



# My Autobiography

## *Exceeding on expectations*

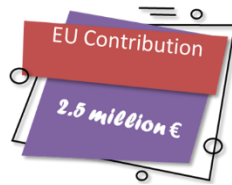


**October 2023**

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## Preface

The ambition of my creators is to address the scarcity of freshwater in the Mediterranean by promoting me as a provider of a reliable, all-year round available, non-conventional source of water. Not only will I provide a quality of water that is safe for irrigation in agriculture and for urban greening, but I will also produce biogas and even fertilizer. To make my eco-innovative functioning possible, my creators designed me as having three components: an anaerobic digester, one or more constructed wetlands and a solar raceway pond reactor for photocatalytic disinfection.

The present manuscript brings the sequel to **My Autobiography: *Anxiously waiting to make my physical appearance***, published in February 2022. Thankfully, the ENI CBC Med Managing Authority had approved my creators' request to extend the duration of the research conducted under my name from 36 to 50 months, i.e. until October 2023. Following on my physical appearance in Spain just over a year ago, this extension allowed me to make two further appearances, one as a demonstration unit in northern Lebanon and the other as a demonstration unit in Bent Saidane, which is located in the Zaghuan Governorate in Tunisia.

Apart from my joy that the Lebanese University had succeeded in finding a solution to the country's severe financial crisis, the partners at CITET in Tunisia continued to pursue my construction despite facing daunting bureaucratic hurdles. I hope this sequel is a testament to how my creators kept my wheels turning at an exceedingly rapid pace during this final lap of 20 months.

Readers will recall my early Christmas present in 2021, a 3-dimensional miniature model of myself. As expected, it proved to be an excellent way to showcase my eco-innovative functioning at international brokerage events, exhibitions and other major events.

I learned that farmers in the Almería province of Spain unanimously wished to copy the pioneering pace of reusing treated domestic wastewater in the neighbouring region of Murcia. Yet, deep-rooted concerns about reuse in Tunisia, and even fear with the very notion of reuse in Lebanon, called for stepped up actions by my creators to address these concerns. No matter how much junior high school children in Greece had taken fancy to my miniature prototype, the ultimate proof that my treated wastewater was safe for reuse, was always going to have to be established through my physical presence.

Fortunately, by the time my creators organized a training-of-trainers event on my design, operation, and maintenance, I had already been in operation at the existing Blanca wastewater treatment facility for almost a full year. Analysis of my treated wastewater demonstrated that my efficiency in treating domestic wastewater improved over time and as the constructed wetland flourished, my efficiency at treating domestic wastewater improved to the point where my creators could confirm that I was fully compliant with the recently introduced EU regulation on the minimum requirements for wastewater reuse!

Still, my creators also wished to demonstrate that it is perfectly feasible for local communities to actively participate in the drawing up of action plans for the reuse of treated wastewater. This was made possible thanks to the participatory GIS (PGIS) Practice Sessions which are a clear example of how to achieve good governance in the water and sanitation sector in the Region you call the Mediterranean. The feedback from local communities in Lebanon and Tunisia speaks volumes about how important this initiative has been.

In the final chapters of this sequel, it becomes clear why my creators consider that I actually exceeded on their initial expectations!

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## A hectic month of presenting my credentials

### *AQUACYCLE Log January 2022*

Visibility is key to deliver on my creators' expectations, and thanks to my team of creators, January 2022 saw a very hectic schedule of presenting my credentials online!

My Project Manager, Dr. Konstantinos Plakas called me just before the Christmas recess at the Centre for Research and Technology, Hellas (CERTH) in Greece. He looked quite solemn when he told me that I had been invited to present my credentials to the European Court of Auditors.

Organized online on 17 January 2022, the meeting created the very first opportunity to show off my last year's Christmas present, a 3-dimensional miniature model of what I will look like in my much-awaited physical appearance in Lebanon, Spain and Tunisia. Understandably, I did feel a bit daunted at the challenge of extolling my virtues to such an important, and unexpected, audience.

Ms Erika Katalin Söveges and Ms Annette Farrugia, who joined the meeting on behalf of the European Court of Auditors (ECA), had fully anticipated my being a bit perplexed with their invitation. Thus, they started the meeting by explaining that as part of ECA's mandate to assess the efficiency of EU funding, they had invited my creators to bring insights from a project implementation point of view.

Dr. Konstantinos Plakas kicked off with a brief overview of the many results achieved to date, not least the e-learning platform that provides guidance to water treatment plant operators on the design, operation, and maintenance of each of my components. The ECA representatives were particularly keen to better understand my cross-border dimension and the expected benefits I should bring about.



Following on Kostas' presentation, my Communication Manager, Eng. Dirk De Ketelaere from Integrated Resources Management Company Ltd. (IRMCo), based in Malta, outlined the ingredients of my Capitalization Plan which aims to ensure the sustainability of results after the end of the ENI CBC Med funding.



*Figure 1: Presenting my credentials to the European Court of Auditors*

Concluding the meeting, my Overall Coordinator Creator, Prof. Anastasios Karabelas (CERTH) acknowledged the Managing Authority (MA) and the Joint Technical Secretariat (JTS) for their active support and guidance both during the application process and during the implementation of the research conducted under my name.

Shortly after this meeting, I received another invitation to present my credentials and in particular my contribution to achieving the objectives of the ENI CBC Med Programme. The invitation informed that the company NAXTA was contracted to perform this evaluation in the first half of February 2022.

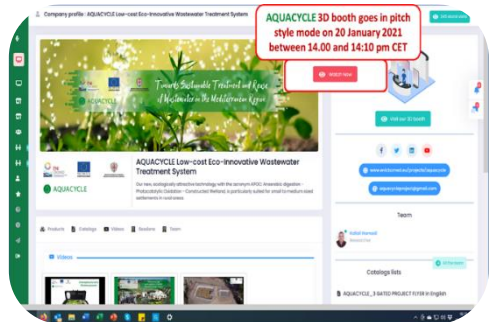
Around the same time, my Team Leader at the Water Research and Technologies Center (CERTE) in Tunisia, Dr. Hamadi Kallali, enquired about my availability to present myself at the Water-Energy-Food (WEF) Nexus Innovation Week.



He felt that this regional online event would be an excellent opportunity to give my replication in the Region a ‘technological push’ beyond the EU funding towards the construction of my 3 pilot demonstration units.

**Figure 2: Presenting my credentials at the Water-Energy-Food (WEF) Nexus Innovation Week**

I welcomed more than 275 visitors to my booth, including business angels and investors! My creators had equipped my online booth with a short video clip of my miniature model and a catalogue describing the details of my components.



**Figure 3: My online booth at the WEF Nexus Innovation Week**

At the opening of this regional brokerage event, the Managing Authority’s Communication Manager, Mr. Martin Heibel, had given a lucid presentation in which he reiterated on the challenges that the Mediterranean Region is facing



today to achieve the sustainable management of water, energy and agri-food systems.

**Figure 4: Address by Martin Heibel, ENI CBC Med Communication Manager, at WEF Nexus Innovation Week**

“It is not a secret that the Mediterranean Region is a climate change hotspot”  
*Martin Heibel, ENI CBC Med Communication Manager*

Martin described the ENI CBC Med Programme as a huge platform for cooperation that is currently accessible to organizations in 13 partner countries from both the northern and the southern sides of the Mediterranean basin.

“Cooperation is the DNA of the ENI CBC Med Programme”.

The Programme forms part of the European Neighbourhood Instrument (ENI) policy of the European Union.

“The ENI CBC Med Programme currently has a budget of 2009 million Euro, which is a lot, but it is nothing compared to the magnitude of the challenges that need to be addressed!”

He emphasized that the ENI CBC Med Programme cannot solve the problems alone, but can - through the funded projects – develop concrete and practical solutions that can then be adopted by local communities, national institutions and the private sector.

“The philosophy of the ENI CBC Med Programme is not focusing on a north-south transfer of knowledge but rather on exploiting the full potential of cooperation, by sharing knowledge and expertise that is held by all the actors in the Mediterranean Partner Countries”.

The ENI CBC Med Programme was launched in 2007 and is currently in its third edition with a horizon of 2027, with new calls for proposals and a larger budget. The current list of partner countries includes Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, Malta, Palestine, Portugal, Spain, and Tunisia. The third edition welcomes Algeria and Turkey.

“The new edition of the programme will be tied to the principles of the European Union’s Cohesion Policy, and retitled as the Interreg NEXT MED Programme”.

“Women and youth are identified as the most vulnerable groups among civil society, and therefore merit special attention”.

