodiversity in Lesvos – ethnobotanical studies

Preparation of agricultural sites



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Seabuckthorn



Pomegranate



Apple tree



Rosemary



Catnip



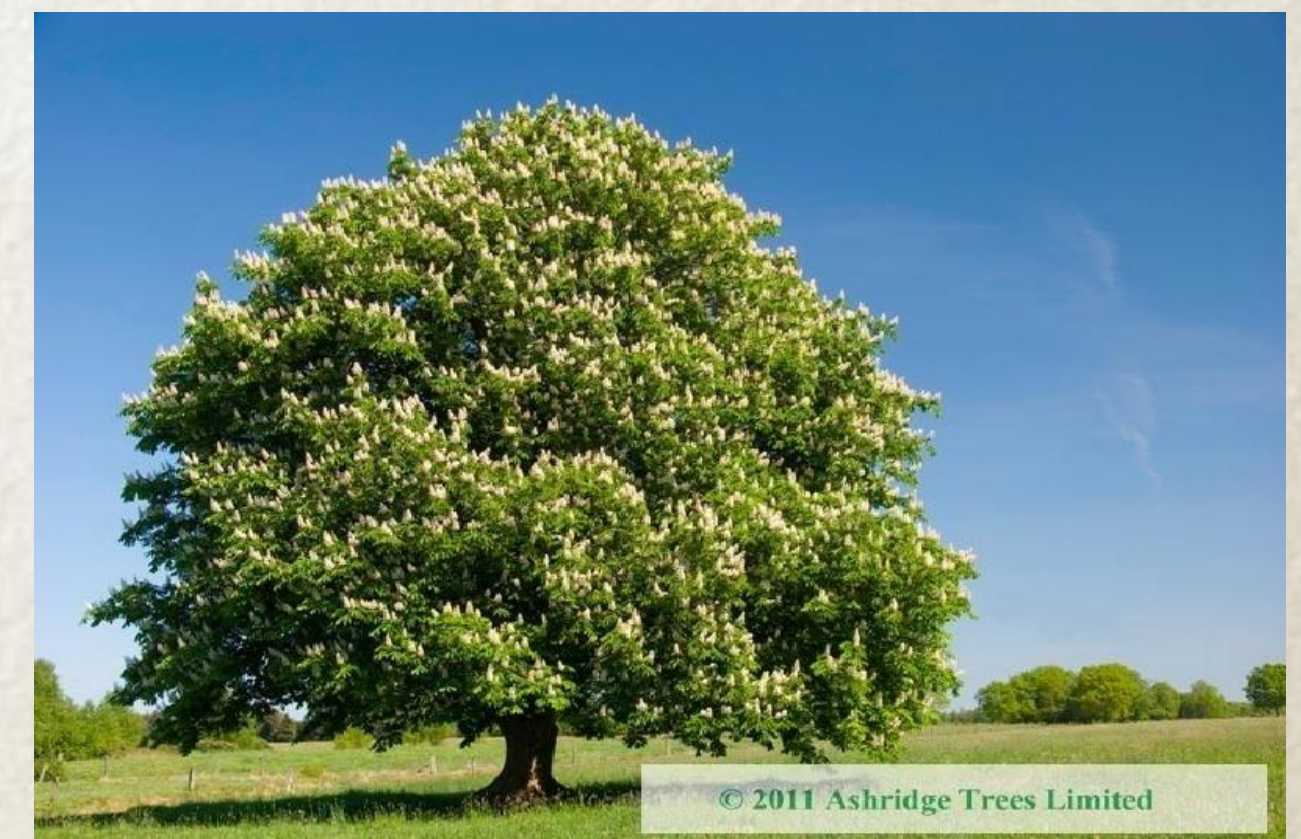
Mint



Quinoa



Camelina



Chestnut tree

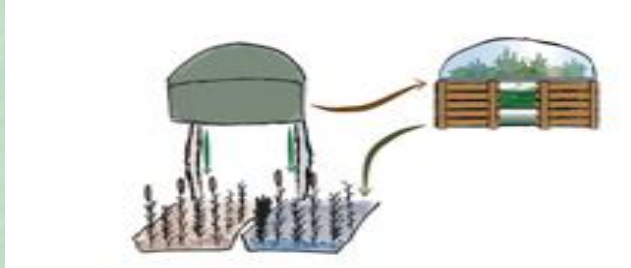
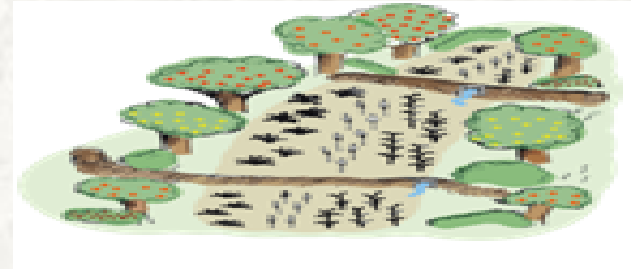
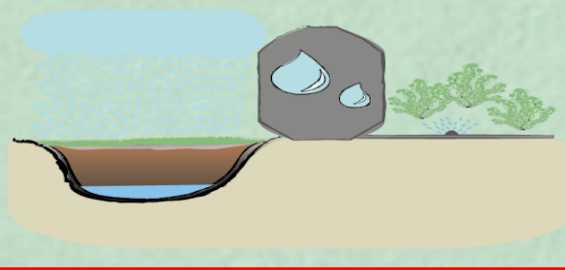
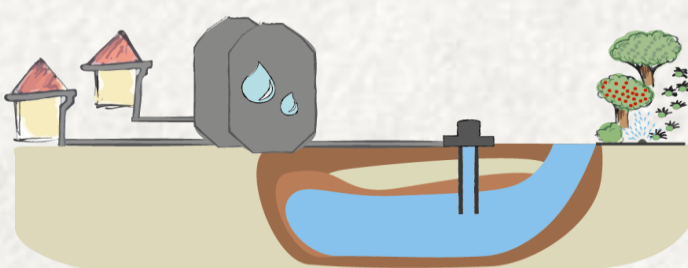
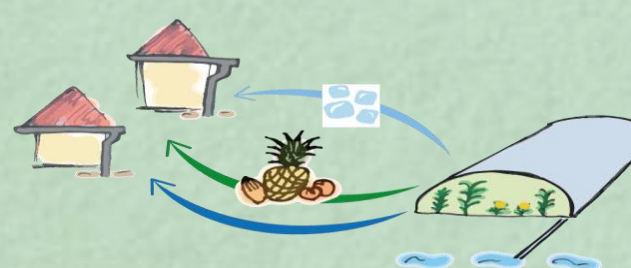
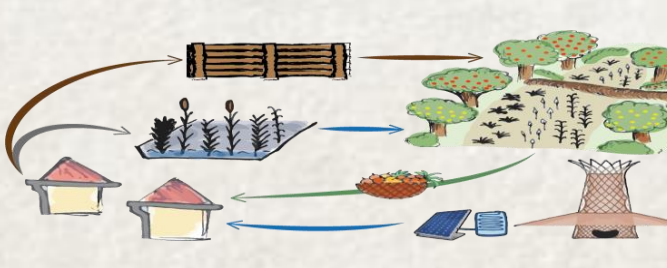
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HYDROUSA

