Project coordinator: BIOAZUL S.L.

Funding programme: H2020

Duration: 30 months (February 2016 – July 2018

Budget: ca. 2.1 M€

RichWater

First application and market introduction of combined wastewater treatment and reuse technology for agricultural purposes

Context

In recent years a growing concern has been expressed throughout the EU regarding water scarcity and the significant impacts on water resources by agricultural activities. Overabstraction of water from surface and groundwater bodies is a significant pressure in some areas of Europe and may be driven by wider problems of scarce water resources and increased by climate change. Especially in Southern Europe, water scarcity already leads to severe conflicts between different water users. In some Mediterranean areas, irrigation water is estimated to account for up to 80% of total water abstraction. Besides the difficulties regarding freshwater, the European agricultural sector is facing serious issues strongly linked to other exploited resources such as nutrient availability, the concurrent growing demand for food and biofuels and an increase of extreme weather events due to climate change.

Simultaneously, huge amounts of nutrient-rich wastewater run untreated and unused in our surface water bodies causing environmental damages (e.g. eutrophication or groundwater pollution) and health risks. Wastewater has a huge fertigation potential in agriculture. However, due to strict health regulations only a small part of all produced municipal wastewater in Europe is used for irrigation in agriculture (in Spain only about 20% of the total treated wastewater amount). One of the major problems in Southern Europe is the fact that many water scarce regions are producers of water rich products such as vegetables and fruits. Therefore, the re-use of “reclaimed water” (i.e. treated wastewater) can be an alternative water resource for agriculture. Several highly innovative water solutions focusing on water reuse in agriculture are under development. The technology presented here, RichWater, is an ugpraded technology from the Treat&Use system, a successful EU research project (FP7) approaching the safe and economic reuse of wastewater in agricultural production (GA no. 311943).

Project objectives

The main objective is the successful market entry, commercialization and replication of the RichWater system in water scarce regions in Europe and the MENA countries. This objective will be reached by developing and following a business plan, which includes a market strategy as well as the validation within the EU Environmental Technology Verification (ETV) Pilot Programme of a ready-to-market RichWater system (150m³/day) for the energy-efficient, sustainable and safe application of treated wastewater for irrigating different fruit trees and vegetables (market reference). In addition to other marketing activities such as the IP protection plan, visits to the demonstration-site, promotion workshops for clients, the project aims for the development of local PPP models between wastewater treatment plant operators (WWTPOs) and food producers.

General Objectives:

- Supporting SMEs to develop green economy products and boost economic growth and job creation in EU by uptaking Treat&Use results and development a commercial treatment and reuse near-market prototype
- Rich Water's market introduction in the wastewater treatment sector in combination with the farming sector (especially in the greenhouse part) in Spain, Italy and Greece and later worldwide.
- Establishment of the safe and economic reuse of wastewater in agricultural production as an sustainable and accepted method in the EU-28
- Assessment of potential benefits and risks of the near-market prototype for the environment and human health
- Tackle pre-commercialization challenges by developing competitive marketing and finance strategies
- Reduction of freshwater and fertilizer consumption in water scarce areas of the Mediterranean
- Reducing the environmental impacts of untreated wastewater (eutrophication)

Specific objectives:

- Up-scaling and long term demonstration of a modular ready to market wastewater reuse system (min. 150 m^3/day) producing a pathogen-free (99% of E.Choli removal) and nutrient-rich effluent (presence of N,P,K according to crop needs)for direct application in a real fruit and vegetable production-site in a water scare region (Eastern Spain)
- Reaching low energy costs for water treatment (max. 1 kwh/m3)
- Recovery and recycling of pathogen-free water from wastewater resource in agricultural production (Nearly 100% recovery rate)
- Recovery and recycling of nutrients from wastewater resources (i.e. 80 % recovery rate of nitrogen and 68 % of phosphorus in the effluent)
- Reaching compatibility of the system's modules with the RichWater Irrigation Management software to apply individual and pin-pointed fertigation influx for farmers
- Tackle market entrance barriers by standardisation and certification of the modules(within the ETV pilot Programme), compliances with regulatory issues (e.g. health), new finance and business models (PPP, B2B), in depth market assessment and business plans for Spain, Greece, Italy and the MENA region
- Strengthen the economic competitiveness of the participating SMEs and the targeted wastewater treatment plant operators and farmers (increased turnover by 15-25 % and cost savings of 20 %)
- Support the implementation of related European legislation (Water Framework Directive'(2000/60/EC), the Urban Waste Water Treatment Directive (91/271/EEC), the 'Scheme for Fertilizers' (EC2003/2003)'Pollution caused by nitrates from agricultural sources' (91/676/EEC).