“A further strong emphasis is given to communication on project outcomes to key stakeholders, particularly through online means. This in turn leads to more visibility of the practical solutions and best practices that are being developed through the funded projects.”

Yes, I fully concur that giving more visibility to the eminent benefits I am about to deliver on is certainly a much-needed recipe for my successful replication around the Mediterranean and beyond!

In January 2022, yet another event took place that I could not miss out on!

Ms Georgia Karavangeli, Coordinator and Ms Esperanza Castro Arillo, Communication Manager of the ENI CBC Med funded MEDTOWN project invited my creators to present my social innovation and the dimension of inclusion at an International Seminar on this topic, which took place on January 27, 2022.



*Figure 5: Presenting my social innovation and inclusion dimension at MEDTOWN Online Event*

Ahead of the event, my Communication Manager, Eng. Dirk De Ketelaere, had rushed to compile a 3-minute video clip which could be accessed on the MEDTOWN homepage.

The event was joined by 100 participants from around the world. A lady participant from Japan proved very active on the chatline to find out more about what the panellists were discussing in a first session which focused on how social innovation experiences are affecting public policies at different levels throughout the Mediterranean.

Dirk then took part as a panellist in the second thematic discussion, which focused specifically on how experimentation at the project level can impact policy, as well as on the legal and institutional impediments for the successful uptake of the outcomes of the projects which were represented, i.e. MoreThanAJob, MedUP, InnovAgroWoMed, SIRCLES, MedRISSE, and my good self AQUACYCLE.

This entry in my logbook has gotten quite long. Let me close by inviting you to watch a longer clip on my dedicated channel on YouTube, based on the content of Dirk's presentation at the MEDTOWN international seminar<sup>1</sup>.

Stay tuned and don't forget to subscribe to the channel so you don't miss the new clips... including an interview in Arabic with Dr. Hamadi Kallali which was screened on Tunisian TV Channel Wataniya 1 on the 6<sup>th</sup> of January 2022. Subtitles in English and French were added with the help of Dr. Tawfik Naboulsi, who is part of my team at the Lebanese University.

One thing is certain: in all these efforts, my creators were keeping to their mantra:

**“Together we are stronger!”**

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<sup>1</sup> <https://youtu.be/wkWz4AaX2PU>

## Farmers have their say on World Water Day

*AQUACYCLE Log March 2022*

You will recall how a desperate-sounding voice on World Water Day 2021:

***AQUACYCLE, AQUACYCLE please come in haste  
For all water is too precious to waste!***

from a water stakeholder in the region of the world you call the Mediterranean, had caused me to call on my siblings, MEDISS, MENAWARA, NAWAMED and PROSIM, by going into poetry mode!

I now realize that this had spurred on my creators to find out more about the reasons of this particular stakeholder’s anxiousness. Of course, my creators are aware that rainfall in the region has been steadily decreasing over the past two decades and that climate experts’ projections indicate that renewable freshwater resources will become even scarcer in the coming years.

As the theme of World Water Day 2022 read “Groundwater – Making the Invisible Visible”, my creators decided to invite farmers in Lebanon, Spain, and Tunisia to have their say about their dependence on groundwater and whether this dependence is influenced by the impacts of climate change.



**Figure 6: Farmers have their say on World Water Day 2022**



One of my co-creators in Spain, Samira Nahim from PSA-CIEMAT, met up with Sergio and Maria Isabel, who till the land in the Almería region.



*Figure 7: Sergio and Maria Isabel's cucumber cultivation extends over 22000 square metres*

The cultivation phase lasts from October to the end of February, but the cucumbers are only harvested in the last three months, with an average production of 8 kg of cucumbers per square metre. To save water, they installed a drip irrigation system with built-in irrigation drippers. The irrigation takes place every other day, for about 30 minutes. The water already contains fertilizer and about 15000 litres of water are used for each irrigation. Their source of water is groundwater, which is sold and distributed to them by a community of irrigators. Sergio shared his view on the future of their livelihood:

“At this moment we have water availability, but we are afraid that in the future this aquifer will dry up. Moreover, due to fact this is an intensive agriculture we are also afraid of its contamination due to the (intensive) use of fertilizers as happened previously with another aquifer.” *Sergio*



My co-creators in Tunisia, Khitem Mensi, Sonia Jbeli, and Anis Ghattassi, from the Tunis International Center for Environmental Technologies (CITET) met up with Hasnia Hamrouni, a woman farmer who tills the land in the Bent Saidane locality which belongs to El Fahs, Governorate of Zaghouan in Tunisia.



*Figure 8: Hasnia Hamrouni's farming land extends over 2 hectares*

Her farmland produces beans, peas, potatoes, peppers, tomatoes, onions, olives, and almond. Due to the increasing scarcity of rain, her land is nowadays irrigated only with groundwater from a well.

Hasnia Hamrouni's outlook proved very similar to that of Sergio:



“Previously, there was water thanks to the availability of rainwater but now it is reduced under the effect of climate change. In recent years we have noticed that the soil has become dry, the level of the water table has decreased: sometimes we can't irrigate the entire field in the face of the low flow of water.” *Hasnia Hamrouni*



Dr. Tawfik al-Naboulsi and Khoder Kahil from the Lebanese University met up with Mohamed Bahri, who tills the land in northern Lebanon. Mohamed is 60 and has been working in agriculture since he was about 18 to 20 years old.

The area of Mohamed’s reclaimed land is 25 dunums, and he also has the same area or a little more, but it needs to be reclaimed so that he can invest and cultivate it. He grows all kinds of fruit trees: apple, pear, cherry, kiwi, peach, and apricot. He also grows avocado and citrus fruit for his household needs. He invests in about 7 greenhouses or more in a year, which enables him to grow also lettuce in winter. *Editor’s note:* A dunum is a unit of land area covering approximately 1000 square metres.



**Figure 9:**  
**Mohamed has**  
**about 3 dunums**  
**of greenhouses**

Mohamad Basri has a large agricultural area and considers he needs to have water (all year round):

“We used to have strong water abundance. For example, it used to snow seven times a year, and now it snows only once. Our 15-inch channel springs are now 3 inch or even less. “We benefit from the water of springs and wells. What is currently happening is tantamount to witnessing desertification.” *Mohamed Bahri*



The farmers were given a leaflet illustrating my design and informing about the benefits I am expected to bring about. Following this introduction, they were asked for their own views on the use of treated domestic wastewater to support their livelihoods. The farmers had the following to say:

“We are ready to use the water supplied by **AQUACYCLE** if it is of good quality and brings no risk on the level of production and the quality of crops.” *Hasnia Hamrouni*



“Yes, we are open-minded and we would agree to irrigate with urban wastewater if it gives good quality to my crops and it is not very expensive as we must take into account that farming is a business. Almería being a coastal region, another alternative would be for us to use a mixture of groundwater with desalinated water, but this would considerably increase on our water bills. Moreover, as another positive aspect, we are aware of the saving of fertilizers which this alternative would bring about.” *Maria Isabel*



“For the reuse of treated sewage and wastewater, if there is a reliable source, an entity that secures the issue (of safe reuse in agriculture) in a correct and scientific way, and a method that does not have either an environmental impact or any other impact. I speak as a farmer, this is my culture, and I do not know how to further elaborate the issue, the details are up to those concerned. Wastewater instead of being wasted, can bring benefits in several ways, first it can be used for irrigation, and we can have organic fertilizer and, we can avoid the pollution of the environment and many other things. This topic serves the community, I think, it’s a necessary service, necessary for the community now and in the future.” *Mohamed Bahri*



## Left amazed by junior high school students in Greece

*AQUACYCLE Log June 2022*

Researchers from the Centre of Research and Technology, Hellas (CERTH), and Junior high school teachers in Greece, were left amazed at how teenage students took to my eco-innovative wastewater treatment system design.

During a visit to the Gymnasium - High School of Nikiforos in Drama, Greece, my Project Manager, Dr. Konstantinos Plakas, started off by explaining about each of the various components that make up my design. It came as no surprise to me that for this very purpose, he had brought along the 3D model of my prototype design which he had given to me as an early Christmas present to me last year.



