



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

## **Active PGIS Users (Output 5.1)**

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# Active PGIS Users (Output 5.1)

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## Executive Summary

The present **Active PGIS Users** report informs how the bottom-up inputs towards the drawing up of action plans for the reuse of treated domestic effluent was achieved through the successful organization of the second series of stakeholder workshops in Lebanon and Tunisia. For the reasons explained in this report, the venue of the workshop in Spain was moved to a farmer community outside the Murcia Region. In lieu of the PGIS practice session, the participants in Spain were shown the actual reuse action plans in the Murcia Region where the reuse of treated effluent continues to be among the highest in Europe.

The first chapter reiterates on the scope of the Participatory GIS (PGIS) in **AQUACYCLE**, the motivation for targeting local communities around the pilot demonstration sites of the project's eco-innovative domestic wastewater treatment system (APOC) and the logistics that were put in place ahead of the workshops. The second chapter informs on how the PGIS practice was introduced to the participants and its outcomes in both Lebanon and Tunisia. An appraisal on the PGIS practice sessions is provided both on the part of the organizers and on the part of the participants who joined in the event in the third chapter. Concluding remarks and a look ahead at the next steps make up the final, fourth chapter.

## 1. Aims and scope to the second series of stakeholder workshops

The second series of stakeholder workshops had a dual purpose, i.e., (1) to enable the collection of bottom-up inputs towards the drawing up of reuse action plans of treated domestic wastewater, and (2) to collect the ‘voices’ and ‘aspirations’ with respect to reuse of treated domestic wastewater of local communities in Lebanon, Spain and Tunisia in a charter for the safe and sustainable reuse of treated domestic wastewater, i.e., the foreseen MedAPOC Charter. This title for the charter directly links to AQUACYCLE’s eco-innovative domestic wastewater treatment system, the APOC system. The scope and outcomes of the second purpose of the workshops are collected in the MedAPOC Charter (Output 6.2, part 2).

The present report informs about the scope and outcomes of the former purpose of the workshops, i.e., the participatory planning towards the drawing up of wastewater reuse action plans.

### 1.1 What is the scope of the participatory planning in AQUACYCLE?

The scope of the participatory planning is to enable the collection of bottom-up inputs towards the drawing up of reuse action plans of treated domestic effluent. The treatment of domestic effluent itself is derived from the implementation of an eco-innovative treatment system, abbreviated to the ‘APOC System’.

The **APOC System** comprises 3 successive stages: anaerobic digestion, constructed wetlands and a raceway pond reactor for solar disinfection. In the earlier, first series of stakeholder workshops organized in Lebanon, Spain and Tunisia during 2020, public and private entities responsible for water and sanitation, and including also wastewater treatment plant operators, provided their feedback on their expectations and training needs on the technologies employed by the APOC System (see Output 3.3 for a more extensive write-up).

This novel treatment system is foreseen to be tested in 3 pilot demonstration sites (see Fig. 1), i.e., at the location of an existing wastewater treatment facility in the Murcia Region of Spain (Blanca); at a site in the Zaghouan Governorate of Tunisia (Bent Saidane), and at a site owned by the real estate company Sanabel in Deddeh, which is located south of Tripoli in Lebanon.



*Figure 1: Satellite images of the demonstration location sites in Lebanon, Spain and Tunisia*

Whereas the volume of domestic effluent to be treated by these pilot demonstration units is limited to around 5 to 25 m<sup>3</sup> per day, the reuse action plans of the treated effluent will target a volume of 300,000 m<sup>3</sup> per year. The latter target represents the volume of domestic effluent that is typically generated in one year by a small to medium sized rural community.