RichWater technology

RichWater entails an innovative water solution focusing on bridging the gap from the prototype stage to a commercial version. The RichWater approach is a highly promising method to save freshwater and fertilizers in agriculture by treating municipal wastewater, reusing it for irrigation purposes whilst keeping valuable nutrients in the effluent. The RichWater system is based on a new groundbreaking system combining low-cost and energy efficient MBR treatment, a module for mixing the optimal fertigation water connected to the up-to-date irrigation technology and an advanced monitoring /control module including soil sensors to guarantee demand-driven and pathogen-free fertigation. Implementing the

system in the agricultural production process results in a more eco-friendly use of water resources, cost savings for freshwater and fertilizer and the possibility for commercial food producer to adjust the fertigation unit for individual needs using a mixture of fresh and treated water.

A low energy MBR has been designed for the wastewater treatment module in a way that the contained nutrients (mainly nitrogen and phosphorus) remain after the treatment whilst pathogens are removed. The mixing station mixes the appropriate proportion of freshwater and the treated wastewater coming from the MBR, which is then fed into the fertigation module (drip irrigation). The appropriate mixing level is determined by monitoring the level of nutrient content in the soil via sensors; this information is sent by remote control to the monitoring unit, which converts the signals to be read by the control unit. The control unit automatically adjusts the mixture inside the mixing module via valves according to the crop's demand. The upscale of TREAT&USE prototype will permit to overcome main barriers identified to reach the market: to reduce energy consumption, to increase automation, to improve and simplify end-user interface, etc. and adapt the technology to intensive agriculture production. The result will be a commercial system thoroughly demonstrated and tested in its operational environment.

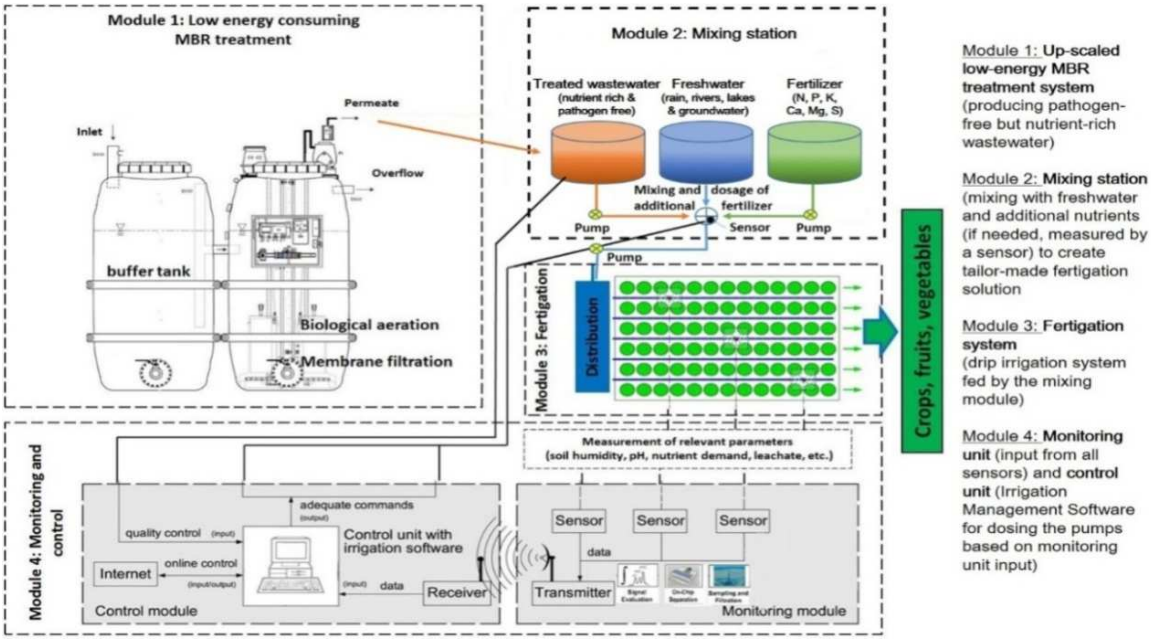

Figure 1: RichWater modular approach

The MBR unit is the core of RichWater technology. It is based on the results obtained in TREAT&USE project, but upscaled to 150 m3/day of treatment capacity. The effluent shall comply with the requirements for irrigation (mainly ISO guidelines and national legislation on wastewater reuse). It will be developed a portable installation treating the wastewater of Algarrobo, a small town in the region of La Axarquia in South Spain. BIOAZUL will be responsible for the design and will take into consideration lessons learnt and improvements identified during TREAT&USE project. According to this, it is planned to carry out the following improvements:

- Energy consumption reduction by:
  - ✓ Speed controllers for bigger motors (Blowers, recirculation pump)
  - ✓ Use more complex hidraulical installations to reduce the number of pumps

- ✓ Installation of self-cleaning impeller pump for transfer raw waster water catching. Non-clogging pump to reduce maintenance
- ✓ Fluid modelling of the MBR tank for increasing the treatment capacity and optimize blower size and decrease fouling in membranes

- Control and adjust of the irrigation water quality on line. Treat and irrigate at the same time.
- Safety for workers: Installation of structures for better maintenance and access to the tanks.