*Figure 10: My Project Manager introducing my components to junior high school students at the Gymnasium - High School of Nikiforos in Drama, Greece*

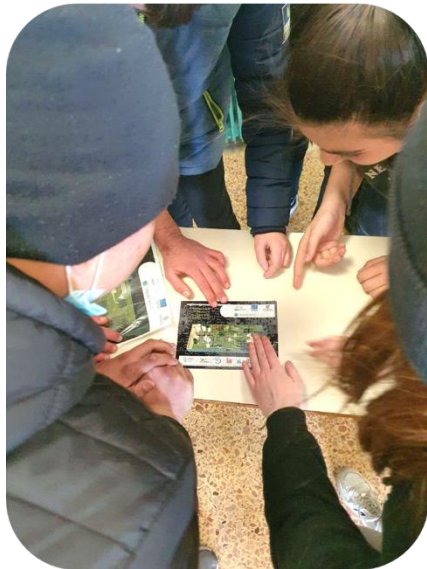
*Photo credit: Angeliki Fotiadou, CERTH*

I must admit that I started getting increasingly apprehensive as he went into every little detail of my design. As his presentation was laden with notions of terms from physics, chemistry and also mathematics that fed into my design, I could not help thinking that he forgot that on this occasion he was not exactly talking to his more usual audience of post-graduate university researchers!

In truth, I simply could not fathom how he expected to instil the active interest of teenagers in the highly complex and even inter-disciplinary concepts and methodologies he was presenting to them. Hence, to my relief, his presentation was followed by a treasure-hunt styled activity.

Divided into smaller groups, the junior high school students were invited to visit thematic stations, each of which was tied to a specific component of my design. At each station, they were asked complementary questions which delved into aspects such as the energy efficiency or other relevant features of a particular component of mine. Obviously, I was all ears at the station where they were asked not only which countries my creators are based in, but also in which countries I was being expected to make a physical appearance in the nearest future.

Returning to the classroom where the event had started, the CERTH research



team had another surprise in store for the teenagers. In a final session, the teams they had been divided into were invited to piece together a puzzle with the image of my eco-innovative wastewater treatment system. A loud cheer went up from the team that had completed the task first, although I can proudly say that all teams succeeded in this final assignment with astonishing speed.

***Figure 11: Junior high school students piecing together my components***  
*Photo credit: Angeliki Fotiadou, CERTH*

The performance of the junior high school students who responded with ease to each of the topics that had just moments ago been introduced to them, their impeccable memory of even the tiniest details of my design, as well as their knowledge of topics such as the water and energy saving targets set by the European Union, left all the adults involved in the accomplishment of this event with a sense of admiration and astonishment of what teenagers are capable of achieving once their interest is stimulated.

I too was amazed that the information had found its way into teenage school children's hearts and minds. The broad smiles on their faces during the treasure hunt spoke volumes about their active interest in all matters related to the importance of wastewater as a means of augmenting fresh water supplies, thereby safeguarding the livelihoods of rural communities, and the environmental benefits that can be gained through my design configuration.

The school's teachers and the team of CERTH researchers who had witnessed the entire event, commented that the initiative had proven to be a highly attractive means of ensuring that a new generation of researchers in the fields of environment and water conservation will be on its way. I could not but heartily agree with this conclusion. The joy and laughter during the award ceremony are still ringing in my ears!

The selection of the Gymnasium - High School of Nikiforos in Drama, Greece, to conduct the exercise was no coincidence. Teachers at this public school have mounted various innovative installations over the years, including a planetarium, a sun clock, as well as an Archimedes technology display. Moreover, the wider environs of Drama, which includes mount Falakro, is a verdant area with abundant water sources and various beautiful lakes and water springs that harmonise perfectly with the built environment, and nowhere more so than in the beautiful city of Drama. Pictured are the old Herman Spierer tobacco warehouse and the springs of Agia Varvara in Drama.



**Figure 12: The beautiful city of Drama**

Source:

<https://www.visitgreece.gr/mainland/macedonia/drama/>, accessed on 21 June 2022



Encouraged by the outcome, the CERTH team repeated the exercise at the Anatolia American College in Thessaloniki, Greece, a private school with sophisticated labs dedicated to technology transfer, renewable energy sources and systems and other related topics.



***Figure 13: My project manager presenting my credentials at Anatolia American College***

*Photo credit: Virginia Arvaniti, STEM Administrative Assistant, Anatolia American College, Thessaloniki, Greece*

*Editor's notes:* In total, more than 100 teenage students participated in both events. The curriculum, which is delivered at junior high level, ensures that students have a basic knowledge of energy conservation, ecology and environmental protection and are therefore already familiar with the topics that were presented to them.

## Jubilant with the tidings from Lebanon

The perseverance of my team at the Lebanese University paid off. The drawing up of the tender for the construction of my pilot demonstration unit in Deddeh, south of Tripoli, had been very time-consuming. Every nut and bolt in my design had to be described in detail and included in a bill of quantities... along with the estimated costs! This already daunting challenge was then met with yet another obstacle, as Lebanon woke up to a severe financial crisis. The Joint Technical Secretariat of the ENI CBC Med Programme wasted no time to come to the rescue with an array of possible solutions, yet it took considerable time and effort to put in place a solid agreement between the Lebanese University and the country's Central Bank to overcome the impasse. I am sure you will understand my excitement when I learned that the tender had indeed been published!

Further good news came with the announcement that the required minimum number of three bids for my construction had been deposited in the University's tender box. The bids were opened in the presence of the Dean of the Doctoral School of Science and Technology at the Lebanese University, Dr. Fawaz ElOmar (seated in the middle), the members of my team at the Lebanese University, and representatives of the 3 companies that had submitted their respective bids on time.



*Figure 14: Official opening ceremony of the tender offers for my construction in Lebanon*

The more advantageous offer was submitted by Modon Group and hence the contract was officially awarded to Modon Group by the Dean, Dr. Fawaz ElOmar, my Scientific Director, Dr. Ahmad ElMoll, and my Administrative Director, Dr. Mohamad Khalil. The Modon Group offers its customers a wide range of products and services in the mechanical, electrical and renewable energy sectors.

A site visit, followed by a meeting organized by the Lebanese University, showed Modon Group's strong willingness to do everything possible to facilitate and speed up the work.



*Figure 15: Location of the site at Deddeh, south of Tripoli, Lebanon, and its current layout*



*Figure 16: Exchanging viewpoints of required site works*



The site visit was purposely organized to permit a delegation from the Modon Group, led by its General Manager, Ahmad Saleh, to familiarize themselves with the layout of the site. Their initial assignment is to draw up a detailed timeline of preliminary site works. At the same time, the visit gave Engineer Ghassan Fakhoury, representing the company TechUniversal, the opportunity to inspect the existing wastewater treatment plant on the site, and to discuss an action plan for its rehabilitation in consultation with the Modon Group.

Following on the site visit, a meeting with the Modon Group was organized at the Doctoral School of Science and Technology at the Lebanese University in the presence of Engineer Ammar Ayoubi, representing Deddeh Municipality.

During this meeting, the participants agreed on the importance of delivering on the initial assignment as soon as possible. First, a topographic survey of the site will be carried out, followed by the levelling of the site and the rehabilitation of the site's retention walls.



*Figure 17: My constructors in Lebanon agree on a speedy timeline of actions*

Participants also agreed on the importance of frequent communication between all the parties concerned, including the Deddeh Municipality. My team at the Lebanese University was represented by Dr. Mohamad Khalil, Dr. Tawfik Al-Naboulsi, Dr. Fatima Yahya, Omar Nachar, Khoder Khalil and Joyce Kreidi.

## Viewpoints on reuse of my treated wastewater resemble traffic lights

**Red** light for reuse in Lebanon, **orange** in Tunisia and **green** in the province of Almería, Spain proved to be the concise outcome of the brainstorming session which was on the agenda of workshops with local communities in the respective countries where I am set to make my physical appearance.



As I learned from the earlier interview with farmers Sergio and Maria Isabel in Spain on the occasion of World Water Day 2022, the province of Almería is facing a significant water deficit. Hence, it came as no real surprise to me that the participants agreed on the importance of reusing treated wastewater.

The decision of my Spanish co-creator teams, PSA-CIEMAT and ESAMUR, to organize the event in Tabernas in the province of Almería, was motivated by the fact that the reuse of treated wastewater in this part of Spain, as in most parts of Europe, is still in its infancy. This created the opportunity to showcase the high level of reuse in the neighbouring region of Murcia.

The event also gave my Spanish co-creators the opportunity to share the first results of me having made my physical appearance in Blanca nearly one year ago. Needless for me to add that these results prove that I have several advantages over my distant cousins who operate on the conventional activated sludge process. *Editor's note:* AQUACYCLE's vanity has obviously been boosted by these first results, but we will share more on these indeed promising results in due course.