## 1.2 Which audience was targeted to participate?

The target audiences included the local communities around the pilot demonstration sites in Lebanon and Tunisia, as well as the local community in the Tabernas municipality of Almería province, which is adjacent to the Region of Murcia. The latter was motivated by the fact that the level of treated effluent reuse in Murcia is among the highest in Europe, whereas the level of reuse in the Almería province continues to be minimal. This led to the realization that Murcia's successful experience in the reuse of treated wastewater could be shared and demonstrated by moving the originally planned venue of the workshop in Blanca, Spain. In the three countries, the target audience included foremost the local community representatives, such as the mayors and councillors of municipalities, representatives of local organized actors, such as farmer and irrigation associations, and environmental NGOs. Every effort was made to also have the participation of members of the local community who may otherwise not have participated in any planning decision affecting their locality, including housewives and teenagers.



Figure 2: View of Tabernas municipality as the selected venue for the workshop (left) and the location of Tabernas and of the Blanca pilot demo plant site in Spain (right)

## 1.3 Why are we targeting this audience?

As elaborated in the Opinion Article entitled “Democratizing spatial decision making in the water sector”<sup>1</sup>, the AQUACYCLE project brings the opportunity to trial a bottom-up process to draw up wastewater reuse action plans. The aim is to bring about a much-needed paradigm shift in how the safe reuse of treated domestic wastewater should be looked at: **All water is too precious to waste!** The aspirations and testimonies of the local communities will feed a Mediterranean Charter for the safe and sustainable reuse of treated domestic wastewater.

“Our ultimate aim is to deliver on the key message that not only all water is precious too waste, but also that local communities can – and should – be engaged in all planning decisions that may have an impact on their well-being.”

*Anna Spiteri and Dirk De Ketelaere, IRMCo, Malta*



<sup>1</sup> [http://www.enicbcmed.eu/sites/default/files/2021-02/AQUACYCLE%20Opinion%20Article%20on%20democratizing%20spatial%20decision%20making%20in%20the%20water%20sector\\_February%202021%20in%20English%29.pdf](http://www.enicbcmed.eu/sites/default/files/2021-02/AQUACYCLE%20Opinion%20Article%20on%20democratizing%20spatial%20decision%20making%20in%20the%20water%20sector_February%202021%20in%20English%29.pdf)

## 1.5 Logistics for the participatory drawing up of action plans for the reuse of treated effluent

The bottom-up inputs towards the drawing up of action plans for the reuse of treated effluent was facilitated through the setting up Participatory GIS (PGIS) Landing pages for the respective sites in Lebanon, Spain, and Tunisia on google maps. A detailed description of the process, which included the selection of thematic layers (e.g., surface water drainage network) and the addition of a layer depicting places of interest in the respective areas has been documented in 'Online PGIS environment for participatory planning' (Output 3.4). As illustrated by the figures below, this process permitted to give the three PGIS Landing pages a streamlined 'look' and 'feel', an intentional decision to facilitate and stimulate a cross-border interpretation and exchange of the eventual outcomes of the PGIS Practice sessions organized on the occasion of the second series of stakeholder workshops.

In both Lebanon and Tunisia, computer facilities and internet connection were available to allow the participants to draw their suggested reuse action plans online, while also a printout of the area as a satellite image was made available for orientation purposes.

Finally, the gmail addresses below were created for the participants to share their PGIS entries during the event:

Collection address for Lebanon: [aquacycle.lb@gmail.com](mailto:aquacycle.lb@gmail.com)

Collection address for Tunisia: [aquacyclecitet21@gmail.com](mailto:aquacyclecitet21@gmail.com)

With all the necessary logistics in place, invitation cards were drawn up to announce the event among the respective local communities (by email and by post) as well as through the project website on the platform provided by the ENI CBC Med Programme:

[AQUACYCLE invites local community in Tunisia to draw up reuse action plans of treated effluent](#)

[AQUACYCLE invites local community in Deddeh Koura, Lebanon to draw up reuse action plans of treated effluent](#)

[AQUACYCLE invites local community in Almeria, Spain to draw up reuse action plans of treated effluent](#)



Figure 3: Invitation cards to the workshop in French and English (Design: Eleanna Pana, CERTH)



## 2. The PGIS Practice sessions in Lebanon and Tunisia

### 2.1 Size and make-up of the audience

In **Lebanon**, the PGIS practice was joined by 20 participants, including residents from Deddeh and the nearby municipalities of Kalamon, Ramaska, as well as of the city of Tripoli. Aside from teenage students and their teachers, the workshop also attracted the participation of a medical doctor, a lawyer, and representatives from the University of Balamad and the air quality laboratory control unit (UCF).