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HYDRO 3 – Lia, Mykonos

Innovative rainwater harvesting system



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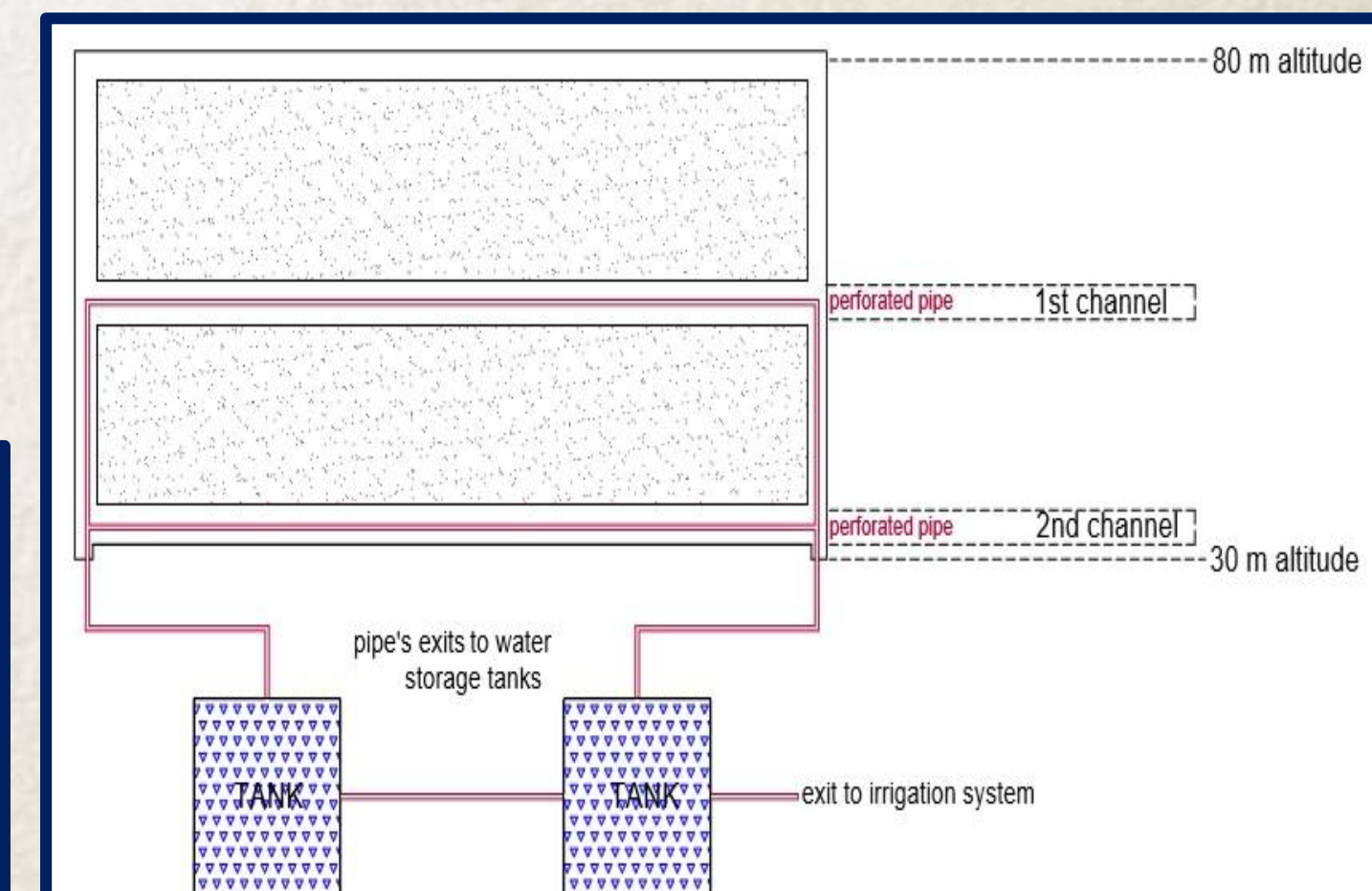
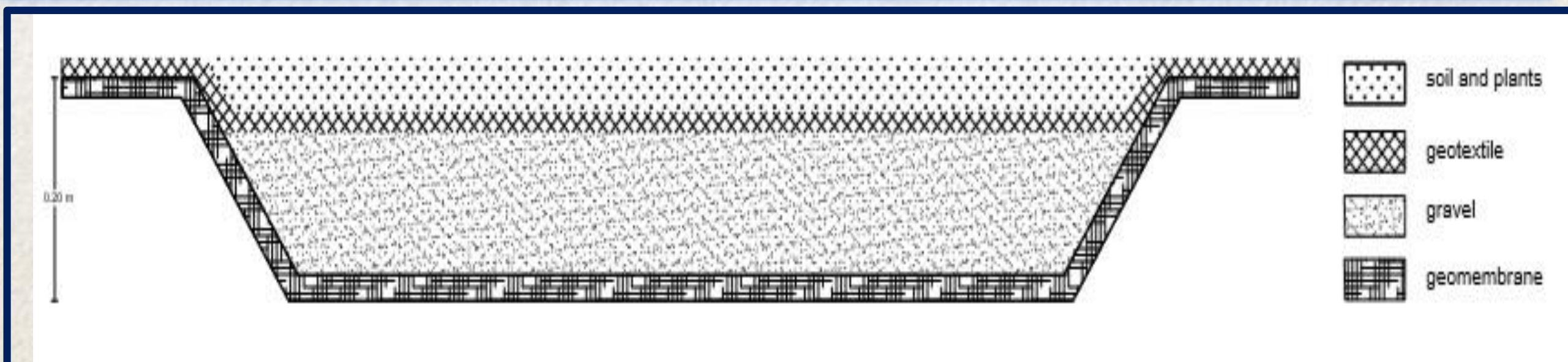
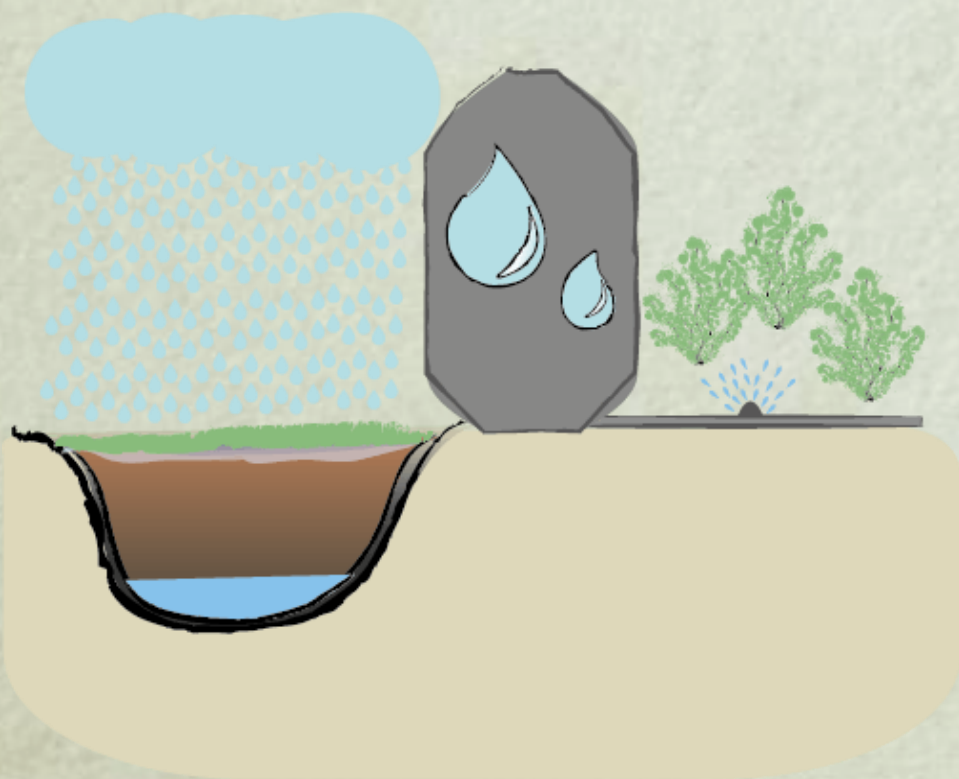
Shallow subsurface rainwater collection system in remote agricultural areas:

- **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

The rainwater collection system will cover an area of **200 m²**.