The municipality of Tabernas is located on the edge of the famous Tabernas Desert, the location of many feature films and TV series. With travel restrictions lifted, I took some time to visit the three film sets in the area: Fort Bravo, Western Leone and Mini Hollywood!



**Figure 18: View of Tabernas municipality in the Province of Almería (left) and the location of the Blanca pilot wastewater treatment plant in the neighbouring Region of Murcia in Spain (right)**

I was impressed that simply everyone attending the workshop stated that they were aware of the existence of alternative, non-conventional sources of water. Moreover, the participants had a clearly positive perception about the use of treated domestic wastewater for irrigation. Evidently, I fully agreed with their viewpoint that this practice is necessary and essential for the future sustainability of water supplies as well as being of great agronomic, environmental, and economic value.

“The reuse of treated wastewater for irrigation purposes is necessary and essential to maintain water sustainability in the future as well as of great agronomic, environmental, and economic value.”

Unanimous viewpoint of participants in Tabernas, Almería Province, Spain

Another interesting finding was that most participants (83% to be precise) consider such reuse to be safe if adequate water treatment takes place; reuse regulations are followed; and a strict and complete monitoring plan is in place.

“Treated wastewater is safe for reuse in agriculture if it conforms with the EC regulation in force and a strict and complete surveillance plan is in place.”

Majority viewpoint of participants in Tabernas, Almería Province, Spain

Some of the participants opined that treated wastewater can be safer as compared to a conventional source, i.e., a surface source or a groundwater source, given the strict EC regulation in force on the reuse of treated wastewater in agriculture and the controls that are applied to ensure compliance with this EC legislation.

More than half of the participants (60%) agreed that treated domestic wastewater could be made available for uses other than irrigated agriculture, such as for industrial purposes, aquifer recharge and the irrigation of golf courses and urban green spaces. Yet, a significant number (40%) felt that treated wastewater should be made available exclusively for crop irrigation since intensive agriculture is the economic engine of the Almería Province in Spain.

I was all ears when participants voiced concern about the lack of information provided to society in general about the reuse of wastewater, as well as about the controls that are in place in Spain to ensure such reuse is safe and complies with current EC regulations.

“Society needs to be better informed about wastewater reuse applications and the controls that are in place to ensure such reuse is safe, in compliance with EC regulations in force.”

Recommendation by participants in Tabernas, Almería Province, Spain



*Figure 19: Group photo of the participants at the premises of PSA-CIEMAT in Tabernas, Spain*

In sharp contrast to the unanimous demand for the reuse of treated wastewater by the participants in the workshop in Spain, their counterparts in Bent Saidane located in the Zaghouan Governorate in Tunisia, and in particular the farmers, proved to be much more reluctant to use treated wastewater for their irrigation needs. Obviously, I immediately took queue and pleaded with my co-creators in Tunisia, CERTE and CITET, to invite the participants to explain the reasons for this reluctance in more detail. The farmers complied and shared the view that the handling and use of treated wastewater for food crops poses a variety of risks to public health. The participants also pointed to potentially harmful compounds and pathogens found in treated wastewater; the risks of exposure of the farmworker to these harmful substances, and the risks to soil health and groundwater quality.

“Our reluctance to reuse treated wastewater is motivated by the fact that the practice carries a variety of public health risks. Moreover, we are concerned about the potentially harmful substances found in treated wastewater, the exposure of the farmworker to these substances, and the risks to soil health and groundwater quality”.

Majority viewpoint of farmers in Bent Saidane, Tunisia

The participants also pointed out that public perception affects the profitability of a product: if a product is considered not desirable the value consumers place on it is low. Yet, the participants were aware that some farmers switch to treated wastewater whenever there is more pressure on conventional sources, and especially when the conventional source they rely on is no longer accessible or too expensive. From the ensuing discussion I learned that farmers in the Bent Saidane area do take their time to pay their bills for the conventional water they use, forcing the Agricultural Development Group (GDA) to sell part of the water to the drinking water supplier SONEDE to balance their budget. I also picked up that despite the economic and environmental benefits of switching to the reuse of treated wastewater, farmers are generally unwilling to pay for the supply of treated wastewater.

Although I was with the conviction that religion is a commonly cited reason for opposing the use of treated wastewater, this aspect had not been raised, neither by the Imam of the village, who was present at the workshop, nor by any of the other participants. What did emerge from the discussion is the view that society's lack of trust in the various levels of government and in the private companies involved in the operation, maintenance, and monitoring of wastewater treatment facilities in Tunisia is a major obstacle to the acceptance of initiatives to reuse treated wastewater.

“Society’s lack of trust in various levels of government and in the private companies that are involved with the operation, maintenance and monitoring of wastewater treatment facilities in Tunisia is a major obstacle in gaining acceptance for the reuse of treated wastewater”.

Farmers’ viewpoint on public acceptance of treated wastewater reuse, Bent Saidane, Tunisia

I did take heart when, despite their reservations about the reuse of treated wastewater, farmers were found willing to share their expectations if I was to make a physical appearance among them. *Editor’s note:* in December 2022, the tender for my physical construction in Bent Saidane was relaunched for a third consecutive time after, much to my regret, also the second tender process had been met with a negative appraisal by an inter-ministerial task force in charge of assessing procurement processes by public entities.

“In order for us to consider the reuse of treated wastewater, the wastewater treatment system promoted by AQUACYCLE needs to produce a very good quality water, permitting the cultivation of economically more productive crops such as vegetables and be provided at a cheaper cost as compared to conventional sources of irrigation water”.

Farmers’ expectations of AQUACYCLE’s wastewater treatment system in Bent Saidane, Tunisia



**Figure 20: Group photo of the participants in the workshop in Bent Saidane, Tunisia**

Due credit must be given to the organizers for attracting wide media coverage of the workshop which was covered by the Albiaa news channel as well as through an interview with Dr. Hamadi Kallali, CERTE Team leader, on Cultural Radio and on Tunisia’s National Television Station TV1. Conducted in French, the interview was uploaded to my channel on YouTube with subtitles added in English<sup>2</sup>.



**Figure 21: Interview with Dr. Hamadi Kallali broadcast on Tunisia’s National TV1 Channel**

<sup>2</sup> [https://youtu.be/nHlfcx-I5\\_0](https://youtu.be/nHlfcx-I5_0)



Meanwhile, my co-creator team in Lebanon, the Lebanese University, decided to organize the workshop at Nawfal Palace in the Al-Tell District of Tripoli. This gave me the opportunity not only to admire the splendid interior of this majestic building with its expansive library, but also to visit the nearby Clock Tower and other truly inspiring historical buildings in this part of Tripoli.



*Figure 22: Nawfal Palace, its interior and the nearby Clock Tower*

If the farmers and local community representatives in Bent Saidane proved reluctant to the reuse of treated wastewater, the unanimous viewpoint of their counterparts in Lebanon was even stronger: *“We are not likely to accept reuse applications of any type since the topic of sewage water draws fear among our society!”*.

*“When people hear about the topic of sewage water, it draws fear, especially the idea of reusing it”.*

Unanimous  
viewpoint of  
participants in  
Tripoli, North  
Lebanon

Not surprisingly, a key outcome of the workshop was the renewed appeal by the Lebanese University team to the country’s policy- and decision-makers to address the country’s poor sanitation record. In his interview with Al-Araby Al-Jadeed news channel on 24 October 2022, Prof. Ahmad ElMoll went on record to establish a causal link between the poor wastewater management and the spread of cholera and diseases in Lebanon. From this interview, I learned that the largest wastewater treatment plant in Tripoli only separates the solid from



the liquid waste in the wastewater stream, after which the solid part is sent to landfill, and the liquid part is discharged into the Mediterranean Sea.

I am pretty confident that the general public is aware that in a conventional wastewater treatment system, this process is designed only as a pre-treatment stage, i.e., a stage that precedes the actual treatment stages. I guess you would be referring to a Neanderthal cousin in your own family tree as a translation of “such a rather primitive system”, since there is no actual treatment in place?

In fact, several additional arguments were put forward by the participants substantiating their deep-rooted fear of reusing treated wastewater. These included the following:

- 1) **Sewage pollutes the groundwater.** Many Lebanese homes, villages and even cities depend on artesian wells for their drinking water supply. At the same time, dwellings are relying on a septic reservoir to store sewage which substantially increases the likelihood of polluting these reservoirs’ underground surroundings, including the groundwater tapped by the artesian wells.
- 2) **Existing sewage plants are not operational.** In Lebanon wastewater treatment plants have been built in several towns and villages. Yet, already within one or two years, these plants become abandoned places, and the investment and construction costs have been in vain.
- 3) **Farmers do not accept the idea of reuse.** The participants acknowledge that treated wastewater can provide a non-conventional source of water which can be reused for irrigation in agriculture, but they argue that farmers will refuse to use it. The question of what to do with the treated wastewater when it is not needed in the winter season is also raised as an obstacle to raise funds for the construction of treatment plants.