*Figure 4: Group photo of the participants in the workshop organized at Nawfal Palace, Tripoli, Lebanon*

In **Tunisia**, the PGIS practice was joined by 37 participants, including farmers and residents from Bent Saidane (El Fahs delegation) and nearby municipalities in the Zaghouan governorate. The workshop also attracted the participation of representatives from the Regional Commission for Agricultural Development (CRDA), the Agricultural Vocational Training Center in Agricultural Machinery (CSFPAMA), the Agricultural Extension and Training Agency (AVFA) and the Agricultural Development Group (GDA).



*Figure 5: Group photo of the participants in the workshop organized at El Fahs, Tunisia*

As evidenced by the group photos, both events were gender balanced and joined by different age groups.

## 2.2 Introductory presentation: purpose of the session and how your PGIS inputs will be used

The **PGIS Practice session In Lebanon**, was led by University of Lebanon team member, **Dr. Tawfik Al-Naboulsi**, who welcomed the participants, informing the session would give the opportunity for the participants to share and draw their own suggestions of sites for the reuse of treated wastewater. He went on to explain that for this purpose, both online and printed satellite images had been prepared so that participants' inputs could be easily inserted. He also informed that all suggestions will be used to feed into a WebGIS platform, on which these same suggestions will be analysed against relevant decision criteria, including cost-effectiveness, and eventually incorporated into local action plans for the reuse of treated effluent with a reuse target of 300,000 m<sup>3</sup> of treated effluent per annum.

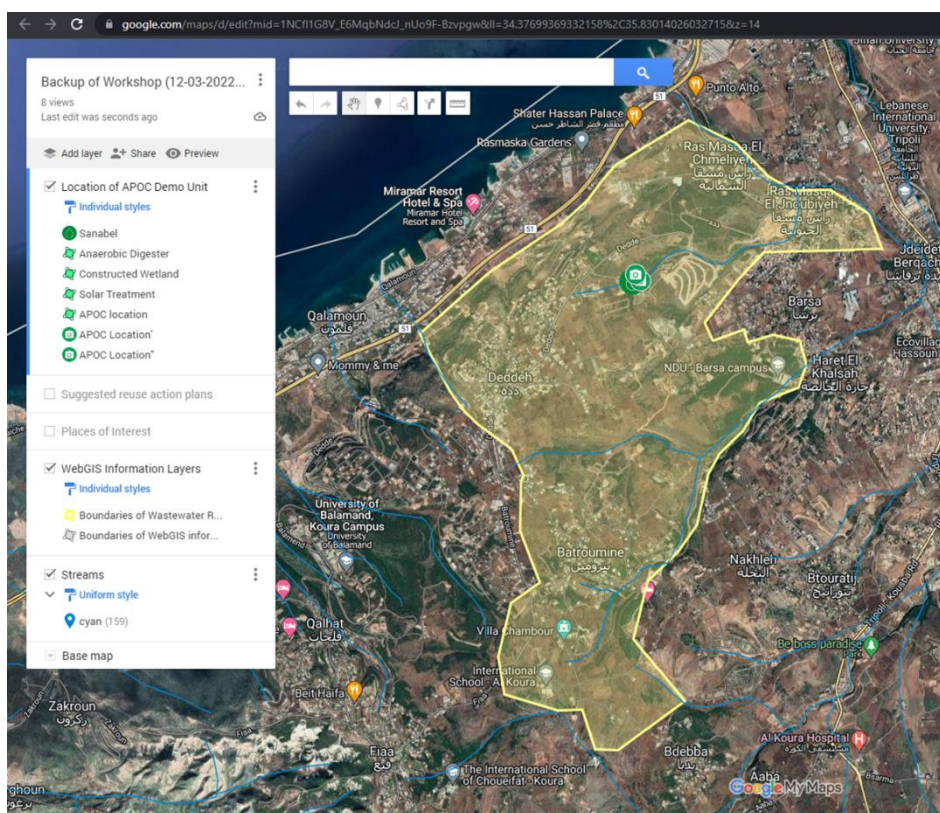
Regarding the WebGIS which is under development by **CERTH**, Greece, Tawfik expressed the view:



*"It is user friendly and easy to use platform and it can be easily accessed using your pc or mobile phone. Once the user accesses the open data cube, s/he can create a personal account and then in our case [Lebanon], the user can access the Deddeh pilot. Once the user accesses the Deddeh pilot on the platform, there are two ways to proceed: the user can define a proposed area for irrigation with treated effluent or upload it to the platform as a .kml file. It is this latter approach which we are going to use today on the Google My Maps Landing Page we have prepared for the purpose of this PGIS Practice session."*

Tawfik Al-Naboulsi

Next, the participants were introduced to the PGIS Landing page for Lebanon, where a larger area of 275 km<sup>2</sup> had been delineated for the purpose of including various thematic layers, such as the surface water drainage network, and a much smaller area of 7.41 km<sup>2</sup> for the foresee reuse action plan.



**Figure 6: 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)**

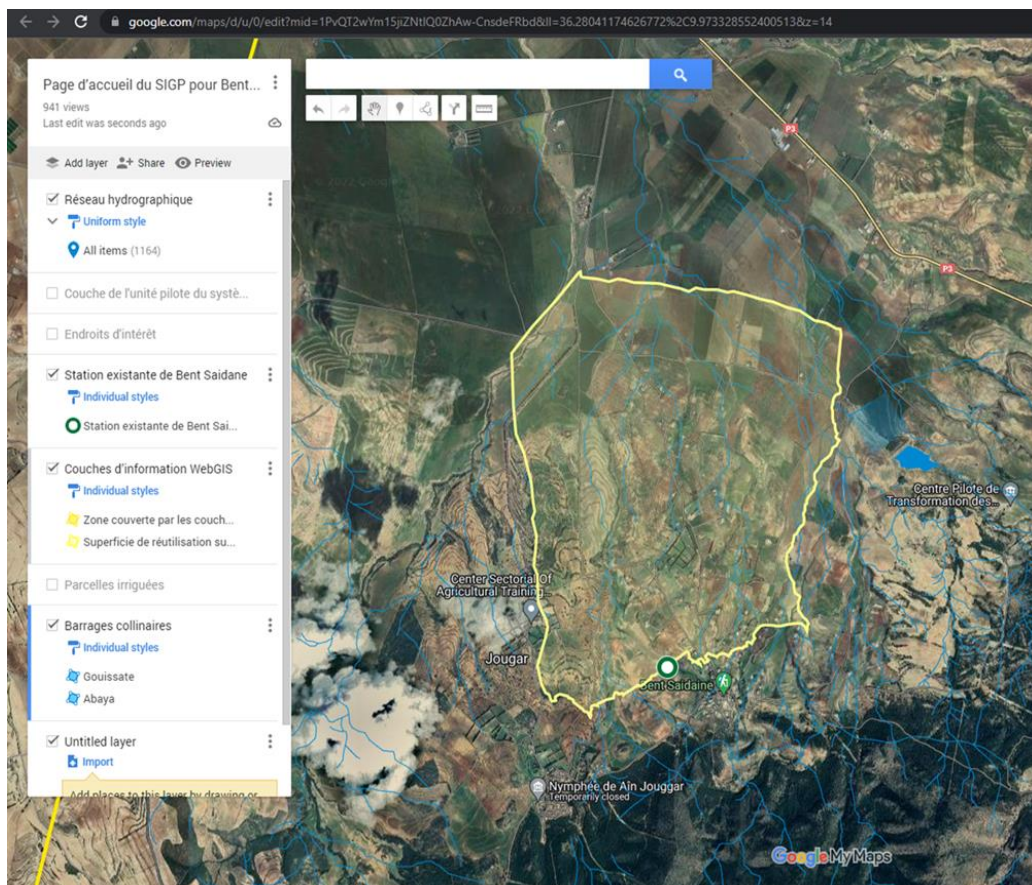
Tawfik invited the participants: “To insert a suggested area or site for the reuse of treated effluent, you can simply draw a line around that site by clicking ‘*Draw a line*’, and once you close the line around the site you will see a pop-up, which invites you to insert the description of the site, which we will use to describe the nature of the irrigation application. For example, for this site I have just enclosed with the line I have drawn, I am typing ‘olive’. As you can see, it is automatically assigned the colour of light green, and this is because we already inserted suggested sites for the irrigation of olive trees beforehand. We are going to assign different colours for other applications, and I am now kindly inviting you to insert your proposed sites either on our online PGIS landing page or on the printed satellite images.”