Rainwater use for the irrigation of **oregano**.

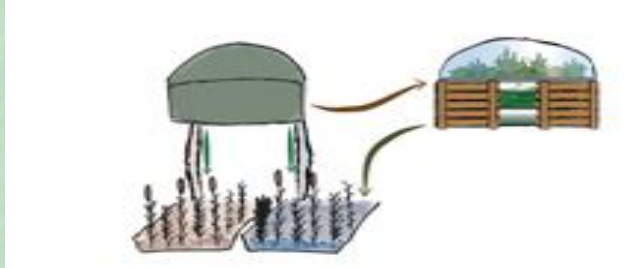
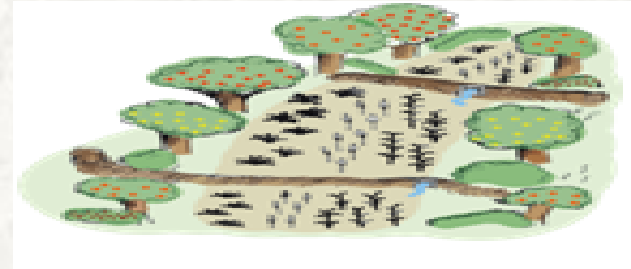
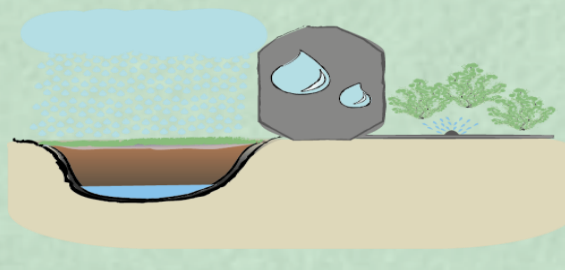
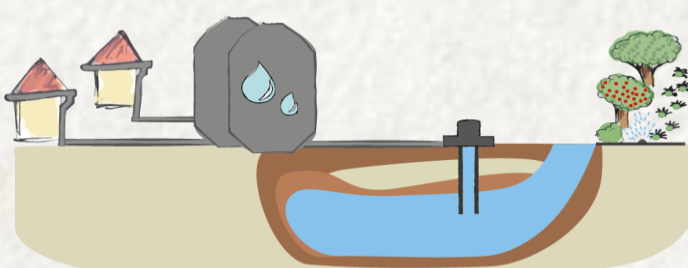
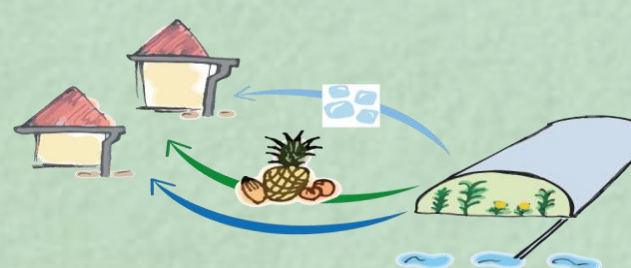
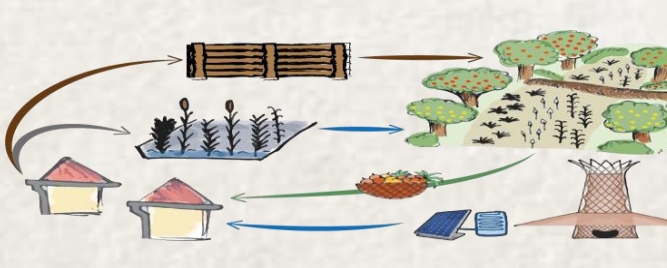
Applicable in remote areas with significant seasonal water pressures



HYDROUSA

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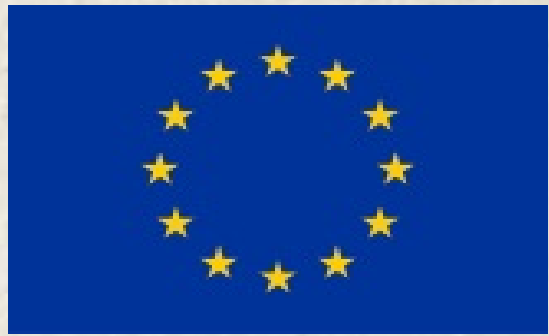


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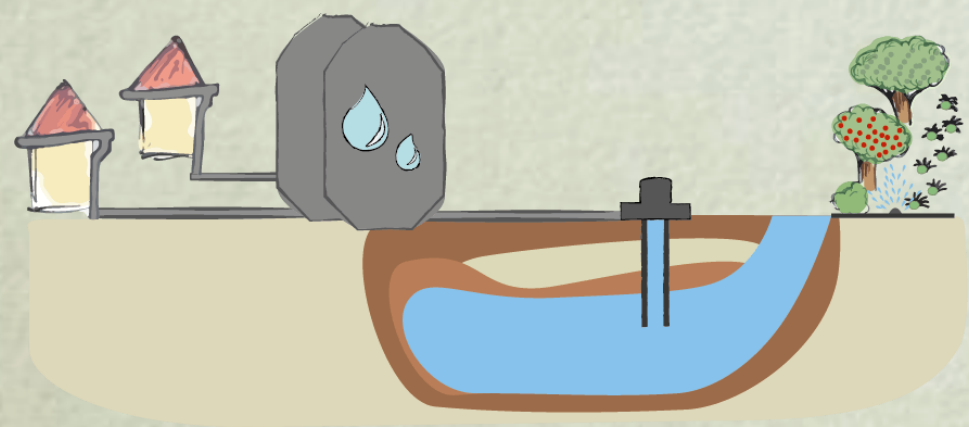
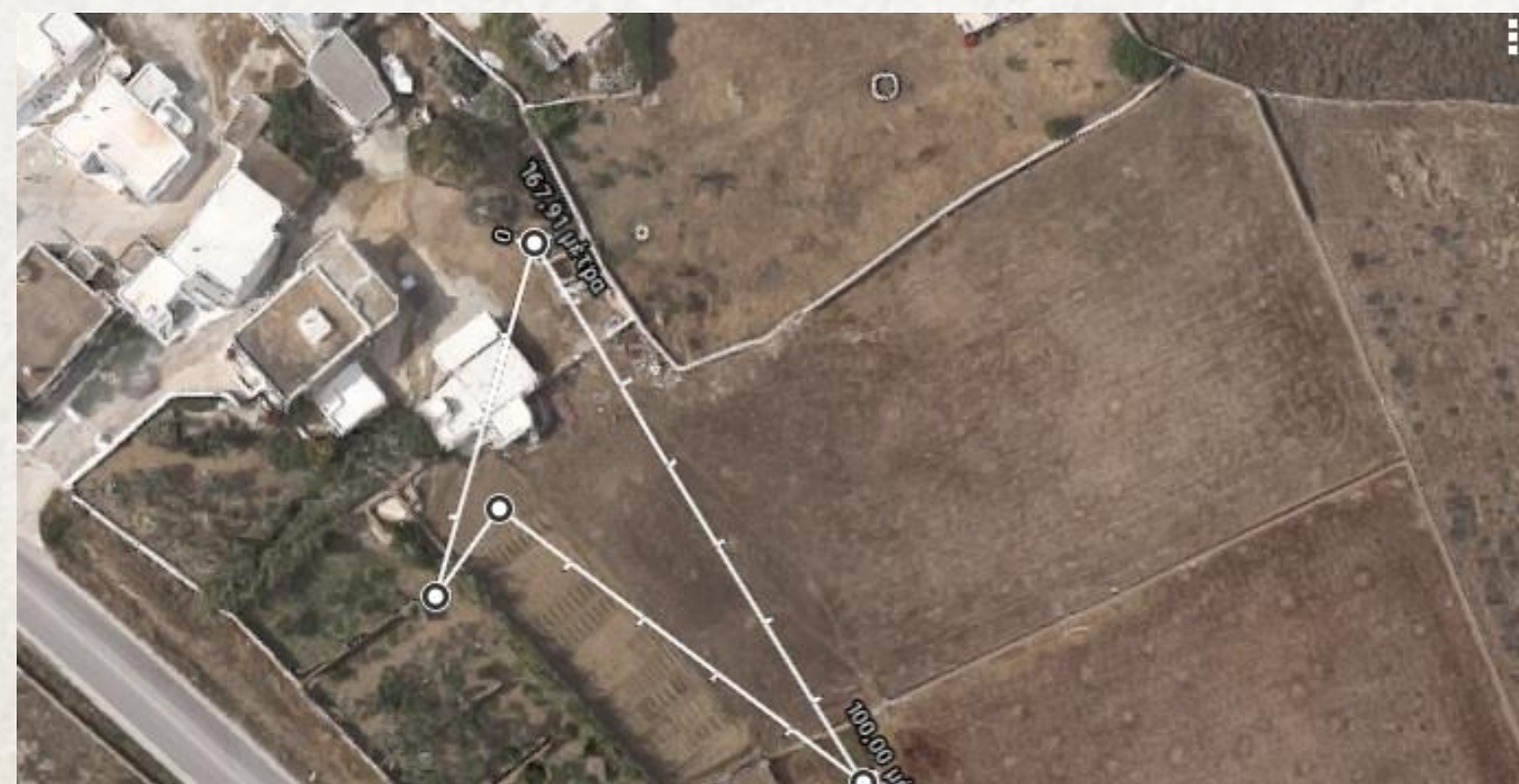
HYDRO 4 – Mykonos