To be perfectly honest, my earlier jubilation on the award of the contract for my construction in Deddeh, south of Tripoli, had all but evaporated. Yet, I took heart when the participants continued reflecting on the wider gravity of the country’s poor water management strategies, for which solutions urgently needed to be found. One by one, participants started to bring arguments that

the reuse of treated wastewater was necessary. Realistically, the reuse of grey water could be the most cost-effective solution to overcome water scarcity and desertification in the region, which is being further aggravated by the impacts of a changing climate.

One participant speaking on behalf of the municipality of Tripoli, considered that everyone is predicting that the region is destined for a war over water. He referred to the book entitled “*Le dérèglement du monde*”, the disruption of the world, penned by the Lebanese French writer Amin Maalouf, in which the internationally acclaimed writer asserts that one of the greatest dangers threatening the whole world is climate change, and that alternative sources of water and clean renewable energy must be sought.

Another participant asserted that the research carried out under my name, AQUACYCLE, was very purposeful, particularly as it was not limited to desk and laboratory research but aimed to demonstrate my functioning as an eco-innovative wastewater treatment system under real-life conditions.

A representative from the Chemical Engineering Department at the University of Balamand, expressed his gratitude for having been invited to the workshop for two reasons: *“I am a resident of Deddeh, and I am pleased to learn that a pilot wastewater treatment plant will be constructed in my town, not least because I work in the field of wastewater treatment.”* He shared his experience in treating hospital wastewater as part of an EU funded project: *“Through our visits to Europe, we had the opportunity to see how they treat the wastewater there and specifically in Spain. In Andalusia, we saw how they treat the wastewater from their largest hospital. The treated wastewater is not only used for irrigation, but also returned to rivers. This allows the treated water to be used by simply everyone, not only by farmers. Therefore, we hope to achieve a higher level of wastewater treatment which will bring us multiple benefits.”* In his expert opinion, the sewage sludge produced could be treated cost-effectively as it can be used as fertilizer. This confirms that my mode of treatment will be a best practice example of the circular economy concept.

He emphasized that while the local community clearly does not wish to accept the idea of reuse, the farmer needs solutions to ease his burden: *“You offer the farmer, in these difficult circumstances, a new source of water and organic fertilizer of high quality and at low cost. These initiatives are now timely, the farmer needs these types of solutions to ease his burden. If we start from a specific place, such as my town, and everyone sees and hears about this initiative, I think it will help people to accept and be convinced by the idea of reuse. If I was asked to pay money to try it out, of course I would refuse, anyone else would refuse too. But if you tell me that my neighbour irrigates with treated wastewater and is satisfied with the results, and that I can visit him and see with my own eyes, of course I would be encouraged to use it too. In the end, this approach will encourage not only the neighbours but also nearby villages and municipalities to embrace the idea of reuse. When an idea is new to society, it is usually not accepted. But when people have heard about a concept and become accustomed to it, they accept it.”*

His research colleague, the Dean of the Faculty of Engineering at the Université Libano-Francaise (ULF), called for joint cooperation between universities, municipalities and NGOs. He described Deddeh and Tripoli as one of the best municipalities in northern Lebanon when it comes to working with residents and because they actively support actions such as those promoted under my name. He pointed out that while cooperation exists in all countries around the world, such cooperation had been regressing in Lebanon due to the country’s prevailing financial crisis. As the university is located close to the pilot site at Deddeh, it could benefit from reusing the treated wastewater for landscaping its 25,000 square metre ULF campus.

Hence it came about that the eminent professors from three universities in the area of Tripoli, who as it turned out were long-time residents of Deddeh and its environs, resolved to find a way forward by joining forces. They seized the opportunity created by the workshop to extend the invitation to the representatives of the local communities and NGOs who had joined the event.

“Together we are stronger, hence our appeal for joint cooperation between universities, municipalities and NGOs for the benefit of everyone and especially the local community. If we work jointly on the common points of our EU funded research projects, that will bring happiness to all of us”.

Outcome of  
Workshop in  
Tripoli, North  
Lebanon

Now I could finally light up, because after literally having witnessed a unanimous “No!” to the idea of reusing my treated wastewater, the participants decided it was time to join forces to find a way forward to the poor situation in the country’s water and sanitation sector. Perhaps at the end of the day, and with my construction in Deddeh finally in full swing, I would get the “green light” to use my treated wastewater after all!



*Figure 23: Group photo of the participants in the workshop in Tripoli, Lebanon*

## How local communities can take an active part in the drawing of actions plans for the reuse of treated wastewater

The active engagement of farmers and of local community representatives in the drawing up of reuse action plans is perfectly feasible!

**“The workshops conducted in Lebanon and Tunisia bring evidence that democratizing spatial decision-making in the water and sanitation sector is perfectly feasible. People of all walks of life, and therefore local communities, can have a meaningful and active role in the drawing up of action plans for the reuse of treated wastewater.”**

*My conclusion from the PGIS Practice Sessions I witnessed in Lebanon and in Tunisia, AQUACYCLE*

Let me start by explaining the entire process that permitted me to reach this conclusion. Aside from a brainstorming session to gather the viewpoints of farmers and local communities on the reuse of my treated wastewater, the workshops in Lebanon and Tunisia also included a **Participatory GIS (PGIS) Practice session**. The scope of the PGIS Practice session was to demonstrate that it is perfectly feasible for local communities to take an active part in the drawing up of action plans for the reuse of my treated wastewater.

My creators in Malta had successfully mastered this approach in previous EU-funded research projects. In the FP7-funded **SIRIUS project**, they adapted it to invite local communities in Egypt, Italy, Spain, and Turkey, to draw their vision of a sustainable water future in the agricultural sector. I particularly liked how the approach had enabled them to resolve a water conflict between neighbouring local communities in Forquilha. The low-income, agrarian area around the town of Forquilha is in north-eastern Brazil, which like the coastal city of Fortaleza enjoys a Mediterranean climate.

Representatives of the Brazilian water authorities, present at the PGIS Practice Session, learned why the water retention dam they had constructed ended up serving only the downstream local community. Their upstream counterparts drew the location for a water reservoir that would serve to share the available water in a fair and equitable manner. Within three months of the workshop they had organized, news came through that their wish had come true, and the authorities were taking charge to build the new water reservoir!



*Figure 24: Resolving a water conflict using Participatory GIS in Forquilha, Brazil*

More recently they adapted the approach to the realm of coastal zone management. As part of the ENPI-funded **Mare Nostrum project**, they invited local communities in Malta's Grand Harbour to draw eco-heritage trails, i.e., trails that would connect the blue and green open spaces in this very densely populated part of the Islands. Spread over a series of ten workshops, including four PGIS Practice sessions, the effort proved most timely. My research team



*Figure 25: Open Spaces in Malta's Grand Harbour mapped through fieldwork*

in Malta, IRMCo, had prepared a canvas on Google My Maps which showed the outcome of their fieldwork to map the open spaces including their features, such as the level of their accessibility and their canopy cover.

Yet, as the field work progressed, the participants drew the attention that such and such an open space had since already been built over, trees had been chopped, natural pathways in the small woodlands had been concreted and so forth. Not surprisingly this sparked off a debate as to why these open spaces were disappearing at an alarming rate. Impacts on citizens' well-being and quality of life included less tree shaded areas, more air pollution, and a higher risk of flooding due to soil sealing.