in **Tunisia**, the PGIS Practice session was animated in the same way by **Dr. Hamadi Kallali, Teamleader** of the Water Research and Technologies Center (**CERTE**). **Ms. Rim Mahdeoui**, representing the African Association for Geospatial Development (**AGEOS**) explained about the purpose of the PGIS application as a decision-support tool to guide on the drawing up of optimum water reuse action plans.



“AGEOS is a non-profit Tunisian association founded in November 2016, which brings together students, academic, public, and private players in the geospatial field in Tunisia to promote the use of geographic information and geospatial technologies. One of our main activities concerns the monitoring of Tunisia’s Smart Cities ecosystem, and in partnership with the FNCT, AGEOS implements municipal GIS strategic action plans.”

*Ms. Rim Mahdeoui, AGEOS*



**Figure 7: 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)**

### 2.3 Examples of PGIS entries

The figure below brings an example of the PGIS entries proposed by participants in the PGIS Practice in Tunisia. Aside from parcels proposed for the irrigation of cereals (shown in yellow), the entries inform that the local community is keen to also create 'green spaces' in the town (shown in red).

Another worthwhile observation from the same figure is that a farmer personalised his parcels by adding his name and surname to the description of his parcels (shown in orange).

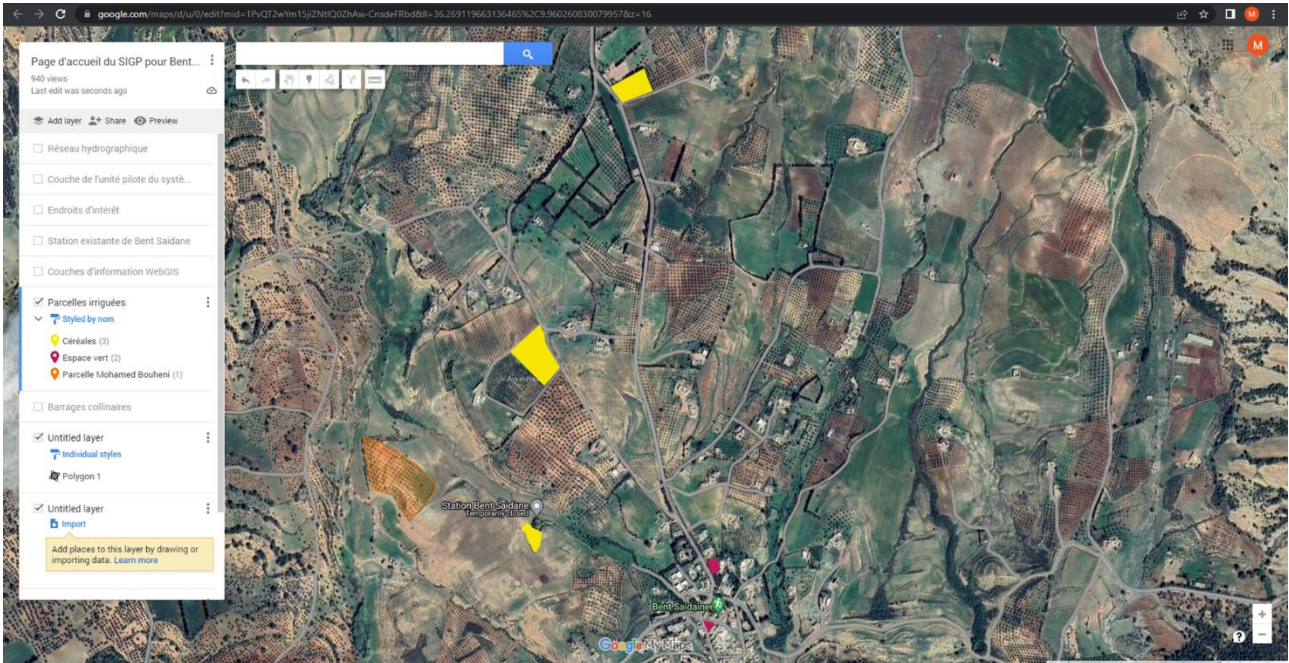


Figure 8: Sites for reuse of treated effluent proposed by the participants in Bent Saidane, Tunisia



Figure 9: The PGIS Practice session in Tunisia in pictures

### 3. Appraisal of the PGIS Practice sessions in Lebanon and Tunisia

In **Lebanon**, the participants expressed their sincere gratitude for having been invited to join the workshop in which they were given the opportunity to actively participate in deciding the reuse applications of treated wastewater as a reliable, all-year round, source of water. They expressed their appreciation that aside from choosing their suggested areas on the landing page and on a printed satellite image, in the near future it would become possible to provide their suggestions directly on the 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 effluent, 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*

In **Tunisia**, the main aspects raised by, particularly the young farmers and the primary school staff who joined the PGIS Practice session, included the following requests:

- The organization of a guided site visit after the installation of the APOC system;
- A presentation on the results of laboratory scale experiments which are underway at CERTE on the performance of the APOC system;
- To place all documents relating to this technology online and accessible for all participants.

In this concluding address of the workshop in Tunisia, **Dr. Hamadi Kallali** thanked the participants for having joined the event and in particular the Chief of the Water Management Division for aiding the moderators in their mission.

He assured the participants that he considered their requests as valid ones, which would definitely be honoured by the Tunisia partners in the **AQUACYCLE** partnership. He invited the participants to acknowledge that the event with the local community of Bent Saidane had been organized precisely because the **AQUACYCLE** partnership considers the farmer involvement to be very important for the legitimacy and acceptance of this kind of project, which involves the development and testing of a novel technology. Furthermore, he assured participants that the analysis of the laboratory scale experiments and, eventually, of the APOC demo plant to be installed at the existing Bent Saidane wastewater treatment facility would be made accessible both through the project website on the ENI CBC Med online platform and through the CERTE/CITET websites. Dr. Hamadi Kallali also expressed the wish that the construction of the APOC system pilot demo plant would be initiated in the nearest future so that the local community would indeed be in a position to visit the demo plant in a real-life environment.

## 4. Concluding remarks and a look ahead

The workshops proved that is perfectly feasible for local communities to take an active part in the drawing up of action plans for the reuse of treated effluent. This foremost conclusion corroborates the theme of the second series of stakeholder workshop: ‘Have your say in the drawing up of reuse action plans of treated wastewater’. It supports and brings evidence that is perfectly feasible to democratize spatial decision-making in the water and sanitation sector.

“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 effluent.”

*Foremost conclusion from the second series of stakeholder workshops in AQUACYCLE*

With an aggregate attendance of 57 participants in the two PGIS Practice sessions, the originally foreseen target of 30 active PGIS users was clearly exceeded by a wide margin.