Rainwater harvesting and aquifer storage & recovery system



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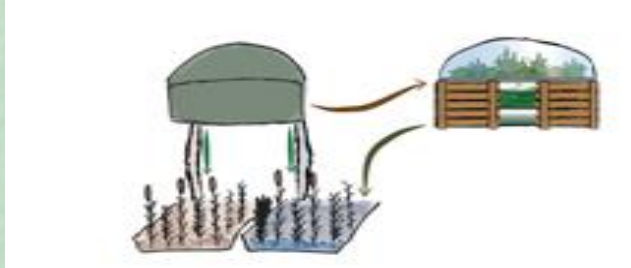
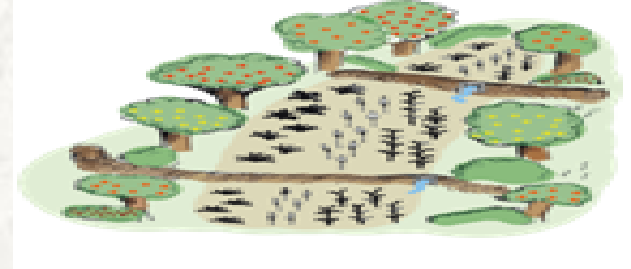
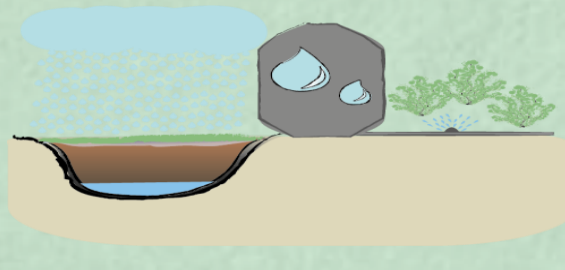
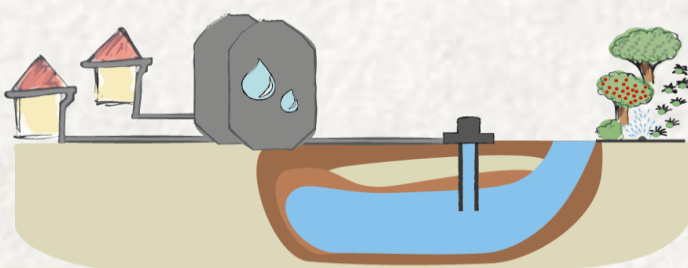
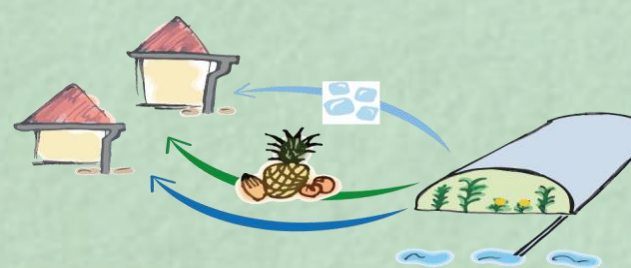
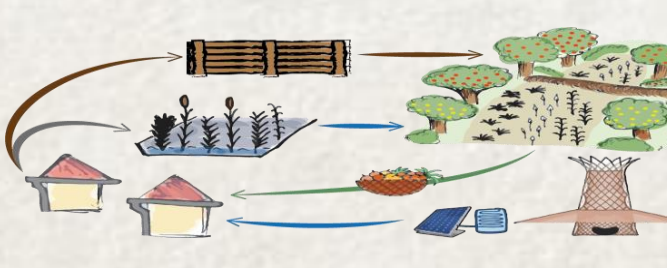
- Harvested rainwater from residential roofs will be reserved in existing tanks for domestic use
- Surface runoff from road will be collected, filtered and stored into existing tanks and into the aquifer
- To be used for irrigation purposes (**lavender**)



HYDROUSA

DEMOSTRATION SITES



Site	Scheme	Specification	Issue Solved
HYDRO1, Lesvos		Integrated UASB-wetland Anaerobic treatment & sludge composting, water reuse, biogas production	No wastewater discharge in 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