Consortium and network – multiactor approach

A highly professional and complementary consortium has been brought together for RichWater project. The 5 RichWater partners (3 SME's and two Applied Research Centres) from three different countries across Europe (Austria, Germany, and Spain) bring their own expertise for the design and construction of the different components of RichWater system: BIOAZUL for the MBR module, CSIC-IHSM for the fertigation module, TTZ for the mixing unit, PESSL for the monitoring module and the provision of soil sensors, and ISITEC for the control module. Each of these technology providers has successfully developed several innovative technologies in his area of expertise – waste water treatment, irrigation, sensor technology, automation and control. As experts in their respective fields, they have all identified the significant potential of future commercialization of the RichWater technology and intend to invest their experience in innovation and optimization to fully exploit that potential and fulfil their commercial interests. Their complementary knowledge and experience with different parts of the system guarantees correct functionality of the different modules separately, while the right scientific coordination – carried out by an experienced RTD in this field, TTZ – will ensure proper system integration and operative readiness of the system as a whole.

<u>Network and quadruple helix:</u>

RichWater project has sougth a wide engagement of stakeholders. With this purpose, RichWater consortium has had an intense communication with local and regional actors. In particular, an agreement between the Spanish partners BIOAZUL and CSIC-IHSMwith local actors have been signed in the region of La Axarquia (Malaga) where the prototype and demo-site is located. These contacts have crystalised in a formal agreement with the municipality of Algarrobo, the association of municipalities of La Axarquia, the community of irrigators of Algarrobo and the wastewater treatment operation company, AXARAGUA. Thus, government, academia, industry and citizens are collaborating together to facilitate the adoption of reuse solutions that cope with the lack of water in the region and contributes to boost the agricultural sector.

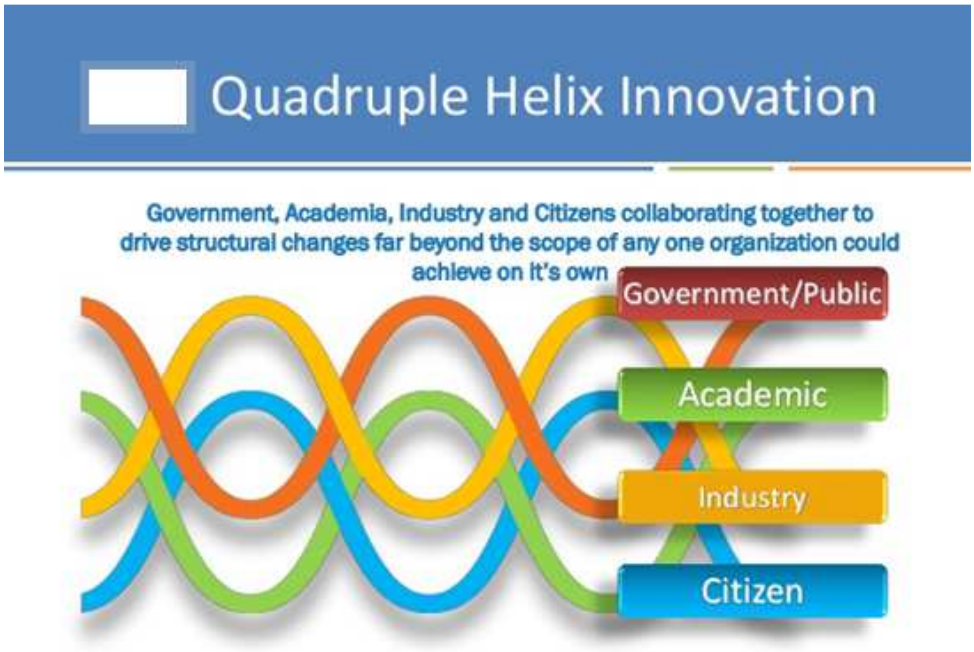

Figure 2: Quadruple helix

This agreement has facilitated the access to the wastewater treatment plant of Algarrobo which will feed RichWater system with raw wastewater and will also allow RichWater consortium to place the prototype and carry out the necessary analyses and tests to assess the system performance. There is also an agreement to disseminate the project results using the channels of the municipal authorities as well as to collaborate in the organization of dissemination and capacity building activities in order to increase the project impact at local level.