As evidenced by the examples of PGIS entries shown in Fig. 9, farmers and local community representatives in PGIS Practice sessions, do not require any particular training to locate the fields they till or the properties they reside in. Indeed, as witnessed by IRMCo in similar PGIS applications (e.g., FP7 funded SIRIUS project which dealt with satellite-based irrigation advisory services and the ENPI CBC Med funded Mare Nostrum project which dealt with coastal zone management), people from all walks of life typically have no difficulty to navigate a satellite image provided to them as a printout or online.

One of the farmers in the Bent Saidane workshop clearly opted to not abide by the envisaged protocol of the event, i.e., instead of denoting for which application he wished to reuse the treated effluent, the farmer wrote his name, i.e. denoting his ownership, of the tract of land where he wished to avail himself of the treated effluent for irrigation purposes. Once again, also this is not an unexpected outcome, as it can be easily attributed to people wishing to delineate their ‘property’ and hence their ‘ownership of such property’. In this instance, the farmer drew the boundaries of the land he tills in Bent Saidane.

Clearly, a 90-minute PGIS Practice session in both Lebanon and Tunisia was never going to produce an action plan that would require as much as 300,000 cubic metre of treated effluent per annum. Such a volume, which translates in around 6 to 8 square kilometres of land requiring irrigation, can only be reached through the organization of multiple sessions. Also this notion is supported by past experience: in the ENPI CBC Med funded Mare Nostrum project, IRMCo undertook the organization of more than 10 PGIS Practice sessions with the local communities in Malta’s Grand Harbour, to draw their suggestions for eco-heritage trails, i.e. walking trails connecting the blue and green open spaces in the area. In this instance, the sessions were purposely organized in each of the municipalities located within the Grand Harbour.

However, representatives of the private company NAXTA, which had been commissioned by the Managing Authority to run an audit of the efficiency of the ENI CBC Med Programme, drew IRMCo’s attention that inviting local communities to produce such a large-scale reuse action plan could well backfire.

In the NAXTA representatives' point of view, there was a clear discrepancy between the ENI CBC Med Programme Key Performance Indicator (KPI) which set the reuse target of 300,000 cubic metre per annum, and the notion that the pilot demonstration units of AQUACYCLE's eco-innovative wastewater treatment system were to be designed with a treatment capacity of just 5 to a maximum of 25 cubic metre of effluent per day. Given these numbers, NAXTA opined that while local communities would be given the impression that they were designing a reuse action plan matching the ENI CBC Med Programme KPI, such a plan could actually not be implemented with AQUACYCLE's pilot units alone. IRMCo agreed that it was not in the project's interest to raise false expectations among the local communities in Lebanon and in Tunisia.

In the 7<sup>th</sup> AQUACYCLE Project Progress Meeting, which took place online on 26 September 2022, IRMCo shared NAXTA's viewpoint with all partners, and proposed an alternative approach to reach a reuse target of 300,000 cubic metre. In their respective reports on the stakeholder workshops, both the Lebanese and the Tunisian partners had included a recent land use map of the areas around the foreseen locations for the construction of their respective pilot demonstration units. As an example, the irrigated perimeters and parcel boundaries around Bent Saidane are shown in Fig. 10. This led IRMCo to propose to CERTH to make use of the webGIS they developed to furnish reuse action plans that would demonstrate which of the current land uses could be furnished with irrigation water supplied as grey water (treated effluent) in the most cost-efficient manner in the scenario that an aggregate volume set at 300,000 cubic metres of treated effluent would be available per annum. In this context, a small town of around 5000 to 6000 people would guarantee such a volume of grey water would be produced on an annual basis, which translates into an average of around 140 to 160 litres/per day of effluent per person. In comparison, a medium-sized town of 10,000 to 15,000 people would guarantee an aggregate volume of 600,000 cubic metres to be available on an annual basis.

It should be noted that the originally foreseen approach was designed to employ the webGIS to determine the optimum action plan for reuse based on the action plans as suggested by the local community. The partnership resolved that IRMCo's proposed alternative approach would nonetheless bring a valid and useful exercise to demonstrate the functionality of the webGIS to planners and decision-makers in the forthcoming, third series of stakeholder workshops.