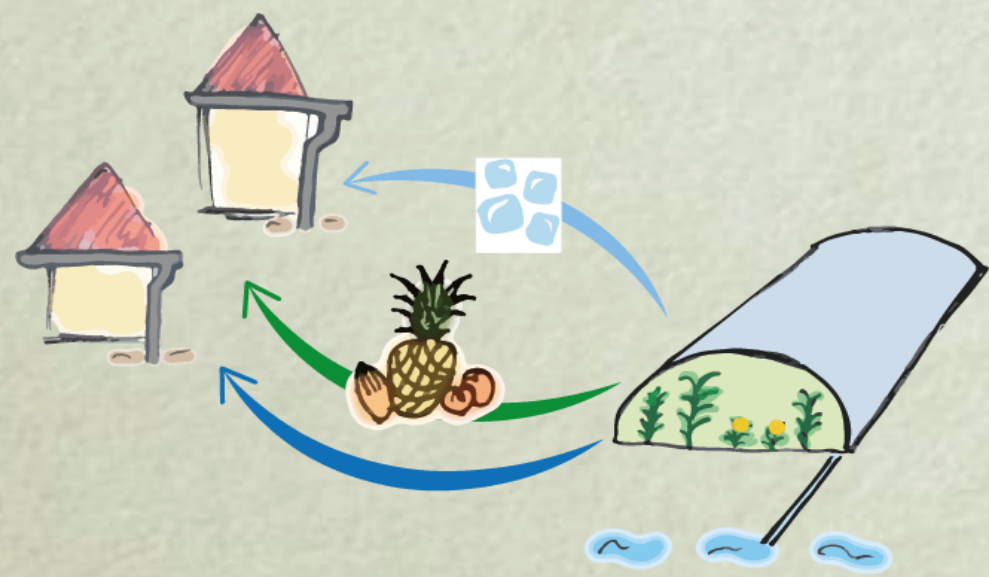
HYDRO 5- Agios Fokas, Tinos

Mangrove Greenhouse



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

- ✓ Modular Desalination system based on **solar still technology** (evaporation/condensation process).
- ✓ Inspired by the way Mangrove trees function
- ✓ Feed saline water from local Desalination Plant (seawater and brine)
- ✓ Production of **salt for commercial use**
- ✓ Production of **distilled water for land regeneration practices and food production in arid, semi-arid areas.**
- ✓ Optimize Integration with Greenhouse to produce **tropical fruits and other fruits/vegetables**



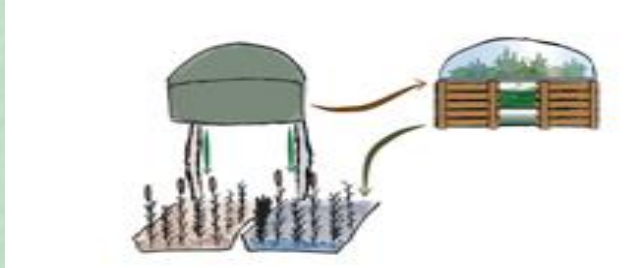
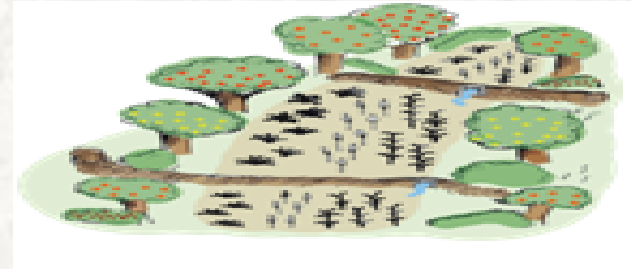
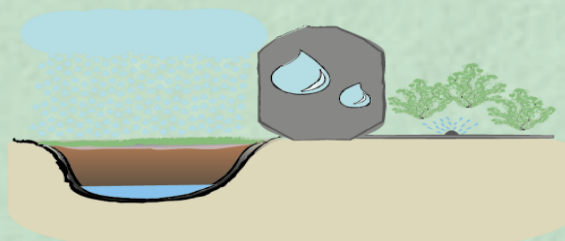
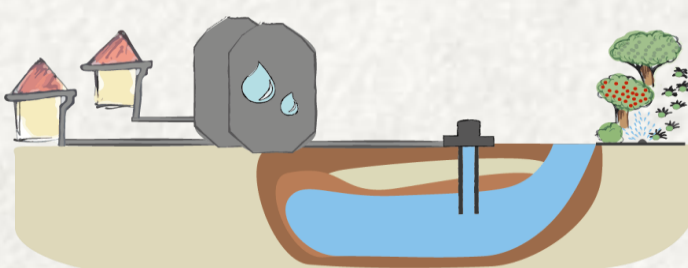
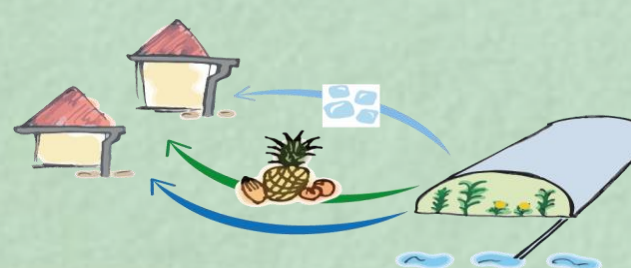
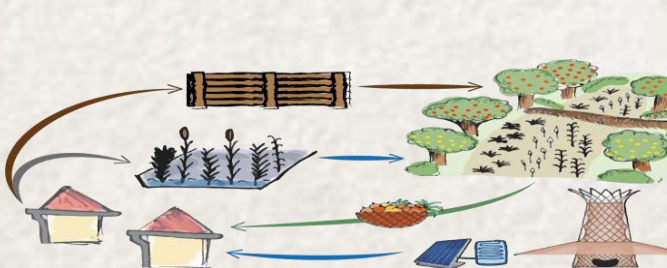
Initial pilot test in Cyprus
10 Desalination units

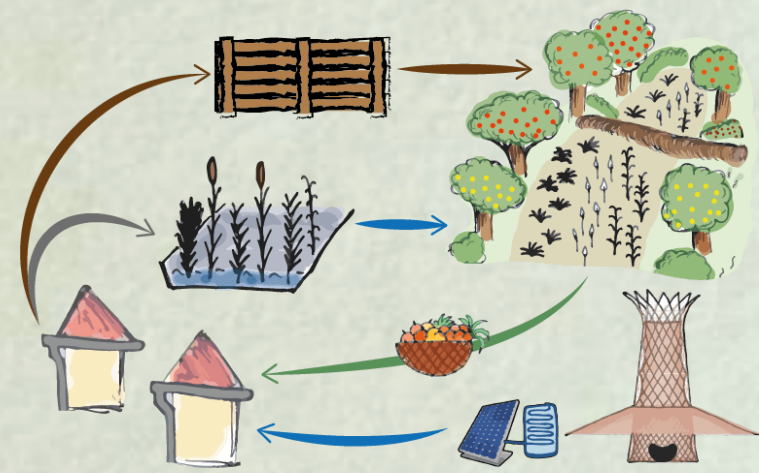
Current performance:
• 2.5-5 liter/day/m²

HYDROUSA

DEMOSTRATION SITES



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HYDRO 6 – Steni, Tinos

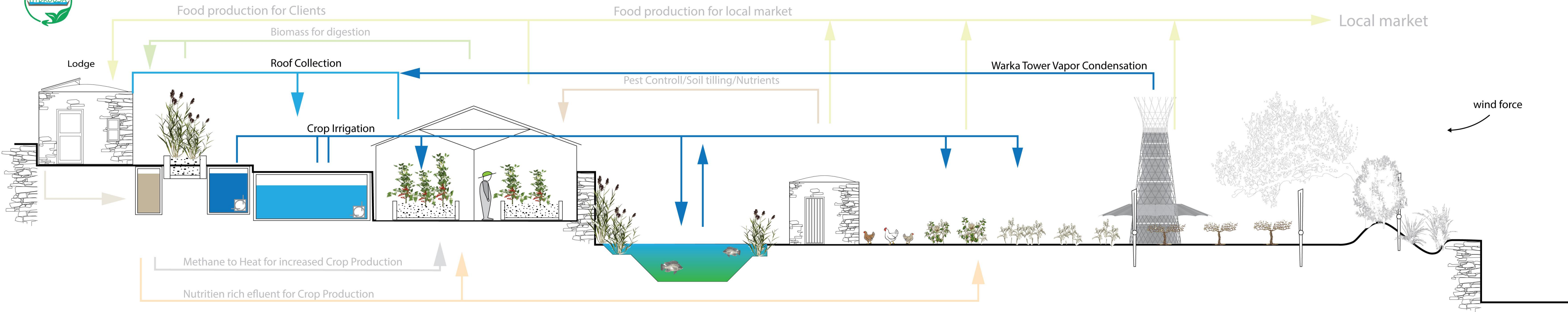
Water loops in eco-tourist facility

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



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Hydrousa: Rainwater catchment and storage