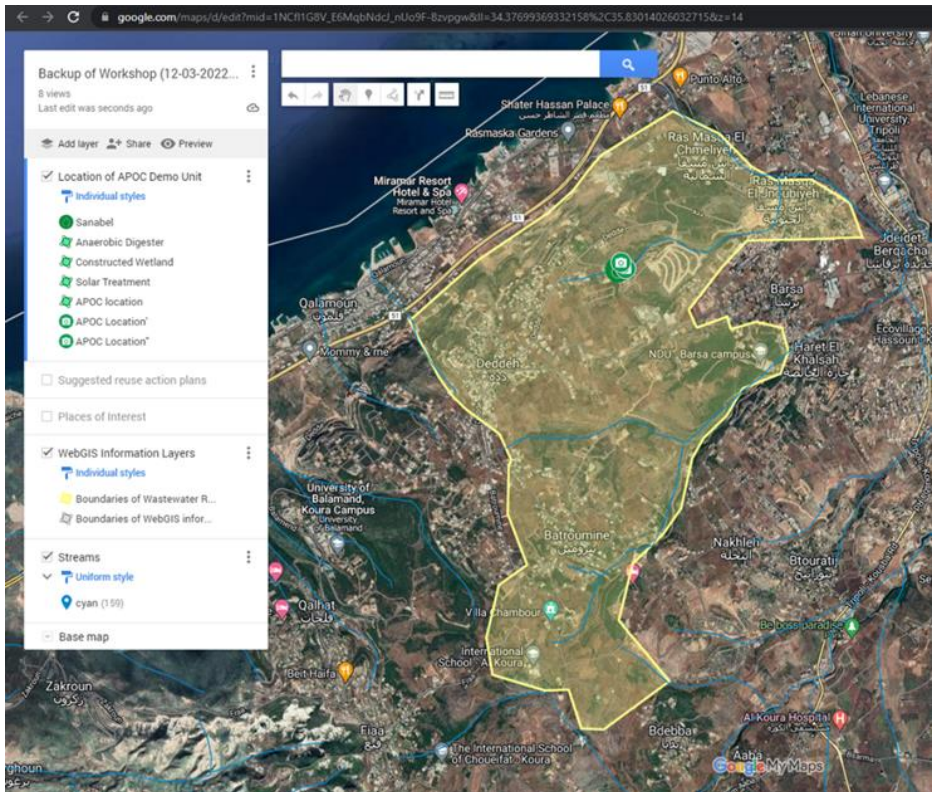
But let me come back to the research conducted under my name. Due to the ongoing travel restrictions, IRMCo decided to organize the training on the use of Participatory GIS (PGIS) through a series of online sessions with their research colleagues in Lebanon and Tunisia. The main scope of the training was to create so-called **PGIS Landing Pages**, using **Google My Maps** as a canvas. The PGIS Landing Pages for the respective locations in Lebanon and Tunisia were purposely designed in a directly similar fashion so to facilitate a cross-border understanding of the eventual action plans the local communities would be invited to draw. A first layer was asked to depict the planned location of my physical appearance and its components, i.e. an anaerobic digester, one or more constructed wetlands, and a solar raceway pond reactor for disinfection. Another layer was asked to display the surface drainage network and surface water bodies, such as lakes and reservoirs. These layers were encouraged to be illustrated with photos, e.g., of the hillside lakes around Bent Saidane, as shown below.



*Figure 26: Hillside lakes of Abaya (left) and of Gouissate around Bent Saidane, Zaghouan Governorate, Tunisia*

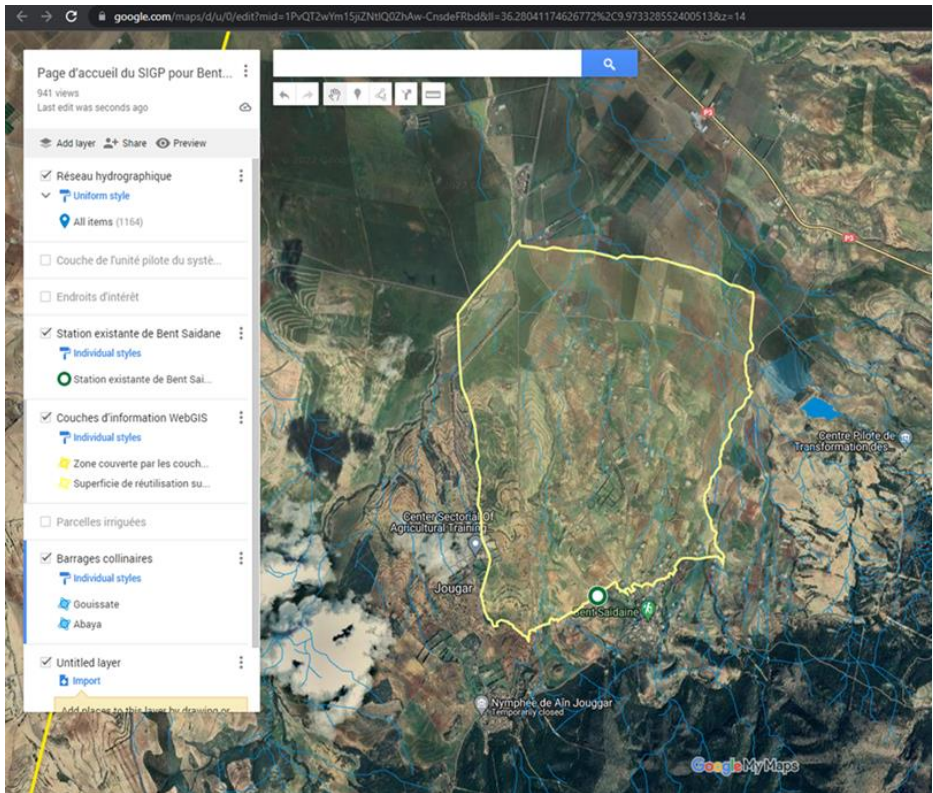


Every effort was made to give the PGIS Landing Pages the same 'look' and 'feel' as illustrated below.



**Figure 27: PGIS Landing Page for Deddeh, Lebanon, showing the surface water draining network (cyan), the boundaries for the drawing of proposed reuse action plans (yellow shaded area) and the envisaged location of the APOC system components (green icons)**





**Figure 28: PGIS Landing Page for Bent Saidane, Tunisia, showing the surface water draining network and hillside reservoirs (cyan), boundaries for the drawing of proposed reuse action plans (yellow shaded area) and the location of the existing Bent Saidane wastewater treatment facility (green icon)**

My creators resolved to add a further layer depicting places of interest, be it in the form of archaeological, historical, cultural, and religious sites, the townhall and other public buildings, as well as scenic spots and other tourist attractions as appropriate. This layer was purposely intended to make it as easy as possible to navigate the respective PGIS Landing Pages.



**Sanabel Compound**



**Hamilat Al-Tib (nursing home)**



**Lebanese University**



**Municipality of Deddeh**



**Mostapha Mosque**



**St. Barbara's Church**



**International School**



**Collège des Frères**



**St. Jacob Orthodox Monastery**



**University of Balamand**



**Université Libano-Française**



**Notre Dame University**



**Lebanese International University**



**Hopital Dr Succari**

*Figure 29: Places of interest on PGIS Landing Page around Deddeh, North Lebanon*



**Agricultural development office**



**Agricultural development and training centre**



**Jougar wastewater treatment facility**



**Basic Health Center**



**Marbout Fatima Bent Saidan**



**Cemetery**



**Mosque**



**Post office**



**Primary school (1)**



**Primary school (2)**



**Youth club (1)**



**Youth dub (2)**

*Figure 30 Places of interest in and around Bent Saidane, Tunisia*

People around the world are for the most part already familiar with Google Maps, whether to find directions to a particular location or to a nearby restaurant, among many other uses. However, to leave no one behind in the PGIS Practice session, it was opted to also provide a print-out of the PGIS Landing Page at both events. This gave the participants the option to draw their suggestions for the reuse of treated wastewater either directly online or on a print-out of a satellite image.

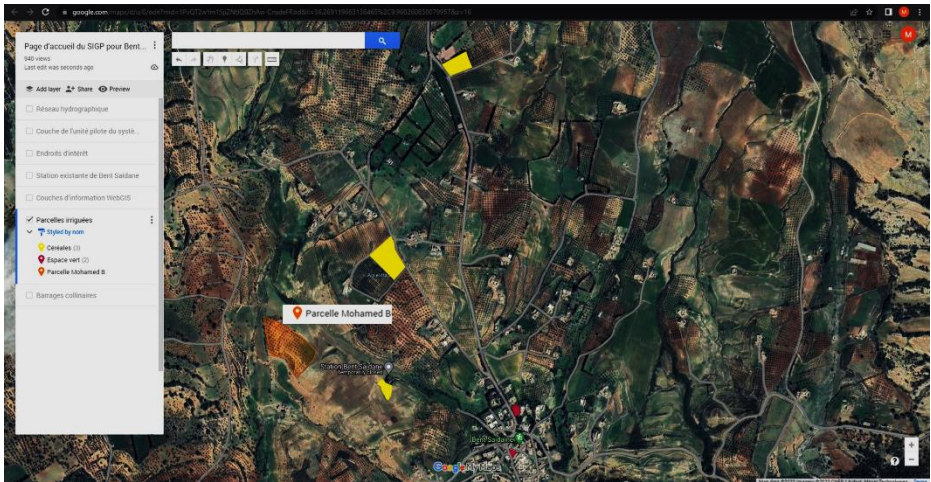
Prior to drawing their suggestions for reuse, the participants were asked about the different types of applications they would wish to use the treated wastewater for. These were written out on a whiteboard so that all participants could see the collected suggestions. Whereas farmers foremost wished to see the treated wastewater used for the cultivation of their crops, local community representatives were encouraged to make suggestions for urban greening and roadside landscaping. Once the list was considered complete, participants were invited to assign different colours to each application.