Figure 3: Signature of agreement with local authorities

Operational group AXARQUIA SOSTENIBLE:

As a result of the networking activities carried out within the frame of RichWater, a working group has been set up with key players in the region of La Axarquia, showing their interest and support in the project and its continuity. These agents are: the association of Municipalities of La Axarquía, the city council of Algarrobo, the Community of Irrigators of Algarrobo, AXARAGUA as operator of the wastewater treatment stations of Axarquía, and the Spanish Association of Tropical Crops. The objective is to extend the working group and find external funding to continue with RichWater project. The current working group has created an operational group within the EIP-Agri called "AXARQUIA Sostenible" which has already obtained funds from the regional government to carry out the submission of a project proposal. The four components of the quadruple helix ensure the real commitment of all actors involved in decision making and value chain. The operational group AXARQUIA SOSTENIBLE is intended to:

- Seek innovative solutions based on regeneration and a more sustainable management of water resources to combat the effects of water scarcity in the agricultural sector in La Axarquía.
- Disseminate the RichWater project to ensure that results have the greatest possible impact in the region.
- Carry out demonstration activities in La Axarquia including the optimization of RichWater technology and more in-depth agronomic studies to evaluate the effects of using treated waste water for irrigation
- Organize visits to the demonstration plot to show in situ the effects of regenerated waters on crops.
- Seek further funding instruments to continue the studies and the development of technological solutions that complement the RichWater project and allow to continue its activity once this end

Figure 4: Logo of AXARQUIA SOSTENIBLE operational group

Test site: a potential living lab

RichWater prototype is installed in the municipality of Algarrobo (Malaga province) in Southern Spain. The following figure represents the test site and the different plantation sectors that have been planed for the demonstration phase. Tomatoes, mangos and avocados will be planted and will be irrigated with both reclaimed water produced by RichWater technology and local water. There will be a total of 14 irrigation sectors: 7 irrigated with local water (test site) and 7 irrigated with reclaimed water (reference site).

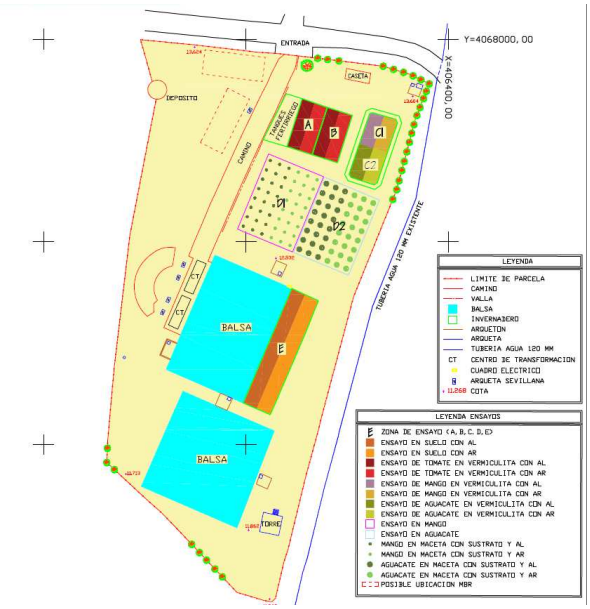

Figure 5: Plan of the test site

There is a strong interest in the region to have access to scientific results on the cultivation of avocados and mangos, however the demonstration phase of RichWater lasts only for one year and there's not enough time for the plant to give fruits. Tests can be done with the leaves and roots of the mangos and avocados. In order to have results on fruits, we will also plant tomatoes.

PESSL and CSIC-IHSM have selected the appropriate sensors for each parameter that needs to be measured (soil sensors and weather stations), and also have given recommendations on the most appropriate sensors to be used in plants according with the singularities of tomato, avocado and mango crops.

Figure 6: Greenhouses for agronomic evaluation of the target crops

Figure 7: Mango crops irrigated with RichWater effluent

The MBR unit is located at the wastewater treatment plant of Algarrobo which is close to the tes site and will send the treated wastewater to the mixing station. All the installations will be running from August 2017 and will be available for visits. Indeed, it is foreseen in the frame of RichWater project to organize visits of key stakeholders including farmers, authorities, scientific community, wastewater operators, etc. It is foreseen to continue the activity of Richwater treatment and irrigation plant after the end of the project.

Figure 8: Satellite view of the test site and wastewater treatment plant of Algarrobo town

Figure 9: MBR unit of RichWater technology