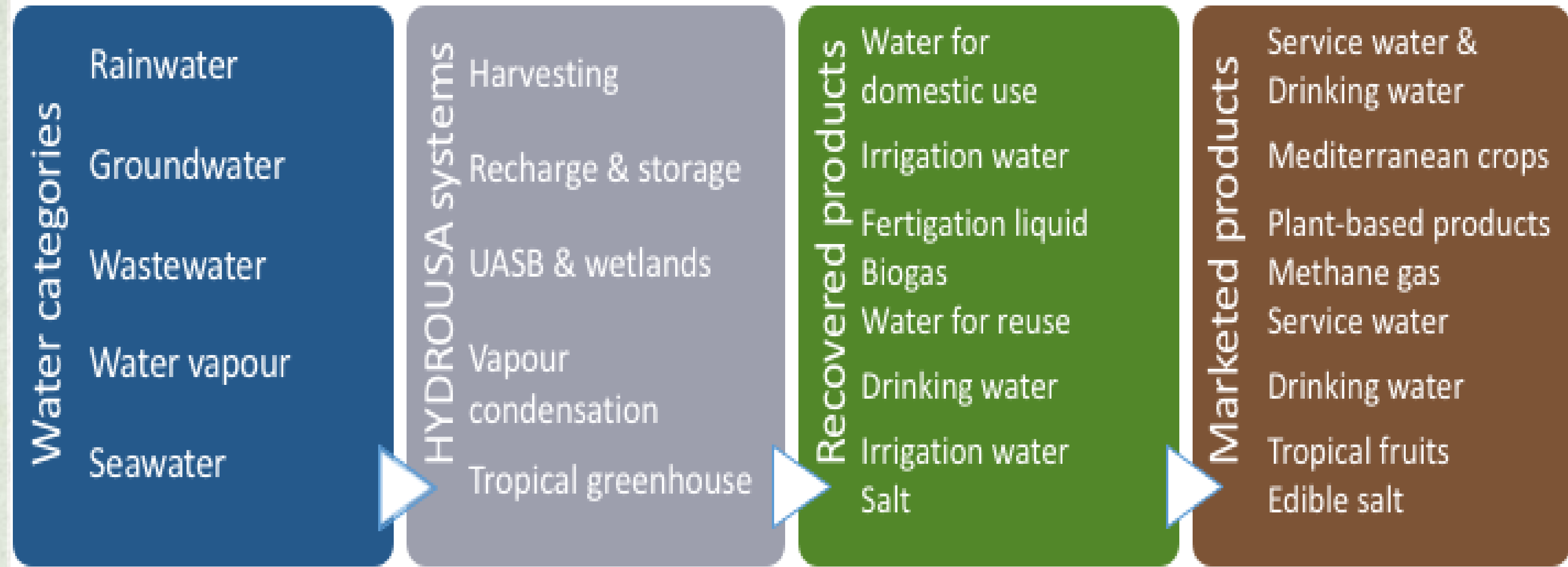
Sewage Water	Biodigester	Water Treatment	Treated Water Cistern	Rain Water Cistern	Greenhouse	Open Cistern/Pond	Chicken Coop	Artichoke P. & Caper plantation	Grape P.	Wind brake hedge Fog Catcher
	Produced Methane could be used for direct burning for heat or stored and transformed into electricity	natural system with excess production of biomass, could be used for biodigestion	water quality control by sensors, if quality low, repass 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 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.



HYDROUSA Project



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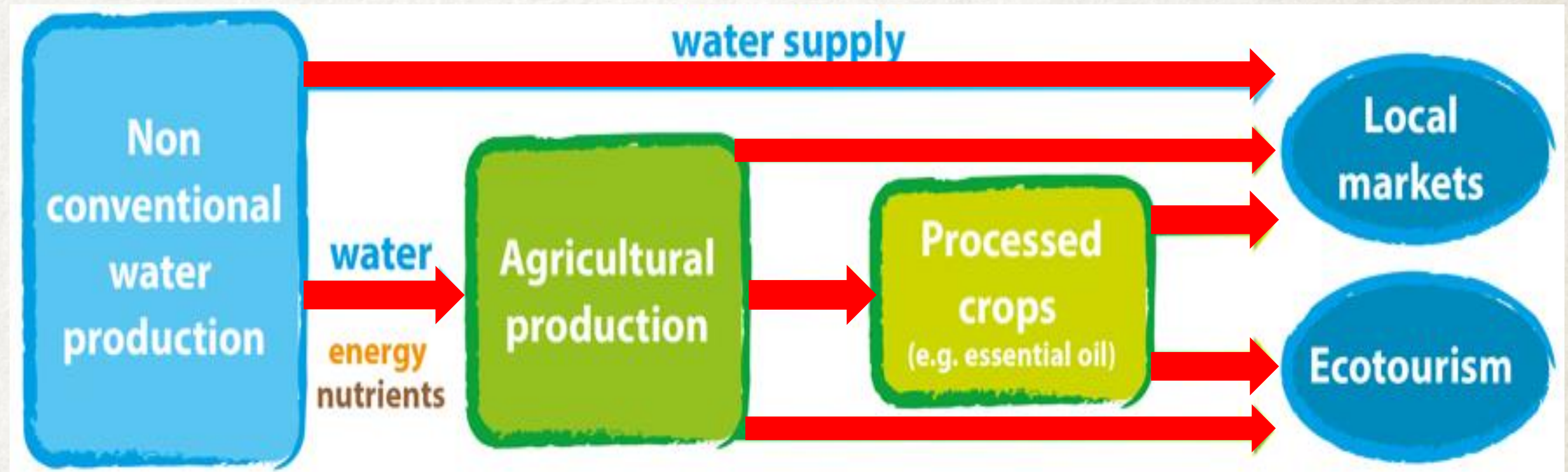
- ❖ Demonstrate the feasibility of **innovative, nature based technologies** to **recover** and **preserve** valuable materials and energy from different types of water
- ❖ Demonstrate **innovative supply chain** within the concept of the circular economy
- ❖ **Decrease water acquisition cost**