**“As anticipated by my creators, in both workshops, neither farmers nor any of the local community representatives required any training to locate the fields they till or the properties they reside in.”**

*My observation from the PGIS Practice Sessions I witnessed in Lebanon and in Tunisia, AQUACYCLE*

As shown by the below example of online entries, a farmer in Tunisia, rather than specifying the type of reuse wrote his name, i.e. denoting his ownership, of the tract of land on which he wished to use the treated wastewater for irrigation purposes. Again, this is not an unexpected result, it can easily be attributed to people wishing to delineate their ‘*property*’ and thus their ‘*ownership*’ of such property.





**Figure 31** Example of online entries in the PGIS Practice session in Tunisia

Other entries in the same illustration show field plots intended for the irrigation of cereals (in French, ‘Céréales’, shown in yellow) and for the irrigation of an open space (in red, ‘Espace vert’) in the town of Bent Saidane. *Editor’s note:* in this illustration, the ‘active’ layer is set to the layer depicting the irrigation applications provided by the participants. The other layers in this illustration, such as the layer with the hillside lakes (*‘barrages collinaires’*) is not active and therefore not displayed.

In both Lebanon and Tunisia, participants expressed their sincere gratitude for having been invited to a workshop in which they were given the opportunity to actively participate in deciding on the reuse applications of treated domestic wastewater.

Furthermore, in Lebanon, participants expressed their appreciation that aside from drawing their suggested areas for the reuse of treated effluent on the PGIS landing page or on a printed satellite image, soon it would become possible to submit their suggestions directly on a dedicated WebGIS platform. The fact that they were able to enter the data by themselves drew their special attention.

**“Being able to share our suggestions and ideas means a lot to us, yet placing a user-friendly platform in our hands so we can also indicate our suggested areas for the reuse of treated domestic wastewater, has taken us to another level, we really felt that our voice matters”.**

*Appraisal of PGIS Practice Session by local community in Deddeh and environs, Lebanon*



**Figure 32: Photos captured during the PGIS Practice Session in Bent Saidane, Tunisia**



## Launch of a Mediterranean Wastewater Reuse Alliance in my honour

My creators had yet another great surprise for me in store. They thought hard about how to ensure my lasting legacy. Rather than bringing their own appraisal of my functioning, they collected the testimonies of water stakeholders from around the Region who had taken part in one or more of the events organized over the project’s lifetime in a Charter. In doing so, the Charter collects many of the personalities you will have met in My Autobiography, from farmers and local community representatives to wastewater treatment plant operators, researchers, junior high-school students, decision-makers in the water and sanitation sector, and more.

My creators choose to call it the MedAPOC Charter, to reflect its Mediterranean-wide coverage, and APOC stands for “Anaerobic digestion”, “Photocatalytic Oxidation” and “Constructed wetland(s)” which make up my full design as an eco-innovative wastewater treatment system.



*Figure 33: The MedAPOC Charter (cover image)*

Signatories to the Charter are informed they are joining a Mediterranean Wastewater Reuse Alliance. You are most welcome to join too. You can find the link to read and sign up to the Charter below<sup>3</sup>.

The launch of the Mediterranean Wastewater Reuse Alliance took place on the occasion of a Final Conference, organized by the Lebanese University and under the patronage and presence of Lebanon’s Minister of Environment, Dr. Nasser Yassin. Scheduled over two days, the Conference was held at the Chamber of Commerce, Industry & Agriculture in Tripoli on the 23<sup>rd</sup> and 24<sup>th</sup> of June 2023. Finishing touches towards the organization of the Final Conference were discussed during a pre-conference field excursion to the scenic,

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<sup>3</sup> <https://www.enicbcmec.eu/aquacycle-shares-final-version-charter>

mountainous area of Akkar al-Atika in northern Lebanon, where my creators received a very warm welcome.



*Figure 34: The scenic, mountainous area of Akkar al-Atika where my creators received a very warm welcome*

Over the next two days, I was the main topic of discussion during the Final Conference. The event began with welcome addresses by my Team leader in Lebanon, Prof. Ahmad ElMoll, my Project Manager, Dr. Konstantinos Plakas, and Dr. Esmat Al-Karadsheh, from the Eastern Mediterranean Office of the ENI CBC Med Programme. They were followed by Mr. Tawfik Dabboussi, President of the Chamber of Commerce in Tripoli and North Lebanon, Prof. Bassam Badran, President of the Lebanese University and finally Prof. Nasser Yassine, Lebanon’s Minister of Environment. Upon the conclusion of this introductory session, all the speakers received an award in my honour together with a copy of the first tome of my autobiography, which obviously made me very proud.



*Figure 35: Awards presented on the occasion of the Final Conference*

An impressive, over 200 participants joined the event who endorsed the Charter. With a further 150 participants who endorsed the Charter online, the Mediterranean Wastewater Reuse Alliance had been launched in style!



***Figure 36: Prof. Nasser Yassine, Lebanon's Minister of Environment addressing the participants at the Final Conference***

I was on my way back by bus from a post-conference field visit and overhearing the conversation between my communication manager and the Lebanese University team members who were drawing up a press release on the outcomes of the Final Conference. As you can no doubt tell from the snippets which I picked up, I started beaming!

These snippets bring the voices of my creators who attest that I exceeded on their initial expectations. Hence the subtitle of this sequel to the first tome, in which I was still anxiously waiting to make my physical appearance!

I truly wish that many of my readers shall have the opportunity to meet up with me in Lebanon, Spain and Tunisia!

## Snippets from the press release issued on the occasion of the final conference in Tripoli, Lebanon

*Farmers around the Mediterranean, including farmers in Lebanon, have drawn our attention that they are having less and less access to freshwater. AQUACYCLE brings an eco-innovative solution in the form of a three-stage wastewater treatment system. Moreover, AQUACYCLE brings multiple benefits beyond what conventional treatment systems can offer.*

*The first stage known as anaerobic digestion enables AQUACYCLE to additionally produce biogas and sludge that can be reutilized as fertilizer in agriculture. AQUACYCLE's second stage consists of one or more constructed wetlands which thrive as a biodiversity habitat, and thus bring a clear example of a climate change mitigation measure. Last but not least, the final, third stage is a raceway pond reactor. This component guarantees the disinfection of the treated wastewater to a level that complies with the new EU regulation concerning the minimum requirements for the reuse of treated wastewater.*

*This means that AQUACYCLE supplies a treated wastewater that is safe for reuse in irrigated agriculture. These results have been validated in the region of Murcia in Spain where AQUACYCLE made a physical appearance over one year ago. We are looking forward to further physical appearances in both Lebanon and Tunisia in the nearest future. It is important to note that the use of nature-based solutions in the form of constructed wetlands and the use of solar energy for disinfection result in lower operation and maintenance costs as compared with conventional wastewater treatment systems.*

*Yet, through AQUACYCLE, we have learned that it is not just about technological advancements; it is also about fostering collaboration and sharing knowledge across borders. It encourages partnerships between governments, academia, private sector, NGOs, and local communities, facilitating the transfer of expertise and creating a global network of water stakeholders.*

*AQUACYCLE represents a pivotal moment in our collective journey towards sustainable development. It is an opportunity to reshape our relationship with water and leave a lasting positive impact on future generations. Let us join forces and embrace what AQUACYCLE stands for, as we strive for a world where water is cherished, conserved, and revitalized.*