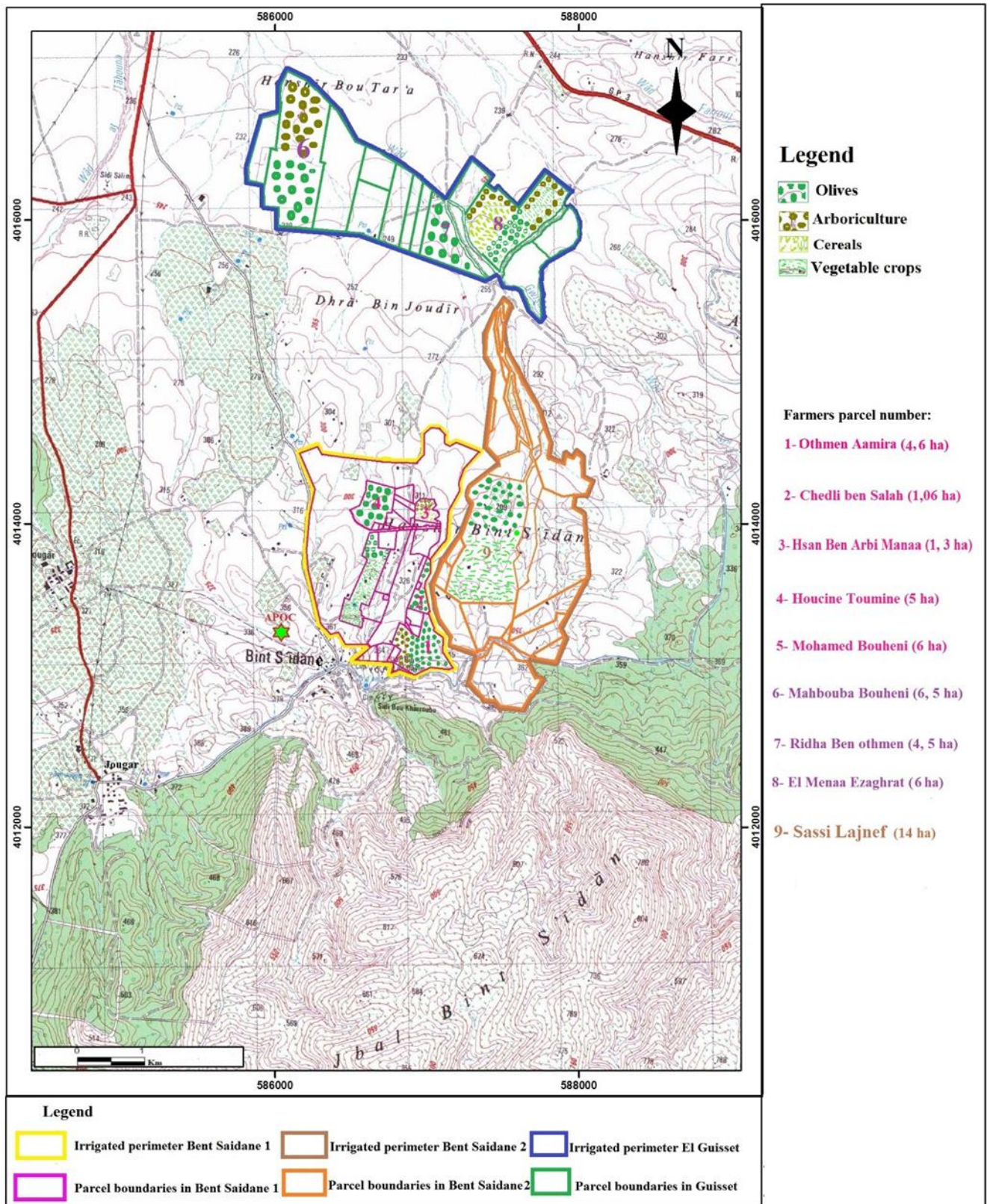


Figure 10: Parcel boundaries and irrigated perimeters around Bent Saidane, Tunisia