- ✓ 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



HYDROUSA

Overview and ICRA's role



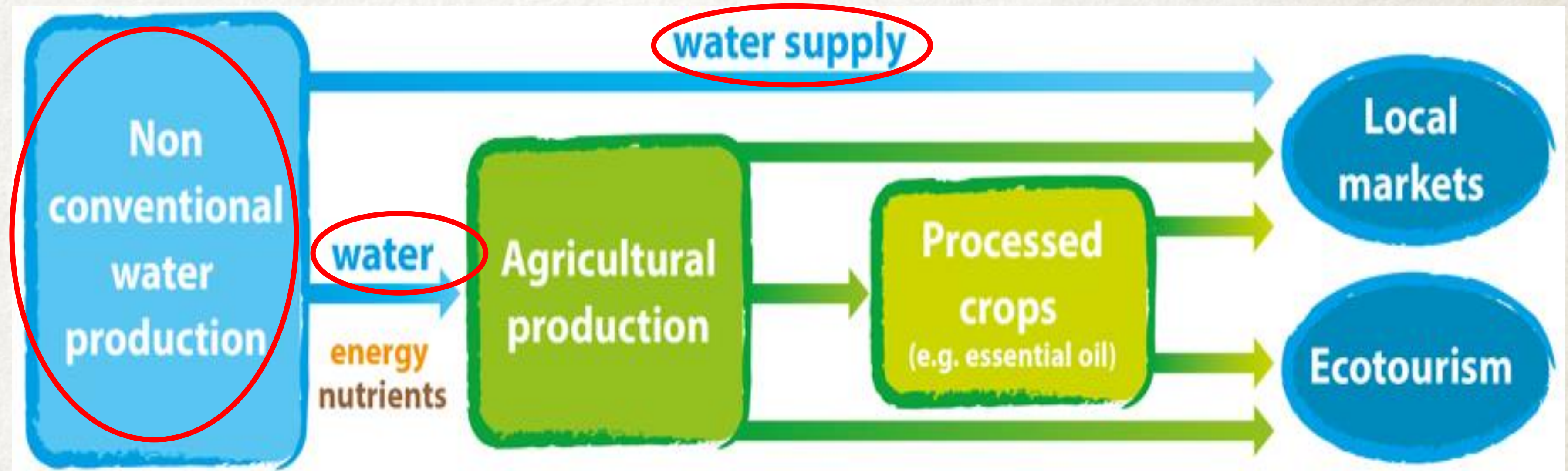
Pollutants monitoring

Analyses **along the water cycle** of selected **micropollutants** including some from:

- agricultural origin (pesticides)
- industrial origin (e.g. bisphenol A)
- wastewater derived origin compounds (pharmaceutical, including antibiotics, and personal care products), Watch List (Decision 2015/495).

HYDROUSA

Overview and ICRA's role

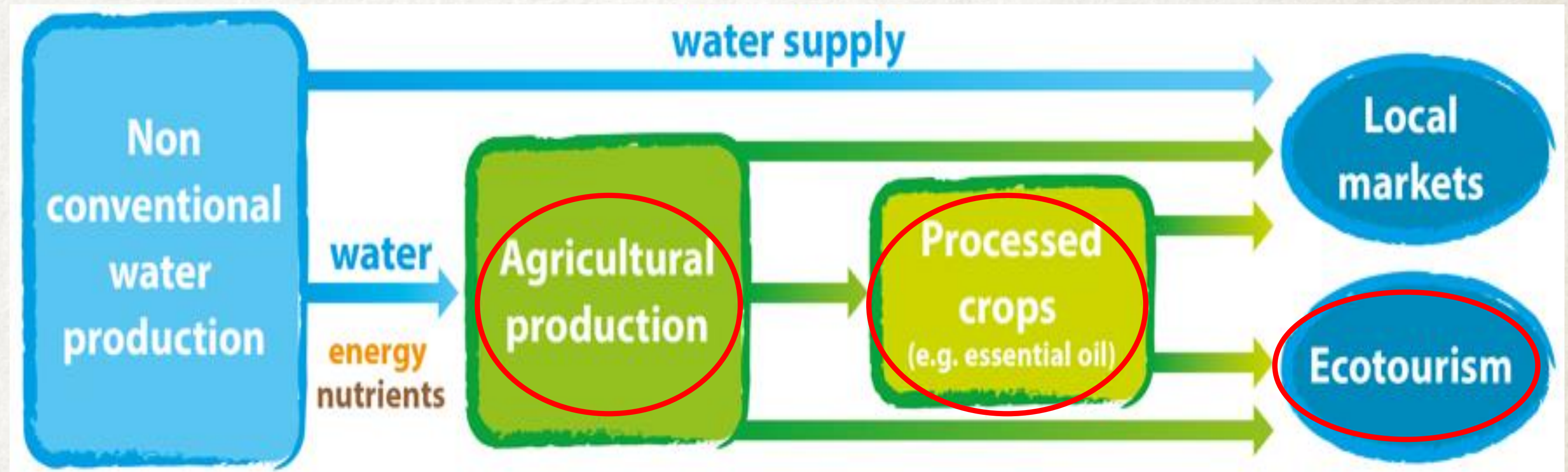


Pollutants monitoring

- ICRA will **evaluate the performance of the solutions** and its variability between season, once reached stable conditions.
- ICRA will **identify the most adequate reuse train,**

HYDROUSA

Overview and ICRA's role

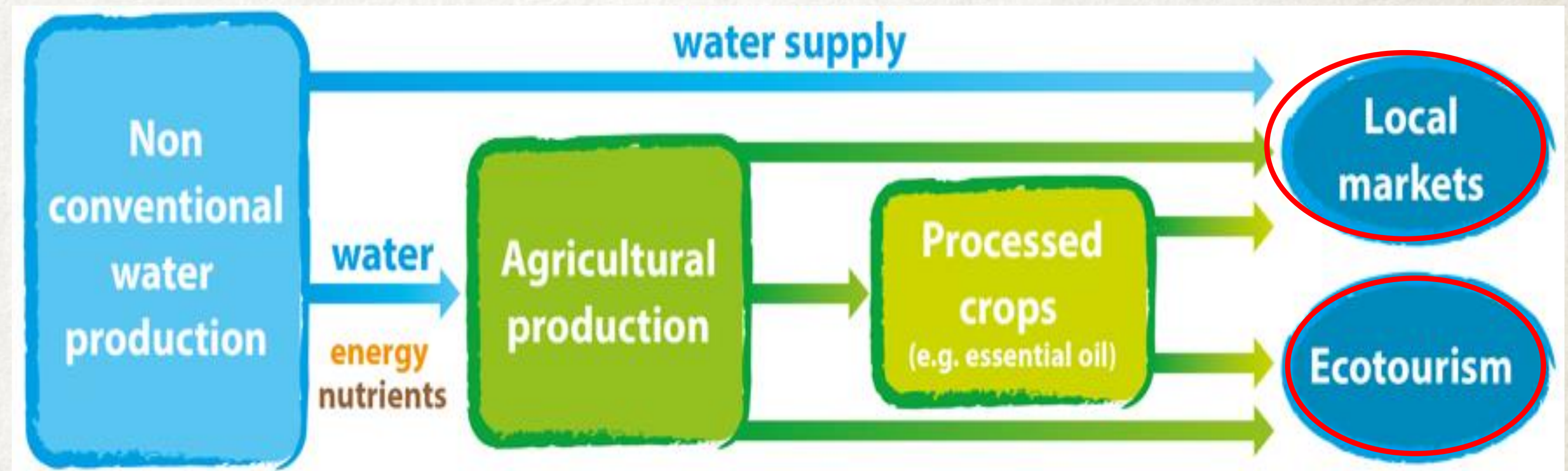


Pollutants monitoring. Food safety and pest control.

- Selected organic **micropollutants compounds** with high likelihood of contaminant uptake in the **edible part of the plants**.
- ICRA will also evaluate bacterial **antibiotic resistance in the soil**

HYDROUSA

Overview and ICRA's role



Pollutants monitoring

- apply **environmental risk assessment**
- evaluate **food safety issues**.
- **suitability** of the corresponding **water reuse application**



The main objective of HYDROUSA is to offer a set of regenerative solutions for real problems that are easily adaptable and replicable to other possible circumstances around the world.