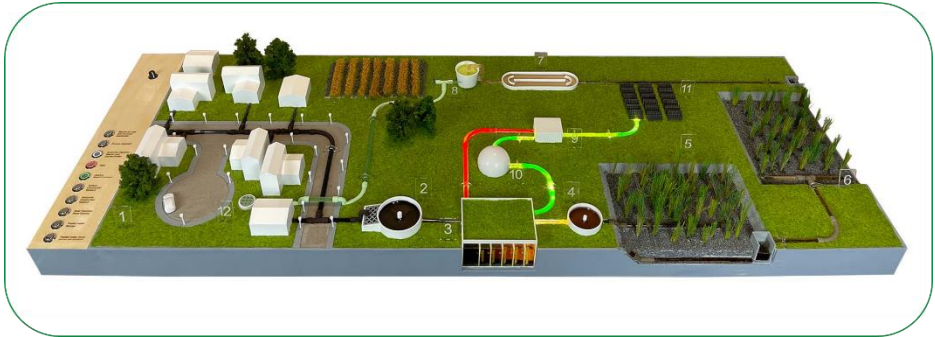
*To this effect, the voices of farmers and of the rural local communities around the pilot demonstration units in Lebanon, Spain and Tunisia have been collected in a Charter. This Charter documents their growing concerns to sustain their livelihoods in the face of increased water scarcity and their expectations from AQUACYCLE. Today, the participants at this Final Conference have been invited to join a Mediterranean Wastewater Reuse Alliance by signing up to this Charter.*



**Figure 37: Group photo of my creators at the Final Conference in Tripoli, Lebanon**

## My components explained

This 3-D Model introduces AQUACYCLE's new "green" technological approach for wastewater treatment and reuse which is particularly suited to small and medium-sized towns and villages in rural areas under Mediterranean climate conditions.



1. Residential area and municipal wastewater
2. Primary treatment
3. Anaerobic Digestion Reactor
4. Clarifier/Settler
5. Vertical Constructed Wetland
6. Horizontal Constructed Wetland
7. Solar Raceway Pond Reactor
8. Treated Water storage
9. Renewable Energy storage
10. Biogas
11. Photovoltaics
12. Treated water reuse (rural and urban applications)



## AQUACYCLE Partnership

Centre for Research and Technology,  
Hellas, Greece (Lead-partner)  
[www.certh.gr](http://www.certh.gr)



Integrated Resources Management  
Company Ltd. (IRMCo), Malta  
[www.environmentalmalta.com](http://www.environmentalmalta.com)



Lebanese University, Doctoral school for  
sciences & technology/Azm Center for  
Research in Biotechnology & its Applications,  
Lebanon  
[www.ul.edu.lb](http://www.ul.edu.lb)



Regional Entity for Wastewater Sanitation  
and Treatment in Murcía, Spain  
[www.esamur.com](http://www.esamur.com)



Plataforma Solar de Almeria (PSA-CIEMAT),  
Energy Department, Solar Treatment of  
Water Unit, Spain  
[www.psa.es](http://www.psa.es)



Water Research and Technologies Center,  
Tunisia  
[www.certe.rnrt.tn](http://www.certe.rnrt.tn)



Tunis International Center for Environmental  
Technologies, Tunisia  
[www.citet.nat.tn](http://www.citet.nat.tn)



## My team of creators

<b>CERTH</b> Greece	Coordinator	Prof. Anastasios Karabelas
	Project Manager	Dr. Konstantinos Plakas
	Innovation Manager	Dr. Vasileios Takavakoglou
	Social Media Manager	Eleanna Pana
	Team members	Ioannis Manakos, Vasilis Chatzis, Angeliki Fotiadou, Rizos-Theodoros Chadoulis, Avgi Karastogiannidou, Sotirios Karavarsamis, Danai-Eleni Aristeridou, Vasilis Sarasidis
<b>IRMCo</b> Malta	Communication Managers	Anna Spiteri, Dirk De Ketelaere
<b>LU</b> Lebanon	Team Leader	Prof. Ahmad ElMoll
	Team Members	Prof. Mohamad Khalil, Dr. Tawfik Al Naboulsi, Dr. Fatima Yahya, Eng. Omar Nachar, Khoder Khalil, Maha El Hajj, Jana El Hajj, May Ibrahim
<b>ESAMUR</b> Spain	Team Leader	Pedro José Simón Andreu
	Team Members	Román Francisco López Aragón
<b>PSA-CIEMAT</b> Spain	Team Leader	Dr. Isabel Oller Alberola
	Team Members	Dr. Inmaculada Polo López, Leila Samira Nahim Granados, Alba Hernandez Zanoletty
<b>CERTE</b> Tunisia	Team Leader	Dr. Hamadi Kallali
	Team Members	Dr. Baha Chamam, Dr. Mohamed Ali Wahab, Dr. Samira Melki, Dr. Mariem Ben Said, Dr. Yasmin Cherni, Raja Jomni, Kaouther Bergaoui
<b>CITET</b> Tunisia	Team Leader	Dr. Fadel M'Hiri
	Team Members	Khitem Mensi, Dorra Laater, Dr. Safa Chaabane, Anis Ghattassi, Sonia Jbeli

## About the author

**Dirk De Ketelaere** is Senior Researcher at Integrated Resources Management Company Ltd. (IRMCo), an environmental research company based in Malta, established since 1994. He has been project manager of the EU funded FP6 PLEIADeS (2006-2009) and FP7 SIRIUS (2010-2013) projects which focused on satellite imagery assisted irrigation services. In PLEIADeS, he also led the work package dedicated to the impact of external drivers, i.e. climate change and policies with pilot study areas in Italy, Greece, Portugal, Spain, Morocco, Turkey, Brazil, Mexico and Peru. In the ENPI CBC Med funded project Mare Nostrum (2013-2015), he oversaw field surveys combined with the satellite-derived mapping of the Blue and Green Open Spaces in Malta's Grand Harbour. The use of Participatory GIS (PGIS) enabled the drawing up by the local communities of a new vision for the area in the form of eco-heritage trails, connecting the multitude of historical and cultural heritage sites of the area with the sparse and alarmingly fast disappearing green open spaces. In the ENI CBC Med funded project AQUACYCLE, Dirk guided the partnership on the use of PGIS towards the drawing up of action plans for the reuse of treated wastewater by the local communities around the pilot-demo sites in Lebanon and in Tunisia. Prior to joining IRMCo, Dirk lectured on hydrology related subjects at post-graduate level at the Free University Brussels (1983-1985), where he graduated as a civil engineer with major distinction in 1982, and at the University of Dar es Salaam (1985-1987). Following his participation as a consultant to the Government of Malta in a major study of the Island's fresh water resources (1988-1992), he designed the MSc Water Studies at the University of Malta. His first successful application for EU funded projects enabled him to coordinate the Med Campus Project 355 Network: Water Resources for Future Generations (1993-1994), which provided training on Integrated Water Resources Management to over 100 water professionals from around the Mediterranean. Dirk is co-editor of the Horizon2020 funded NEXT project publication *A Practical Toolkit addressed to Mineral Exploration and Mining Companies*<sup>4</sup>, issued in September 2021.



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<sup>4</sup> Available for download from [www.new-exploration.tech](http://www.new-exploration.tech) (media section).



# AQUACYCLE

## Towards Sustainable Treatment and Reuse of Wastewater in the Mediterranean Region

### Eco-Innovation

Eco-innovative technology combining:

- ◊ anaerobic digestion
- ◊ constructed wetlands
- ◊ solar treatment

for cost-effective treatment of urban wastewater with maximum environmental benefits.

Demo units in Tunisia, Lebanon and Spain.

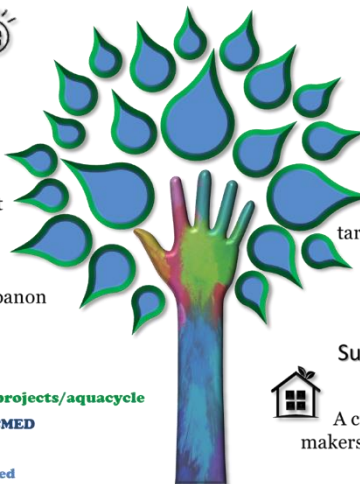


[www.enicbcmcd.eu/projects/aquacycle](http://www.enicbcmcd.eu/projects/aquacycle)

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@AquaCycle\_ENI

@AquaCycle ENI CBC Med



### Participatory Water Governance

Active stakeholders in planning and decision making processes through participatory GIS.

Action and investment plans targeting the reuse of 900,000 m<sup>3</sup> treated effluent.



### Sustainable Development and Economic Growth

A cross-border Alliance of decision makers, researchers and private actors for the sustainable use of non conventional water resources in Mediterranean.



### Project Partners



**CERTH**  
CENTRE FOR RESEARCH & TECHNOLOGY HELLAS



**esamur**  
Ente di Sviluppo e Direzione di la Regione di Sardegna

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