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HYDROUSA replication sites

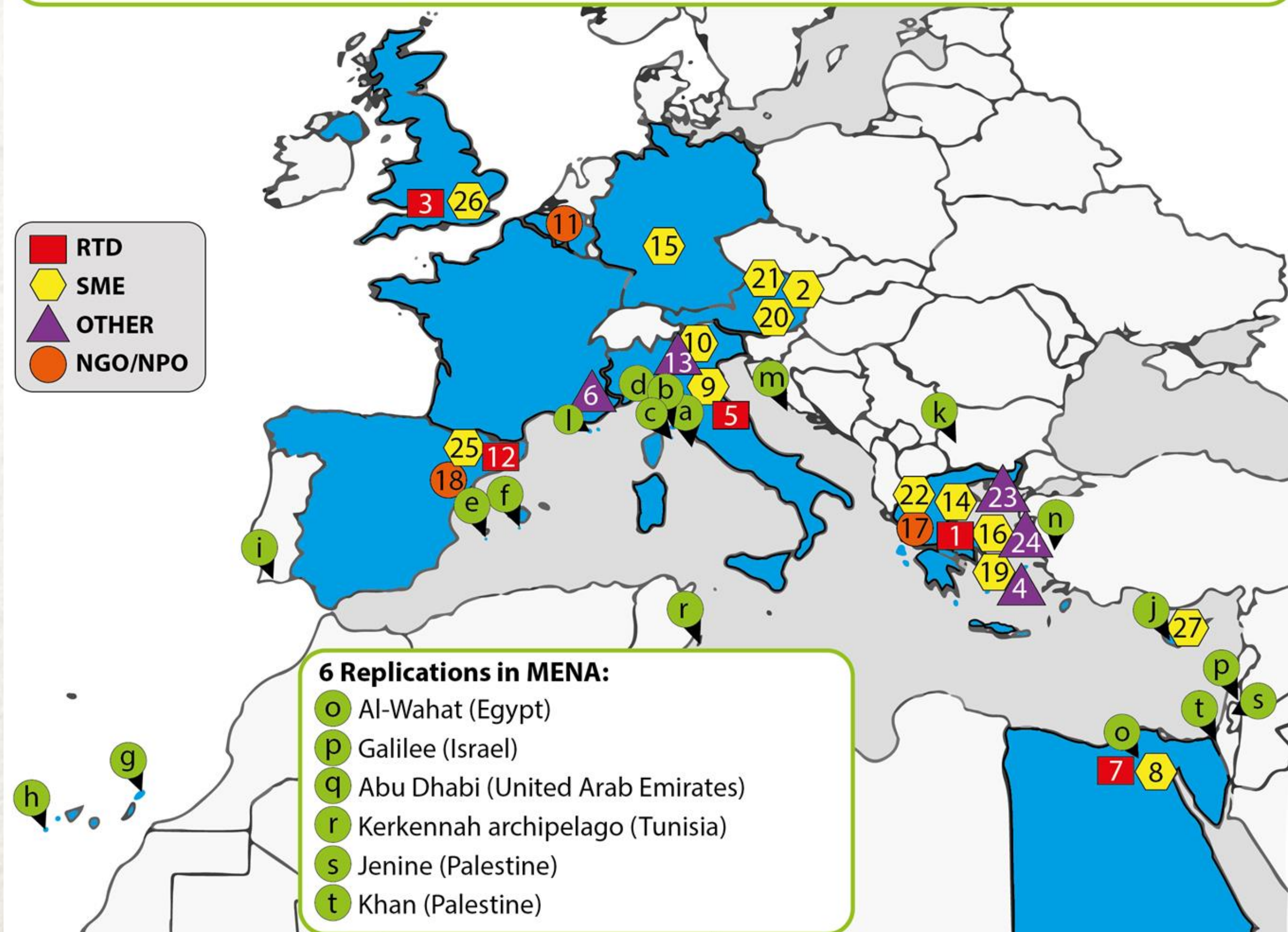


14 Replications in Europe:

- | | |
|------------------------------|--------------------------------|
| 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)





<https://www.hydrousa.org>

Thank you



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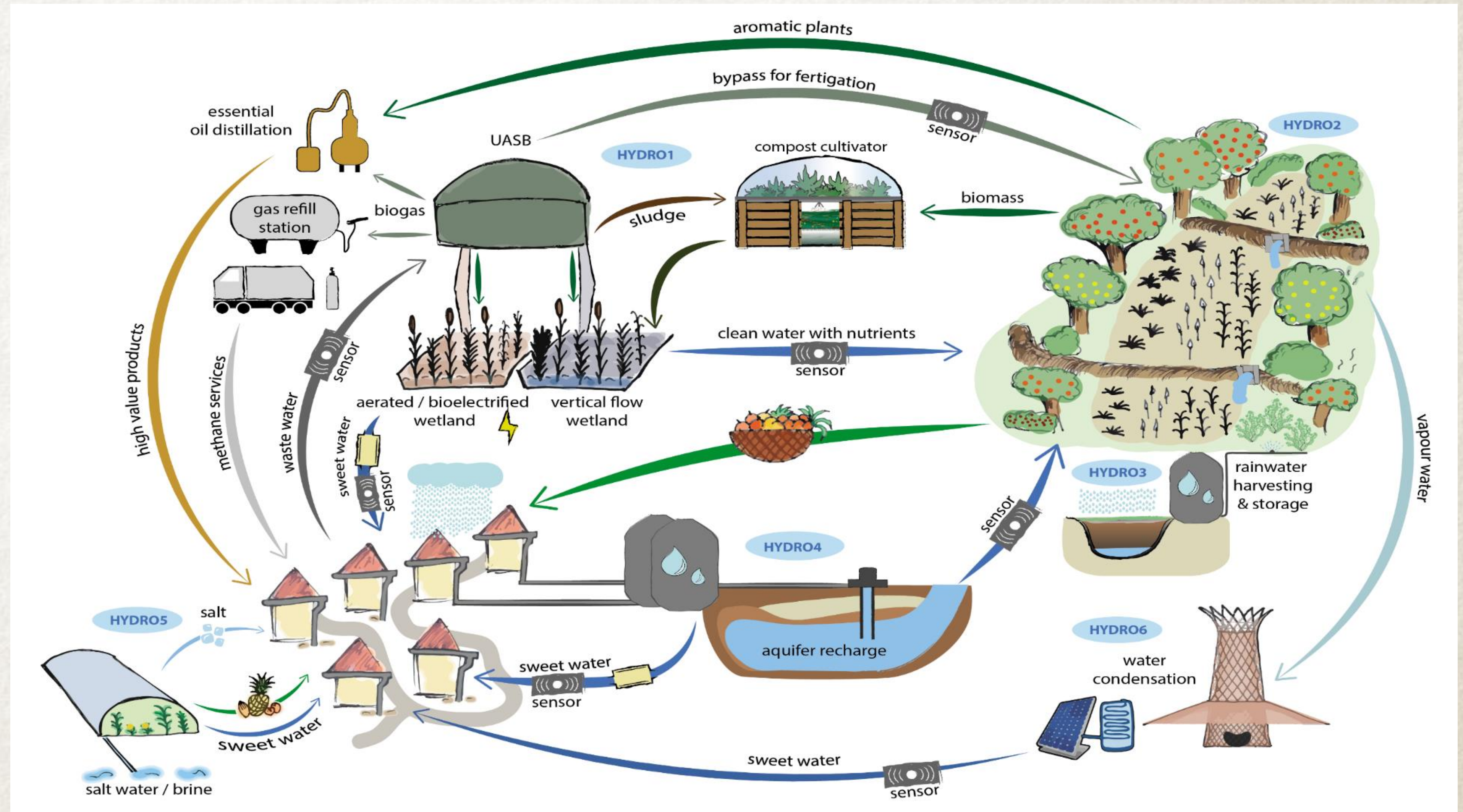


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HYDROUSA IN ONE PICTURE



Circular Approach